

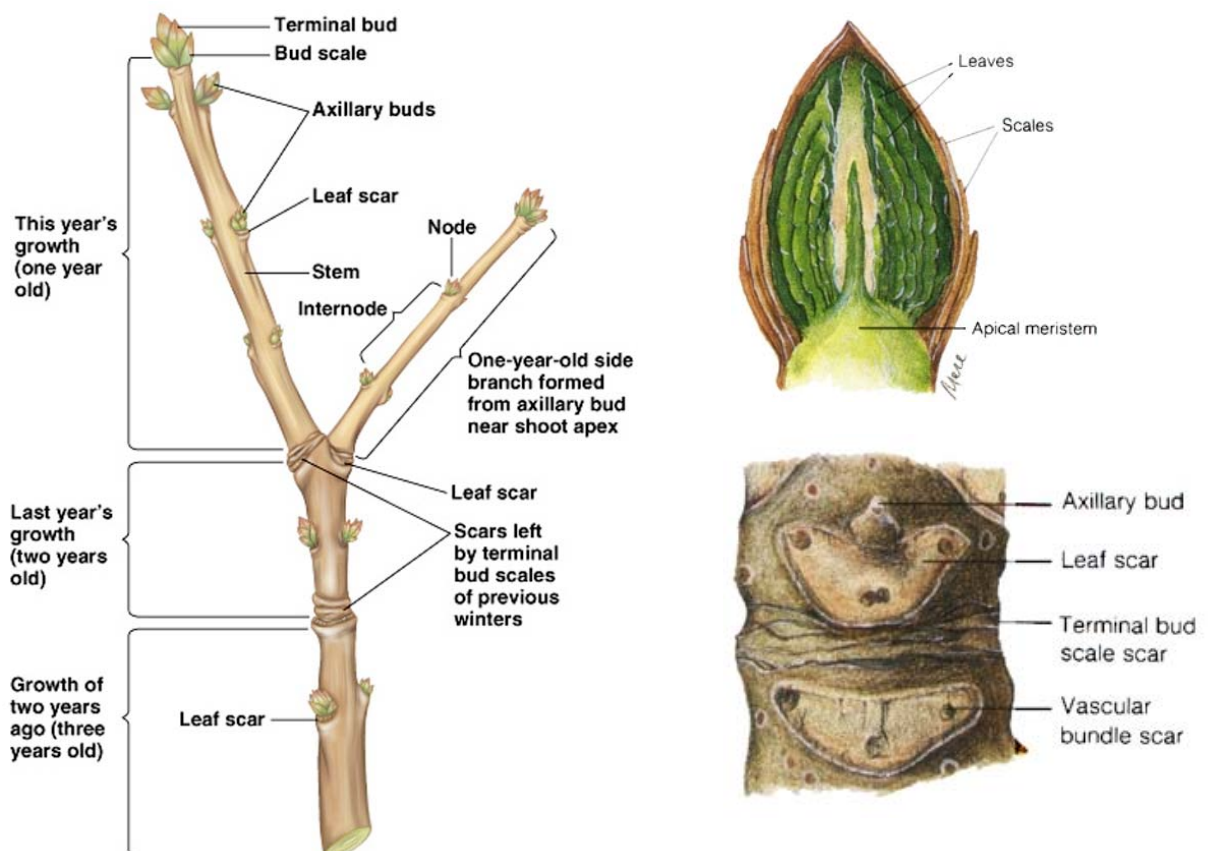
Secondary Growth and Wood Structures

Woody plants - trees and shrubs - live for many years. Each year, new primary growth is resumed, and the plant increases in length at its growing tips. In addition, the plant increases in diameter, or girth. Increase in girth is called **secondary growth** and results from activity of **cambium**. There are two types of cambium, **vascular cambium** and **cork cambium**. The vascular cambium produces the secondary vascular tissues - secondary xylem and secondary phloem. Cork cambium produces cork, a secondary surface tissue. Secondary growth structures are found in two regions: the bark, which consists of cork and phloem; and the wood, which consists of xylem. The vascular cambium separates the bark from the wood.

There are distinctive external and internal features of woody plants. This laboratory will provide you the opportunity to observe both the internal structure characteristic of the secondary growth in woody plants and distinguishing external characteristics of twigs, particularly in their winter dormancy.

A. External Features of Twigs

Observe a twig provided. Note the terminal bud, protected by bud scales. Lateral buds will be located at nodes. Note the leaf scars beneath the lateral buds. Within the leaf scar you will see tiny vascular bundle scars.



