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How A Tree Grows

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The crown of a tree is its food factory. Water plus nutrients absorbed by the roots are transported to the leaves via the xylem. Through a process called photosynthesis, the leaves use sunlight to turn carbon dioxide and water into sugars through the aid of chlorophyll. The sugars are used by new leaves and shoots and are carried down the tree in the inner bark or phloem to build wood cells. Through a process called cell division, twigs elongate from meristematic cells at the tip and increase in diameter from cambial cell division.

ROOTS

The underground portion of a tree is called the roots. The massive underground root system has three main functions.

Support. The root system must be large enough to support the stem and crown of the tree.

Absorption. The roots absorb water and dissolved minerals from the soil which is transported to the crown via the xylem in the stem.

Food Storage. The roots store a reserve food supply that was manufactured by the leaves and transported to the roots via the phloem tissue of the stem.

Root systems can vary among the various species of trees and within the same species, depending on soil type and the availability of moisture. Roots can, and often do, extend beyond the canopy of the crown or what is referred to as the drip line. (If the entire crown were an umbrella, rain water would drip around the outside edge. This in relation to the ground is called the drip line.) Some tree species have the ability of producing a root growing straight down, which is called a tap root. Some species that would normally produce a tap root on a dry site may instead grow a shallow lateral root system on a good site. All trees, even those with tap roots, will develop lateral roots. Large roots will have annual rings showing yearly growth. Very fine roots, called root hairs, greatly increase the absorbing surface of root systems. However, not all trees develop root hairs.

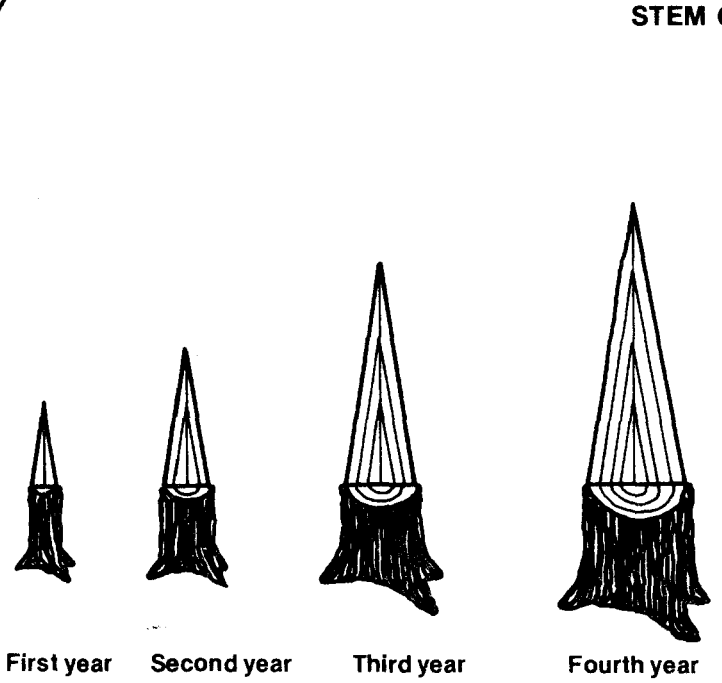


Figure 1. The growth of a tree, after the first year could resemble inverted cones stacked on top of each other. Each cone represents another year's growth.

STEM GROWTH

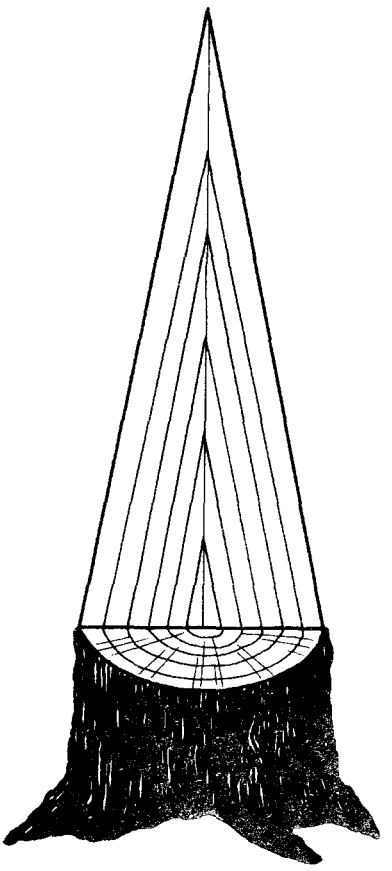


Figure 2. Each year a layer of wood is added to the tree between last year's wood and the inner bark. This layer of wood occurs over the entire trunk and every live branch and twig. As the tree grows in diameter, it pushes against and stretches the bark until it cracks, giving a rough texture to its outer skin.

