

# **Unit D: Forest Products**

## **Lesson 2: Understanding the Characteristics of Wood**

# Terms

- ◆ Bound water
- ◆ Cellulose
- ◆ Diffuse-porous
- ◆ Extractives
- ◆ Fiber saturation point
- ◆ Free water
- ◆ Hardwoods
- ◆ Lignin
- ◆ Medullary rays
- ◆ Middle lamella
- ◆ Moisture content
- ◆ Parenchyma cells

# Terms

- ◆ Resin
- ◆ Resin ducts/canals
- ◆ Ring-porous
- ◆ Softwoods
- ◆ Specific gravity
- ◆ Tracheids
- ◆ Tyloses
- ◆ Wood fibers

# What are the chemical characteristics of wood?

- ◆ I. Wood is often thought of as the hard, fibrous substance that forms the greatest part of the stems and branches.

# What are the chemical characteristics of wood?

- ◆ A. There are several chemical properties of wood.
  - 1. Wood is made up of about 50 percent cellulose, 28 percent lignin, and minor quantities of other materials.

# What are the chemical characteristics of wood?

- ◆ Cellulose and lignin are responsible for some of the properties of a wood, such as the wood's ability to absorb moisture and its resistance to corrosion by salt water.
  - 1. Hardwoods have less lignin than softwoods.

# What are the chemical characteristics of wood?

- ◆ Cellulose forms the framework of the cell walls and is the product used in the manufacture of paper.
- ◆ Lignin is the cementing material that binds the cells together and is also found mixed with cellulose in the cell walls.
- ◆ When the lignin is dissolved with chemicals, the cells may be separated for papermaking.

# What are the chemical characteristics of wood?

- ◆ Characteristics like color, odor, and natural resistance to decay cannot be attributed to cellulose or lignin, but rather to other materials in the wood.

# What are the physical characteristics of wood?

II. Wood is indispensable in our everyday lives, and many products are derived from trees.

# What are the physical characteristics of wood?

- ◆ A. There are several physical characteristics of wood.
  - 1. The relationship between moisture and wood is very important in understanding wood behavior.
  - The wood-water relationship causes most of the problems in using wood products.

# What are the physical characteristics of wood?

- ◆ Nearly all wood properties are affected by the amount of water in wood.
- ◆ The amount of water in wood is affected by changes in temperature and humidity.



# What are the physical characteristics of wood?

- ◆ The water found in wood originates in the living tree.
- ◆ When a tree is harvested, most of the cells still contain a high percentage of water.
- ◆ The water in wood is found in two areas.

# What are the physical characteristics of wood?

- ◆ 1. Water contained in the cell wall is called bound water and the bond formed with the cell wall is not easily removed.
  - Heat must be used to remove bound water.
- ◆ Bound water is the last to leave the wood when a wet piece of wood is dried.

# What are the physical characteristics of wood?

- ◆ 2. Water contained in the cell cavity is called free water.
- ◆ Free water is the first to be removed.

# What are the physical characteristics of wood?

- ◆ 3. The fiber saturation point is reached when there is no free water in the cell cavity and any remaining water is in the cell wall.
  - Wood reaches the fiber saturation point when the cell wall contains 20 to 30 percent water.

# What are the physical characteristics of wood?

- ❖ Sometimes the amount of water varies because of the amount of extractives in the cell wall.
- ❖ Extractives tend to bond to the same sites as does water.

# What are the physical characteristics of wood?

- ◆ 1. Extractives are organic, non-wood substances that give color, odor, or other characteristics to wood.
- ◆ Their presence may or may not affect the amount of water in the wood.

# What are the physical characteristics of wood?

- ◆ The moisture content of wood is a measure of the amount of water contained in the wood.
- ◆ Moisture content is the weight of water in a wood sample expressed as a percentage of the dry wood weight.

# What are the physical characteristics of wood?

- ◆ Shrinking and swelling of wood occur as a result of changing moisture content within wood.
  - 1. Shrinking does not occur until the fiber saturation point is reached.

