



Learning More About Wood Itself

Now that you know a little about how the wood was manufactured for your woodworking projects, you may want to learn more about the wood itself—the structures and properties of wood, how to identify different kinds of wood, and which type of wood works best for a particular woodworking project. If you learn this, you will know more about wood than many people who have spent a lifetime working with it but never bothered to learn anything about it.

Wood is divided into two groups, “hardwoods” and “softwoods.” When magnified, hardwoods look different than softwoods. Each group also has different properties which may make one group of wood better for a particular wood product than another. For example, hardwoods are usually heavier and harder than softwoods, and might be better for flooring than a softwood. There are many other properties, as you will learn later, that make a particular wood more appropriate for a particular product than another.

Within the hardwood and softwood groupings, different kinds of trees are further identified by name. Let’s see how each group of trees gets its name.

Names of Woods

There are more than 100 different kinds of woods (trees) in the United States. Approximately 60 are widely used for wood products. Your lumber yard may only sell a few of the different kinds. Each different kind of wood is called a “species.” Each species has at least two names: a **common name** and a **scientific name**. The common name, such as white oak or eastern white pine, may vary in different parts of the country because a number of different woods have the same common name. Some woods may even have several common names.

One scientific name is given to each species, and this name is always the same. The scientific name has two parts. For example, the scientific name of white oak is *Quercus alba*. The first part, which always begins with a capital letter, is kind of like your last name—the family name. It is the same for closely related woods. All oaks are given the first name *Quercus*. The second part of the scientific name is like your first name. It tells which oak it is. *Quercus alba* is white oak, and *Quercus rubra* is northern red oak. Likewise, the scientific name for eastern white pine is *Pinus strobus*.

The scientific name is handy to know when discussing wood products with technical people, but don’t expect the clerks at the lumber yard to know the scientific name of the lumber they sell you.

Activity: Wood Sample Collection

Start a collection of wood samples. It will help you learn more about the different types of woods that are available and what they look and feel like. It will also make a very good 4-H demonstration; or, you can use it to show some younger club members how they can tell the differences between woods. The collection can also be used in displays and exhibits.

A 1” x 3” x 5” piece of wood is a good sample size for your collection. Label each sample. Some of the things you might include on the label are: the common name, scientific name, whether it is a hardwood or softwood, where the wood grows, and some of its common uses.

Each time you work with a new kind of wood, add a sample of it to your collection. Your leader may have some woods that you do not have, so you can exchange samples.

Other sources for wood samples are lumber yards, cabinet shops, sawmills, and woodworking shops. Products that can be included in your collection are plywood, particleboard, fiberboard, edge grain and flat grain lumber, and treated wood. **Treated wood** is wood that contains a chemical that makes the wood resistant to decay and insect damage. The other terms were discussed in Unit II. Do you remember what they mean?



Structure of Wood

Knowing more about the structure of wood will help you know how to use it. In the first two units, you learned a little about the structure of wood. You learned that a tree has annual rings; one for each year that the tree has grown. Let's look at a tree to learn more about its structure.

A tree can be divided into three parts — the crown, trunk, and roots. The crown contains the branches, twigs, and leaves, and it is the “food factory” in the tree. The roots anchor the tree to the ground and absorb water and nutrients from the soil. The trunk of the tree holds the crown up to the sun. It also conducts water and nutrients up to the leaves and distributes the manufactured food to points of growth.

The trunk of the tree is the major source of the wood we use. The wood in the branches and the wood in the roots is similar but not often used, because branches and roots are usually not long enough nor straight enough to make lumber.

The trunk is divided into many parts. There is the bark, sapwood, heartwood, pith, and rays. Take a look at each part. Get a piece of tree trunk to look at when identifying these parts and refer to the illustration shown. Even a small tree will have all of these parts, except that some small trees may be too young to have developed heartwood.

