

### Lesson #1: How Trees Grow

#### Objectives

##### Students will be able to...

- Understanding how trees grow, the basic components of a tree, and gather information about California Forests.

#### Common Core Standards

Cabinetmaking and Wood Products Pathway A1.4, A1.7, A2.1, A2.2, A3.1, A2.3, A6.1, A6.2  
A3.4, A6.7, A4.1, A5.1, A5.2, & A5.4  
Residential and Commercial Pathway D2.1, D2.2, D3.1, D3.3, & D4.1  
Reading 11-12.4  
Writing 11-12.1  
RIST 11-12.2  
Problem Solving/Critical Thinking 5.4  
Health and Safety 6.2, 6.3, 6.6, & 6.12  
Responsibility and Leadership 7.4 & 9.3  
Demonstration and Application 11.1  
Technical Knowledge and Skills 10.1, 10.2, & 10.3

#### Materials

Parts of a Tree Handout  
Twelve Basic Components of a Tree Vocabulary  
Cornell Notes Example  
California Forest Resources Information Packet

#### Lesson Sequence

- Introduce new unit which will be addressing materials (wood, fasteners, and tools) (5 minutes).
- Read *Parts of a Tree Handout* as a class. Be sure to stop along the way and ask student's clarifying questions to check for their understanding of the material (15-20 minutes).
- Review *Twelve Basic Components of a Tree vocabulary* as a class. Answer any

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questions regarding vocabulary as needed (10 minutes).

- Go over *Cornell Notes example* as a class. Let students know that they will be using Cornell notes for a note taking strategy (5 minutes)
- Begin reading *California Forest Resources Information Packet*. Instruct students to use the Cornell notes to take notes while reading this information. (10-15 minutes)

### **Assessment**

Check for understanding while reading information about parts of a tree and vocabulary.

### **Accommodations/Modifications**

Highlight Important Information for Students on Reading Handouts  
One-on-One Support  
Peer Support  
Provide A Copy of Cornell Notes Already Filled Out

## Parts of a Tree Handout

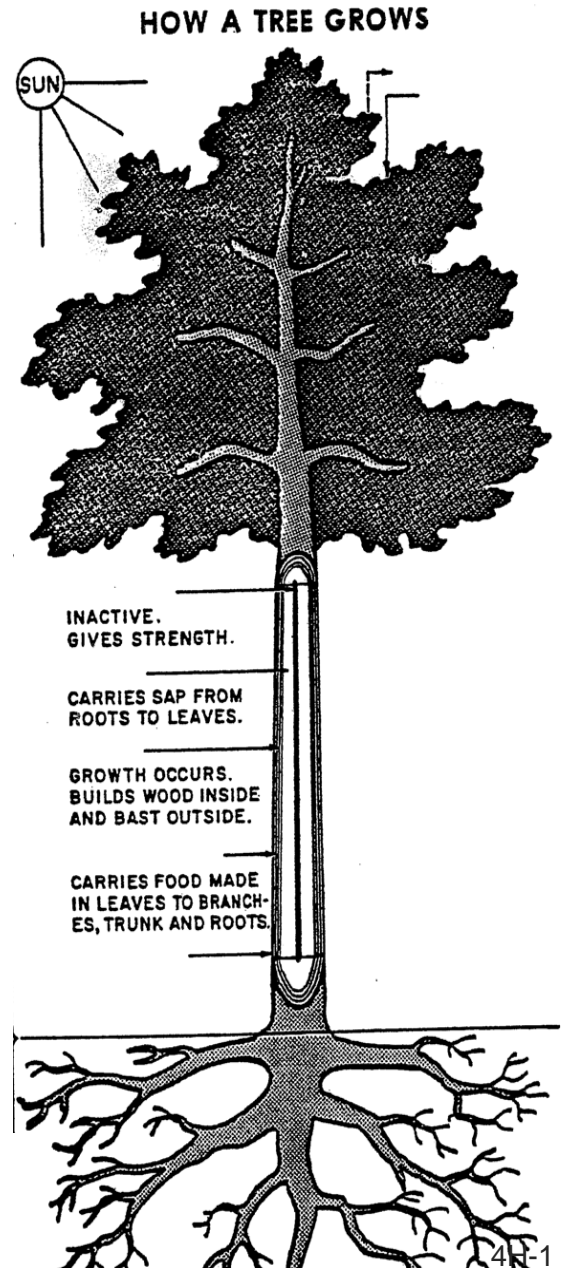
**Question:** If you make a mark on a tree's trunk, will the mark move higher off the ground, as the tree gets taller?

