WOOD AS A MANUFACTURED MATERIAL

CROWN

TRUNK

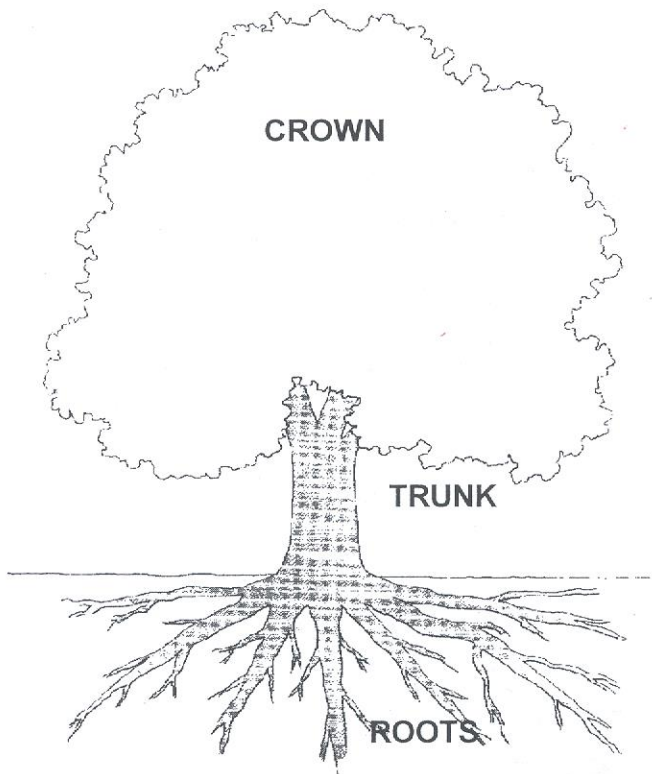ROOTS

WHERE DOES WOOD COME FROM?

(hint: dogs really like these things)

CROWN
Consists of the branches and foliage that catch sunlight and carbon dioxide and releases oxygen into the atmosphere.

TRUNK
Supports the branches and foliage and is the source of most of the usable lumber.

ROOTS
The roots anchor the tree and absorb water, nitrogen and trace elements used to produce food for growth.

PHOTOSYNTHESIS
PRODUCES FOOD FOR GROWTH
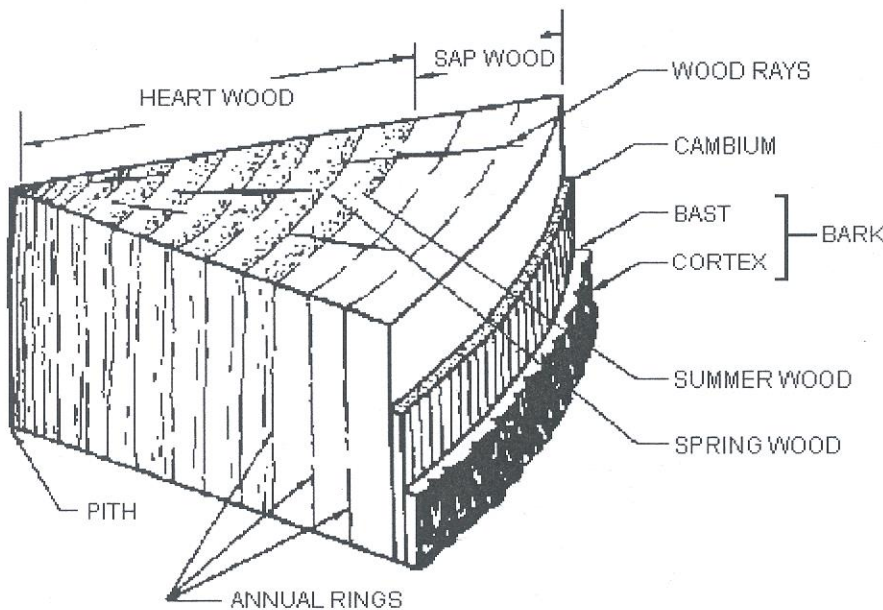
sunlight + water + carbon dioxide + trace elements + nitrogen

