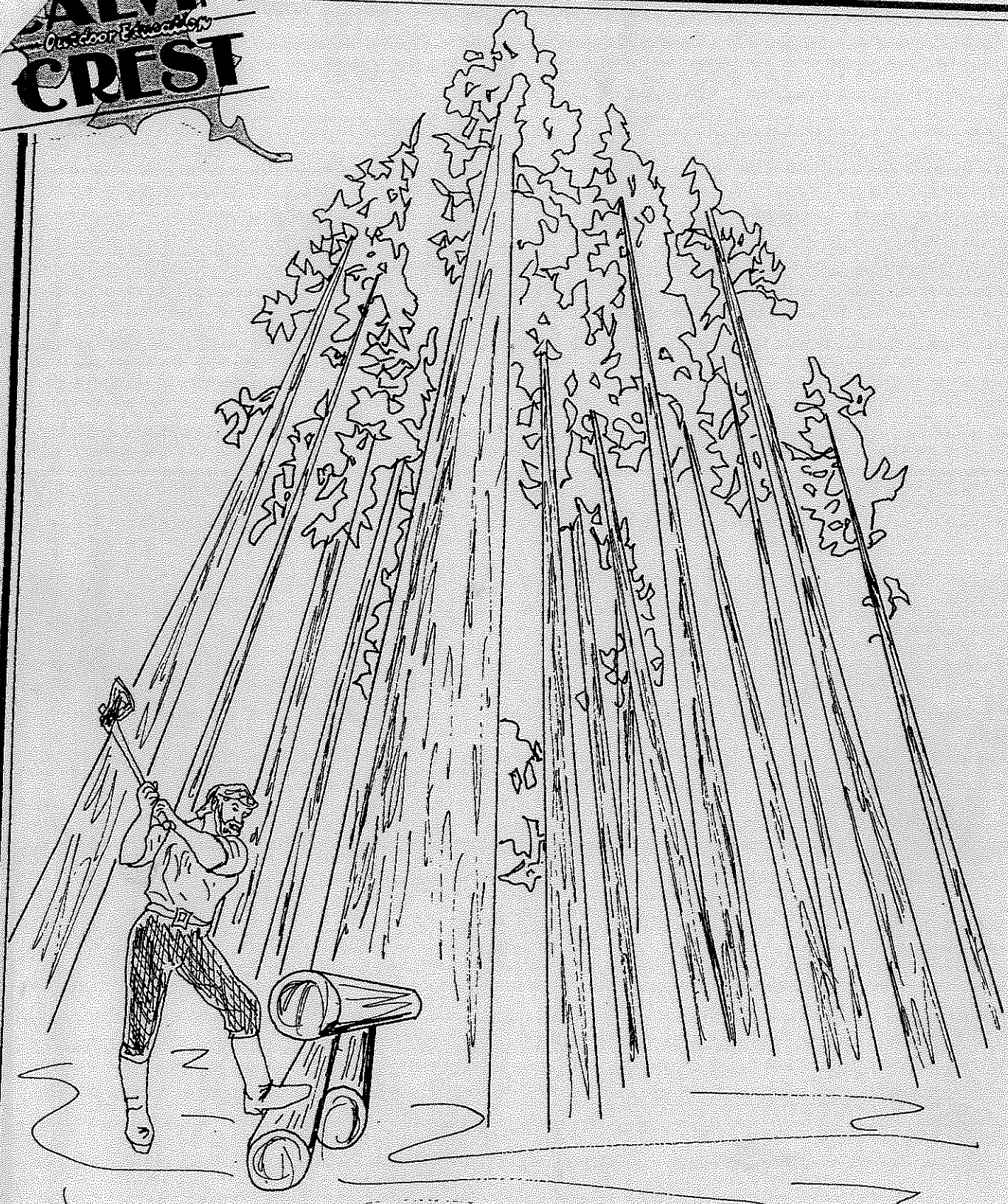
CALVIN CREST
Outdoor Education



Logging and Forestry

LOGGING AND FORESTRY UNIT

CONTENTS:

GOALS:

The student will:

1. Gain an understanding of the necessity for wise logging practices.
2. Learn the different species of tree found on the Calvin Crest grounds and their uses.
3. Learn about the history of logging practices in the Sierra.

MAJOR CONCEPTS:

-Forest Management Techniques
-Historical Aspects of Logging
-How to Fell a Tree
-Tree Heights and Diameters
-Tree Identification
-Uses of Wood Products
-Similarities and Differences in Species of Trees

MATERIALS NEEDED:

- Log Rounds (10)
- Wood blocks and wood identification sheets
- Pencils (15)
- Tree Identification Cards (5 sets of 6)
- Blindfolds (10)
- "How a Tree Grows" poster (1)
- "How a Tree Grows" fact sheets (5)
- "Parts of a Tree" poster (1)
- Photo - oxen pulling logs over skids (3)
- Photo - flume (3)
- Magnifying Glasses (10)
- "Stories in Stumps" worksheets (1/group of 2)
- Clinometers (8)
- Calculators (4)
- 50-meter tape (1)
- D.B.H. tape measure (1)
- "Observations of a Giant Sequoia" worksheets (1/group of 4-6 students)
- Photo - oxen pulling wagon with sequoia log (3)
- Posters: Living Parts of Trees; Hardwood, Softwood; Tree Bark's Story; Annual Rings; Logs Work Harder; Autumn's Colors

SUPPLEMENTAL RESOURCES:

They Felled The Redwoods, Hank Johnston
Thunder In The Mountain, Hank Johnston
California Tree Finder booklets

LOGGING AND FORESTRY - Introduction

The most obvious feature that strikes most first-time visitors to Calvin Crest is the forest. Many visitors have never been surrounded by so many trees before. Everyone, however, tends to come with preconceived ideas about what a forest is, what it should be like, and how its resources should, or should not, be used.

We live in a world that depends upon vast quantities of natural resources to carry out the everyday process of living. Often, because we are so far removed from the processing and manufacture of goods, we give little thought to where things come from, how they're made, or what they're made from. Our forests are an enormous source of ***renewable*** natural resources. In other words, when a tree is removed from a forest, it can be replaced by another tree. To be sure, a great deal of time is involved in the process of replacing a tree. However, these are important concepts to grasp: our forests are a natural resource that we depend on daily; forests are renewable, wise management is essential for the sake of the forest ecosystem as well as for ourselves.

How we harvest those resources, how we manage them, what the impact of man's use is (not just on the trees themselves, but on the entire ecosystem of which they are but a part), are all major considerations in the practice of logging (forestry).

This unit is developed so that students are exposed to some of those issues, and so that they can gain insight into what is involved in the wise use of such a valuable natural resource. Additionally, students will develop skills in recognizing the characteristics of the principle local tree species, and learn historical information about logging practices.

LOGGING AND FORESTRY- LESSON PLAN

Introduction

Before beginning the hike, ask the class to name as many different uses of wood as they can. Try to get at least one suggestion from each student. The wider the variety of answers given the better, as this helps make the students aware of the fact that wood is a very valuable resource. Discuss some of the uses of wood the students didn't mention. Assign each student a different wood product to remember for the duration of the course. At the end of the course see if students can remember all the uses assigned.

Hike from the Dining Hall down to the dam where the Logging Trail towards Sherwood Forest begins. Look for the plastic blue triangular markers with a symbol of an axe in a log which will guide you along the trail. Soon after you leave the dam and head down the "Logging Trail" you will begin encountering the numbered markers.

Activity #1: Meet a Tree

(From Sharing Nature With Children by Joseph Cornell)

Activity Overview

In this activity, students will learn that all trees in a forest are not only not alike, but that each one is unique from every other tree. Not only are various species of trees different from one another, but each individual tree within a species is different from every one of its relatives. They will discover this before they even see the tree they're observing.

Focus Question

How can I learn anything about a tree that I can't even see?

Main Ideas

1. Every tree in a forest is unique, just as every person in the world is unique.
2. Much can be learned about a tree without ever seeing it.
3. Careful observation yields much information, while little is learned if little effort is made.
4. Clues for identification can be gained by learning about texture, size, shape, and smell.

Activity Organizer

Objectives

By the end of this activity, students should be able to:

1. Locate the tree each of them observed blindfolded.
2. Be able to describe at least 4 distinctive features about their trees.
3. Explain that although a forest is made up of trees that have similarities, each tree is unique.
4. Apply observation skills used to similar situations.

Materials

- Blindfolds (1 blindfold/2 students)

Time Required
15 - 20 minutes

Location
At **Post #1** approximately 100 feet down the trail from the dam.

What to Do

The following exercise is designed to help students appreciate individual, unique living trees--not just lump them all together as a "forest." Stay in the immediate area that has been cleared of much of the forest floor debris and low, bare branches that could potentially cause injury to blindfolded students. This activity is for groups of two.

1. Have the students pair off. Explain that they will take turns discovering a tree, getting to know about it (size, shape, texture, fragrance, etc.) without ever seeing it. The "guide" will blindfold his/her partner and lead him/her through the forest to any tree that attracts the guide. Help the "blind" child to explore his tree and to feel its uniqueness.
2. Specific suggestions are best. For example, if you tell children to "Feel the tree," they won't respond with as much interest as if you say, "Rub your cheek on the bark." Instead of, "Explore your tree," be specific: "Is this tree still alive?. . .Can you put your arms around it?. . .Is the tree older than you are? . . .Can you find plants growing on it?. . .Animal signs?. . .Lichens? . . . Insects?"
3. Pass out the blindfolds and have your cabin leader help make sure all of the partners going first have their blindfolds put on correctly and securely.
4. Remind guides of their responsibility to make sure their blindfolded partners cannot be hurt in any way. They can guide them by:
   A. Standing to the left of the blindfolded person
   B. Holding on to the blindfolded person's left elbow
   C. Using verbal commands to help the blindfolded person know which direction to travel
   D. Allowing the blindfolded person to use his/her right hand to "feel" his/her way
5. Give the teams about 5-8 minutes to travel to a tree and observe it. When the blindfolded partner if finished exploring, lead him back by indirect route. (This part has its fun side, with the guides leading their partners over imaginary logs and through thickets that might easily have been avoided.)
6. Now, remove the blindfold and let the child try to find the tree with open eyes. Suddenly, as the student searches for his/her tree, what was a forest, becomes a collection of very individual trees.