**Answer:** No. Height growth happens only at the ends of branches. The trunk does not stretch out as the tree grows. A tree grows two ways: branches and roots grow longer from buds and the trunk and branches grow wider thanks to an incredibly thin layer of cells located just under the bark.

**Trees Grow UP** -Trees grow taller when new cells (buds) are produced at the tips of the branches, causing the branches to grow longer.

**Trees grow OUT** -Tree trunks and branches grow thicker as new cells are added beneath the bark. These cells make up vessels, called **xylem and phloem** that carry water and food throughout the tree. **Xylem** carries water and nutrients from the roots up to the leaves. Active xylem is called **sapwood**. Old xylem no longer carries water. It forms the **heartwood** of the tree and may be a different color from the sapwood. **Phloem**, also called inner bark, carries food from the leaves to the branches, trunk and roots. Outside the phloem is the outer bark, which protects the tree from injury. The **cambium** is found between the phloem and xylem. If you looked at a tree stump, you could not see the cambium, because it is only one cell layer thick. The cambium's job is to make new xylem and phloem cells.

**Trees Grow DOWN** - Tree **roots** grow from specialized tissue at their tips. **Roots** anchor a tree in the soil and absorb the water and nutrients a tree need. Most of a tree's roots are found in the top two feet of soil, even when the tree is very large. Root hairs near the growing tips take in water from the soil. You'd need a microscope to see these tiny, tube-like hairs; yet, in a large tree, they can absorb hundreds of gallons of water each day. Surprisingly, only a small amount of this water is used in photosynthesis. The rest is released from the leaves in a process called transpiration.



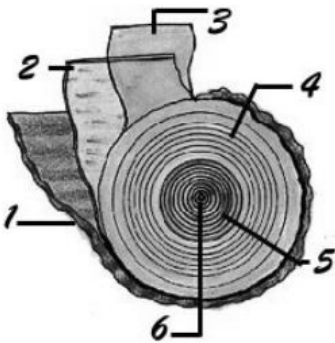
## Parts of a Tree

### Tree Parts and How They “Work”

In addition to having leaves and roots, trees have special layers in their trunk and branches that help them move nutrients and water to every part of the tree. The trunk and branches also contain a growing layer of cells that create the tree's annual growth rings, making the trunk, branches, and roots thicker each year.

Although there are thousands of different kinds of trees in the world, most trees work the same way. Here's a look at how the parts of a tree work together to help a tree get the food, water, and minerals it needs to survive.

**A. The Trunk:** The trunk of a tree is important for two reasons: First, it acts as a support rod, giving the tree its shape and strength. Second, it acts as the central "plumbing system" in a tree, forming a network of tubes that carries water and minerals up from the roots to the leaves, and food (sugar) from the leaves down to the branches, trunk, and roots. The easiest way to see how a tree works is to look at a cross section of the trunk. Look at the diagram to see the six main layers and what each layer does.



**1) Bark:** The outer layer of the trunk (and branches) is called the outer bark or just the bark. Its texture, thickness, and flexibility depend on the type of tree. Although bark looks different from tree to tree, it serves the same purpose—to protect the tree from injury and disease. Some trees have very thick bark that helps prevent damage from fires. Others have bad-tasting chemicals in their bark that discourage hungry insects. And some bark is covered with spines or thorns that keep browsing mammals away.