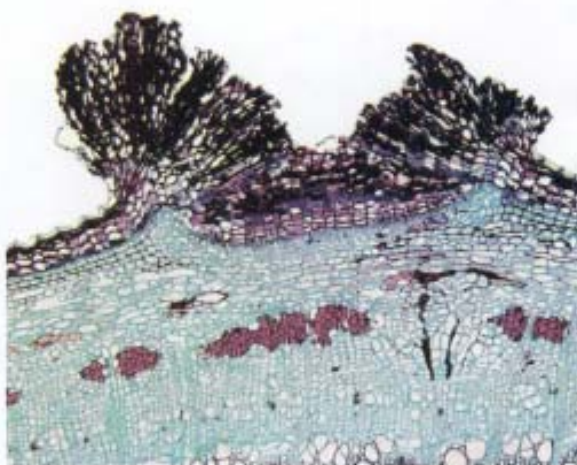
Note assorted raised areas on the twig surface. These are **lenticels**, needed for gas exchange. Lenticels are a distinctive feature on some species of shrubs and trees. Lenticels are also distinctive surface features anatomically. Be sure you identify them in the prepared slides of woody stems later in the laboratory period.

The patterns of leaf scars, bud scale scars and lenticels can be used to identify different trees and shrubs. Bud scale scars can also be used to age twigs.

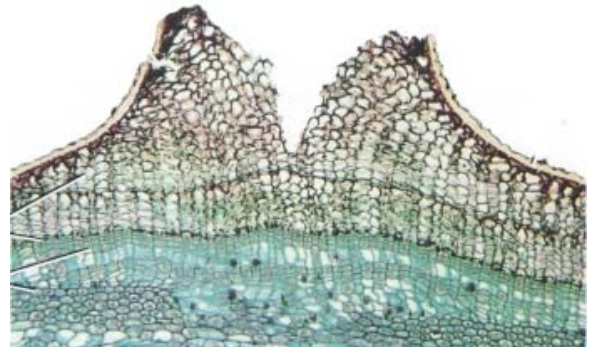
B. Lenticels

Examine a prepared slide of *Sambucus* bark, xs. to observe lenticels. The lenticels are particularly conspicuous in elderberry. Lenticels are composed mostly of parenchyma and appear as “eruptions” on the bark surface.

You should also look for lenticels on the surface of younger stem sections in exercise C.