=

a basic sugar (food) + oxygen
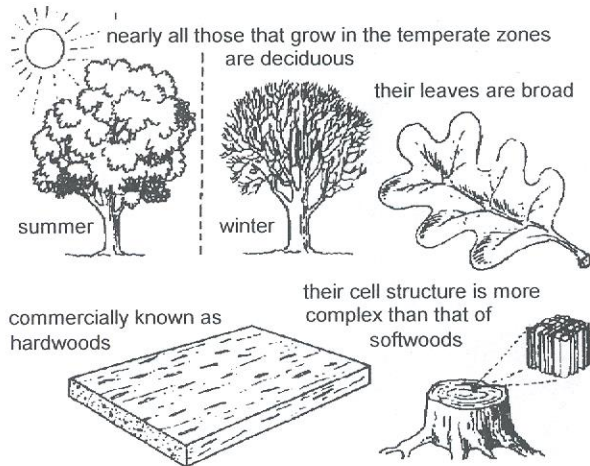
$CO_2 + H_2O$
(through chlorophyll with sunlight)

$\Rightarrow$

$C_6H_{12}O_6$ + O_2

SAP WOOD

HEART WOOD

WOOD RAYS

CAMBIUM

BAST

CORTEX

BARK

SUMMER WOOD

SPRING WOOD

PITH

ANNUAL RINGS

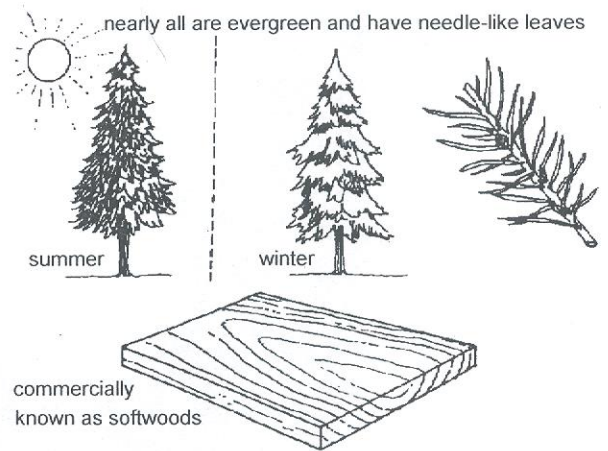The food is then converted into *cells* for storage and ultimately reproduction. There are many different types of cells for different purposes all contributing to growth. The diagram is a typical arrangement of these cells. Cells are arranged in rings, one added each year from the cambium layer underneath the bark, hence the name 'annual ring'.
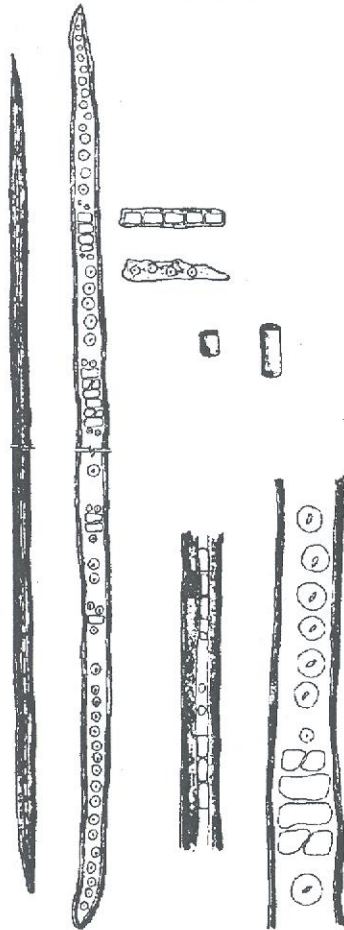
WOOD AS A MANUFACTURED MATERIAL

WHAT'S A HARDWOOD?