As Cornell states, "A tree can be unforgettable experience in the child's life. Many times children have come back to me a year later, after we play 'Meet A Tree,' and have literally dragged me out to the forest to say, 'See! Here's my tree!'"

Activity #2: Tree Species Identification

Activity Overview
In this activity, students will use the skills they just learned for observing trees, add to that their eyesight, and "key out" or determine the species of marked trees. They will use tree identification cards describing characteristics of different tree species to aid them in their determinations.

Focus Questions
1. *What is a species?*
2. *Which characteristics of a species are helpful in keying out a tree?*

Main Ideas
1. Just as individual trees are unique, tree species are unique from one another.
2. Recognizing differences in the form, shape, size, and structure of a tree and its trunk, limbs, bark, leaves, and seed bearing structures enable us to correctly identify tree species.

Activity Organizer
Objectives
By the end of this activity, students should be able to:
1. Recognize six different species of trees
2. Describe at least one distinguishing characteristic of each species
3. Apply the knowledge gained to correctly identify other trees in the forest as to species.

Materials
- Tree Identification Cards (1 set/group of 4-6 students)

Time Required
20 - 30 minutes

Location
Along the Logging Trail over the next 1/4 mile after leaving the "Meet a Tree" site

What to Do

Markers #2 -#7 correspond to the six species of trees covered in this unit (the red fir is not covered). Rather than tell the students the names of the trees, have them "key them out." That is, have them identify the trees themselves. They can do this by using the six tree identification cards to match the characteristics of the tree to the drawing, thus discovering the name of the tree themselves. Not only will that be more rewarding for them, but, additionally, they will more fully appreciate the differences in the trees and remember them better than if you merely tell them names. The trees marked are as follows:

#2 - Incense Cedar
#3 - Black Oak
#4 - Sugar Pine
#5 - White Fir
#6 - Ponderosa Pine
#7 - Giant Sequoia

Markers #2-5 are encountered along the left hand side of the trail. Marker #6 is in the large clearing at the bottom of the trail across the parking area from the plywood platform and the large ponderosa pine to the left of it. Marker #7 is located alongside the dirt road that crosses the ditch about 50 feet east of marker #6.

1. Divide the class into groups of 4 - 6 students.
2. Make sure that each group has a full set of tree i.d. cards.
3. Have students divide the cards among themselves so that each student has at least one card.
4. As the groups approach each numbered post, have them work as a team deciding which card has the correct features that match the tree being observed.
5. Students can keep the same card throughout the activity, or they can switch the cards at each post.
6. After all students know the correct identification of the tree at each site, look for other specimens along the trail as you continue.
7. Once students have keyed out all six species of trees you can randomly choose trees along the rest of your route and see how well students can identify them, first with the tree identification cards, then without them.

Activity #3A: Wood Specimen Identification

Activity Overview
In this activity students will learn about the unseen, inside section of a tree. They will learn about the differences in characteristics between species, and how that affects their usage and appearance in wood blocks.

Focus Questions
1. *How do the properties of wood affect how it is used?*
2. *Why are some species of wood better for construction than others?*
3. *How can we use the characteristics described on the worksheets to help key out the wood blocks?*

Main Ideas
1. Each species of wood has characteristics that affect its appearance and how it can best be used.
2. Using observation skills, we can determine what species of tree a block of wood comes from.

Activity Organizer
Objectives
By the end of this activity, students should be able to:
1. Correctly identify each block of wood based on the descriptions and their observations.
2. Explain why the characteristics of wood determine how it is used.

Materials
- Wood block sets numbered 1 - 6 (1 set/group of 4-6 students)
- 1 Wood Identification Worksheet and 1 pencil/group

Time Required
15 - 20 minutes

Location
Sherwood Campfire area (Marker #8)

What to Do

Proceed from Marker #7 along the dirt road another 100 feet to the Sherwood Campfire area (**Marker #8**). Materials needed for the two activities here are located in the wooden cabinet across the dirt road from the seating area.

1. At the campfire area, tell the students that just as trees have very different outward appearances, they also each produce a unique kind of wood - and each type of wood has special, unique uses. Briefly review some of the uses of the different trees as pointed out in the species descriptions in the General Information section of this unit.
2. Divide the class into groups of 4 - 6 students, or continue with your existing groups.
3. Pass out the wood identification worksheets, pencils, and sets of wood blocks. Be sure that each group has a complete set of blocks (#1 - #6). Have students work together to attempt to match the blocks with the description and names of the trees.

4. Have each group present its findings to the rest of the class before you actually go over the correct answers. Consult the sample worksheet that follows for an example of what to do, and for the key below for the correct answers.

Wood Identification

Match the wood samples to these descriptions. Use your senses - touch, feel, and smell to see the differences. Draw a line from the wood sample number to the description that best fits the piece of wood.

Wood Sample	Description of Wood
#1)	• heartwood red, sapwood whitish
#2)	• heavy, hard to scratch with fingernail
#3)	• smells like pencils, soft, reddish brown
#4)	• white with many short dark streaks
#5)	• reddish color throughout
#6)	• whitish, easily scratched with fingernail

Try to match the wood samples with the names of the trees below:

Sugar Pine_____ Incense Cedar _____ Ponderosa Pine _____

White Fir _____ Redwood _____ Oak _____

*Note: The names of the trees give clues to their characteristics.

Sugar Pine	#6	- white, with many short dark "sugar" streaks
Incense Cedar	#5	- smells like pencils, soft, reddish brown
Ponderosa Pine	#2	- heartwood red, sapwood whitish
White Fir	#3	- whitish, easily scratched with fingernail
Redwood	#1	- reddish color throughout
Oak	#4	- heavy, hard to scratch with fingernail

Activity #3B: Log Round Observations

Activity Overview

In this activity, students will view a poster displayed by you, use a worksheet to learn about the information that can be learned by examining tree rings, and make observations of actual log rounds. They will use evidence they see in the tree rings to describe what may have occurred in that tree's life span.

Focus Questions

1. *What are tree rings?*
2. *What can tree rings tell us about the life of a tree?*

Main Ideas

1. Tree rings can provide much information about a tree's growth patterns throughout its life.
2. Every year a new layer of wood forms just beneath the tree's bark.
3. This layer of wood is called the cambium. The tissues in the cambium make new wood (xylem) and new bark (phloem).
4. The cells produced in the spring are much larger and lighter than the ones produced in the summer, which are smaller and darker.
5. Each set of light and dark bands makes one annual ring, or represents one year of growth.
6. When a tree is growing rapidly the rings are larger than when the growth is slowed.
7. Some of the causes of slow growth include, but are not limited to: drought, competition for resources among trees, insect attack, fire damage to the tree.
8. Some of the causes of rapid growth are adequate moisture, lessened competition among trees, ideal growing conditions.

Activity Organizer

Objectives

By the end of this activity, students should be able to:

1. Recognize annual growth rings in log rounds.
2. Tell the difference between spring growth and summer growth.
3. Describe some of the causes of slow growth and rapid growth in trees.
4. Tell how long a tree lived by examining its rings.

Materials

- How a Tree Grows poster
- Parts of a Tree poster
- Stories in Stumps worksheets (1/group of 2 - 3 students)
- How a Tree Grows handouts (1/group)
- Log rounds (1/group)
- Pencils (1/group)
- Magnifying glasses (1/group)

Time Required
20 - 25 minutes

Location
Sherwood Campfire area (Marker #8)

What to Do

1. Display the poster "How a Tree Grows" and point out the annual growth rings as well as other telltale signs that provide information about the tree's life.
2. Divide the class into smaller groups (2-3 students) than you just had for the previous activity so that everyone will have a chance to examine log rounds.
3. Give each group of 2-3 students the a laminated copy of the "How a Tree Grows", and a "Stories in Stumps" paper as well. Have them use the information to decide, as a group, what probably happened to the tree pictured. Each group should pick a recorder to write their story of what happened to the tree.
4. Give each group an opportunity to share what they think happened.
5. The two log rounds that are used for visual aids in this unit are useful for pointing out an important concept in timber management. These pieces of wood were cut from the trunks of two incense cedars. They are nearly the same age, both being about eighty-five years old. The larger cross-section was cut from a tree that for the first sixty years of its life grew in an environment similar to that of the smaller tree. This is evidenced by the very tight set of growth rings in the center of the log round. About twenty years before these trees were cut, this area was logged and the taller, dominant trees surrounding this cedar were removed, With the competition for the sunlight, water and soil nutrients reduced so significantly, and with the resulting better growing conditions, this tree began to grow very rapidly. The dramatic increase in the size of the annual rings shows this to be true. By comparing and contrasting these two pieces of wood we can see the need to provide a suitable environment for growing new trees.
6. Pass out the other log rounds and magnifying glasses. These log rounds are from a tree that was either cut down or fell down this year.
7. Have the groups determine the age of the tree. What year did the tree begin its life?
8. Have them examine the tree rings to decide, as a group, what probably happened to the tree during its life.
   A. Was the tree growing well during its last years of life?
   B. During what years did the tree experience the slowest growth?
   C. What might have caused such slow growth?
   D. What were the years 1975 and 1976 like for this tree? (Drought years)
   E. What were the years 1981 and 1982 like for this tree? (Very wet, cold years)
   F. Is there any evidence of fire or insect damage?
   G. Is there a period of time where a series of small growth ring for a number of years is followed by a series of large growth rings for a number of years? If so, what might have caused this? (Very possibly the area where the tree was located was logged and the tree's competition was removed allowing it to grow rapidly for quite some time.)
9. Discuss how knowing this kind of information could be helpful to forest managers. Use the other posters in the cupboard for group presentation/discussions if you wish.

