

WOOD STRUCTURE IN HARDWOODS

Mount Wachusett Community College and Wood Digest present part two of an ongoing series of college-level wood technology courses in the course titled "Wood Structure and Properties."

THE FOREST AND WOOD PRODUCTS Institute at Mount Wachusett Community College (MWCC) in Gardner, Mass. has partnered with *Wood Digest* magazine to present a series of college-level wood technology courses. Readers may enroll at MWCC on a distance learning basis for college credit. The courses will be taught using popular wood technology textbooks, coupled with online lessons, discussions and exams. The online component will use the MWCC Distance Learning System known as "Blackboard."

Over the next two years, *Wood Digest* magazine will publish monthly articles based on the course content from the Mount Wachusett Community College's

Wood Products Technology curricula. The initial course is titled "Wood Structure and Properties." Articles from this material will continue through the summer of 2003. The second course, "Wood Machining,"

will continue on to September 2004. For more details on this on-line course and its syllabus, visit the website at <http://www.mwcc.mass.edu/HTML/default.html>.

The first half of the course begins with an overview of structure of wood and covers:

- The physical characteristics of hardwoods and softwoods
- Wood identification
- Strength characteristics
- How and why moisture has such a dramatic effect on wood

The second half of the course covers wood properties, including:

- Adhesives
- Engineered wood products
- Machining, house construction
- Furniture production

The series of *Wood Digest* articles will highlight specific topics throughout the course. They will guide both the student and the *Wood Digest* reader through the technological uses of wood so they may all become better in their chosen profession. The enrolled student will take quizzes, exams, form discussion and study groups. They will receive three undergraduate credits per course,

which may be used toward the completion of a degree at MWCC or any partnering college of your choice.

Interested in college credit via this distance learning course? To receive college credit for this "Wood Structure and Properties" distance learning course, all students are required to register. To become a student at Mount Wachusett Community College, you must be admitted by following this step-by-step application for admission process:

Step 1. Go to

<http://www.mwcc.mass.edu/HTML/default.html> and print out the "Registration Form" from the Forest and Wood Products Institute website, located after opening the Business and Industry site.

Step 2. The course syllabus is available on our website for your review.

Step 3. Fill in the blanks. Please note that the pertinent information is preprinted for your convenience.

Step 4. Mail, fax or scan/e-mail the form to MWCC admissions office. The numbers and addresses are on the form. The fee amounts are preprinted.

Step 5. Contact the instructor Ken Hanson at (978) 630-9179 or khan@mwcc.mass.edu with questions.

Step 6. Upon registration confirmation, the institute will e-mail you a welcoming packet of information and your first homework assignment. It is required that you will have Internet access. Due to the rolling enrollment process, any student may start this course anytime throughout the 12-month period, with completion in September 2003. There is no maximum number of students.

To all new students and readers: MWCC and *Wood Digest* are excited about being able to offer these Wood Technology courses in this new, exclusive format. We welcome your enrollment to the college, your questions and comments as we start this Wood Structure and Properties wood technology course.

WOOD STRUCTURE IN HARDWOODS-MONTH 2 OF 12:

What is the Plant Kingdom? How are hardwoods classified in the Plant Kingdom?

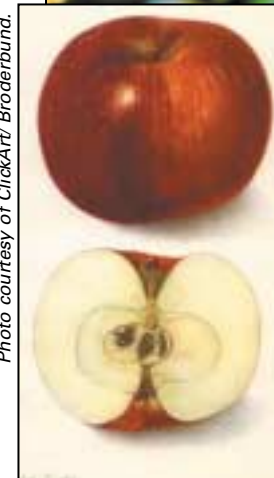
In September, we studied the structure of softwoods. The students who have enrolled in the class have purchased the textbook, read the required reading and have entered into the MWCC Blackboard Learning System. For those students who have just started, please review September's assignments, then continue into this month. While investigating hardwoods, the reader may want to make some comparisons with the softwood structure information.

Hardwoods are different than softwoods. Hardwoods are classified in the **plant kingdom** in the division of **Angiosperms** (seeds that are covered). Angiosperms are a taxonomic class of plants in which an **ovule** surrounds the mature seed. An example of this would be a black walnut seed, an apple or a pear.

As a tree, hardwoods have leaves and the softwoods have needles. Angiosperms include **deciduous** trees with leaves that may change color and fall to the ground every year or (at the end of the growing cycle. Oaks, maples and birches are examples of deciduous trees. Some angiosperms, such as a rhododendron, retain their leaves throughout the year. Angiosperms are further divided into monocotyledons



Photo courtesy of ClickArt/ Broderbund.



BLACK WALNUT AND APPLE TREES FEATURE ENCAPSULATION OF SEED.