**2) Phloem:** The layer next to the outer bark is called the inner bark or phloem (FLOW-um). The phloem acts as a food supply line from the leaves to the rest of the tree. Sap (water containing dissolved sugars and nutrients) travels down from the leaves through channels in the phloem to the branches, trunk and roots, supplying all the living parts of the tree with food. If you were to cut a band around the trunk through the bark and phloem, the tree would probably die. That's because the phloem would be severed, and food could no longer flow to the lower trunk and roots.

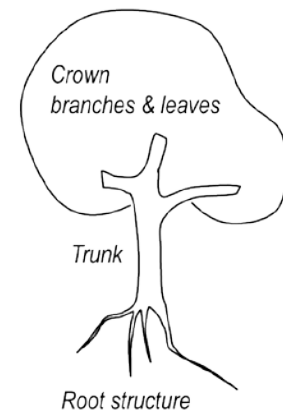
**3) Cambium:** Next to the phloem is a very thin layer called the cambium. It is often only one or two cells thick, and you need a microscope to see it well. The cambium is a growth layer of the tree making new cells during the growing season that become part of the phloem, part of the xylem (see below) or more cambium. The cambium is what makes the trunk, branches and roots grow thicker.

**4) Sapwood/Xylem:** The layer next to the cambium is called the sapwood or xylem. Each year the cambium adds new layers of woody tissue; the sapwood is made up of the youngest layers of wood. The sapwood is a network of thick-walled cells that forms a pipeline, carrying water and minerals up the tree from the roots to the leaves and other parts of the tree. The sapwood also stores nutrients and transports them across the tree, from one part to another.

**5) Heartwood:** Most of the trunk in an old tree is dead wood called heartwood. The heartwood is old xylem that no longer transports water and minerals up the tree. (After a few years the sapwood in most trees gets filled in with resin-like material and slowly changes into heartwood. The new xylem is the only part of the wood that works as a transport system.) The heartwood is often much darker in color than the sapwood. The heartwood gives the tree support, but sometimes it rots away leaving a hollow, living tree.

**6) The pith** is the central core of the tree (missing in many species). It is the inner most part of the tree and hence the oldest part. When the tree becomes old, the pith dies and becomes fibrous and dark. It varies in size and shape.

**B. The Roots:** A tree's roots are long, underground branches that spread out to help anchor the tree and to absorb water and nutrients from the soil. Some trees have long taproots that reach straight down for 15 feet (4.5 m) or more. Other trees have more shallow root systems that lay closer to the surface of the ground. Large taproots and lateral roots branch into smaller and smaller roots. An average tree has millions of these small rootlets, each covered with thousands of fine root hairs. The root hairs can easily soak up water and dissolved minerals because the rootlets lie very close to the surface where water and nutrients are found.



**C. The Leaves:** From skinny pine needles to broad palm leaves, all tree leaves serve the same purpose—to make food for the tree. The leaves are the food factories of a tree. They contain chlorophyll, which facilitates photosynthesis and gives leaves their green color. Through a process called photosynthesis, leaves use the sun's energy to convert carbon dioxide from the atmosphere and water from the soil into sugar and oxygen. The sugar, which is the tree's food, is either used or stored in the branches, trunk and roots. The oxygen is released into the atmosphere.

**D. The Crown:** which consists of the leaves and branches at the top of a tree, plays an important role in filtering dust and other particles from the air. It also helps cool the air by providing shade and reduces the impact of raindrops on the soil below.

## **What's wood like?**

The inner structure of a tree makes wood what it is, what it looks like, how it behaves, and what we can use it for. There are hundreds of different species of trees, so generalizing about something called "wood" isn't always that helpful: balsa wood is different from oak, which isn't quite the same as hazel, which is different again from walnut. Having said that, different types of wood have more in common with one another than with, say, metals, ceramics, and plastics.

## **Hardwoods and Softwoods**

Wood is divided into two distinct kinds called hardwood and softwood, though confusingly the names don't always refer to its actual hardness or softness:

**Hardwoods** are ones that come from broad-leaved (deciduous) trees (those that drop their leaves each fall, also known as angiosperms, because their seeds are encased in fruits or pods). Examples include ash, beech, birch, mahogany, maple, oak, teak, and walnut.