Continue your hike by taking the trail at the lower right corner of the campfire area. After crossing the footbridge, walk up the hill past several buildings and you will arrive at **Marker #9** located by the edge of the road. Here you will find a giant sequoia and an incense cedar. This is a good place to compare and contract the two species.

Activity #4: Compare/Contrast a Giant Sequoia and Incense Cedar

Activity Organizer

In this activity the students find examples of cones and needles from each tree and determine their differences. They will also examine the bark of each tree. Based on their findings the students should be able to correctly identify each tree.

Focus Questions

1. *How can we tell the difference between a giant sequoia and an incense cedar?*
2. *What are the distinctive characteristics of each species of tree?*
3. *Why might some people mistake incense cedars for giant sequoias?*

Main Ideas

1. Each species of tree has distinctive characteristics.
2. Giant sequoias and incense cedars have some similarities in their appearance.
3. Careful observation enables us to tell the difference between the two kinds of trees.

Activity Organizer

Objectives

By the end of this activity, students should be able to:

1. Correctly identify leaves, cones, and bark from each species of tree.
2. Recognize and describe similarities between the two tree species.
3. Apply this knowledge to observations made of other trees in the forest.

Materials

- None

Time Required

5 - 10 minutes

Location

Marker #9 by the ropes course and just past the candle shop and Ye Olde Village Inn

What to Do

1. Divide the class into groups of 4 - 6 students.
2. Explain that the students are going to do a little competitive detective work.
3. Challenge the groups to provide three pieces of evidence from each of the two trees before them

that provides positive identification as to what species of tree it is.

4. As an incentive, offer a reward of chance ticket(s) to whichever group can first find evidence and correctly identify the two trees. If they are having difficulty, allow them to use the tree i.d. cards as an aid.
5. Remind them of the skills they have learned so far in this class and suggest they apply them the rest of the week to become more familiar with, and more fully appreciate the diversity of a forest.

Leave Marker #9 and proceed down the dirt road to **Marker #10** which is located next to a large giant sequoia stump.

Activity #5: Examining the Giant Sequoias and History of Logging

Activity Overview

This sequoia stump and another stump a short distance away serve as reminders to us of the logging practices of 100 years ago. Those two trees were probably cut in the early 1870's. This is an excellent area to discuss the history of logging and present day logging practices. Have the students make observations of the giant sequoia stump and trunk lying next to it.

Focus Questions

1. *What happened to this tree?*
2. *Why is much of the tree still lying on the ground?*
3. *How large was this tree?*
4. *What difficulties did the early loggers face in cutting and using the giant sequoias?*
5. *Was the cutting of the giant sequoias a wise use of resources?*
6. *What makes giant sequoias special?*
7. *What lessons can we learn from the destruction of the giant sequoias?*

Main Ideas

1. The giant sequoias were very difficult to cut down, and even more difficult to move once they were cut.
2. Much of the giant sequoia is unusable for lumber because of the size of its branches, and therefore the size of the knots in the wood of the trunk. Also, the wood was very brittle and shattered upon impact.
3. Early loggers did not have the technology or tools available to today's loggers. They cut these trees using only axes and hand saws. They moved the logs by skidding them along the ground with teams of oxen.
4. Because of the size of the trees and their branches, and brittle nature of the wood there was tremendous waste. Also, the number of mature giant sequoias (over 1,000 years old) is very small, and as such, they are rare trees. To destroy all of them would be incredibly foolish.
5. We can learn lessons from the giant sequoias such as: man's greed causes him to do foolish,

wasteful things; the quest for wealth can cause us to ignore or forget other values such as beauty, uniqueness, longevity, the fact that the natural world is valuable for what it is - **natural** - and not just valuable for what we can get out of it or take from it; we can use alternative resources when a resource is unique or limited; we can wisely manage and use resources without being wasteful.

Activity Organizer

Objectives

By the end of this activity, students should be able to:

1. Explain what happened to the giant sequoia they are observing.
2. Estimate the height of the tree before it was cut down.
3. Describe the evidence that shows how it was cut down.
4. Express other values the sequoia possesses besides monetary value.
5. Discuss the wise use of natural resources.
6. Demonstrate an understanding of how man's manipulation of the environment has long-term impacts.

Materials

- Copies of early logging photographs
  - A. Team of oxen pulling logs across greased skids
  - B. Team of oxen pulling wooden/iron wheeled wagon with giant sequoia log
  - C. Madera flume used to transport cut lumber from mountains to Madera

Time Required

20 - 30 minutes

Location

Sequoia stumps near Marker #10, about 100 yards down the dirt road from Marker #9

What to Do

1. Allow the students a short time to simply explore the area around the stumps and the large living giant sequoia that remains.
2. Pass out the "Observations of a Giant Sequoia" worksheets and pencils to teams of 4-6 students. Pose the questions:
   "What do you think happened here?"
   "What does the evidence that we can directly observe here tell us?"
   "How long ago do you think these trees were cut down?"
   "How do you think the trees were cut?"
   "What can we learn from our observations?"

3. Answer the questions as they relate to the sequoia stump and trunk by the gate. Tell students to be careful around the barbed wire fence. Have students see if they can find the end (top) of the tree. What's happening to the main trunk of the tree? (It's gradually being buried) Why? (As soil is washed down the hillside it is backed up behind the dam formed by this giant tree, and

filling in the uphill side).

4. See if students can determine the length (height) of the tree. Encourage them to come up with ways they can measure it. (Pace off distance, use a stick equal to their height, or determine who is nearest to 5 ft. in height and use them like a yardstick, etc.) (The height is approximately 275 feet.) How much of the tree was utilized? How much, therefore, was wasted? What does that tell us about logging practices of a hundred years ago?
5. Have students closely examine the end of the trunk lying nearest the stump. How do you think this tree was cut down? (By axe without even the use of a crosscut saw). How can you tell? (Marks left by axes.) How long do you think it took to cut this tree down? (A tree of this size probably took two men at least one week to cut down.)
6. Why do you suppose so much of the tree was left lying there? (Possibly due to the enormous size and the lack of adequate equipment to move sections of the tree.)
7. Show the students the copies of the three early photographs of logging in this area. Discuss the evidence in the pictures that shows the challenges faced by early loggers.
8. How might this tree have been used? (Judging from the shortest section of the trunk lying nearest the stump, it was probably split into fence rails.)
9. Have students examine the smaller stump between the Calvin Spire (the large living sequoia close to the creek), and the large stump you've been studying. Look for the places on the stump where notches have been made for holding springboards (similar to scaffolding today), where the loggers stood while the actual undercut was being made. Why do you suppose the loggers would want to stand so high off the ground to cut a tree? (The trunk is a smaller diameter at that height, so there is less thickness to cut through; and the shape of the base makes much of its wood useless as lumber.)
10. Look at the Calvin Spire, the remaining living sequoia. Why do you suppose it was left when the others were cut? (Although we will never know the real reason, it may be surmised that due to the difficulties encountered in making use of the large one lying nearby it was not considered to be worth the effort to cut the spire. Additionally, you can see several enormous branches in the spire that are becoming the new tops to replace the dead main spire. These were, no doubt, already growing when the loggers cut down the others in this area. Thus, that section of the tree would have been useless for lumber.
11. Pose this question to the students. If you were a logger and had to decide whether or not to cut this remaining tree, what would you do–and why? Try to get students to name factors they would consider to justify their decisions.

Name_____

OBSERVATIONS OF A GIANT SEQUOIA

Answer the following questions as well as you can.

1. How old do you think this tree was when it was cut down?
   Probably between 1,000 -2,000 years old
2. How long ago do you think the tree was cut down?
   It was most likely cut between 1874 - 1878 by loggers for the California Lumber Company

3. How tall was the tree?
   The tree was approximately 275 feet (85 meters) tall
4. How much of the tree was used?
   Only the very short missing section, and a portion of the biggest part of the log that remains.
5. How much of the tree is still left?
   The majority of the tree remains. Less than 1/4 of the tree was ever utilized.
6. Why do you think that there is still so much of the tree here?
   The tree was very large and difficult to move. Possibly the tree was cut in 1877 shortly before the company went bankrupt, and thus the loggers never returned to finish the work they had begun.
7. What do you think was done with the section of the tree that was taken?
   The sequoia lumber was very rot resistant and was most probably used in the construction of the flume that carried the lumber produced by the mill out of the mountains and to Madera (the flume required over 7 million board feet of lumber to construct), or the wood may have been used for fence posts, railroad ties, or irrigation gates.
8. Trees are a renewable natural resource. How long do you think it would take to grow a tree this size? *At least 1,000 years*
9. If you were a logger and had to decide whether or not to cut down a tree of this size, what factors would you need to consider? List advantages and disadvantages of cutting giant sequoias:

Advantages	Disadvantages
Huge volume of lumber from a single tree	*Too large to easily handle*
Lower sections of trunk had very few limbs	*Some limbs larger than ordinary trees, enormous knots*
Very rot resistant, great for contact with water, ground	*Very brittle, shattered on impact*
Split easily for shakes, fence posts, grape stakes	*Too weak structurally for construction*
	Very rare resource, national treasure
	Incredibly long time to replace one of the same size

10. Based on the lists of advantages and disadvantages, would you cut down a giant sequoia? We hope not!!!! Why, or why not? *Student answers will vary.*

11. Look around this area and decide whether the giant sequoia seems to be a common (many of them), or uncommon (few of them) tree. Underline your choice.