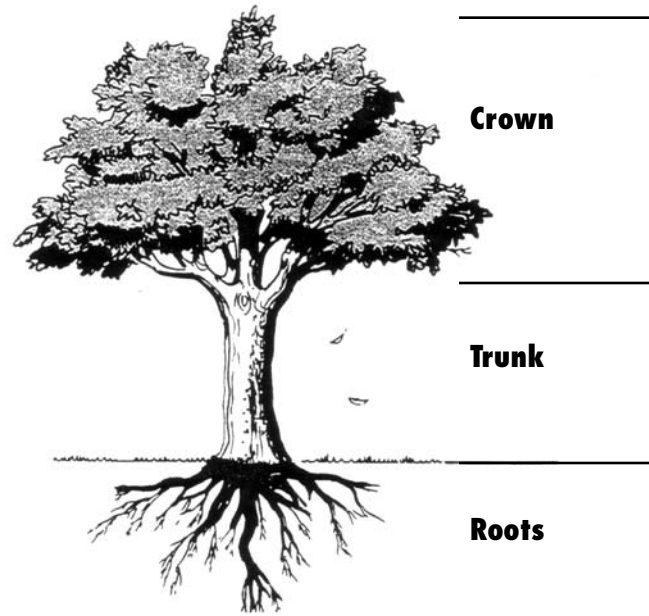
On some trees, the bark is thick and chunky, and on others, it is thin and smooth. Tree bark is made up of inner bark and outer bark. The **inner bark** (“B”) on a living tree is soft and moist. It is a living part of the tree and carries food from the leaves down the trunk. The **outer bark** (“C”) is dry and crumbly. It protects the growing areas from outside injury.

The **sapwood** (“D”) is the living part of the wood. The sapwood layer may be very narrow or it may be wide. It carries water from the roots to the leaves and also serves to store food.

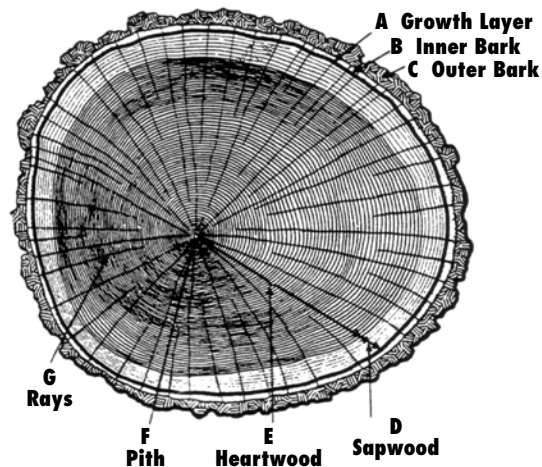
The **heartwood** (“E”) is generally darker or more brightly colored than sapwood. Early in the life of the tree, the heartwood was sapwood; but, as the tree grew older, the inner sapwood died and turned to heartwood. The major function of heartwood is to help support the tree, but heartwood is important for another reason — it sometimes makes the wood decay resistant.

The very center of the tree is called the **pith** (“F”) and was formed when the tree was very young. Wood close to the pith may have properties very different from the wood that is formed later on in the life of a tree.

Between the bark and the wood in the tree trunk is the **cambium layer** (“A”). The cambium is the growth layer. It allows the tree to grow larger in diameter, adding new wood just inside the cambium



Parts of a Tree



Parts of a Tree Trunk

layer and new bark just outside the cambium layer. In other words, the tree grows two ways at once: an inner layer of tree trunk and an outer layer of bark. The additional inner layer of wood makes the tree bigger, so the cambium layer has to stretch. At the same time, each year the bark gets thicker by the additional layer of bark grown. In fact, the reason that the bark of older



trees is rough with ridges is that the bark you see is old bark, which was grown when the tree was small, and it cannot stretch enough to smoothly cover the now larger tree. There are a few exceptions to the rule. For example, older beech trees, aspen, and red alder have smooth bark. It's a characteristic of these trees.

Wood is a very complex material. It is made up of millions of small fibers or **cells**. These long hollow tubes are connected together with a gluelike substance. If you look at the end of a piece of wood that has been cut with a very sharp knife, you may be able to see the open ends of some of the cells.

Most of the cells in the trunk of the tree are aligned up and down the trunk. This is what gives the wood its grain direction along the trunk. A tree also has cells that are aligned from the bark to the pith. These are called **rays** ("G").

