Module 2: Wood Inside a Tree

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Macroscopic Characteristics
Macroscopic characteristics are properties (in this case of wood) that can be detected by observation *without* the use of a microscope. These observations can be used to determine conditions under which wood has grown, provide an indication of physical properties, and serve as an aid in wood identification.
**Outer bark** – Protects tree from diseases, bugs, and fire

**Phloem (inner bark)** – Moves sap (sugar and nutrients) from the crown down to the roots

**Vascular Cambium** – Produces new phloem and xylem cells

**Sapwood** – Active xylem cells  
Conducts water and nutrients up from the roots

**Heartwood** – Physiologically dead xylem cells  
Formed as sapwood ceases to function  
Changes in biochemistry not anatomical function  
Provides mechanical support

**Pith** – physiological center of tree, oldest cells
**Growth Ring** –
Increment of wood formed during a single growth period

**Annual ring** – One growth period (growth ring) that occurs throughout one year of time

In temperate regions, cell formation in most trees follow a *growing season* (spring and summer) and a *dormant season* (fall and winter)

Composed of *earlywood* and *latewood* longitudinal cells
Growth Ring –
Composed of earlywood and latewood longitudinal cells

**Earlywood** –
Rapid growth at beginning of growing season
Larger radial cell diameter
Thinner cell wall, lower density

**Latewood** –
Slower growth toward end of growing season
Smaller radial cell diameter
Thicker cell wall, higher density
LAB ACTIVITY

Instructions: Looking at the tree cookie provided, estimate the age of the tree when it was cut down by the tree cookie provided.

AGE OF TREE:

TYPE HERE
Instructions: Match the key terms below to the corresponding location on the diagram.

Key Terms
- Outer Bark
- Phloem or Inner Bark
- Cambium
- Sapwood
- Heartwood
Instructions: Looking at the tree cookies provided and the areas indicated by the arrows, estimate what occurred to the tree at those areas:

6. ____________
7. ____________
8. ____________
DISCIPLINARY CONTENT

Microscopic Characteristics
Microscopic characteristics are properties that require detection through observation with a microscope. These observations can be used to provide an indication of wood quality, the impacts of ecological disturbances, and cambial age. Microscopic characteristics are the principal features used in accurate wood identification.
Nonresinous softwood

Latewood cells appear as distinct bands.

Cross section view of *Sequoia sempervirens*, redwood, 50X,

Quantitative Wood Anatomy Lab, Virginia Tech
Resinous softwood

Latewood cells appear as distinct bands. Resin canals appear as large circles. Cross section view of Pinus strobus, eastern white pine, 50X,

Quantitative Wood Anatomy Lab, Virginia Tech
Ring porous hardwood

Ring Porous hardwood. Earlywood cells appear as large openings. Cross section view of Quercus spp, 40X,

Quantitative Wood Anatomy Lab, Virginia Tech
Diffuse porous hardwood. No difference in cell size across the growth ring. Cross section view of *Liriodendron tulipifera*, 40X,

Quantitative Wood Anatomy Lab, Virginia Tech
LAB ACTIVITY

Classification of Wood and Trees
Classification and Naming of Biomaterials

**Eastern White Pine**
*Pinus strobus*

- **Kingdom:** Plant
- **Division:** Spermatophyta
- **Class:** Gymnospermae
- **Order:** Coniferales
- **Family:** Pinaceae
- **Genus:** Pinus
- **Species:** strobus

**Angiosperms** – Seeds enclosed in a fruit
**Hardwoods**

**Gymnosperms** – Seeds naked on cone bract
**Softwoods**

<table>
<thead>
<tr>
<th>Softwood lumber (pine, fir, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardwood lumber (maple, mahogany, etc.)</td>
</tr>
<tr>
<td>Woody monocots (bamboo, palm, etc.)</td>
</tr>
</tbody>
</table>
Classification and Naming of Biomaterials

Gymnosperms:
Softwood
Conifers – needle-like or scale-like foliage, usually evergreen
Excurrent form – dominant mainstem with lateral side branches

Angiosperms:
Hardwood
Dicot – two initial seed leaves
Deciduous – losing foliage during winter dormancy
Dendritic form – branching or rebranching of mainstem
Angiosperm:

**Woody monocots** – one initial seed leaf

Temperate zones – grasses or corn

Warmer Climates – bamboo or palm
Question:

Considering seasonal growth and physical form, Do you think the cellular anatomy will differ between hardwood and softwoods? How?

Remember:
Growth is a determinant of preferable environmental conditions and tremendously affects properties (cell size, cell shape, wood density, color)
ACTIVITY INSTRUCTIONS:

1. With your partner or team, review the microscopic pictures (look back at slides 12 - 15)
2. Then categorize the following macroscopic slides by gymnosperm (softwood) vs angiosperm (hardwood) using the microscopic template slides
3. Further categorize the gymnosperms into resinous or non-resinous and the angiosperms by ring-porous vs diffuse porous
Determine if the wood in the picture is a softwood or hardwood? If it is a softwood (gymnosperm), is it resinous or nonresinous? If it is a hardwood (angiosperm), is it ring porous or diffuse porous?
#3

Quantitative Wood Anatomy Lab, Virginia Tech

#4
Answer key:
1. RING POROUS HARDWOOD
2. NONRESINOUS SOFTWOOD
3. RING POROUS HARDWOOD
4. RESINOUS SOFTWOOD
5. RESINOUS SOFTWOOD
6. DIFFUSE POROUS HARDWOOD
GROUP ACTIVITY

Click on this link for an interesting story that can be discussed later some discussion questions could include what did you find most interesting, what surprised you the most, would you have done anything differently?

Murder Mystery: When the witness is a tree

SUMMARY

Wood can be characterized at the macroscopic and microscopic levels.

Macroscopic characteristics are properties that can be detected by observation without the use of a microscope. These observations can be used to determine conditions under which wood has grown, provide an indication of physical properties, and serve as an aid in wood identification.

Microscopic characteristics are properties that require detection through observation with a microscope. These observations can be used to provide an indication of wood quality, the impacts of ecological disturbances, and cambial age through connection with the dendrochronology field of study. Microscopic characteristics are the principal features used in definitive wood identification.