12. Would your answer to question #11 (common, uncommon), affect your decision about cutting down a giant sequoia? We hope so!!! Why, or why not? *Student answers will vary.*

Leave this area by backtracking up towards the John Knox Tree (the other large giant sequoia) that you passed near Marker #9. Go past the John Knox Tree, veer slightly to the left and continue uphill across the open grassy area to **Marker #11** near the building (bathroom). Here have students do the activity "Measuring The Height Of A Tree."

Activity #6A: Measuring the Height of a Tree

Activity Overview

At this location you will have two options for measuring the height of a tree. Option #1 allows students to gain practice in using a technique that will allow them to measure the height of a tree, a building, or just about any other thing of any size that they can think of. It is a technique that gives a good **approximation** or **estimate** of a tree's height. Option #2 is a more exact method of determining the height of a tree. Students use clinometers, tangent tables, a 50-meter tape, and calculators to measure the height of a tree. This method has been developed in conjunction with the protocols established by the GLOBE program of making scientific observations and measurements. *****To save time, introduce this activity, and the next activity (Measuring Tree Diameter) together. Have half of your groups measuring diameters while the other half measure heights, then switch roles and materials.**

Focus Questions

1. *How can we measure the height of a tree without actually climbing it?*
2. *Why does it matter to a logger how tall a tree is?*
3. *How important is it to know the exact height of a tree?*

Main Ideas

1. We can estimate the height of a tree without having to climb it.
2. There are several ways of estimating the heights of trees.
3. Principles of geometry are helpful in measuring the height of a tree.
4. A clinometer enables us to measure the height of a tree with a high degree of accuracy if used correctly.

Activity Organizer

Objectives

By the end of this activity, students should be able to:

1. Use at least one method for determining the height of a tree without having to climb it.
2. Understand that principles of geometry are helpful for calculating tree heights (even if they do not understand geometry).
3. Be able to apply the techniques they used to measure tree height to other trees or objects.
4. Understand that often estimating gives us a good enough answer to a question.

Materials

- Clinometers
- 50-meter tape measure
- Calculators

Time Required

25 - 35 minutes (in conjunction with Activity #6B)

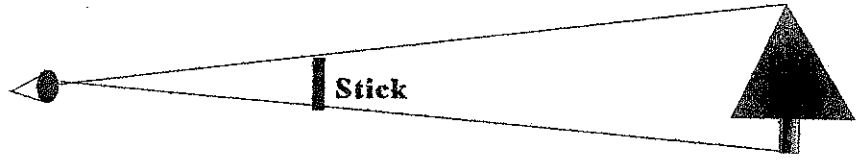
Location

In the large grassy area between the "Greenwell" bathroom and the ropes course by Marker #11

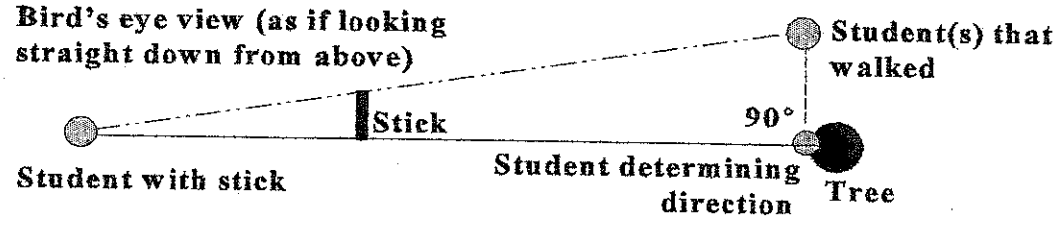
What to Do

Option #1: Measuring Tree Height With a Stick:

Have students divide into groups of 3 (or 4). Have each group find a straight (or nearly so) branch 1-2 feet long (break stick to customize if necessary). The students need to pick out a tree whose height they would like to measure, down near the ropes course on the edge of the grassy area. Two of the students should walk to the base of the tree. The student with the stick needs to stand far enough away from the tree so that when (s)he holds the stick vertically out at arm's length and sights along the stick, it lines up exactly with the top and bottom of the tree. See diagram below.



When this is done the student then, without moving from the spot where (s)he is standing, rotates the stick so that it is held horizontally instead of vertically. One end of the stick is used to sight the base of the tree. One of the students remains at the base of the tree and stands facing the student with the stick. This student makes sure the walker(s) walk at a 90° angle to the line formed between the tree and the sighter. The other student(s) at the tree walk away in a direction that is 90° (perpendicular) from the line between the student with the stick and the tree. See diagram below.



The student(s) walking away from the tree walk until the sighter tells them to stop. They should stop when sighted by the sighter at the end of the stick opposite the end sighting the base of the tree.

The measurement of the tree's height is now made by stepping off the distance between the tree and the student(s) who walked. Try to determine the length of the student's footstep and multiply this number by the number of steps taken to arrive at the approximate height of the tree.

Have several groups measure the same tree from different places. Compare results. Are the results similar? Why or why not? What factors might affect the measurements? What might be the purpose for measuring the height of a tree? Have the students discuss these questions. (Hint: purposes include determining volume of lumber, how far the tree will reach when it falls, etc.)

Option #2: Measuring Tree Height With a Clinometer:

In this activity, students will measure the heights of the same trees as mentioned above. This activity gives them practice accurately measuring and recording scientific data. They will also use a tangent table and calculators to help them calculate each tree's height. All students will make the measurements.

Additional Main Ideas

Standardized measurement techniques need to be used to ensure consistent, reliable results in scientific research.

Use of geometry and trigonometry techniques and calculations can help us measure the heights of trees without having to climb them or cut them down. This kind of measurement is termed an indirect measurement.

Scientists often study a selected number of individuals to obtain a representative sampling, rather than to try to study every single individual in a population.

Lesson Organizer

Additional Objectives

By the end of the activity, each student should be able to:

1. Use a clinometer to determine the angle of elevation from his(her) eye to the top of a tree.
2. Measure the distance from the ground to his(her) eye.
3. Use a tangent table to find the tangent for the angle of elevation.
4. Use a metric tape to determine the distance from the base of the tree being measured to the observer's location.
5. Use the information gained in the first four objectives, and mathematical calculations to determine the height of a tree.
6. Record and interpret the scientific observations made during the activity.

New Terms

Arc: a line drawn on the perimeter of a circle that can be graduated (divided) into degrees.

Clinometer: an instrument used to measure heights of objects indirectly by determining the angle of elevation.

Tangent: the ratio between the side opposite (tree height in this case) and the side adjacent (distance from the observer to the base of the tree) of an acute (less than 90°) angle (the angle of elevation mentioned in Objective #1) when that angle forms part of a right triangle.

What to Do

1. Ask your students how they think they could accurately measure the heights of one of the trees they can see from this location that are down near the ropes course. Discuss pros and cons of methods suggested.
2. After discussion of #1, introduce the clinometer, and demonstrate how to use it **(see the**

Worksheet on Indirect Measurement on pg 20). Use the steps as follows:

A. Measure the height of each observer from the ground to eye level. Write the heights on the back of the group's assessment sheet, as these numbers will be used in the final calculations of the tree's height.

B. Use the 50-meter tape to measure the distance from the base of the tree being measured to the observer (this is the adjacent side in our right triangle). Be certain to:

1. Try to measure a line that will keep the observer's feet as close as possible to level with the base of the tree (try not to get too far uphill or downhill from the base of the tree - go across the slope if possible). The closer to level you are, the more accurate will be your measurements.
2. Get far enough away on a straight line made by the 50 meter tape to see the highest point on the tree.
3. Station students at different vantage points along the line so that they can all be measuring the same tree at the same time (e.g. one group could be 25 meters from the tree, another group could be at 30 meters, a third group at 35 meters, and so on).

C. Hold the clinometer in one hand and tilt it so that as you look through the sighting tube you will see the very top of the tree. Be sure that the weighted string can swing freely on the clinometer side of the board.

D. While sighting on the top of the tree, use the other hand to "pinch" the string against the clinometer to hold it in place so that the angle of elevation can be seen.

E. Read the clinometer to the nearest degree (each mark represents 1°).

F. On the tangent table, find the tangent for the degree reading determined by the clinometer.

G. Multiply the tangent times the distance in meters from the observer to the base of the tree. This number will represent the height of the tree from level with the observer's eye to the top of the tree.

H. Add the number calculated in "G" to the height determined in "A" to get the actual height of the tree. **(Again, see the Indirect Measurement Worksheet).**

By using the steps above with the example on the worksheet, you would get the following results:

A. Height from ground to eye level	150 cm	=	1.5 m
B. Distance from tree to observer			60.0 m
C-E. Angle of elevation	24°		
F. Tangent of 24°	.45		
G. Tangent multiplied by distance to tree	.45 X 60 m	=	27.0 m

H. Tree height from eye level + height from ground to eye: 27.0 m + 1.5 m = 28.5 m (total tree height)

3. Review the activity by discussing the following questions:

A. Why did we use an indirect method of measuring tree heights?

B. Why was it important to include the height from ground level to eye level in our calculations?

C. Why is it important to use standardized measurement techniques in measuring tree heights?

D. How can the measurements of a tree's height serve as indicators of its health, growth rate, and influence on the surrounding environment?