As a tree grows, it produces branches as well as a vertical stem. As the tree trunk grows in diameter, it grows over the branches. An overgrown branch is called a **knot**. If a branch remains on the tree throughout its life, the knot will extend from the center of the trunk out through the bark where it becomes a visible branch (left side of illustration). However, many times the lower branches on the tree die and fall off, or they are cut (**pruned**) from the tree. When this happens, the tree grows over the stub, and the knot ends in the wood at the point where the branch stub becomes overgrown with clear wood (right side of illustration). This is how it becomes possible to have a board which has a knot on one surface and no knot on the opposite surface—if the board happened to be cut so that the knot ended within the board. The grain direction in the knot will be perpendicular to the trunk and the grain

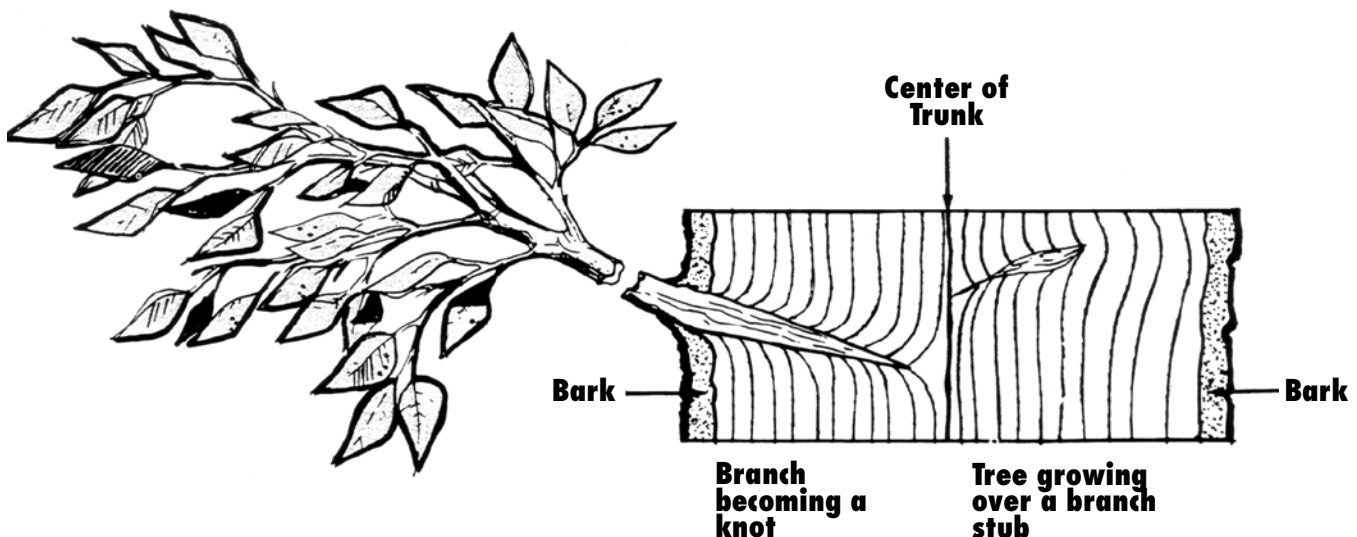
in the wood that surrounds the knot will have to curve around the knot. These changes in grain direction, and the knots themselves, can give wood a very attractive appearance or detract from its appearance; and knots usually reduce the strength of wood, because the grain direction is different than in clear, knot-free lumber.

As long as the branch is alive, the wood and knot grow together. Lumber cut from these trees has tight knots which stay in the wood. If the branch dies but remains on the tree, the trunk still grows around the knot, but the wood of the knot and the wood of the tree will not actually grow together. Such a knot will be loose; and, when cut into lumber, the knot may fall out leaving a **knot hole**. Loose knots and knot holes weaken wood; therefore, knots are referred to as defects in wood.

Activity: Compare Tight and Loose Tree Knots

Find a piece of wood that has a loose knot and a piece of wood of the same species that has a tight knot. Examine the area around the tight knot to see if you can tell how solidly the wood in the branch and trunk are grown together.

Compare this with the loose knot. Do you see any differences? Could you knock the loose knot out, leaving a knot hole? Add these two pieces to your wood sample collection.





Identifying Hardwoods and Softwoods by Structure and Appearance

Wood identification is not easy. It is both an art and a science. The art cannot be taught in a book. It comes from handling different woods. The science can be taught, and the first step is learning the characteristic differences between hardwoods and softwoods. Start learning the differences by trying the following activity.

Activity

To help you in identifying woods, you will need a hand lens or magnifying glass and a sharp knife. You will also need a piece of hardwood and a piece of softwood. Oak (a hardwood) and white pine (a softwood) work best.