**Softwoods** come from evergreen (coniferous) trees (those that have needles and cones and retain them year-round, also called gymnosperms. Examples include cedar, cypress, fir, pine, spruce, and redwood.

It's generally true that hardwoods are harder than softwoods, but not always. Balsa is the best-known example of a hardwood that is actually very soft. Hardwoods have lovely, attractive grains and are used for such things as making fine furniture and decorative woodwork, whereas softwoods often come from very tall, straight trees, and are better suited for construction work (in the form of planks, poles, and so on).

## Twelve Basic Components of a Tree Vocabulary

1. **Roots:** Organs that pick-up water and nutrients from the soil. They manufacture chemicals, store energy, and provide support for the tree.
2. **Trunk:** In botany, the term trunk refers to the main structural component of a tree. It is supported by the roots and in turn supports the branches.
3. **Crown:** Upper portion of a tree that includes the branches and leaves.
4. **Bark:** The outer/protective layer of the tree. It keeps the tree's moisture in, while keeping bugs and microorganisms out.
5. **Cambium (layer):** Where new cell growth takes place within a tree.
6. **Sapwood:** Carries sap to and from roots and leaves. Usually lighter in color than a tree's heartwood. It can take between 10 and 25 years for sapwood to become heartwood.
7. **Phloem:** Phloem cells transport sugars (food) produced by the leaves throughout the tree. Eventually, they become bark.
8. **Xylem:** Makes up the woody tissues of a tree. Xylem cells act like miniature pipes, allowing water and nutrients from the roots to climb to the branches and leaves.
9. **Heartwood:** Inactive wood found towards the center of a tree. Acts as "column" that provides support for the tree. Usually darker in color than the sapwood.
10. **Rings:** A tree grows twice a year; in the spring and in the summer. The spring rings are much lighter in color than the summer rings. We usually count the summer rings when determining a tree's age.
11. **Pith:** Dead center of a tree, made up of soft spongy cells.
12. **Lignin:** The glue that holds the wood fibers (and thus the tree) together.

**CORNELL NOTES *example***

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Topic: \_\_\_\_\_

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

*QUESTIONS*

*NOTES*

What's  
Who's  
When's  
Where's

**This section of your page is dedicated to lesson time and in class note taking. You might want to include:**

Main points, key words & ideas

Vocabulary

Diagrams, charts

Bullet points

Concise sentences

Try to leave lines between points so you can add more that you might have missed.

When you go back over your notes highlight main ideas

Circle key words or vocabulary words

*SUMMARY: Write 4 or more sentences describing specific learning from these notes.*

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



*Natural Resource Fact Sheet*

# Forest Resources

*Information compiled by the California Forest Products Commission*

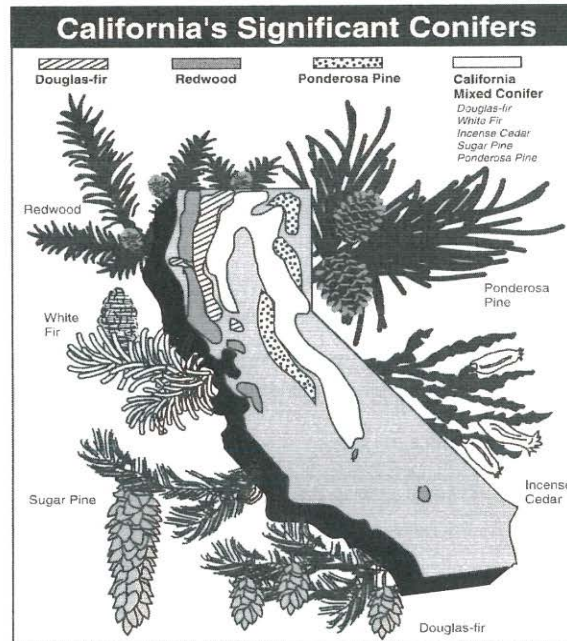
**Sources** - Nearly one-third of California's 101 million acres is forests, 45 percent owned by the federal government, 45 percent in private land, and 10 percent held by other public owners and the United States Bureau of Land Management. Conifers are the largest inhabitants of the forest. Their needles act as leaves, capturing energy from the sun through photosynthesis and converting carbon dioxide and water into sugars used for growth and reproduction. The roots absorb water and nutrients from the soil, transporting them through the trunk to the rest of the tree. The trunk protects the tree and provides support. In spring, a tree grows wood in a ring of large, light cells. In summer, it grows more slowly, forming a ring of darker, smaller cells. Dark rings are counted to tell the age of the tree. Coastal redwood, Douglas-fir, white fir, sugar pine, ponderosa pine and incense cedar form the mainstay of California's forest products industry. California utilizes the equivalent of one 100-foot tree per person per year in forest products. In addition to natural regeneration, foresters replant an average of 30 million seedlings annually – about one for each person in the state.