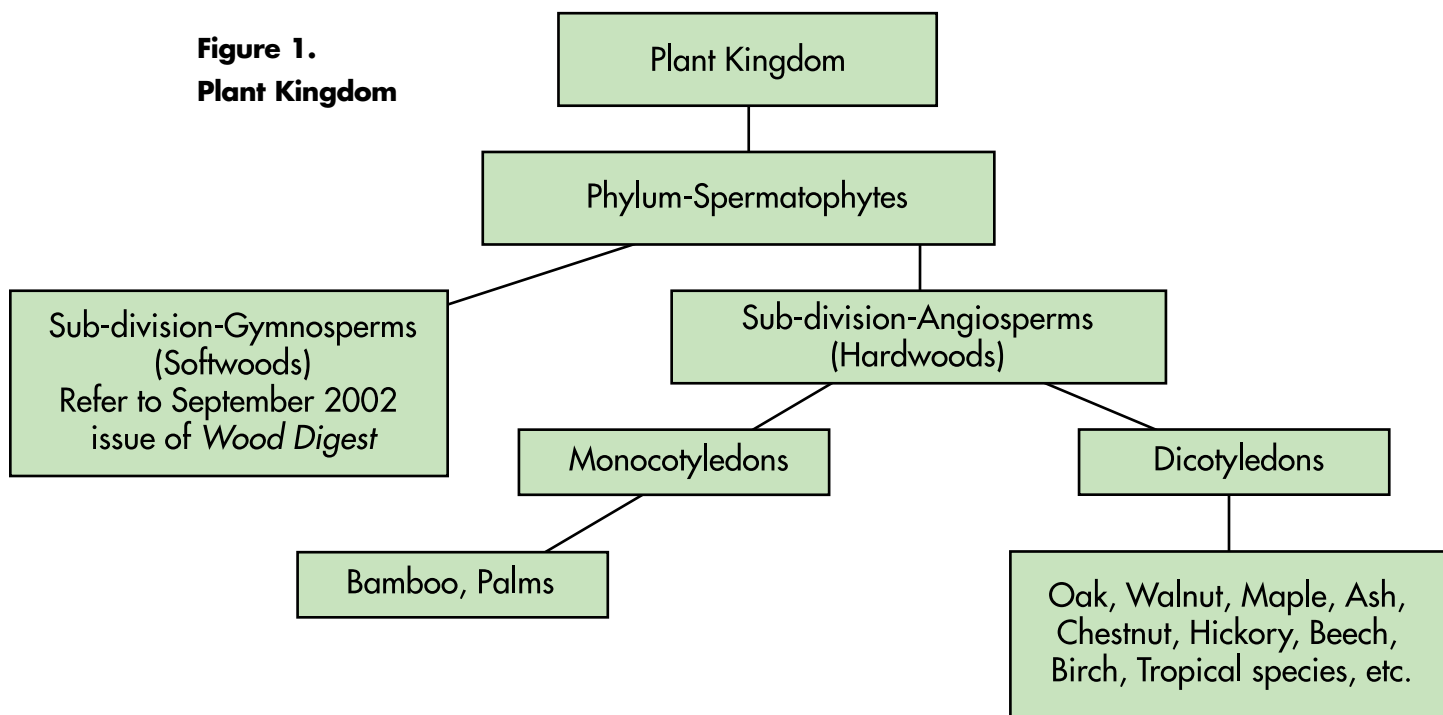
(monocots) and dicotyledons (dicots). (See chart

one.) As a plant is growing, the initial seed leaf protruding from the ground will have either one leaf or two. A monocot, i.e., corn, bamboo and palms, will have one seed leaf. Dicots will all have two initial seed leaves.

For this article, we will focus on



Figure 1.
Plant Kingdom



three tree groups of deciduous dicotyledons. They are the oaks (*Quercus* sp.), black walnut (*Juglans nigra*) and the maples (*Acer* sp.). As discussed in September, we are familiar with the common name, i.e., red oak, but they are often inaccurate. To correctly identify an individual species, the scientific name should be

Southern yellow pine on the other hand, is a softwood; however, its density is about the same as black walnut.

SUBCATEGORIES OF HARDWOODS

Hardwoods are considered to be porous due to their large tubular structures called **vessel elements**.

but not in the latewood portion. Ring-porous species have vessels that form a distinct ring in the cross section. See the figure of red oak shown as an example.

Black walnut is a semi-diffuse-porous specie. Its pores gradually reduce in size from earlywood to latewood in the growth ring; however, the pores are uniformly distributed throughout the ring. In the diffuse-porous hard maple sample, pores are uniform in sizes and are spread evenly throughout the growth ring.

RAYs

The rays in hardwoods are similar to the rays in softwoods; however, they tend to be much larger. In the radial view (quarter-sawn and rift), the ray shows a distinct pattern called a ray fleck. Extremely noticeable in red and white oak, beautiful ray flecks are also found in maple, beech and sycamore. Rays are also a plane of weakness. If the moisture conditions in the **dry kiln** are not controlled according to a proven schedule, the rays may split causing a variety of defects. These drying defects are called **surface checks, end checks and honeycomb**.