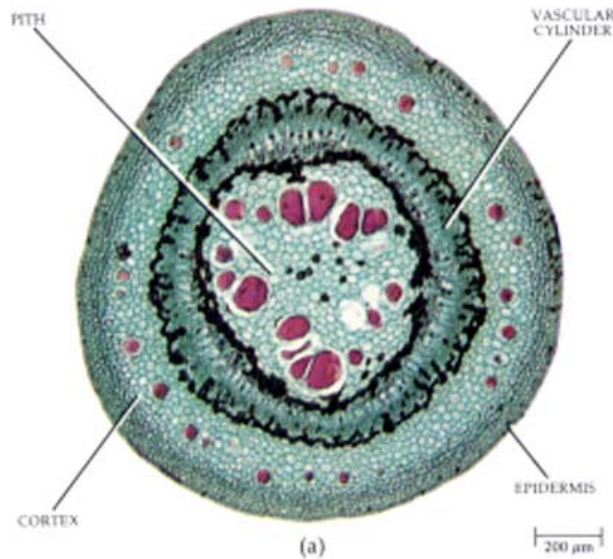
Lenticel in *Sambucus*



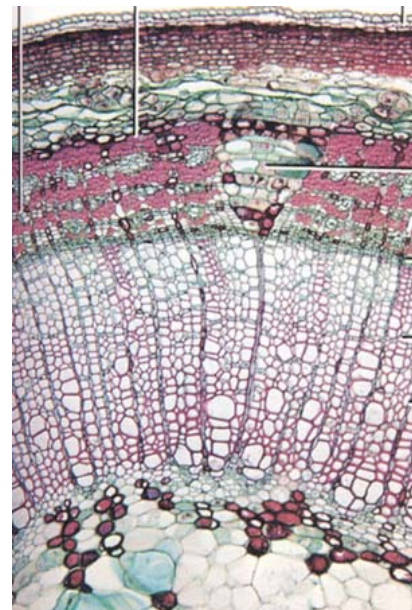
Lenticel in *Aristolochia*

C. Internal Structure of a Woody Dicot Stem

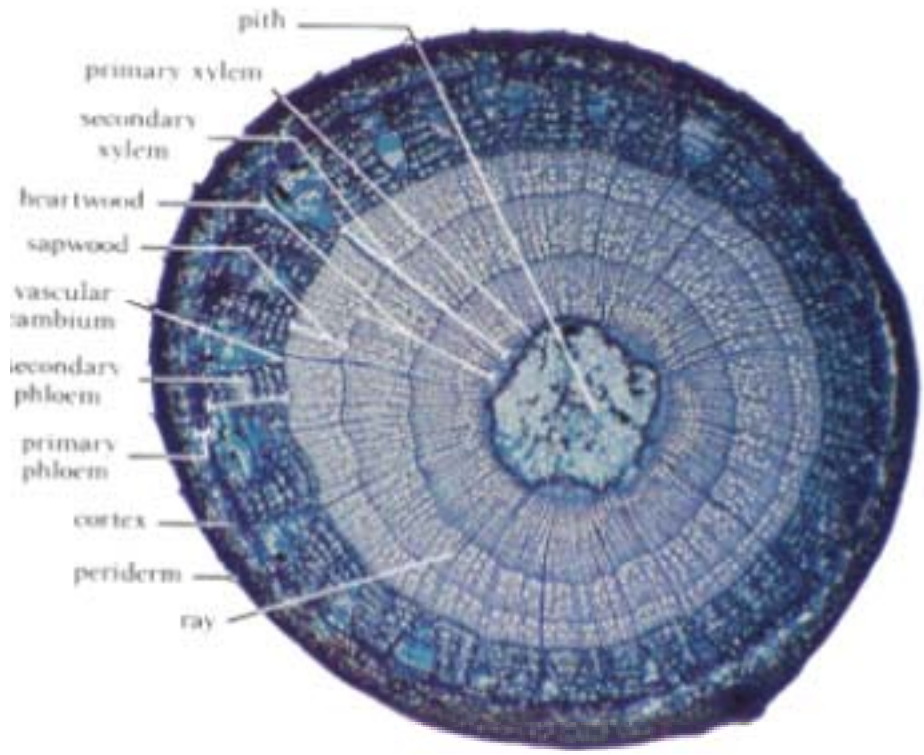
Examine a prepared slide of *Tilia* (Basswood) or other woody stem provided. Look for the annual rings of xylem. How old is your section? The primary pith will be compressed in the center of the section. Locate the vascular cambium. Note how fibers and phloem alternate in the inner bark. In young (first or second year) sections, the cork and phloem are distinct from each other. As stems age, and bark is sloughed off, phloem and cork become intermixed. In between patches of phloem are triangular groups of parenchyma cells. They are **dilated phloem rays**. Rays are also present in the xylem. What is the function of rays?



Young Woody Stem Cross Section



One-year Woody Stem Cross Section

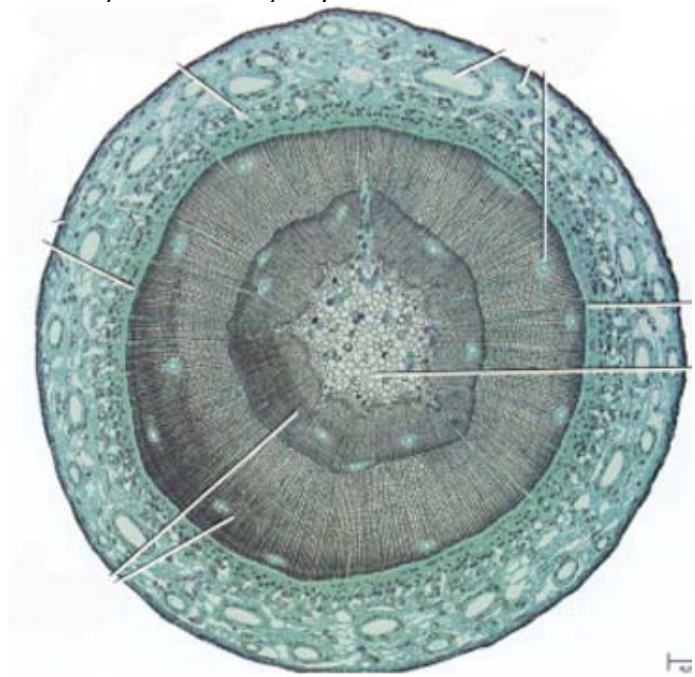


Woody Stem at the Completion of Three Years Growth

D. Internal Structure of a Conifer

Conifers are gymnosperms whose reproductive structures are cones. All conifers have secondary growth. Their xylem contains tracheids, not vessels. Conifers also have conspicuous resin canals in their roots, stems and needles. Much of the Pacific Northwest is in the Taiga biome, whose predominant vegetation is the conifer.