**Uses** – California's forests provide more than just forest products. They provide beauty, sources of recreation, and are home to many Californians and to almost 650 species of fish and wildlife. Forests protect against erosion, purify the air through photosynthesis, and recycle water. Nearly 100% of each tree is used to produce more than 5,000 products. Lumber, furniture, and paper are easily identified wood products. Other items are less obvious. Rayon is cellulose acetate, a by-product of tree fibers. Lignin, which holds tree cells together, is often used as a thickener in baby foods, pet foods and cosmetics. Baked goods sometimes contain torula yeast, derived from sugars in wood pulp. Flavorings and fragrances from tree oils are often used in foods, beverages, cosmetics and medicines. Energy is generated from the wood waste left over from logging and milling lumber. In many cases that energy is used to provide power for the sawmills.

**History** - Long before the arrival of Europeans, Native Americans located near forests. They burned and opened up parts of them to provide wood for daily needs, build villages, plant crops, make hunting easier and to protect against enemies. The process helped maintain forest health. Arriving in the 1600s, European settlers respected the forests which gave them building materials and plenty of game. In colonial days, towns often had a liberty tree, under which important decisions were made. A tree was stamped on America's first coins, and trees were sewn on the flags of the first colonies. During the settlement of the West in the mid-1800s, wood was used without much thought to the future. The Gold Rush town of San Francisco was built almost entirely of redwood – even its curbs! Today, California foresters practice sustainable forestry – more trees are grown than are harvested.

**Economic Value** - California is the third largest producer of forest products in the nation,

after Washington and Oregon. More than 110,000 people work in the lumber, wood products, paper and allied industries in California, earning an annual payroll of approximately \$3.4 billion. The value of California forest products shipments was nearly \$14.4 billion in 1998, much of which stayed in the state. Californians consumed more than seven billion board feet of lumber and panel products in 1999. More than 70 percent of those products were imported from other states and countries.

**For additional information:**

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## California Forest Resources

Directions: Using the "Forest Resources" handout, answer the following questions:

1. Approximately how much of California is covered in forests? \_\_\_\_\_
  
2. Where does California rank in the United States as far as lumber production? \_\_\_\_\_
  
3. How much of California's lumber is exported outside of the United States? \_\_\_\_\_
  
4. Name a fabric made of tree fibers. \_\_\_\_\_
  
5. List three reasons Native Americans used controlled burns in the forests they inhabited.
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
  
6. How many species of fish and wildlife inhabit California's forests? \_\_\_\_\_
  
7. About how many forest products come from trees? \_\_\_\_\_
  
8. Name the six main types of conifers used for California wood products.
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
  - d. \_\_\_\_\_
  - e. \_\_\_\_\_
  - f. \_\_\_\_\_

*Extra Credit:* Which of the six main types of conifers are known as California's "Big Four"?

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

California Forest Resources *Answer Key*

1. 101 million acres
2. 1/3
3. None
4. Rayon
5. Provide wood for daily needs, build villages and plant crops, make hunting easier & protect against enemies
6. 650 species
7. 5,000 products
8. Douglas-fir, coastal redwoods, white fir, sugar pine, ponderosa pine, incense cedar

*Extra Credit* - Douglas fir, sitka spruce, western red cedar, western hemlock