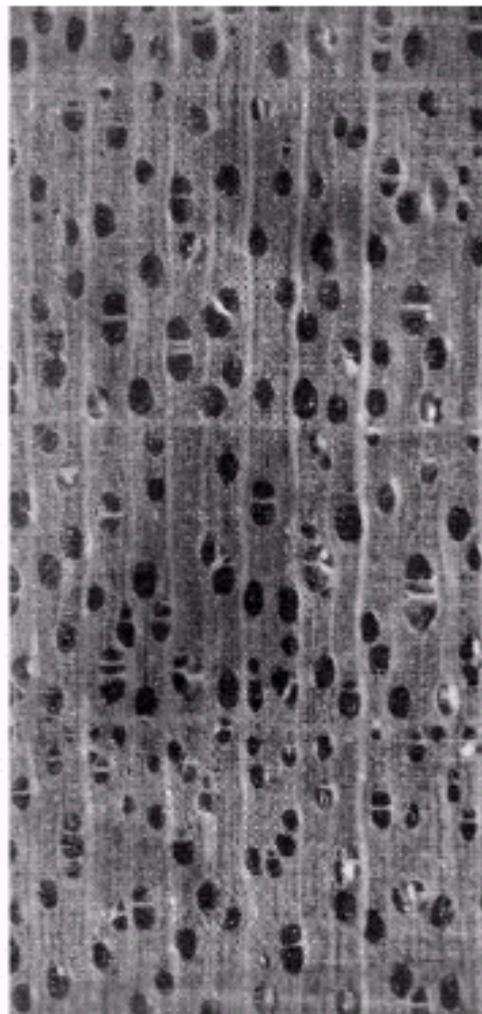
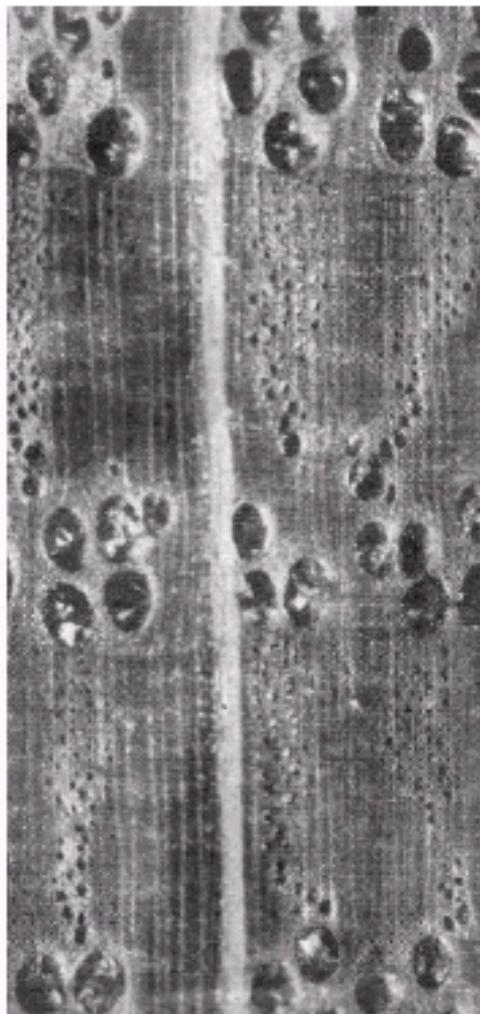
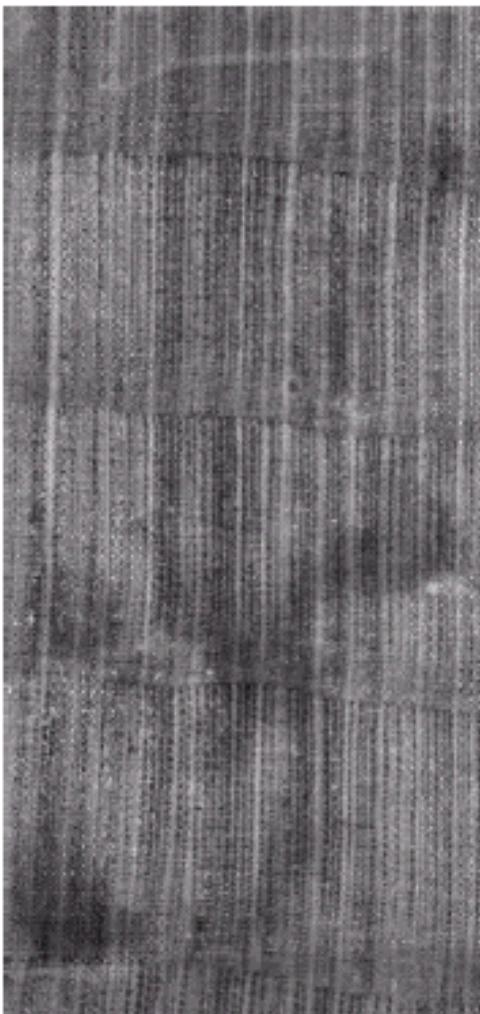
# What are the physical characteristics of wood?