(Answers)

A. We used an indirect method of measuring the trees' heights because it was much simpler than trying to climb each tree, and much less wasteful than cutting them down and then measuring them

B. If we had not included the ground-eye level measurement in our calculations, we would have been wrong in our statements as to how tall each tree was.

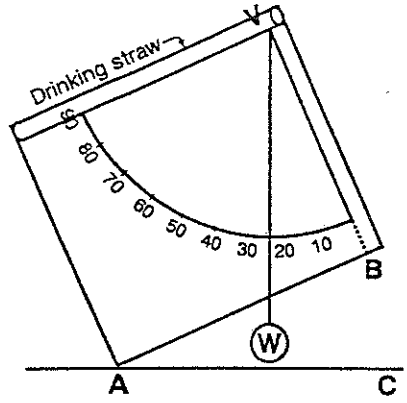
D. The same methods of measurement need to be used on a consistent basis in order to ensure the accuracy and dependability of such measurements. Also, the measurements can be replicated in the future by using the same techniques.

E. Tree heights are affected by their growth, or lack of it. Healthy, vigorous trees show greater increases in height and diameter than unhealthy, crowded, heavily shaded trees. Larger trees with greater canopy size impact the surrounding environment by consuming more nutrients and water, limiting the amount of resources available to other vegetation, and also limiting the species diversity of a habitat. Large trees have a greater impact on the microclimate of their environment as well; cooling it and minimizing the impact of wind and soil erosion.

Indirect Measurement

Worksheet:

1. The clinometer is used to measure heights of objects and is an easy device to construct. It is a simplified version of the quadrant, an important instrument in the Middle Ages, and the sextant, an instrument for locating the positions of ships. Each of these devices has arcs which are graduated in degrees for measuring angles of elevation. The arc of the clinometer is marked from 0 to 90 degrees. When an object is sighted through the straw, the number of degrees in angle BVW can be read from the arc. Angle BAC is the angle of elevation of the clinometer. What will happen to angle BVW as angle BAC increases?



Angle BVW on the clinometer is equal to the angle of elevation of the clinometer, angle BAC. In the diagram below, the clinometer was used to find the angle of elevation from eye level to the top of the tree. This angle is 24°. The distance from the person to the base of the tree, ET, is 60 meters. The observer's eye is 150 cm. (1.5 meters) above the ground. In this diagram, the person and the tree are not drawn to the same scale.

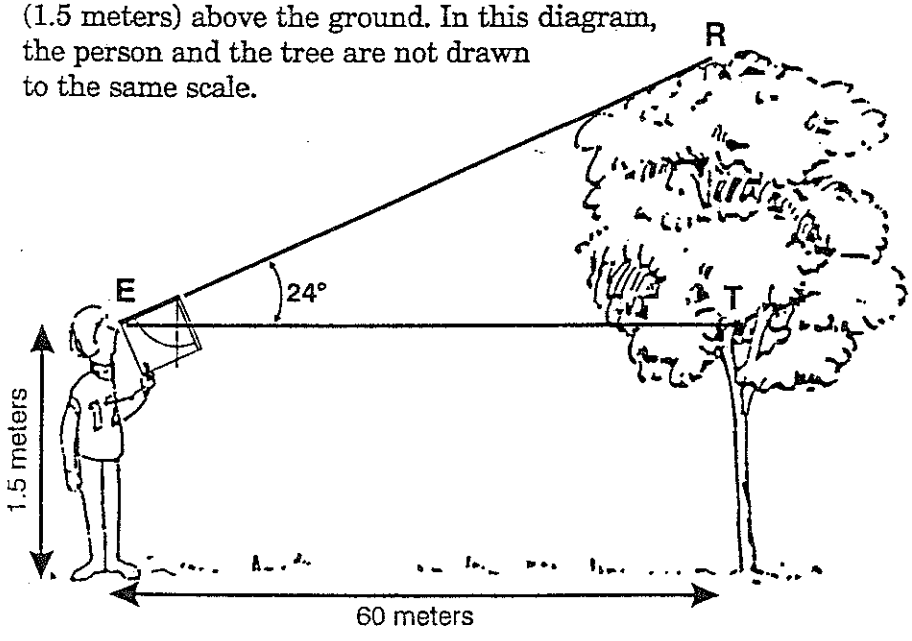


Figure 13: Indirect Measurement Worksheet

Activity #6B: Measuring the Diameter of Trees

Activity Overview

In this activity, students will measure the diameters of trees. The activity gives them practice comparing tree sizes and enforcing what they have learned about the different species' characteristics, as well as practice in accurately measuring and recording scientific data.

Focus Question

How can we accurately measure the diameter of the trees that we determined the heights for?

Main Ideas

1. Scientists and forest managers often study a selected number of individuals to obtain a representative sampling, rather than to try to study every single individual in a population.
2. Standardized measurement techniques need to be used to ensure consistent, reliable results in scientific research.
3. Making systematic measurements over a long period of time (a number of years), allows scientists and forest managers to monitor the changes that may occur in the health and stability of an environment and its individual components.

Activity Organizer

Objectives

By the end of the activity, students should be able to:

1. Use a diameter tape to correctly measure the DBH (diameter at breast height) of an individual tree.
3. Explain how representative samples can be useful in making statements about a given population.
4. Define the term diameter, and explain why it is a useful measurement when examining tree growth.

New Terms

Diameter: the length of a straight line through the center of an object.

DBH (Diameter at Breast Height): measurement made of the diameter of a tree taken at a height of 1.35 meters above ground level. The height of 1.35 meters is close to chest height on an average person, and is a comfortable, convenient height from which to make measurements. As all people are not the same height, students need to use the 1.35 meter standardized height which ensures consistent measurements by any number of observers.

Representative Sampling: process of selecting a suitable part of a population for the purpose of determining the characteristics of the whole population.

Materials

DBH tape

Time Required

25 - 35 minutes **(in conjunction with Activity 6A)**

What to Do

Explain to students that certain measurements can be useful in the study of trees which enable scientists and forest managers to keep track of their growth patterns, health, and impact on the environment. These measurements are most useful when carried out over an extended period of time during which scientists can

observe changes that take place. This is done in much the same way that human growth charts are used. In healthy humans, we can expect certain growth rates to occur as both males and females grow from babies to adulthood. Growth rates are often influenced by external factors, some of which may increase growth rates, and some of which decrease the rate of growth. (Remind students of the concepts that were introduced in the study of the log rounds.) These rates reflect the overall health of individuals and populations. The measurements that students take during this activity would be most valuable when combined with measurements taken in ensuing years by other students, and when compared and contrasted with data from other locations. Scientists can use the information gathered by student scientists to get a better picture of the entire global environment, as well as better understand what is going on locally.

1. Ask your students what kinds of measurements might be useful for them to make that could help foresters know more about the trees on our study site. If the suggestion is made that they should measure how big a tree is, ask them how they might be able to do that. What might be some problems that they could encounter in an effort to measure the "bigness" of a tree? Lead the discussion towards the concept that knowing the diameter of a tree is a useful measurement for foresters. This is because changes in the **diameter** over time can indicate how rapidly the tree is growing, and even how healthy it might be. (Remember how growth charts are used with growing children?)
2. Find out what students know about the term "diameter". Ask how one could go about measuring the diameter of a tree if (s)he couldn't make a straight line through the center of it.
3. Display a **DBH tape,** and demonstrate how to properly use one in measuring the diameter of a tree. Point out how one side of the tape gives the measurement of the circumference (distance around the outside) of the tree, but the other side gives the measurement of the diameter. The circumference is measured in meters, the diameter in centimeters. You might ask if they know the term "pi"(ratio of circumference of a circle to its diameter). The diameter is found using the formula: circumference ÷ pi (3.1416) = diameter. The DBH tape eliminates the need to do the mathematical equation because it's already done for you.
4. Explain that they will work in the same teams as the tree height activity to measure the diameters. Each individual in the group should be responsible for making the actual measurement on at least one tree. Some groups could be measuring diameters while others are measuring heights. They will need to switch roles when appropriate so that every group does both the diameter and height measurements. Offer assistance as needed to each group. Encourage them to check one another's accuracy of measurements.
5. Review the activity by discussing the following questions.
   A. What does the term **diameter** mean, and how can knowing the diameter of a tree be useful to scientists?
   B. What is different about a **DBH tape** from other tape measures, and how is that difference helpful in making our measurements?

(**Answers**)

A. Diameter is the measure of a straight line through the center of an object. Scientists can monitor the changes over time in a tree's diameter to determine the health of the individual tree as well as gain some insight into the changes that are likely occurring in the surrounding environment.

B. A DBH tape has two different kinds of measurements. On one side is a normal measurement of length while on the other side is a measurement that is divided by pi (3.1416). The second measurement shows the diameter of an object that the tape has been wrapped around.

***** Remember that this activity should be done in conjunction with Activity #6A in order to save time, and to enable all students to be actively involved in the measurements and calculations.** Emphasize to students that just as the heights of trees are useful measurements, so too, are

the diameters of trees. The rate of change of tree diameters over time serves to indicate the health of individuals, as well as serves as an indicator of the overall health and vigor of a population. These measurements are most useful when combined with the measurements of tree heights.