DRYING DEFECTS

These defects may be hard to detect in an unfinished board. Once stain is applied to the wood's surface however, these checks will appear as dark cracks. Honeycomb defects are located within the board, becoming noticeable after surfacing or cutting to length.

Some drying defects can be controlled by careful drying. Care must be taken to calibrate your equipment accurately, maintain your sensing equipment, and by monitoring your

charge of lumber. In addition, many of these drying defects occur prior to drying in a kiln. Uncontrolled sun, excessive airflow and dry conditions will cause checking as the lumber is waiting for processing, sometimes in only a few hours.

QUARTER-SAWN VS. FLAT-SAWN FLOORING

Ray flecks in quarter-sawn red oak appear as lines or wide shapes if cut longitudinally through the ray. The grain pattern exhibits straight earlywood figure, quite different from the conical flat-sawn grain figure. Quarter-sawn flooring and furniture are sold at a premium vs. flat-sawn products, mainly due to the lower volume of production and higher consumer demand.

TRY IT YOURSELF

To all readers and students: To explore the discussion topics above, you can follow along at home or at work:

Locate a magnifying glass and view a cross section of a piece of red oak. You may have to cut the wood with a very sharp knife or single edge razor to expose a small surface (BE CAREFUL and do not slip!) If you are uncomfortable using a razor blade, try it without preparation or ask someone to prepare it for you. A measurement of any size will be sufficient.

- Try different methods to cut a clean surface. A clean surface is one in which the pores appear to be cut clean off with no damage. What works the best?

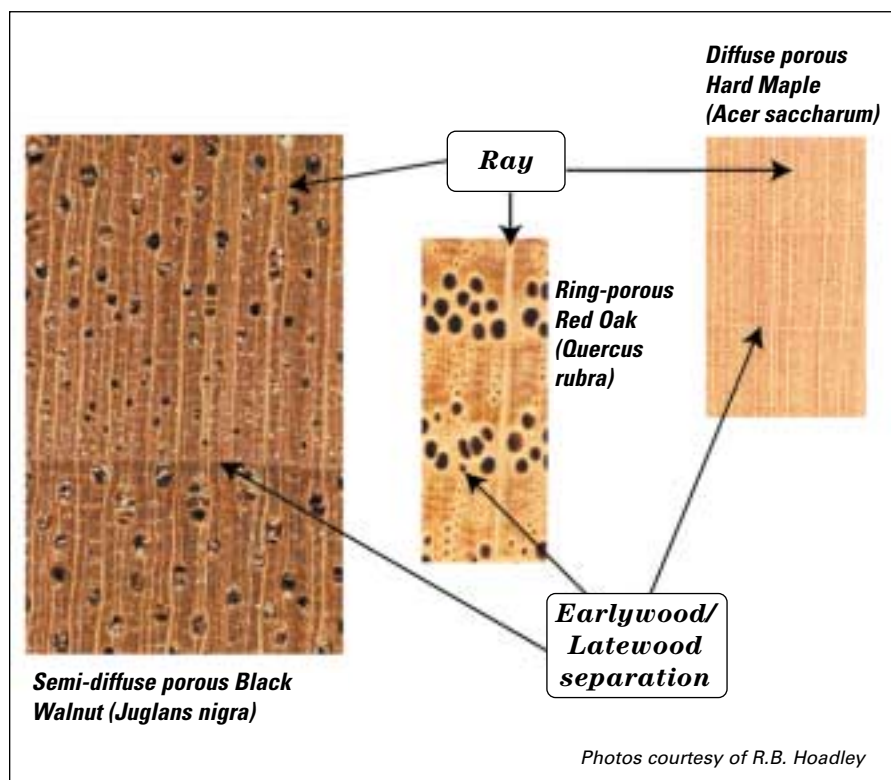
- Cut a cross section, radial and tangential sample. Which one was the easiest to cut?

- Which cut cleaner, the earlywood or latewood?

- Try and locate vessel elements, rays, ray flecks, and measure the width of a red oak ray.

For enrolled students: September's homework and quiz questions are now due. A homework assignment is available for you on Blackboard. If you have any questions about Blackboard or the homework, contact Ken Hanson or review the help section available on the MWCC website. **WD**

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used, for example, *Juglans nigra*. A group of species may be identified as in *Acer* sp., where sp. refers to species.

ARE HARDWOODS HARD WOODS?

Yes, but not in all cases. Density (the weight of an item per unit of volume) is considered as an indicator for hardness, strength, weight and similar characteristics. Consider the example of balsa wood. Balsa is an extremely lightweight wood, very soft and is considered a hardwood.

These vessels are arranged in the tree's growth or annual ring in three distinct patterns. These patterns are **ring-porous, semi-diffuse-porous, and diffuse-porous**. Each of the three tree group examples considered in the article fall into one of these patterns. An example of a ring porous wood is oak. The two major common species of oak are red (*Quercus rubra*) and white oak (*Quercus Alba*). In the majority of oak species, large vessels are very prevalent in the earlywood portion of the growth ring