- ◆ Shrinkage will occur until all water is removed, or the moisture content is 0 percent.
- 2. Shrinkage and swelling are important because dimensional changes in wood often cause structural and appearance problems.

# What are the physical characteristics of wood?

- ◆ 2. Woods can be divided into two groups: those without pores (non-porous) and those with pores (porous).

# **POROUS AND NON-POROUS WOODS**



# What are the physical characteristics of wood?

- ◆ The porous woods are further divided into ring-porous and diffuse-porous.
  - 1. Ring-porous woods have larger pores found in the springwood and smaller pores found in the summerwood.

# What are the physical characteristics of wood?

- ◆ 2. Diffuse-porous woods have rather small and evenly scattered pores throughout both the springwood and the summerwood.
- ◆ 3. The weight of wood is usually expressed in terms of weight per cubic foot or weight per thousand board feet.

# What are the physical characteristics of wood?

- ❖ Since wood readily absorbs moisture, its weight depends on two factors: the weight of the wood material and the moisture retained in the wood.

# What are the physical characteristics of wood?

- ◆ When the moisture content of wood changes, the weight and the dimensions of the wood also change.
- ◆ A more practical way of expressing the weight of wood in relation to its moisture content is in terms of its specific gravity.

# What are the physical characteristics of wood?

- ◆ 1. Specific gravity is the ratio of the weight of an oven-dried volume of wood to the weight of the same volume of water.
  - If a specific gravity of a wood is expressed 0.66, it means that a given volume of this wood weighs 0.66 times as much as an equal volume of water.

# What are the physical characteristics of wood?

- ◆ 2. Specific gravity provides a relative measure of the amount of wood material contained in a sample of wood.

# What are the physical characteristics of wood?

- ◆ 3. Specific gravity of wood is largely influenced by: the amount of gum, resins, and other extractives in the wood; the size of the wood's cell cavities; and, the thickness of the wood's cell walls.

# What are the physical characteristics of wood?

- ◆ 4. The basis for specific gravity is generally the dry weight and volume at a moisture content of 12 percent.

# What are the physical characteristics of wood?

- ◆ 4. In the manufacturing of furniture it is sometimes necessary to bend wood.
- ◆ Some hardwoods are more readily softened by heat and moisture for bending than are other hardwoods.
  - a. A variety of chemicals are used to aid in the bending of wood.
  - Urea, dimethyl sulfoxide, and liquid ammonia are a few.

# What are the physical characteristics of wood?

## ◆ 5. Other physical properties of wood.

- a. Resin ducts or canals, found in pine, are intercellular passages surrounded by resin-secreting cells.
  - ◆ The ducts are often filled with resin.
  - ◆ Resin is a vegetable substance secreted by certain plants and trees and is a characteristic of coniferous trees.

# What are the physical characteristics of wood?

- b. Properties such as color, luster, taste, hardness, odor, and texture are important in wood identification.