Examine a cross section of a young *Pinus* sp. (pine) stem or similar gymnosperm. Compare its internal structure to the woody dicot stem you just examined.



Pine stem, xs.

E Wood Features

Before leaving your observations of plant structures you might be interested in looking at some features of wood and the cellular origin of these patterns.

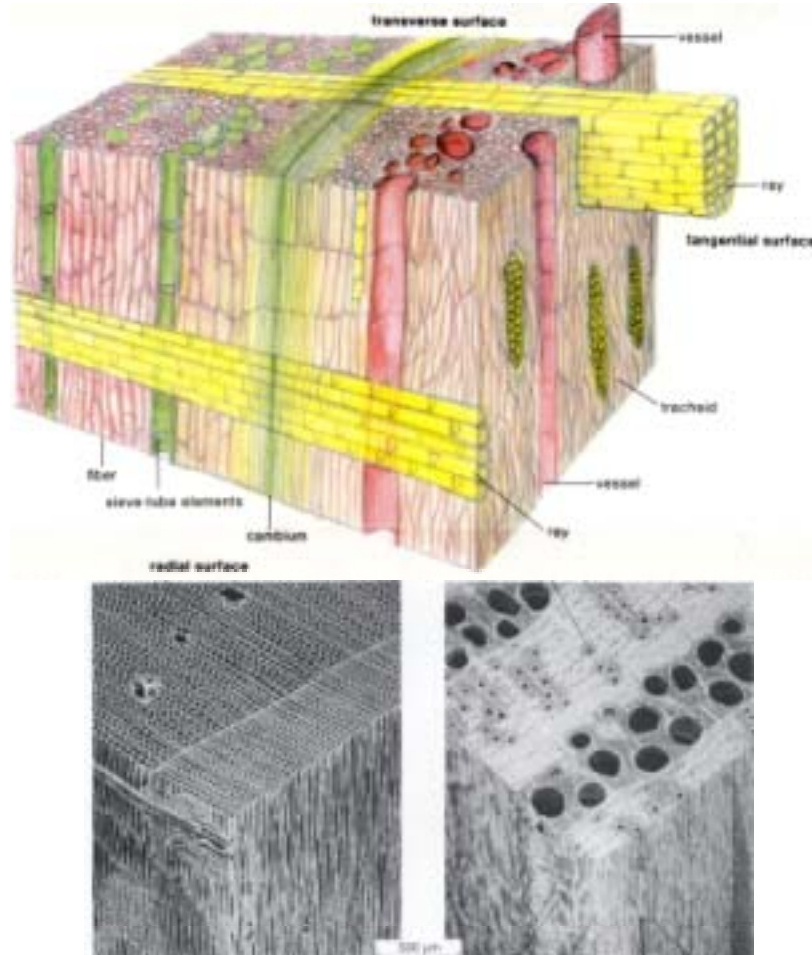
1. Superficial Features of Wood

Examine a wood block provided that has been cut to reveal **transverse**, **radial**, and **tangential surfaces**. Radial and tangential sections are **longitudinal sections**, that is, sections cut parallel to the long axis of the stem. These two sections differ from one another with regard to the orientation of rays. Radial sections are cut more or less parallel to the rays; tangential sections are cut at right angles to the rays, so the rays are seen in cross section. Find the **rays**, which can be seen with the unaided eye, and identify the three types of sections in the wood block.

Identify the annual rings in transverse and radial sections. Such features add variety to the appearance of wood in furniture. The difference in growth rate in spring and summer forms the characteristic rings of wood. Some tropical woods lack distinctive growth rings. Why might this be?

Woody monocots, such as palms have a very different appearance. Observe the Palmetto wood provided.

Now examine blocks of a conifer wood, such as pine or Douglas fir, and note the absence of vessels in the wood. (Why?) Identify growth rings and early and late wood within each of the rings. The pore-like structures in the late wood are **resin ducts**. The rays in the conifer block are often too narrow to be seen.