nearly all those that grow in the temperate zones are deciduous

their leaves are broad

summer

winter

commercially known as hardwoods

their cell structure is more complex than that of softwoods

WHAT'S A SOFTWOOD?

nearly all are evergreen and have needle-like leaves

summer

winter

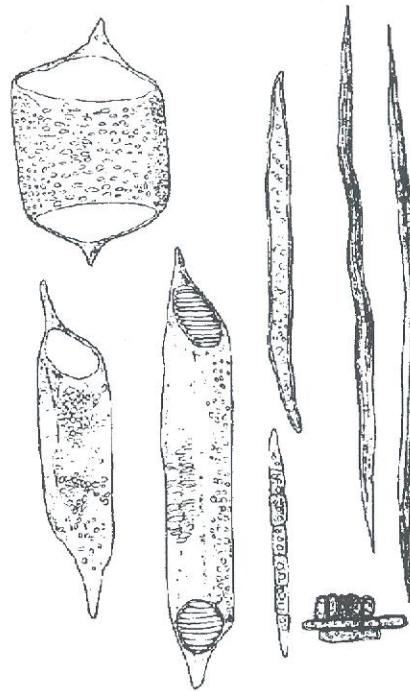commercially known as softwoods

SOFTWOOD CELLS

Softwood cells are *long, thin-walled*. **Hardwood cells** are *shorter and thick-walled*. There are many different types of cells having different functions. The most important of these functions are: (a) transportation of water, nutrients and food. (b) production of mass (more wood i.e. growth) and (c) reproduction.
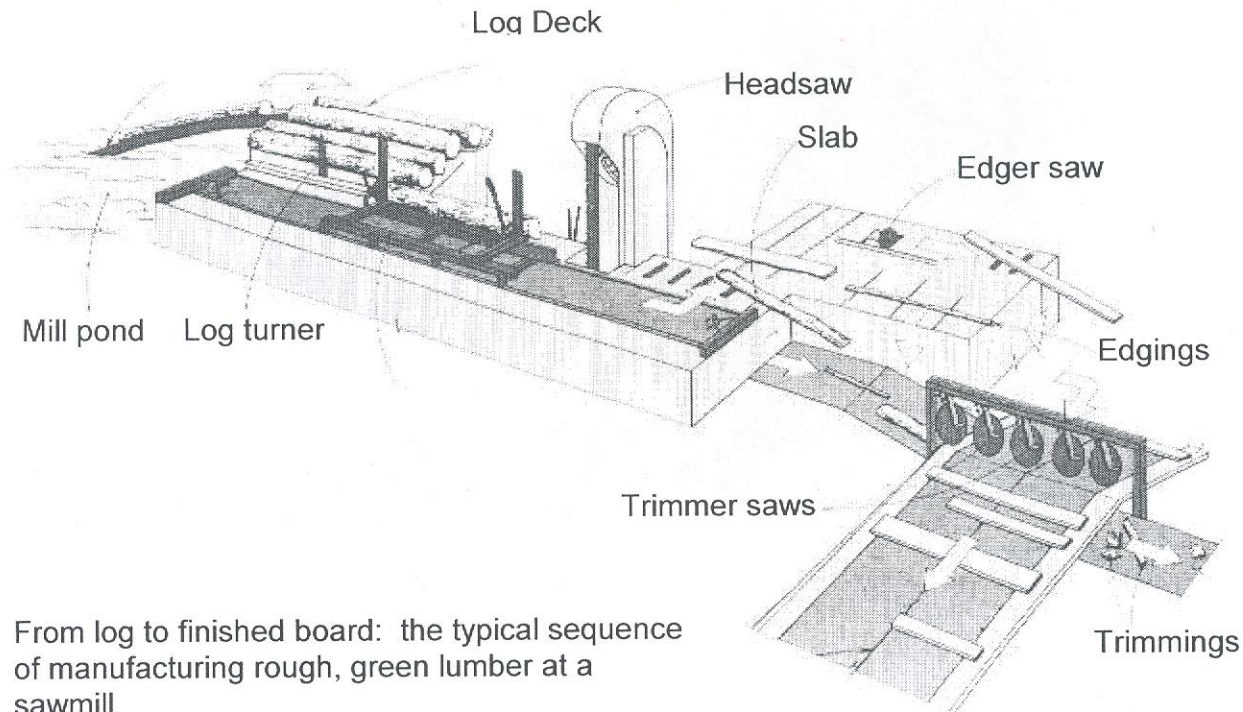
HARDWOOD CELLS