Travel from Marker #11 uphill across the grassy area towards the intersection of the dirt roads. Take the left hand road which heads uphill, and follow it for a distance of approximately 100 feet. Here you will see an abandoned road which forks up to the right. At the intersection of these two roads is **Marker #13.**

Activity #7: Which Way Did It Go?

Activity Overview

At this site students will observe a tree stump, and based on information provided them about how a tree is cut down, will determine which way this tree was felled (logging terminology). They will also discuss the reasons for wanting trees to fall a particular direction.

Focus Questions

1. *Which way did it go?*
2. *Why did it go that way?*
3. *How did the logger make it go that way?*

Main Ideas

1. When a tree is cut down it is important to cut it in such a way that it does the least possible damage to the surrounding environment, and itself.
2. A logger can affect the direction a tree will fall by making his/her cuts correctly, leaving a hinge, and through the use of wedges or other devices that help direct the tree's fall.
3. By examining the stump that remains from a tree, a careful observer can determine which direction the tree fell when it was cut down.

Activity Organizer

Objectives

By the end of this activity, students should be able to:

1. Determine which way the tree that was on this stump fell when it was cut down.
2. Explain how an undercut helps determine the direction of fall of a tree when it is being cut.
3. Describe how a "hinge" helps direct the fall of a tree.
4. Be able to apply the concepts learned here to other trees/stumps.

Materials

- None

Time Required

5 - 10 minutes

Location
Marker #12 at the intersection of the abandoned road and the main road that leads to Sherwood Forest.

What to Do

Next to the marker is a stump. Have students recall the information already covered in the unit, and ask them to determine which way this particular tree fell.

1. Explain the terms *undercut, hinge,* and *backcut* as described in the General Information section of the unit (page 29).
2. Ask, "Which side is the undercut on? Is there a "hinge" that helped direct the tree's fall? If so, how would that hinge affect the fall? Is there evidence that it has been a long time since the tree fell? If so, what is the evidence?"
3. Discuss answers to these questions basing the answers on evidence observed.

Leave this location by continuing up the abandoned dirt road. Travel up the road about 100 yards until you reach **Marker #13** which is located in the middle of the fork in the road where the road splits in two.

Activity # 8: Which Way Should It Go? (Felling a Tree)

Activity Overview
In this activity, students will make observations and determine which way a tree should fall if they were having to cut it down. They will use the knowledge they have gained in the unit to help them make their decisions. They will present their choices and reasons for making such choices to the rest of the class for peer evaluation.

Focus Questions

1. *In what direction should this tree fall to do the least damage to itself and the surrounding environment?*
2. *What factors must be considered in cutting the tree down?*
3. *Where should the undercut be made?*
4. *Where should the back cut be made?*
5. *Would it be necessary to use wedges to help direct this tree's fall?*
6. *What questions should be asked to determine whether the tree should be cut down or not?*

Main Ideas

1. It is necessary to examine a tree and its environment carefully before deciding which direction to drop a tree.
2. The undercut, back cut, hinge, and use of wedges must be carefully considered before ever beginning to cut down a tree.
3. Falling a tree in the location chosen is necessary to prevent damage to the tree and its surroundings.
4. It is necessary to determine whether a tree really needs to be cut down before doing so.

Activity Organizer

Objectives

By the end of this activity, students should be able to:

1. Make a wise choice as to the direction a tree should fall if it needs to be cut down.
2. Explain the purpose of an undercut, a back cut, a hinge, and the use of wedges in cutting a tree.
3. Justify the reasons for cutting, or not cutting down a tree.
4. Evaluate the impact of cutting a tree on the surrounding environment.

Materials

- None

Time Required

15 - 20 minutes

Location

At Marker #13 along the abandoned dirt road halfway from Sherwood Forest to the Mountain View cabins.

What to Do

Here you will note several large ponderosa pines.

1. Divide the students into 3 groups. Have each group pick one of the trees and try to determine which way(s) the trees should fall if cut.
2. Have them consider factors to consider in cutting their chosen tree down (i.e. where the undercut, back cut, hinge and wedges should go to make the tree fall in the proper direction).
3. Each group gets one tree and makes a determination as to where they would make the tree fall. They could do this by looking at the tree from various vantage points, looking at the surrounding area to see what factors would affect their choice and by discussing these things among themselves until they reach a consensus.
4. When all three groups are done bring them all back together. Have each group explain where they would make their tree fall and Why? Have them explain what factors they took into consideration and how these factors affected their decision. Have them explain where they would put the undercut and back cut and why. It would probably be wise for each group to choose a spokesperson.
5. Have the other groups decide whether or not they think the right choice was made. Were all factors considered? What was the most important factor in determining the decision reached?
6. Always remember to mention that what is really important to ask is - "Is it necessary to cut this tree down?" "Why?" If there is a good sound reason then the next question is "How can it be done safely with the least damage to the rest of the environment?"

If time permits, end the class with a short evaluation time. Who can remember their use of the wood (introduction activity)? Cover other aspects of the course such as species identification, and logging history if you have time.

LOGGING AND FORESTRY - GENERAL INFORMATION

Introduction

Man has depended upon trees and their by-products as resources for thousands of years. Trees have served as a source of food in the form of nuts and fruits. They have served as a source of fuel and some of the earliest tools were made from wood. Trees have served as shelters for ages. Today there are literally hundreds of ways in which trees are used. These range from toothpicks to power poles, from boxes to houses. The paper this unit is written on is a wood product. Wood by-products are used in chewing gum, perfume, paints, varnishes, explosives, molded plastics - the list could go on and on.

A resource as important and valuable as trees needs to be wisely managed and utilized. With this in mind, logging practices have been greatly improved as time has passed. In this unit we want to look at some of the reasons behind the present methods of logging as well as review some of the past practices. Besides looking at logging from the perspective of wise utilization of a renewable resource we want to look at different aspects of logging in particular.

Brief Summary of the History of Logging in the Sierra and in the Area of Calvin Crest

Logging began in the Sierra sometime in the late 1800's, after the completion of transcontinental railroads made possible the dispersion of the lumber over vast distances. Lumber barons already established in the east turned their attention to the huge timber belts of the California Southern Sierra. This land was almost entirely public domain and was soon acquired from the Federal Government by far-sighted lumber men. In this way California entered an era of large logging towns, steam engines and giant flumes which lasted into the 1930's and was unequaled anywhere else in the U.S. In those days the vast amounts of timber growing on the sides of the Sierra seemed endless and the loggers saw no reason not to indiscriminately cut down whatever they wanted. Billions of board feet of lumber were cut and shipped to customers all over the world by Southern Sierra loggers and unfortunately, much destruction was left behind in their wake.

The logging technology and practices of the late 1800's are very interesting and quite different from practices of today. In the early days of logging, a sawmill was built in the mountains right among the timber stands. The trees were felled and then transported the short distance to the sawmill where they were cut into lumber. The rough-cut boards were then clamped together and sent down a flume which carried them more the 50 miles to major towns in the San Joaquin Valley. The flumes constructed in this area had their terminus in Madera. There, the lumber was re-sawn, planed and dried. The transcontinental railroad would pick up the timber and transport it to various customers across the country, and ultimately, all over the world.

These mountain sawmills were actually dismantled and moved to new sites whenever the timber supply ran out in the area in which they had been operating. It was a simple system, but one which needed heroic efforts and ingenuity, as well as sheer physical strength, to keep running. The method of transporting the massive fallen trees to the sawmill was at first accomplished by teams of oxen. Later, with the invention of a special heavy-duty steam engine, the logs were moved by train. Just

as in the case of the sawmill, when timber ran out, the train tracks were pulled up and moved to next profitable logging site.

Several large flumes were built in Central California, the longest being the Sanger Flume which was a tremendous 59 miles long! A flume was a v-shaped trough which would be filled with running water and down which the rough-cut timber floated, all the way to the valley. This is quite a distance, just think how long it takes to drive from Calvin Crest to Fresno! Often the timber would catch or jam somewhere along its route, sometimes even causing serious damage to the structure of the flume itself. For this reason, flume houses were built at intervals along each flume. The men who lived in the flume houses had the job of watching for, and taking care of log jams and damage to the flumes.

We are located in an area rich in logging history. One of the first major lumber towns (Sugar Pine) ever built in the Central Sierra was built by the Madera Sugar Pine Company (MSP) and was located just five miles from Calvin Crest. The remains of this town, (some of the houses are still occupied) can be seen down the Sugar Pine Road near Highway 41. The MSP actually had its beginning is a small, short-lived logging operation called the California Lumber Company. The California Lumber Company built the first sawmill in this area at Gooseberry Flat, about 1/4 mile downstream from Sherwood Forest, in 1873.

It was probably this company which cut the four sequoias, the stumps and remains of which you will see near Marker #10 when you walk down into Sherwood Forest. The California Lumber Company built the original flume in this region. This flume was 53 miles long and took three years to build. It began at Gooseberry Flat, and ended up in what is now Madera. In fact, it was this flume which generated enough business and revenue to give the town of Madera its beginning. ("Madera" means *lumber* or *wood* in Spanish.)

The California Lumber Co. soon went bankrupt (1878), but by 1880 a new corporation was formed under the name Madera Flume and Trading Company. This company thrived throughout the 1880's, and in 1889 built the first logging railroad in this entire part of the state. It was constructed near Soquel Meadow, branching out from a newer mill site. The railroad operation continued in that area for four years before a nationwide depression closed down the local mills.

In 1899, a millionaire lumberman from Michigan, along with other investors, built the new lumber town of Sugar Pine and established the Madera Sugar Pine Company, the longest-lived and most profitable of all the southern Sierra logging operations. The demise of the MSP came only when the depression of the 1930's caused the demand for wood and building materials to drop to nothing.