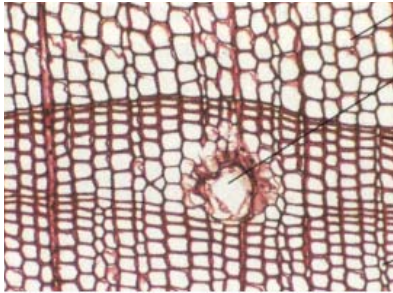


2. Microscope Examination of Wood Sections

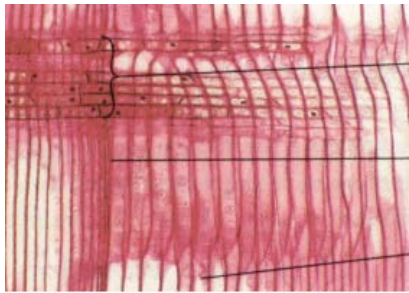
***Taxodium* wood (xrt)**

Obtain a prepared slide of *Taxodium* wood containing transverse, radial, and tangential sections (xrt). Examine the slide with low power and identify all three sections.

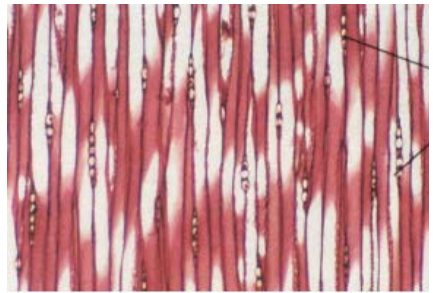
Compare these with similar surfaces of the wood blocks available. *Taxodium* is a conifer. Its wood contains only tracheids, no vessels. Observe the scattered resin ducts, prominent in the transverse section. The wood of Pine, *Pinus* sp., is similar to that of *Taxodium*.



Pine wood, Cross Section



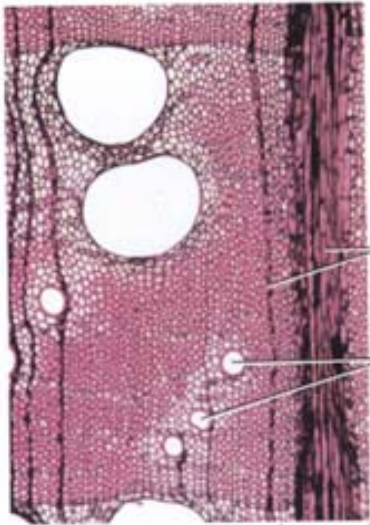
Pine wood, radial section



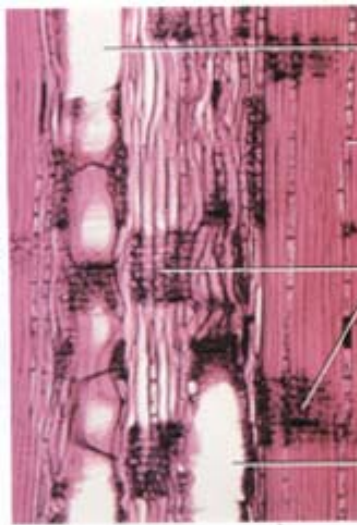
Pine wood, tangential section

Angiosperm wood (xrt)

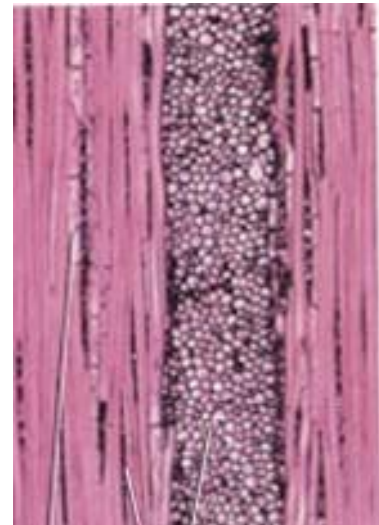
Now observe an Angiosperm "xrt" section such as *Quercus* (Oak), *Acer* (Maple) or *Tilia* (Basswood) and compare the angiosperm wood, with its many vessels and fibers with the conifer wood. Angiosperms do not have resin canals.



Oak wood, Cross Section



Oak wood, radial section



Oak wood, tangential section

3. Examination of Thin Wood Sections

Examine the thin wood sections in 35mm slide format using the dissecting microscopes. How do different wood sections and types of wood compare?