WOOD AS A MANUFACTURED MATERIAL

LUMBER PRODUCTION

(Oh, I'm a lumberjack and I'm O.K.!)

1. Trees are cut down.
2. Branches are trimmed off
3. Logs are transported to sawmill
4. The bark is removed.
5. Logs are cut into usable sizes.
6. 'Slabs" are cut off
7. Then the logs 'go through the old mill'.

Log Deck

Headsaw

Slab

Edger saw

Mill pond   Log turner

Edgings

Trimmer saws

Trimmings

From log to finished board: the typical sequence of manufacturing rough, green lumber at a sawmill.

Rough boards ready to be dried

From the mill **the boards are cut larger than what is necessary** for final dimension because **the wood will shrink as it dries.**

At this point there may be more water than wood in the boards and **the water must be removed** in order to make the wood stable and usable for whatevever it might be made into.
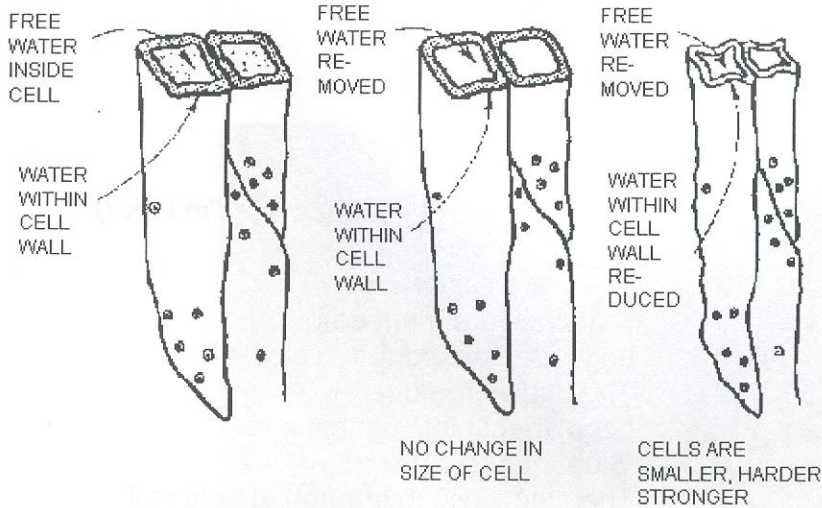
There are *two main methods for drying wood,* **air-drying** and **kiln-drying.**