# **PROPERTIES OF COMMON WOODS**

## **Properties for wood identification:**

- color
- luster
- taste
- hardness
- odor
- texture

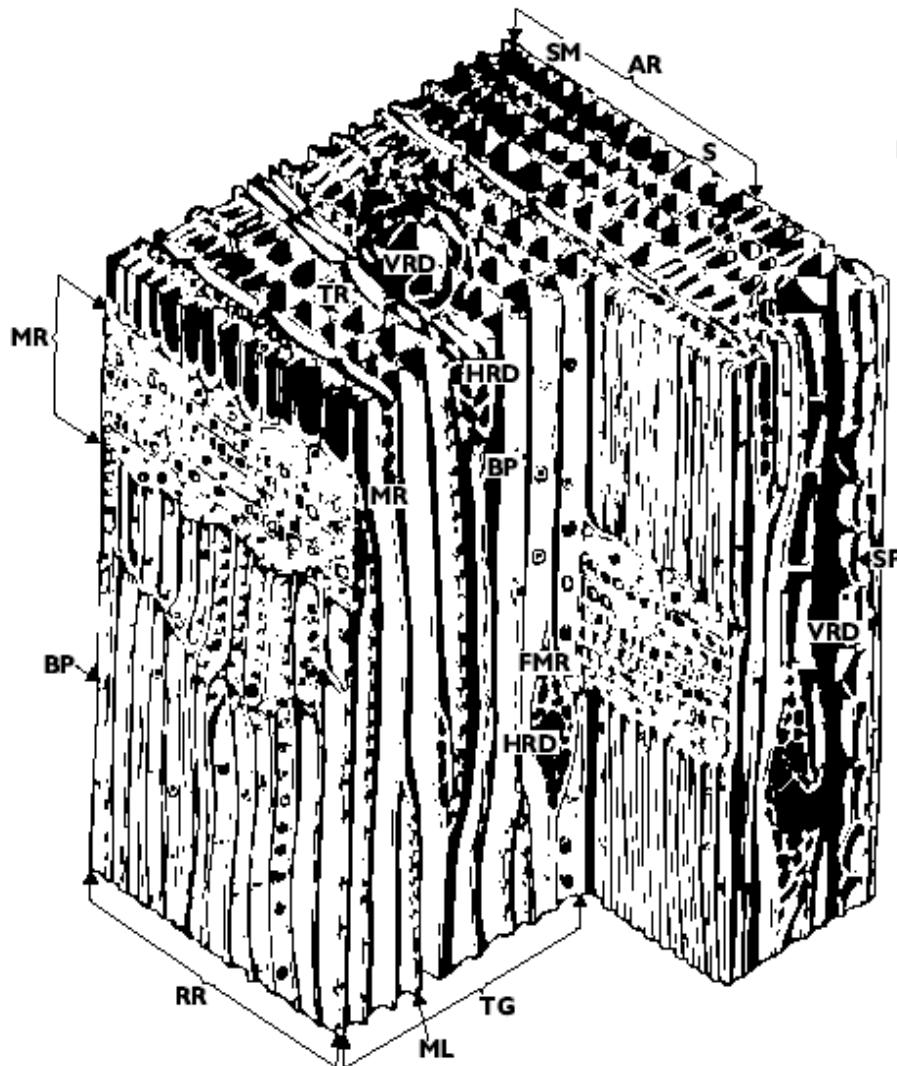
## **Properties important for wood use:**

- weight
- strength
- stiffness
- bending
- woodworking qualities
- hardness
- durability
- permeability to staining and shrinkage

# What are the physical characteristics of wood?

- c. Properties such as weight, strength, stiffness, bending and woodworking qualities, hardness, durability, permeability to staining and shrinkage are among the most important characteristics to someone using wood.

# SOFTWOOD CROSS-SECTION



AR = annual ring  
BP = bordered pits  
FMR = fusiform medullary rays  
HRD = rays with horizontal resin ducts  
ML = middle lamella  
MR = medullary rays  
RR = endgrain

S = springwood cells  
SM = summerwood cells  
SP = simple pits  
TG = surface of wood sample  
TR = tracheids  
VRD = vertical resin duct

