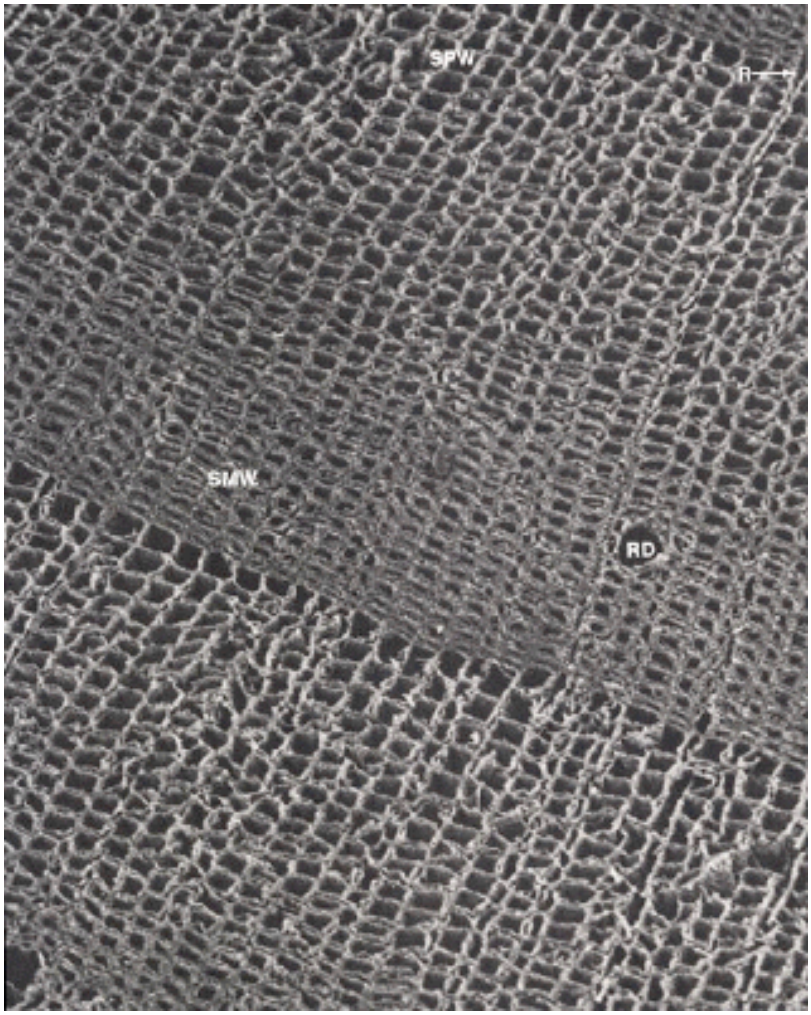
Growth Rings

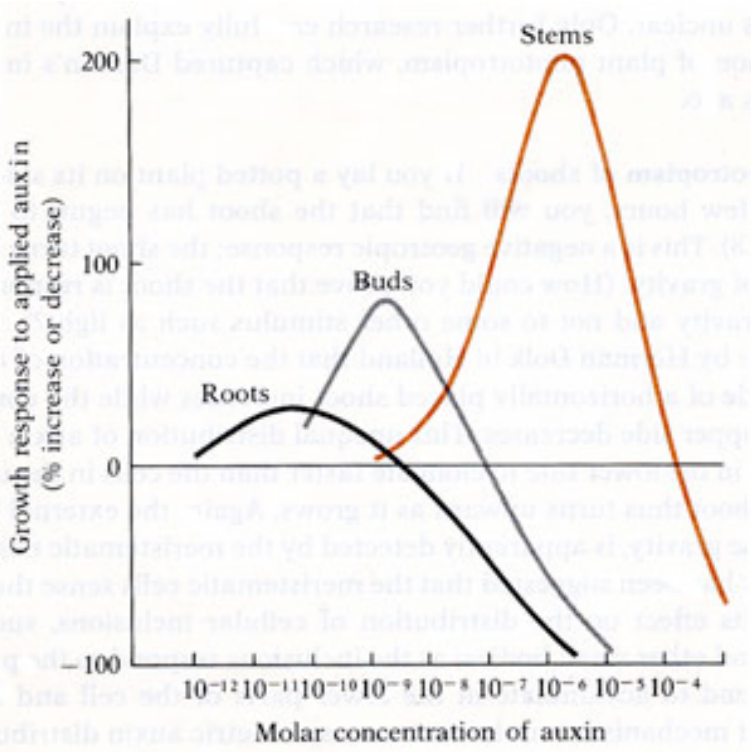
The Origin of Growth Rings



Wood of *Pseudotsuga menziesii* (Douglas fir), transverse section. In temperate climates where growing conditions vary greatly with the seasons, growth in secondary xylem results in the production of annual rings. Early in the spring, growth is active and tracheids with large lumens and thin secondary cell walls form. These cells form the spring wood (SPW). In summer, the tracheids become progressively smaller in cross-sectional area and form much thickened secondary cell walls. These cells form the summer wood (SMW). A resin duct (RD) and ray (R) are also visible. (x425)

The Development of Growth Rings (also see Study Center Demo)

The section of oak and the first 20 rings of the section of conifer shown below have been sanded. Take a look at similar tree sections under the microscope in the Study Center. In these sections only the pith and the primary and secondary xylem are present. You'll also note the lateral rays, and the difference between heartwood and sapwood. The piece of oak shown here has over 150 rings on it.



All trees growing in temperate climates develop one growth increment, or ring, per year. The annual rings develop immediately under the bark in the cambium. In oak there is a sudden change in character between the springwood and the summerwood of a total season's growth. Oaks are known as "ring porous" because the springwood consists mainly of large vessels formed during the period of shoot growth, which takes place between March and May. Since this is before the establishment of any great photosynthetic leaf area, most of the energy and raw materials for springwood formation come from the tree's internal food sources. The springwood vessels are thin-walled. At the time of leaf expansion in oak, usually in mid-May, hormonal activity dictates a change in the quality of the xylem produced and the summerwood becomes increasingly fibrous and contains much smaller, thicker vessels. During the production of summerwood the cambium oscillates between two types of xylem

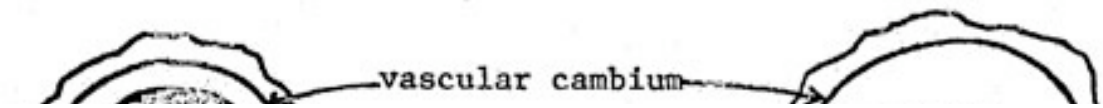
production. These are the alternating light and dark bands perpendicular to the line of springwood vessels. Pines are not ring porous, but summerwood cells are still smaller and denser than springwood cells. This variation between spring and summerwood in oaks and pines makes the transition between the end of summerwood one year and the beginning of springwood in the next year very distinct. The conclusion of a year's growth is marked by the formation of a line of small cells at leaf-fall.

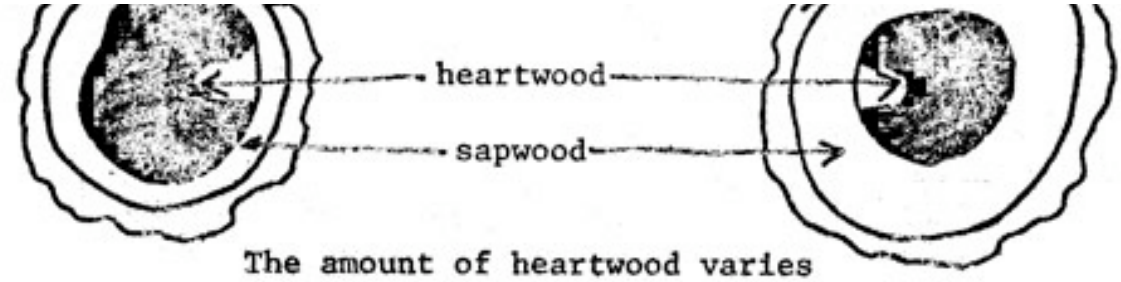
Note that successive rings are not all the same size. The specific pattern of ring widths is determined by the climatic variations between years (i.e, by wet and dry years). By measuring each tree ring we can obtain a unique record of past climatic changes. Moreover, every tree in a given region records the climatic variation in an identical pattern of wide and narrow rings. By matching the pattern of rings in the inner part of old living trees with the corresponding pattern of rings in timbers by American Indians, or by the ancient Greeks, we can determine the exact year in which these people built their houses and villages.

Heartwood and Sapwood

You may have noticed that some wood is darker at the center. As secondary xylem ages, the cells can become infiltrated with substances like resins, gums, and tannins, darkening the wood. This dark, non-conducting wood is heartwood. The rest of the secondary xylem (lighter colored, conducting wood) is sapwood. Some trees (like maple and ash) have lots of sapwood, which is more resilient (and thus better for some things, such as baseball bats). Other trees, such as locust, have mostly dark heartwood and little sapwood. Locust heartwood is permeated with a substance that repels most insects. Thus locust fence posts last a long time and are common in old farm hedgerows.

Do not confuse "heartwood" with "hardwood." Hardwood is a term applied to the wood of dicot trees, while softwood applies to conifers (which are gymnosperms). These terms do not actually describe the relative densities of the wood. Some conifers (such as hemlock) have harder (denser) wood than some dicot trees do.





The amount of heartwood varies among species.

Examine a piece of red oak in the Study Center:

Notice that **most of the secondary xylem is a darkish color**. This is **heartwood**. Only a **small portion of the secondary xylem** - the portion just inside the vascular cambium - **is white**. That is **sapwood**.

Download Printable (PDF) Version

Back to Main Menu / Previous Objective / Next Objective /