TREE RINGS
How They Are Formed

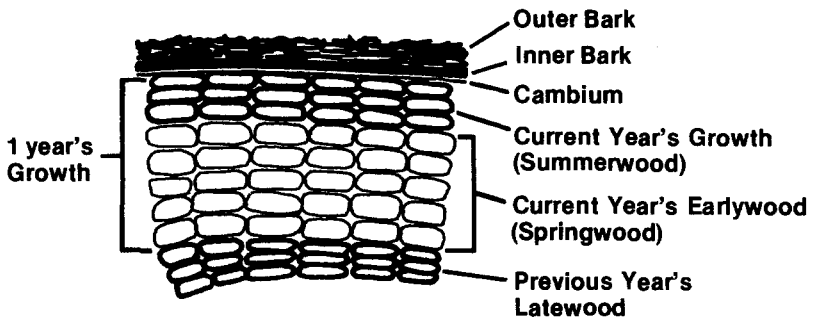


Fig. 3

Conditions in the spring are ideal for rapid tree growth. Probably most important is the longer daylight hours, followed by an accumulation of winter moisture plus spring rains and warm temperatures.

Rapid growth takes place between last year's wood and the inner bark and is represented by large trachied tubes or cells. This growth is referred to as earlywood or spring wood.

As the season progresses to mid-summer, available moisture is much less than in the spring and temperatures are higher, resulting in slower growth. The trachied tubes are smaller and thicker walled. This growth is referred to as latewood or summer wood.

By late summer, because of shorter daylight hours, tree growth has almost ceased.

Together, the earlywood and latewood represent one year's growth.

On a cross section of a tree, the latewood is seen as the dark ring. The earlywood is the often larger light-colored ring.

Two Types of Trees

Gymnosperm
(Gym' no sperm)

Gymnosperms are a large group of plants with naked seeds (seeds not enclosed in an ovary or seed-case), such as pine, spruce, cedar, fir, larch, etc. This group is also referred to as softwoods and evergreen (even though larch lose their needles every fall). Gymnosperms are monocotyledonous by having but one cotyledon or just one seed leaf growing out of the seed.

Angiosperm
An'gi o sperm

The angiosperm group includes any plant that has the seed enclosed in an ovary such as apple, orange, pecan, oak, etc. Trees of this group are referred to as hardwoods, broadleaf and deciduous (even though some holly, southern magnolia and live oaks keep their leaves year around). Angiosperms are dicotyledonous by having two cotyledons, or two seed leaves growing out of the seed.

Angiosperms do not have the neat rows of tracheids found in gymnosperms. The large openings in a cross section of hardwood are actually vessels which are surrounded or associated with very small tracheid and fiber cells. There is no particular shape to the vessel cells, and no particular arrangement to the vessels in angiosperms as a group. However, each species of tree will have its own characteristic arrangement of vessels, which is an aid to identification of a species. Latewood cell arrangement is compact when comparing it to earlywood growth revealing annual rings.

Tree rings from a cross section of log or stump will tell a story of forest conditions during the life of the tree.

If, from the growing center or pith (not necessarily the middle of the stump), the rings are very close together, the young tree started its life in a crowded forest, probably with older trees shading the young seedling. If the rings are rather wide, it would in-