# What are the characteristics of hardwoods and softwoods?

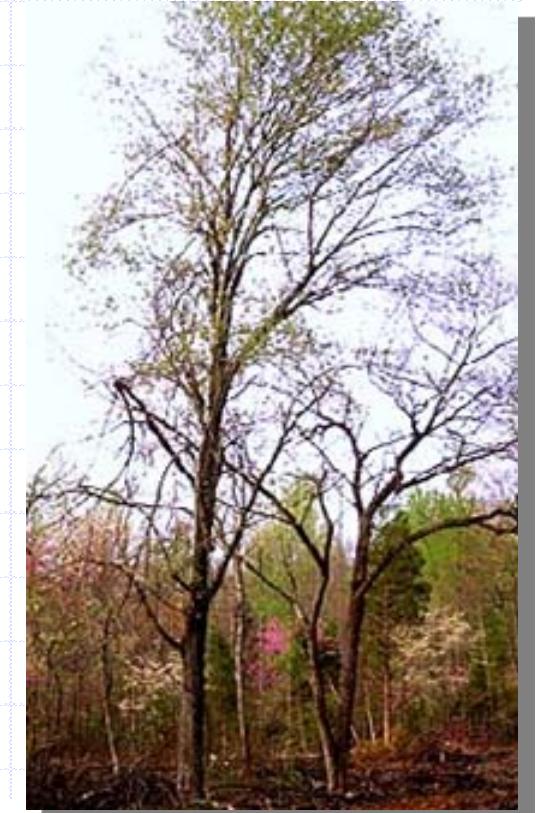
- III. Trees are divided into two classes: hardwoods, which have broad leaves, and softwoods, which have needlelike leaves or scale leaves and are called conifers.

# What are the characteristics of hardwoods and softwoods?

- ◆ No degree of hardness divides the hardwoods from the softwoods.
- ◆ Some hardwoods are soft and some softwoods are hard.
  - 1. The term softwood originated in New England, where the loggers applied it to the light wood of white pine, a conifer.
  - The term was applied to all conifers, regardless of their wood density.

# What are the characteristics of hardwoods and softwoods?

- ◆ 2. Hardwood was the term given to hard maple, a dense wood, and thereafter to all deciduous species.



# What are the characteristics of hardwoods and softwoods?

- ◆ 3. Wood can readily be identified as a hardwood or softwood by the presence or absence of pores when viewed in a transverse section.
- ◆ a. If no pores are present, the section is a softwood.

# What are the characteristics of hardwoods and softwoods?

- ◆ Pines show small, fairly evenly distributed resin ducts on a transverse surface.
- ◆ Resin ducts should not be confused with the pores in hardwoods.
- ◆ The pores in hardwoods are closer together than are the resin ducts in softwoods.

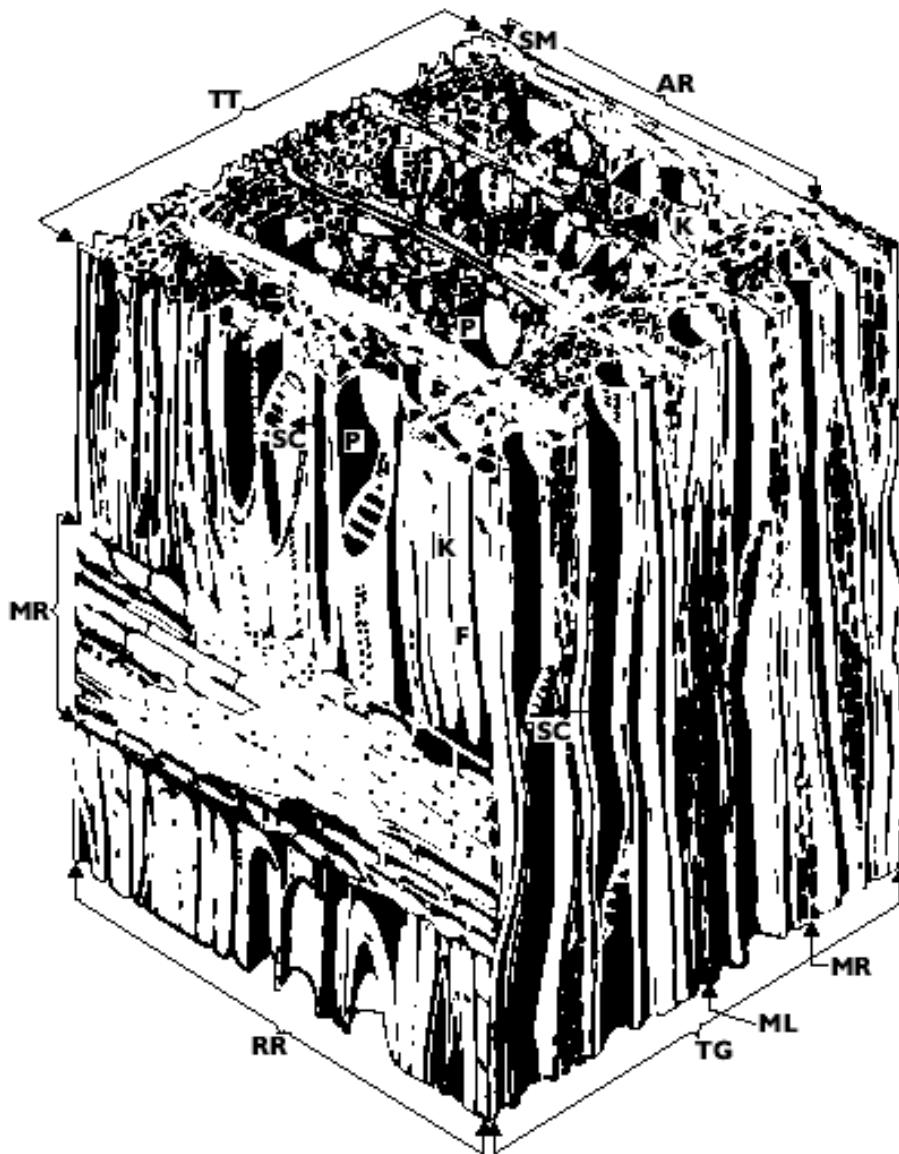
# What are the characteristics of hardwoods and softwoods?