Make a small, clean cut on the ends of the wood samples. Look at the cut surface with the hand lens or magnifying glass. (It may help if you wet the cut surface.) What do you see? Do you see any differences in the two pieces? If you have samples of other woods, examine them also. Do you see any similarities? Differences? Are there similarities in the softwoods? Are there similarities in the hardwoods?

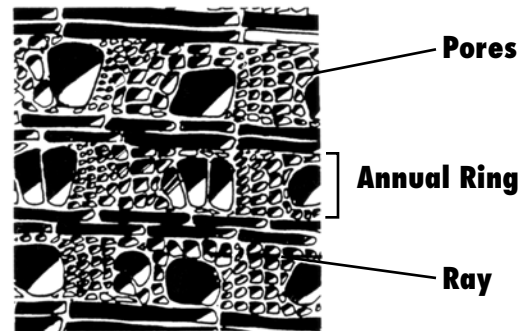
The first major difference that you should notice is that the oak has large open cells at the start of each annual ring. These are called **pores**. All hardwood species have pores, but the pattern and number of pores varies. This is one way of telling different hardwood species apart.

Pine does not have pores. It does have a few scattered openings that are called **resin canals**, but they are not all located along each annual ring, as pores are. Look at the pine sample again. If you have a good, clean cut and look real close, you can see the tiny cell openings. They are shown in the magnified pine sample illustration. These cells are lined up in a very uniform pattern from the center of the tree to the bark. The cells in oak are not lined up in straight rows like the pine.

Therefore, the most accurate method of separating hardwoods and softwoods is the presence of pores and lack of cell alignment in hardwoods, as compared to the lack of pores and obvious cell alignment in softwoods.

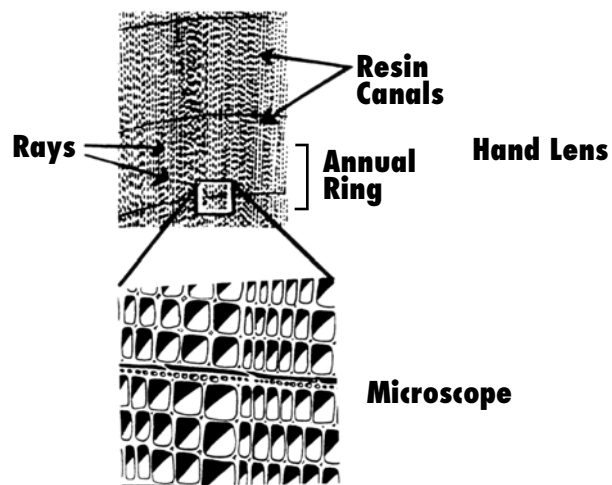
In the end view of the oak, you will also see large bands of lighter colored wood material that cross the

Your oak sample will look similar to this:



Hand Lens

Your pine sample will look similar to this:



Microscope

annual rings. These are the **rays**. Both the oak and pine have rays, but they are larger in the oak and much finer in the pine. All wood species have rays, and their size and spacing can be used to help identify different species.



Activity: Compare Wood Structures

Look at some wood samples other than oak or pine. Look for patterns of cells, pores, or rays that are different from the oak and pine. List some of the things that are different, such as the presence of resin canals, size and spacing of rays, patterns of pores, coloration, odor, etc. Some of these may be used to identify woods. Others may be used to separate woods into smaller groups. Later you will learn how pores and rays affect the use of wood. Your leader may have a book which shows magnified sections or cross sections of different woods which will help you identify your samples. If not, go to your local library for help.

How Moisture Affects Wood

Wood in its natural state always contains some moisture (water). Wood is nearly saturated with water when it is growing, and, although it may feel dry, some of this water is still present in the normal use of wood. Only wood that has been dried at temperatures above the boiling point has no water in it. Even if water is removed by drying, the wood will begin to regain moisture when exposed to the atmosphere, because even the driest climates have some relative humidity (moisture) in the air.

When wood picks up a lot of moisture or becomes saturated with water, it changes in some ways. It gets heavier. It changes shape. And, it can even become deformed. These properties affect how we can use wood, and, in some situations, what we must do to finish and protect the wood from moisture and water.

The suggested experiment on page 12 for observing what happens when wood gets wet requires some assistance from your leader or parent, so be sure to ask an adult to help. To conduct the experiment, you need five small blocks of wood from the end of a 2 x 4 or 2 x 6. It is best to get your leader or parent to help you cut these with a power saw. You might find some scraps of wood to use in the scrap bin at your local lumber yard.

