Tree Biology
Part One

Originally developed by:
Sheldon Hammond
Northwest District ANR Program Development Coordinator
The University of Georgia
Cooperative Extension Service
Almost horticultural plants
Contain tissues which transport water and dissolved materials.
Most produce seeds as a way to propagate or reproduce themselves.
The vascular plants that reproduce by seed can be divided into two classes:
- angiosperms
- gymnosperms
I. Gymnosperms

- do not have true flowers
- seeds are not enclosed in fruits
- most seeds are produced in cones
II. Angiosperms

- produce flowers
- develop fruits that contain seeds
A. **Monocotyledons (Monocots)**

- produce 1 seed leaf (cotyledon)
- flower parts generally in multiples of 3
- leaves long and narrow with parallel veins
- vascular system arranged in bundles (palms - dates, coconuts)
B. **Dicotyledons (Dicots)**

- produce 2 seed leaves
- flower parts generally in multiples of 4 or 5
- diversely shaped leaves with netted veins
- vascular system forms rings inside the stem (hardwood trees - maples, oaks, etc.)
**Monocots**

Xylem and phloem are arranged in bundles that are dispersed throughout the stem.

**Dicots and Gymnosperms**

Xylem and phloem form rings inside the stems. The phloem is nearest the bark; the xylem forms the inner rings and develops into wood in woody plants.
Tree Biology

- **Tree Anatomy** - study of component parts of the tree

- **Tree Physiology** - study of the biological and chemical processes within these structures, providing the basis of function
Tree Anatomy

Basic Structures - Cells and Tissues

- Trees made up of cells, tissues and organs
- New cells come from meristems
  - Meristems - undifferentiated tissue where cell division takes place
  - Cells then undergo differentiation (development of cells in which they become specialized for various reasons)
- Cells with similar structure & function arranged into tissues
- Tissues are organized into organs (leaves, stems, roots, flowers and fruits)
Principal Plant Parts

1. **Vegetative:**
   - Plant parts are NOT involved in the production of seed.
   - stems, leaves, roots

2. **Reproductive:**
   - Plant parts are involved in the production of seed.
   - flowers, fruits, seeds
Tree Anatomy

Meristems

- Two Types
- Primary or Apical meristems - produce the cells that result in elongation of shoots and roots
- Secondary or lateral meristems - which produce cells that result in increase in diameter
Tree Anatomy

Apical Meristems

Bud Scale

Diagram showing root hairs, region of differentiation, region of elongation, root cap, and meristematic zone.
Tree Anatomy
Lateral Meristems

**Two Types**

- **Cambium**
  - xylem to the inside
  - Phloem to the outside

- **Cork Cambium**
  - Bark to outside
Tree Anatomy

Xylem

- Conduction of water & mineral elements
- Support of the weight of the tree
- Storage of carbohydrate reserves
- Defense against the spread of disease and decay
Annual Rings = xylem rings

- Spring xylem is wide & light brown (grows rapidly)
- Summer xylem is thin & darker (grow slower)
- Each pair of light & dark rings = one year’s growth.
Tree Anatomy

Phloem

- Responsible for the movement of sugars, produced in the leaves
- Process is slow
- Requires energy
- Composed of sieve tubes
- Old phloem is crushed & Incorporated into bark
Tree Anatomy

Rays

- Transport sugars and other compounds throughout the trunk
- Store starch
- Aid in restricting decay in wood tissue
Tree Anatomy

Bark

- Protective tissue
  - Moderates temperatures
  - Offers defense
  - Reduces water loss
- Composed of non-functional phloem and corky tissues
- Contains lenticels
Parts of a Woody Stem

- Pith
- Heartwood
- Xylem
- Sapwood
- Cambium
- Outer bark
- Inner bark or phloem
- Bark
Tree Wounds - Compartmentalization

- Fire scar - new growth is gradually covering the wound
- Growth slows - increasing competition from neighboring trees
- Abrupt increase in growth rate - neighboring trees cut down or damaged, as by windstorm or disease
- Sudden decrease in growth area - probably drought; all stumps in the area show little growth for these years
Tree Anatomy
Structure

- Basic tree structure
  - Stems
  - Leaves
  - Roots
Tree Anatomy

Stems

- Twigs, branches, trunk

- Twigs
  - Terminal bud or apical bud
  - Lateral or axillary bud
  - Adventitious buds (epicormic)

- Node
- Internode
Tree Anatomy

Stems

- Branches & Trunk
  - Similar in structure and function
  - Each branch is self-sustaining
  - Branches are strongly attached to wood and bark beneath; weakly attached to wood and bark above.

- Attachment terms
  - Branch collar
  - Branch bark ridge
  - Included bark
Locating the Branch Collar

![Image of tree branch with labeled parts: Branch Collar, Bark Ridge, Conifers]
Tree Anatomy

Leaves

- **Function** -
  - Photosynthesis
  - Transpiration

- **Structure**
  - Chloroplasts
  - Cuticle
  - Stomata
  - