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Wood Growth and Structure

Wood is produced by plants during the process of secondary growth. Woody plants include trees, shrubs, and vines. These plants have a unique architecture and a specialized meristematic tissue, called cambium, which produces wood. It's very convenient that secondary growth occurs because humans utilize wood to create lumber, fuel, paper, and many other products. Wood is a true renewable resource and is important to many cultures worldwide.

The process of wood growth begins with the cambium. The cambium lies just beneath the wood and the inner bark which are also called the xylem and phloem. As the cambium grows, it produces new wood toward the inside and new phloem toward the outside causing the plant to increase in girth. To review, xylem transports sap (water and mineral nutrients) from the soil upward to the leaves where it can be used for photosynthesis and other processes. The phloem transports the products of photosynthesis downward bringing the sugars and other compounds to be used in the stem and roots.

In looking closely at wood, it is composed of tiny, vertically oriented, straw-like cells. These cells are hollow, providing pathways for the conduction of sap as well as support for the weight of the tree. In hardwoods (broadleaf plants), there are also radially oriented cells called "rays". Rays move nutrients between the straw-like cells and store other compounds. Rays also give many hardwoods their unique appearance as is the case with "quarter sawn" oak. If this isn't already complicated enough, coniferous trees do not have ray cells, but have resin ducts that contain the "pitch".

During the annual cycle of tree growth, the straw-like cells grow fast in the spring giving them larger diameters and these growth areas are called "early wood". As the summer sets in and growth slows, the straw-like cells become smaller and denser and are called "late wood". The next spring starts with early wood followed by late wood. Each year, this process is repeated. This annual growth pattern is what creates the annual rings we observe in wood when we look at the end grain. This is how we age trees, shrubs, and vines. Foresters sample trees for age using an increment borer and count rings to determine a tree's age.

Increment borer (Rebekah D. Wallace, University of Georgia, Bugwood.org).

Natural longleaf pines felled in an ice storm, Jan. 2005, in Randolph County, AL. Large cross-section was an open-grown tree with 20 annual rings. Small cross-section grew suppressed (competing with neighboring trees) with 43 annual rings. (David Stephens, Bugwood.org).

As a tree gets older, it still produces new wood on the outer surface, but the older wood toward the center of the tree becomes darker. This is especially evident on woods such as juniper and walnut. The light colored, outer wood is called "sapwood" the darker, inner wood is called "heartwood". Heartwood becomes darker because the cells are filled with rot resistant compounds that help the tree support itself and not succumb to rot-causing diseases. Humans take advantage of this phenomenon by seeking rot resistant woods for fence posts, decks, and other situations where durability is desired.

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Adapted from original Backyard Gardener publications by Jeff Schalau, Agent, Agriculture & Natural Resources, University of Arizona Cooperative Extension, Yavapai County