- ◆ 4. When the wood from a conifer is viewed from the top, in transverse section, tracheids or water carriers, form the bulk of the wood surface.

# What are the characteristics of hardwoods and softwoods?

- ◆ a. Between the various cells is a cementing substance called the middle lamella.
- ◆ Springwood (formed in the spring) cells are distinguished by their larger size from the smaller summerwood (formed in the summer) cells.

# HARDWOOD CROSS-SECTION



**AR** = annual ring  
**F** = wood fibers  
**K** = pits  
**ML** = middle lamella  
**MR** = medullary rays  
**P** = pores

**RR** = vertical plane  
**S** = springwood  
**SC** = grating  
**SM** = summerwood  
**TG** = surface cut at right angle to radius  
**TT** = horizontal plane

# What are the characteristics of hardwoods and softwoods?

- ◆ Together the springwood and summerwood cells make up the annual ring, which is added to the tree each year.
  - 1. Certain chemicals can be used to dissolve the middle lamella, remitting the fibers to be separated.
  - A process used in making paper.

# What are the characteristics of hardwoods and softwoods?

- c. Softwoods use fibers to transfer sap.
  - Simple pits are unthickened portions of cell walls through which sap passes from ray cells to fibers, or vice versa.
  - Bordered pits on the surface have their margins overhung by the surrounding cell walls.

# What are the characteristics of hardwoods and softwoods?

- ◆ 5. Hardwoods have specialized pores or vessels for conducting sap.
  - The pores in hardwoods vary in size depending on the species.
  - Some are visible to the naked eye.

# What are the characteristics of hardwoods and softwoods?

- ◆ a. Hardwood vessels are cells with open ends, one above the other, and continuing as open passages for long distances.

# What are the characteristics of hardwoods and softwoods?

- ◆ In the heartwood and sapwood of some species, the pores are filled with tyloses, which is an organic material that is extruded into tracheids and pores of trees from adjacent parenchyma cells.
- ◆ Parenchyma cells are thin-walled structures that participate in the metabolism and storage of sugars.

# What are the characteristics of hardwoods and softwoods?

- ◆ b. The strength giving elements of hardwood are called wood fibers.
- ◆ Usually wood fibers have small cavities and thick walls.
- ◆ In the fiber walls are found pits by which the sap passes from one cavity to another.

# Review / Summary

1. Describe the chemical characteristics of wood.
2. Describe the physical characteristics of wood.
3. Identify hardwoods and softwoods according to wood characteristics.