Air-drying takes a very long time while **kiln-drying is** an expensive but **relatively fast process.** *Most wood is kiln-dried so that the wood can be sold and used quickly.*
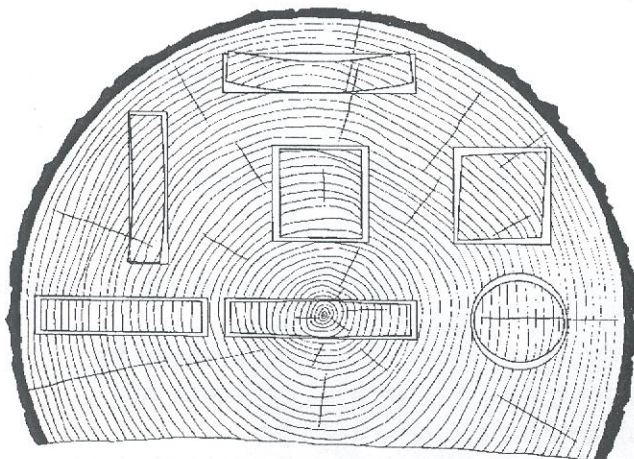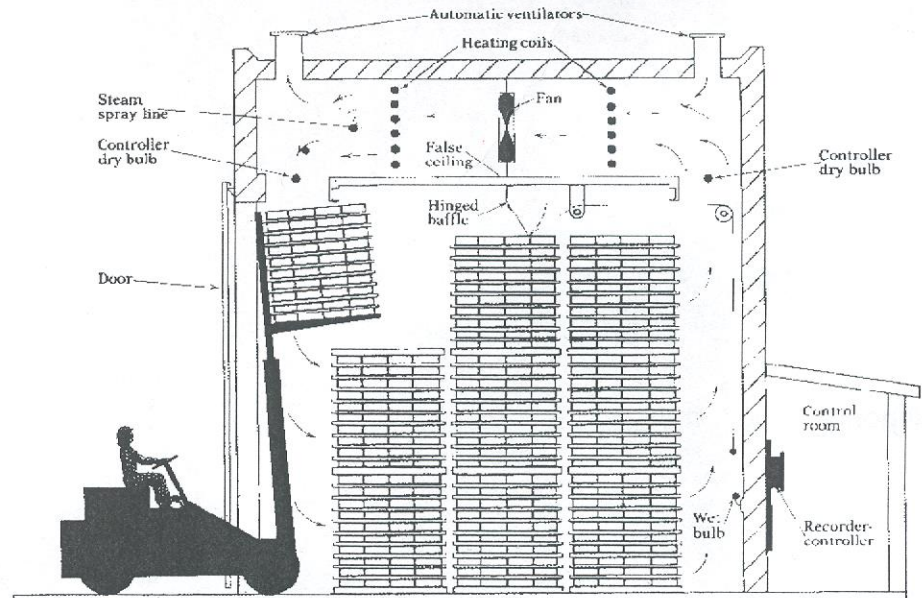
DRYING WOOD

FREE WATER INSIDE CELL

WATER WITHIN CELL WALL

FREE WATER RE-MOVED

WATER WITHIN CELL WALL

NO CHANGE IN SIZE OF CELL

FREE WATER RE-MOVED

WATER WITHIN CELL WALL RE-DUCED

CELLS ARE SMALLER, HARDER STRONGER

Where the water is

Freshly cut or 'Green' wood can be up to 50% or more water by weight.

How to get it out

Wood is dried in a **Kiln** ☞ *quickly* or **Air-dried** *slowly*

Automatic ventilators

Heating coils

Steam spray line

Controller dry bulb

Fan

False ceiling

Controller dry bulb

Door

Hinged baffle

Control room

Wet bulb

Recorder-controller


What happens when it's gone

As wood dries it shrinks and distorts according to what part of the tree it has been cut from and the direction of the annual rings through the individual boards.

THE STRENGTH OF WOOD
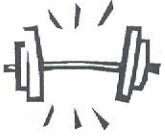
Pound for pound, wood is stronger than steel. Unlike steel, it is also resilient. This combination of strength and resiliency gives wood the ability to absorb the shock of heavy loads providing a greater margin of safety than many other materials.