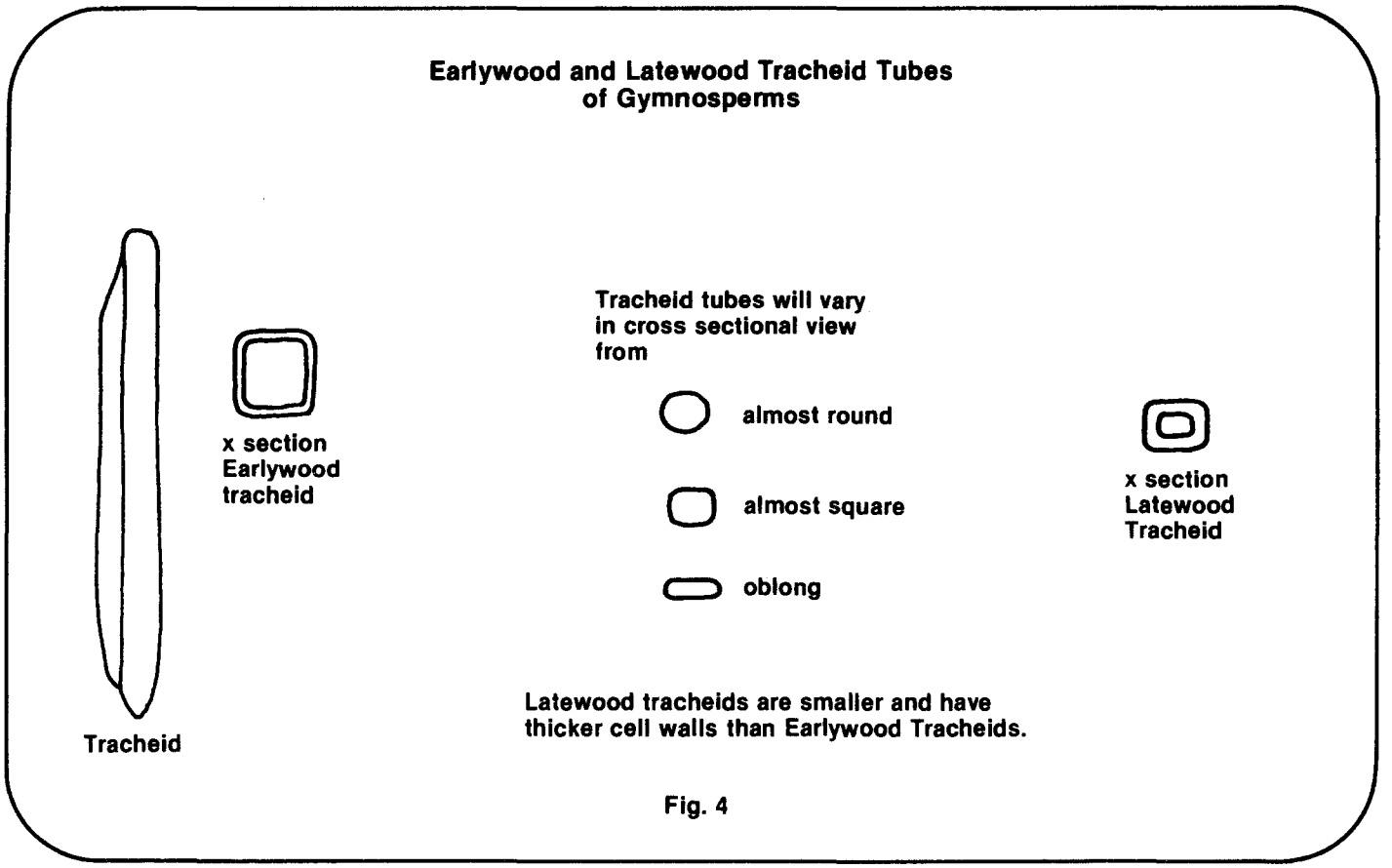


Fig. 4

dicate the tree had ample growing room and good growing conditions.

Rings close together for one year to a few years may indicate drought conditions whereas rather wide-spaced rings would indicate years of above normal moisture.

When tree rings (from the center or pith toward the bark) tend to get closer and closer to each other, it indicates that the competition for water, nutrients and sunlight is getting greater as the trees in the forest get bigger. If this trend is broken or followed by wide spaced rings, it indicates a loss of this competition by some natural cause such as fire, wind or ice storms or a commercial thinning of the forest by a logging operation. This trend could be repeated later as the remaining trees tend to compete with each other as they grow still larger and may show added growth due to another removal of competition.

A series of two, three or four close rings may be drought related as mentioned or could be the result of defoliation by insects. Such insect outbreaks are not uncommon and usually occur for a few years in a row until some disease or other natural cause eliminates the insect problem.