FELLING OF THE SEQUOIAS

One of the saddest chapters in the history of logging was the felling of many of the beautiful giant sequoias. It was in 1853, barely one year after a bear hunter accidently discovered them that the first giant sequoia was cut down. It was cut, not for lumber, but rather as a publicity attraction - the idea being that the public would be willing to pay to see such a giant of nature. As people became aware of the huge trees, it was only natural that the timber industry would be among the most interested.

A large number of the local sequoias were logged by the California Lumber Company and its successor, the Madera Flume and Trading Company. The latter constructed a second California Mill in Nelder Grove about 1882. It was at this site that the majority of the sequoias logged from Nelder Grove began their trip down the flume to Madera. The giant sequoias at Calvin Crest were logged heavily, with only two giants remaining. In other areas throughout the Sierra, such as the Converse Basin in Sequoia National Park, the destruction was tremendous.

The first logging of the redwoods for lumber was done in the 1860's and increased very rapidly. It continued in an on-again, off-again basis until the beginning of World I. As the trees crashed to the ground, their brittle wood often shattered and made large sections of the tree useless. The gigantic sizes of the logs, even after they had been cut into sections, made them extremely difficult to move. As a result, great sections of the trees were just left where they fell, as can be seen in the Sherwood Forest part of camp. There was considerable waste, even in those sections which were used. In order to move some of bigger log sections, they had to be split in half. This was often done by drilling holes into the logs, putting explosives into the holes and blowing the logs apart. Needless to say, enormous volumes of wood was ruined. The entire operation was seemingly undertaken with no thought for tomorrow. To the lumberman of that time, the giant sequoias of the Sierra appeared to just another big tree to cut for lumber. Today they are protected and are considered valuable because of their age, size and beauty, and unique place in the natural world, as the largest living organisms.

Present Day Logging Techniques

Today, logging techniques and loggers' attitudes are quite different than they were in the 1800's. With the beginning of a mechanized age, methods of logging have changed drastically, becoming much more efficient. Also, with the dawning realization that our California forests are not endless, but in need of protection, loggers have become more careful in their forest management techniques.

With the invention of the automobile and the subsequent development of heavy duty trucks, it is now no longer necessary for sawmills to be built as close to the timber stands as they used to be. Instead, logging roads are cut into the places to be logged, and the fallen trees are loaded on large logging trucks and then driven to centrally located sawmills. Today, instead of using two man saws and axes to cut down trees, loggers use chain saws and other large scale equipment, thus greatly increasing the amount of work one man can do in a day.

Another important difference between today's loggers and those of 100 years ago is the care that is taken to wisely manage the forest. Hiking around Calvin Crest, one can see evidence of the clear cutting techniques used 100 years ago when the debris and slash were simply left behind. Just outside the Calvin Crest grounds, on the southwest side of the access road, is an area logged in the summer of 1980. Only certain trees were cut, and many were left standing in order to preserve and perpetuate the beauty of the forest, and admittedly, for the sake of future harvest. Also the slash which is always created by logging operations (tree limbs, young trees, bark, etc.) was cleared, stacked in large piles, and later burned off at a time when weather conditions guaranteed a forest fire was not likely to be started. The loggers also did some re-planting, another means of ensuring the health of the forest. The result, as can readily be seen, is a more beautiful, healthy area of the forest.

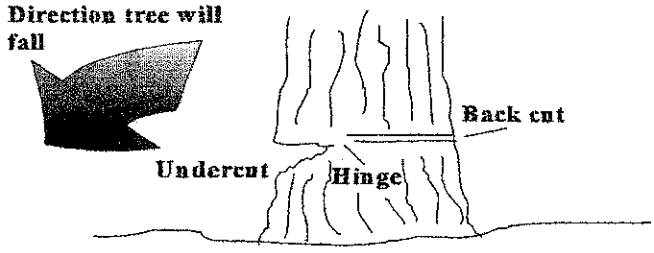
Felling a Tree

Trees are an integral part of their environment. They cannot be removed without affecting the other members of their community. When proper care is taken in logging practices, this impact can be minimized. Properly done, logging can even be beneficial to an area.

When a tree is cut and falls, it invariably affects some of the plants that are nearby. As it falls it may hit other trees breaking off their branches, sometimes even breaking off part of their trunks. As it approaches the ground it may hit smaller trees in the understory. It may go through some shrubs and smaller plants as it hits the ground. The amount of damage done to the tree's neighbors is largely dependent on the skill of the person falling the tree. The faller who knows what he is doing can normally drop a tree with little or no damage to the surrounding plant life. The more unskilled faller may badly damage or even kill much of the surrounding plant life as he falls a tree.

A faller must take several things into consideration as he prepares to cut down a tree. Is the tree leaning? If so, it will normally want to fall in the direction of the lean. If it is standing nearly vertically, which direction does the faller want the tree to go? Ideally, one would want to fall a tree in a spot where it will do the least damage to itself, as well as to the surrounding vegetation. What direction, and how strongly is the wind blowing? On a tall tree the wind might be strong enough to blow it where the faller doesn't want it to go. Are there any buildings or wires in the area? The faller would not want to hit these with a falling tree. In many areas the crown, or upper branches, of the tree that is to be cut is interlocked with branches of other nearby trees. This often affects the direction that a tree will fall and must be considered. Once these things have been thought about and the direction that the tree is going to fall has been decided, the faller goes to work.

The first thing the faller does is to make an *undercut*. This is done by making a wedge-shaped cut on one side of the tree. This serves to guide the trees's descent and prevents the trunk from splitting before it becomes severed from the stump. (See illustration below)



Then the *back cut* is made on the opposite side of the tree from the undercut. This cut is slightly above the undercut so that as the tree starts to fall it will lean toward the undercut. Thus cut goes into the tree until it nearly, but not quite, reaches the undercut. A little bit of the tree is left intact (the *hinge*), allowing that intact part to act as a hinge for the tree to swing on. Leverage can be applied to make the tree fall and sometimes the use of several wedges becomes necessary. Wedges are plastic, wood, or metal wedge-shaped tools that are driven into the back cut with a sledgehammer in order

to force the tree to fall in the direction the faller wants it go. With proper use of the undercut, back cut, hinge, and wedges the tree will fall where it is supposed to fall.

Wise Utilization of Trees as a Renewable Resource

It has been predicted that by the year 2,000 the United States will need millions more acres of timberland than it had 10 years ago! That simply is not going to happen. This means that proper management of the forest land we do have and wise use of the timber cut is imperative. Therefore, today's forest manager is compelled to think in terms of the future as well as the present, of the continued need for more and better trees, and of the necessity for intelligent supervision and regeneration of the woodlands. The principles involved in the care and improvement of trees is known as silviculture- a practice that requires knowledge of the life history and characteristics of trees with an understanding of environmental factors. Its goal is to reproduce trees and manage forests in order to obtain a continuous output of crops.

The objective of forest management today is to obtain sustained yields as opposed to harvesting a one-time crop. First, care must be given to determine what procedures should be followed in managing a forest. Then, a process called timber-stand improvement is begun. This process is designed to improve the overall quality of the forest by removing poor and unsound trees with the objective of improving the growth rate of more desirable plants. Three common problems which exist in unhealthy forests are:

1. Overcrowding - an overcrowded forest has an unsatisfactory growth rate because the roots and branches of the trees are in too much competition with their neighbors, thus restricting their development.
2. Wolf trees - This is a condition existing in a forest with too many old, heavily branched trees. Because of this, young saplings don't get the light they need at the time they would normally be growing the most rapidly.
3. The presence of undesirable species - this condition causes the more desirable species to be crowded out.

Timber-stand improvement is the correcting of the above conditions by the cutting of undesirable trees in order to liberate those the forest manager regards as more promising for future use.

Balancing these considerations, however, are concerns in wildlife management of "Old Growth" forests. If the removal of the largest, older trees is detrimental to the overall environment, or to species that are listed as rare, threatened, or endangered, different management approaches must be undertaken.

Besides proper forest management, more efficient ways of using the trees which are logged also increases productivity. At the turn of the century, as little as one third of a tree might be converted into a handful of useful products. At the sawmill round trees were cut into square lumber and the waste burned or left to rot. In those days lumber accounted for 90% of the use of logs and much was wasted. Today, about 50% of the timber cut is made into lumber for building, while the rest is used for paper, plywood, fuel, posts, and some 5,000 other products.

Modern improvements in processing machinery make possible this more efficient utilization of each log. Improved saws minimize waste in cutting; barkers strip the bark from logs so that there is no loss of valuable wood fibers, and the bark itself is converted into valuable products. Machines known as chippers take pieces of wood once regarded as useless and reduce them to material that is made into pulp for strandboard, paper and cardboard.

As the demand for lumber increases and man increases his manipulation of the environment, it is essential to remember that man is and must remain a part of nature, and whatever changes he brings about must be in harmony with the basic laws of nature. The forest is far more than just trees. It is a vastly complex community of plants and animals, all mutually interdependent - each performing some vital function that makes possible the existence of others. Fortunately, if forest management is done properly and carefully, not only is the quantity and quality of timber logged improved, but the general health of the forest is also improved thus benefitting both man and nature.

Varieties of Trees Found in This Area and Their Uses

The uses of wood are many and varied. The following is a list of trees which can be found on the Calvin Crest grounds. This list includes those that are of primary concern to lumbermen, as well as trees that are important for reasons other than lumber.