This picture depicts some of the main types of stress: Compression, Tension, Bending, Torsion, and Shearing.
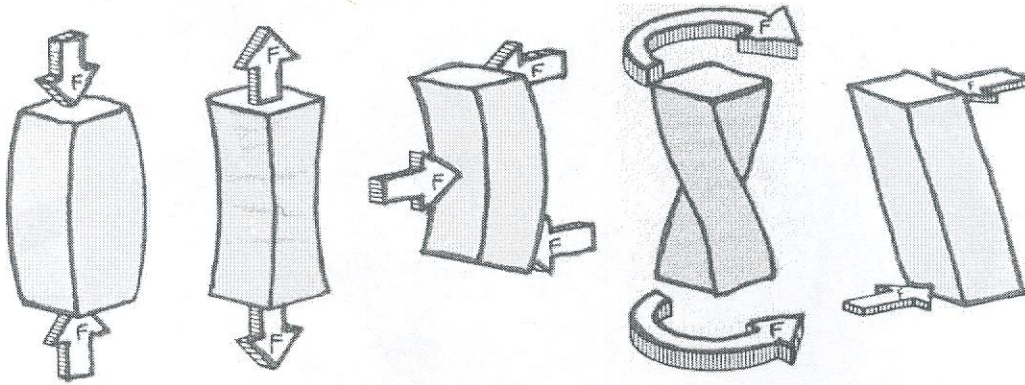
One of woods most outstanding strength characteristics is its resilience. It resists **compression, tension, bending, and shock** while maintaining its original shape.

Tension is the force associated with the stretching of a material.
Compression is the force associated with the compressing of a material.
Shear is the force associated with the sliding of one section of a material against another.
Torsion is the force associated with the twisting of a material.
In each case the direction of the applied force may produce movement of the material in directions other than the direction of the applied force.
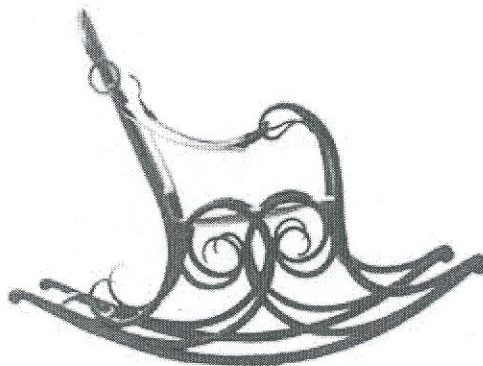
These strength characteristics make it an excellent choice for many applications, for example:

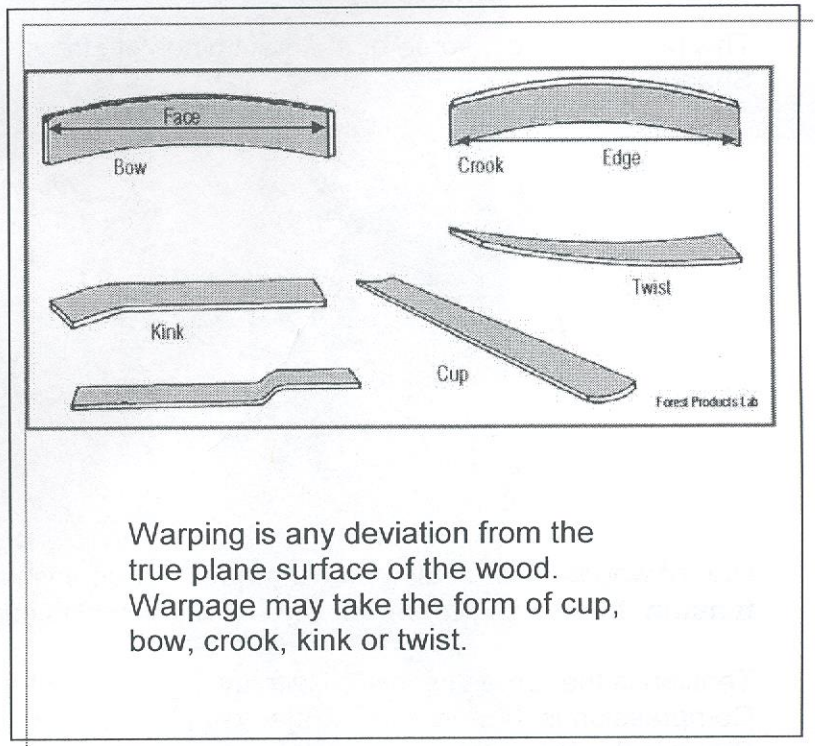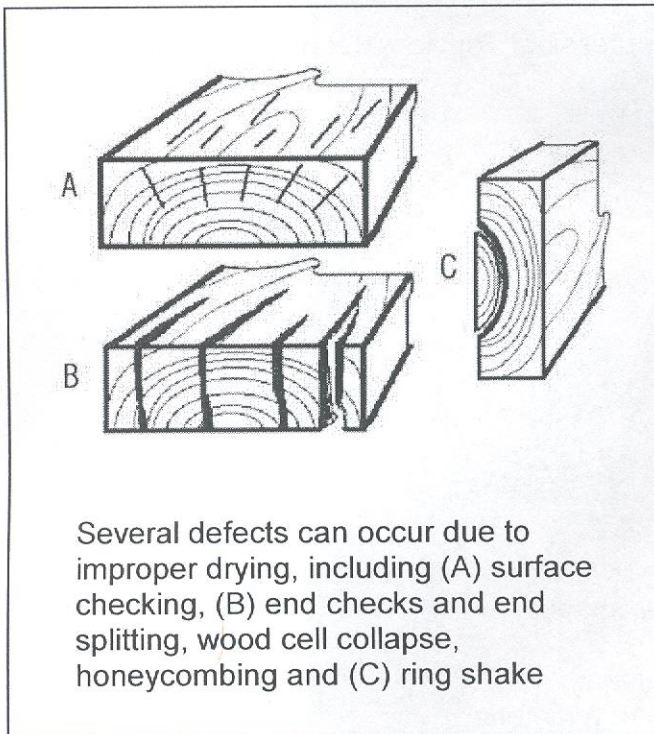|			
pressure:	building construction	**tension:**	bridges
bending:	furniture, musical instruments	**shock:**	sports equipment