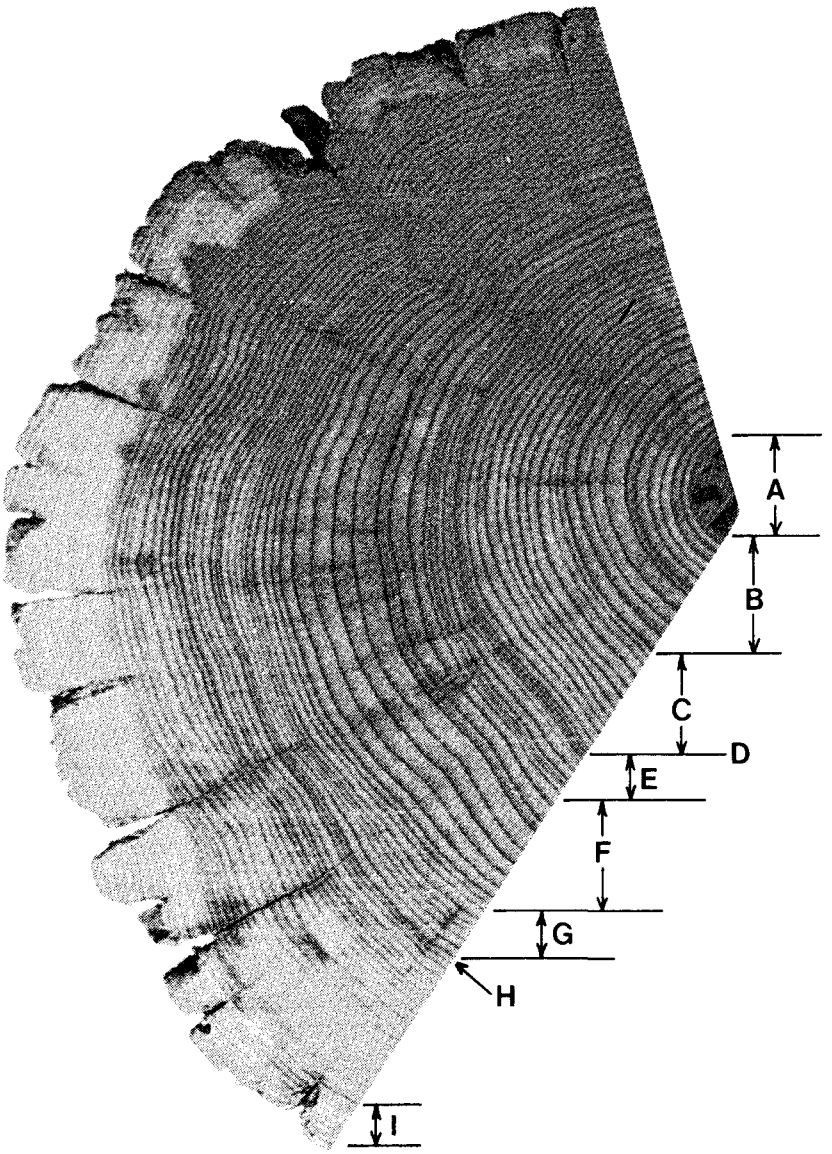
To determine the age of a tree, merely count the rings. One light and one dark ring represent one year's growth. A fairly accurate count can be made if the stump is close to the ground. If the count is made from a stump (or log) that is a foot or two above ground level, the rings may not show the seedling stages of the tree.

To date the various rings, it must be known what year the tree was cut. If a tree was cut in March of a certain year, then the first ring inside the bark is the previous year's ring. If cut in August, then the first ring inside the bark is the current year's growth.

The counting of tree rings gives a good estimate of age. The presence of false rings and the ability to read such rings is a job for the expert. False rings could occur if the tree started its spring growth and was interrupted by very cold weather conditions and started to grow again that same year. There are other causes for false rings. The study of dating with the annual growth layers in wood is called dendrochronology. Some trees develop heartwood. Its presence is indicated by a darker color of the wood toward the center of the stump or log. Heartwood is actually dead, meaning it no longer conducts moisture with dissolved nutrients to the leaves.