SUGAR PINE *(Pinus lambertiana)* - Very valuable as lumber. It cuts easily, polishes well, and warps little. It is straight grained and durable and for this reason is highly prized by cabinet makers, furniture builders and interior finishers. It is used for millwork, boxes and crates, and foundry patterns. The wood is light and soft. It is the largest pine and was particularly prized by early loggers. The Madera Sugar Pine Company specialized in the production of sugar pine, although they did log ponderosa pine, white fir, and incense cedar in some quantity. Sugar pines sometimes reach a height of 200 feet and a diameter of eight feet.

PONDEROSA PINE (*Pinus ponderosa*) - Also know as yellow pine. The most important western pine for timber and second to Douglas fir in total stand in the United States. It provides lumber for many uses, such as building construction, boxes and crates, and millwork, as well as for caskets, furniture, toys, pilings, poles, posts, mining timbers, veneer, railroad ties, and fuel. Ponderosa pines can reach heights of 220 feet and diameters of eight feet.

WHITE FIR (*Abies concolor*) - Its principal uses are for lumber in construction, boxes and crates, planing mill products, and general millwork. It is not as highly regarded by lumbermen as the pines are as it is not as easily worked or as free from warpage. However, it is widely used in construction today. Heights to 200 feet, diameters to four feet.

INCENSE CEDAR (*Libocedrus decurrens*) -This is a hardy and very tolerant tree. It has become more prevalent in the mountains because it is able to grow more quickly and easily in shady areas than the pines which need considerable light when they are young. Thus as logging of the pines has taken place, it is the cedar which has tended to replace them. Formerly, many lumbermen regard the cedar more as a weed than anything else as they choke out the young pines in competition with

them. Their principal value as timber is: leading wood for manufacture of pencils, venetian blinds, lumber for rough construction, fence posts and railroad ties. Also, used for shakes and shingles. Very resistant to rot and was useful for building log cabins. Heights to 125 feet, diameters to 7 feet.

GIANT SEQUOIA *(Sequoiadendron giganteum)* - The world's largest trees are now preserved in national parks and national forest. They were logged heavily during the latter part of the 19th Century, but especially so in the period from 1880's to 1907. They were used largely for building construction, bridges and other heavy construction as well as for boxes and crates, planing mill products, tanks and general millwork. The wood, however, was brittle and due to the size of the trees, as they fell they often shattered badly. Also, due to their huge size they were extremely hard to move. Often they were just made into fence posts and rails right where they fell. The waste and destruction in the logging of the redwoods was enormous! Heights to 300 feet, diameters to 30 feet.

BLACK OAK (*Quercus kelloggii*) - A hardwood that is found in this area whose principle use is fuel. Highly desired as wood for fireplaces throughout California. The wood of the black oak warps easily and is therefore not widely used in furniture or woodworking. It was highly prized for its acorns by many of the California Indian groups. Heights to 80 feet, diameters to five feet.

**Note- This area also provides good growing conditions for apple trees and many orchards are scattered throughout the mountain area.

Logging Terms

Blaze - A spot on a tree where the bark has been removed for marking purposes.
Boomers -Short-term employees.
Bucklers - Persons who cut trees to various lengths.
Bull of Woods - Wood superintendent.
Camp Boss - The person in charge of the logging camp.
Cant Hook - A tool used for moving logs by hand.
Choker - A cable hooked around logs so they can be skidded out of the woods.
Climber - A person who topped trees and set up rigging so trees could be used as spar trees.
Crosscut saw - Large two-man saw used for falling trees.
Cruiser - A person who estimates standing timber.
Deacon Seat - Log sawed in half for sitting on.
Flume - V-shaped trough for transporting lumber.
Flume boat - Transported goods and people down flume.
Flume Clamp - Clamps that held bundles of lumber together for transport in flume.
Flume Herder - A person who herded lumber down flume and did repair work on flume.
High-Lead Logging - The use of cables attached to a spar tree to haul logs out of the woods; it was used in steep terrain.
Horse and Mule Teams - Pulled wagons and hauled logs.
Landing - Point to which logs are brought out of the woods to be loaded onto railroad cars (present day-trucks) for transport to mill.
Limber - A person who cuts limbs from felled trees.

Log Burling - Log rolling.
Lumber jack - Logger.
Madera - Spanish for lumber or wood.
Mill - Place where logs were cut into lumber.
Mill Pond - Reservoir where logs were kept until made into lumber.
Nosebag - Lunch bag.
Peavey - Hand tool for moving logs.
Sawyers - Persons who cut trees into specified lengths.
Scalers - People who calculate how much lumber is n a tree.
Shay - Powerful steam locomotive especially designed for logging railroads.
Skidder - Yarding and loading donkey engine, was moved from place to place on skids.
Skinner - Tractor driver (in early days, mule driver).
Sky-Line logging - Logging method where cables were stretched across steep canyons and logs were hauled out on these cables
Spar Tree -Large tree, usually 100 feet or more in height that was topped and limbed then rigged with cables. These cables were used for hauling logs out of the woods by means of donkey engine. Used in high-lead logging.
Springboard - Platform attached to large redwood trees on which fallers stood.
Timber - Wood. Also a warning call when a tree is felled.
Wedge - V-shaped piece of metal used to keep the weight of the tree from binding the saws. Also are pounded into the tree in order to force a tree to fall in the direction of the undercut.

LOGGING UNIT - TRAIL ROUTE DESCRIPTION

Begin the Logging Unit at the Dining Hall. From there proceed down the road past the recreation field. Go to the east (left) of the Mountain View cabin area (girls' housing). Walk out the road that goes across the dam for about 75 feet to the beginning of the Logging Trail. The trail markers for the Logging Unit are small blue triangular markers with an "ax in a log" silhouette on them. Follow these markers throughout the course. Look for cedar posts with numbers on them for the following activity sites.

Post #1: Meet a Tree (Activity#1)
The trail proceeds downhill from the dam. **Post #1** is the site for doing the Meet a Tree Activity. Be sure to set boundaries for the students so that they stay out of the blackberries and away from the steeper banks that lead down towards the creek.

Posts #2 - #5: Tree Species Identification (Activity #2)
The posts along this section of the trail each designate different species of trees that have been, or are being, logged in this area. At each marker, have the students use the keys to identify the tree immediately behind the post marker.
Post #2: Incense Cedar
Post #3: Black Oak
Post #4: Sugar Pine
Post #5: White Fir
Post #5B: Comparison of young Incense Cedar and White Fir

Post #6: This trail ends in a large open area that is part of our summer camping program called "Sherwood Forest." As you stand by **post #6**, directly across the dirt road from you is a large tree by a wooden luggage platform. Have students identify this tree.
Post #6: Ponderosa Pine

Post 7: Upon leaving the ponderosa pine, go downhill to your left on the dirt road that crosses the small creek to your left. You should be able to see the marker on the tree beyond the creek. After crossing the creek go another 75 feet to **post #7**. This marks a group of young giant sequoias.

Post #8 - Sherwood Campfire Area (Activities #3A and #3B)
Continue past the sequoias along the road for another 100 feet. **Post #8** is on your right at the campfire area. Do the wood identification and log round activities here.

Post #9 - Compare/Contrast a Giant Sequoia and Incense Cedar (Activity #4)
Take the trail to the right from the bottom of the campfire area. Cross a large foot bridge over the creek. At the far end of the bridge a large sequoia stump is on the left. Continue straight ahead for 50 feet and then begin to veer to uphill to the right. Follow the markers past several small buildings. Go between "Ye Olde Village Inn" and the candle shop (multi-colored roof) and continue another 75 feet until you reach **post #9**. Here have students compare and contrast the characteristics of the giant sequoia and incense cedar.

Post #10 Observations of Giant Sequoias (Activity #5)
Leave **post #9** by going downhill on the dirt road following the markers. On your right you will immediately notice a split rail fence surrounding a large giant sequoia (John Knox Tree). After walking down the road several hundred feet veer to the left between a hut (Wickingham) and a large sequoia stump. Here is a good point (**post #10**) to get an excellent view of the Calvin Spire, the large giant sequoia that is spire-shaped due to its dead top. Walk down closer to the Calvin Spire and go over to the smaller of the two sequoia stumps to the right of the spire. Students can sit on this stump for a discussion on the history of logging in this area. Examine the large sequoia log, look at the cut end of it to see the axe marks left there from over 100 years ago when this tree was cut down.

Post #11 Measuring the Height and Diameter of Trees (Activities #6A and #6B)
Leave the stump and head back uphill by following the markers up the dirt road until you see the markers veer off to the left before **post #9**. Follow the markers uphill to the left across the clearing to **post #11**. Now look back downhill towards the ropes course that winds through the trees by **post #9**. Do the two activities, using the cedar trees by the ropes course as trees to measure.

Post #12 Which Way Did It Go? (Activity #7)
Follow the markers up to, and along the dirt road to the marked stump on the other side of the road. Here talk about falling a tree. Use the obvious undercut of the stump to demonstrate which direction the tree fell. Talk about forest management practices as students observe the surrounding forest.

Post #13 Which Way Should It Go? (Activity #8)
Follow the markers leading uphill away from the road to **post #13**. Do the exercise "Falling a Tree - Which Way Should It Go?" Have students split into groups to examine the three large ponderosa pines. Each group should determine the approximate height of the tree, observe the surroundings and make a decision as to which direction their tree should fall, and decide where to put an undercut and backcut. Have each group present its recommendations to the rest of the class.

End of class: Continue up the trail towards the Mountain View Lounge and cabins (girls' area). Go to your right by the lake to the benches and vesper area to have a summary discussion of the concepts presented in the course. Travel to the Dining Hall.

Logging/Forestry Unit Map