Things that *decrease the strength* of wood are:

Defects: Damage from improper drying, improper harvesting or storage, insects, fungus, and growth defects.

Fire: Even though wood burns, it will retain most of its strength until almost 75% of its mass is burned.

Moisture: Wood becomes pliable when wet. Water weakens the bond between the wood cells.

Several defects can occur due to improper drying, including (A) surface checking, (B) end checks and end splitting, wood cell collapse, honeycombing and (C) ring shake

Warping is any deviation from the true plane surface of the wood. Warpage may take the form of cup, bow, crook, kink or twist.

Things that *increase the strength* of wood are: **grain direction, lamination(plywood), proper joinery, good design, dryness.**
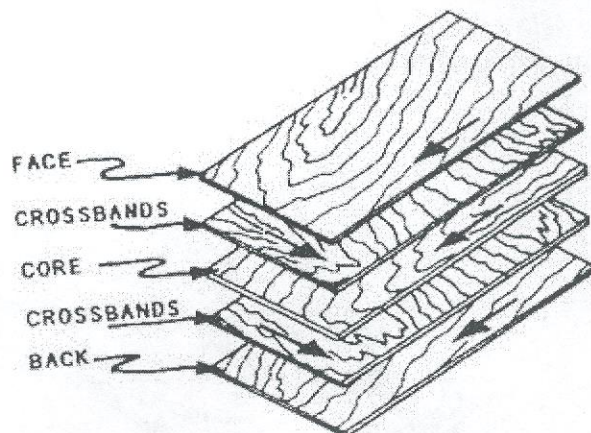
OTHER PROPERTIES OF WOOD


WHY CAVEMEN NEVER HAD MANY NEW IDEAS.

Wood was man's first **artificial heat source**. It has been used throughout history as a fuel for cooking and heating.