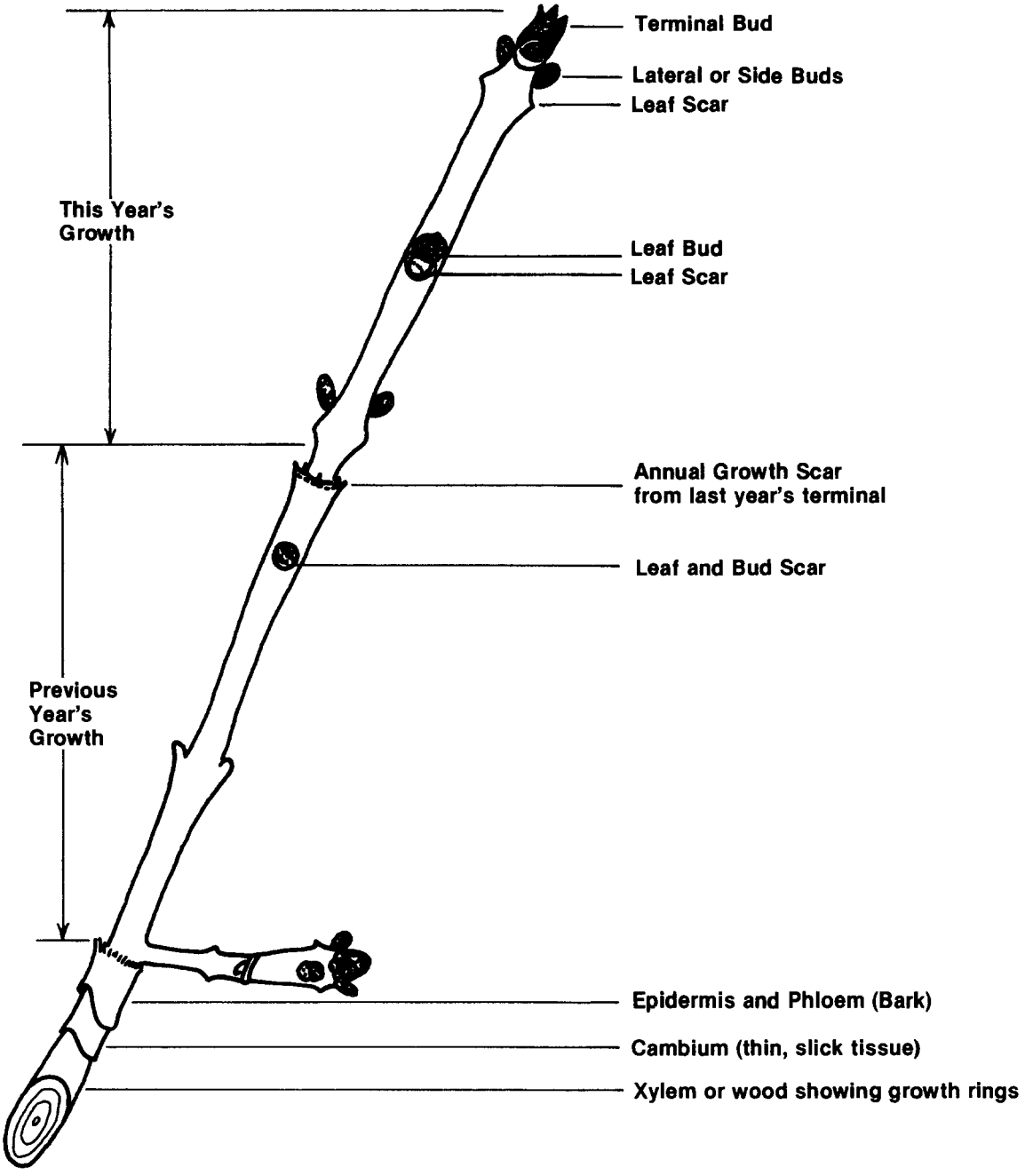
Sapwood is the light-colored wood between the bark and heartwood which still serves as the conducting tissue to bring moisture and nutrients from the roots to the leaves.

Reading Growth Rings



A. Decay caused by a heart rot fungus has consumed the first few years of growth.
B. Good even growth in the early life of the tree.
C. Growth is slowing because all the trees in the forest are getting larger; their moisture and nutrient requirements are also increasing. The trees are starting to compete with each other.
D. Three extremely close rings caused by either three years of drought or a three-year attack by insects such as defoliators (leaf feeders).
E. Five normal years of growth.
F. Forest is thinned — more moisture, nutrients and sunlight available for remaining trees.
G. Forest again becoming overcrowded.
H. Two dry years or insect attack.
I. Sapwood (darker inside is heartwood).