Wood **floats**. This is due to the fact that air is held trapped inside of the cells. It is used for building boats, rafts, buoys, and decoys among other things. After trees are cut they are often transported to their destination by floating down river.
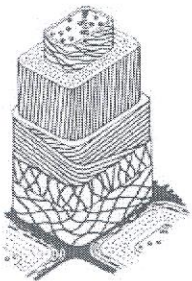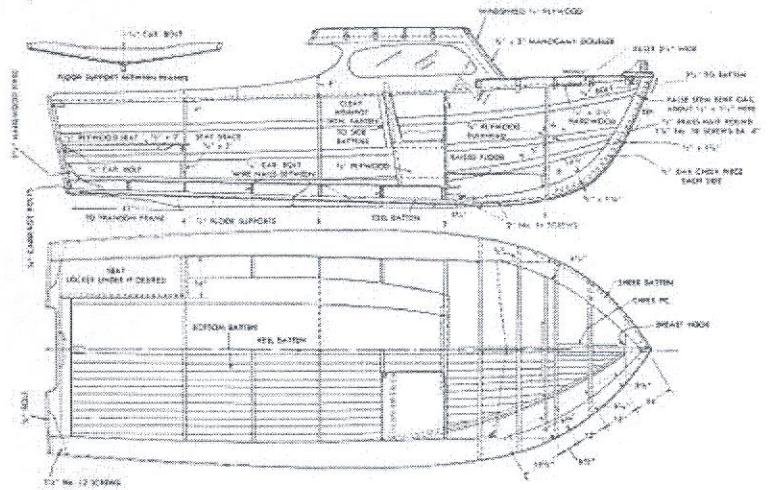
Wood also makes an excellent **insulator** for the same reasons as to why it floats.

Wood **transmits sound**. Thin, hard, dry membranes can make excellent sounding boards. Wood is so good for this purpose that it is the material of choice in nearly all musical instruments.
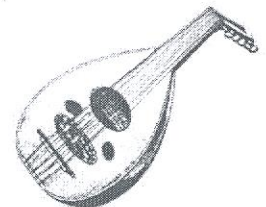
Wood can be processed into **drugs and medicinal extracts:**
Aspirin, for example, is made from the inner bark of the willow tree.
Tea tree oil is extracted from the Melaleuca tree that grows in Australia.

Wood **fibres** can be manipulated into many different products:

Through the 'chemical cooking' of wood chips products such as paper, textiles, chemicals, plastics, and fuel can be made.
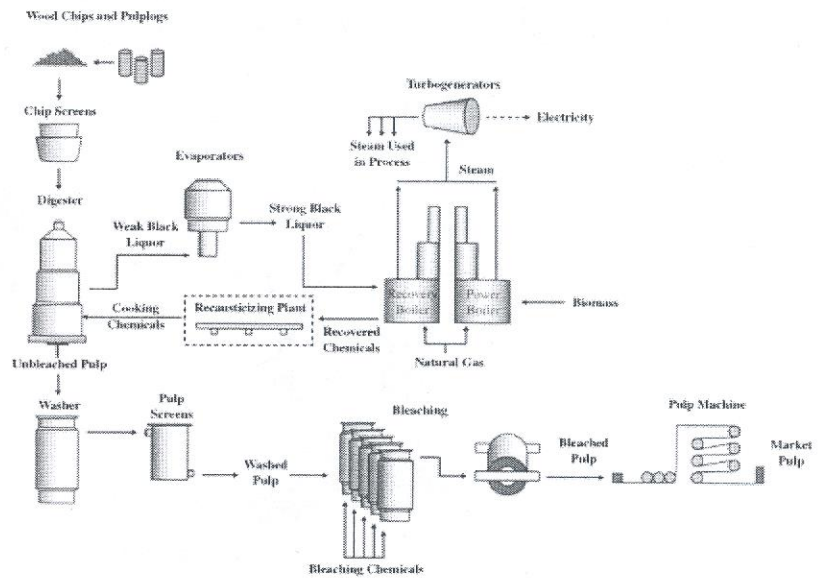
We **recycle** barn boards, wooden pallets and railroad ties. Composite lumber is made from a mix of reused plastic and recycled wood fibres.

Wood is **beautiful:**

As **trees**, wood provides landscaping features, beauty and shade.
As **lumber and veneers**, wood displays beautiful grain features.

Pyramidal   Full-crowned   Vase   Fountain   Spreading

Layered   Columnar   Weeping