Figure 5



The annual growth occurs over every live branch and twig.

BRANCHES

A branch is an extension or projection of the stem or trunk of the tree that supports the twigs and leaves. Since the leaves manufacture food which is eventually carried down the trunk of the tree, the branch will also show annual rings. As the tree and branch grow, both will enlarge in diameter.

The branch has the same conducting tracheid cells as the stem and all functions found in the trunk will also be present in the branch as long as the branch is alive.

When the branch dies because of shading, breakage or other causes, it ceases its growth. The new rings in the trunk of the tree no longer extend out into the branch. Instead they will grow around the branch stub and finally engulf the dead branch stub as the tree grows.

Since there is no bonding of wood cells from the trunk to the dead branch, a board cut through that area of the tree trunk will result in a loose knot which may in time fall out. A board cut from an area of a live branch will result in a tight knot.

MYTHS REGARDING TREE GROWTH

False A lateral branch will rise or get further from the ground as the tree grows.

[My grandfather planted that tree and placed a horseshoe in the crotch of a branch down here (pointing to a place about 2 feet above ground) and now (pointing to a branch about 15 feet above) it's way up there.]

True A branch that was 2 feet off the ground when the tree was young is still in the same place. The branch may have died and/or been broken, but it is still encased in the tree at the same distance from the ground. Soil compaction or a buildup of soil from forest duff may slightly change the distance. When you hang a swing from a branch, do you have to lengthen the rope as the tree grows?

False Trees grow more wood on the south side because of more sunlight.

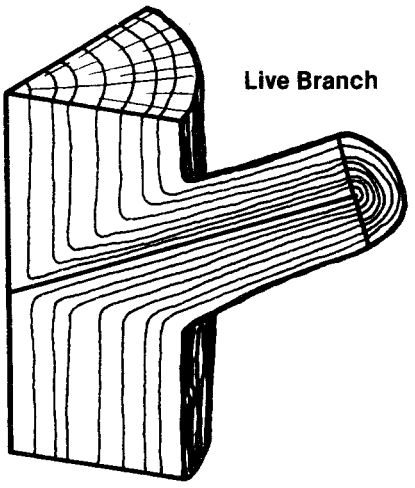
True Trees grow more wood on the side with more roots and/or more branches or leaves. A tree close to an obstruction such as another tree, building, cliff, etc., will grow more wood opposite the obstruction.

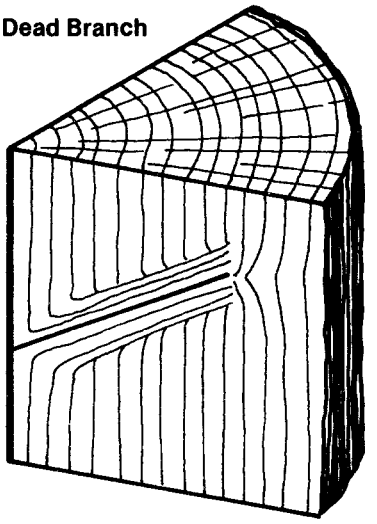
A tree that has had its roots cut due to an excavation will grow more wood on the opposite side.

False Sap rises in the spring and goes down in the fall.

True The sap is moving or circulating in the spring and summer. It is always "up" and never "down." Logs weigh more in the winter indicating there is more sap in the tree in the inactive season.

The sap moves up the tree to the leaves in the xylem. The food manufactured in the leaves moves downward in the phloem.





False Frost or freezing temperature make the leaves change color.

True As the daylight hours get shorter in late summer, the chlorophyll (the green color) in the leaf begins to break down into the various substances of which it is composed. After the breakdown of the chlorophyll, the green color disappears and the other colors that were in the leaf are masked by the green during the spring and summer are now able to be seen.

Anthocyanin, the reddish blue pigment, and carotenoid, red and yellow pigments both increase in cool, highlight conditions of fall.

False It must be spring, the trees are starting to bud.

True What is seen is the swelling or enlargement of the buds. The buds were in position since the previous growing season, have overwintered and start to enlarge in the spring.

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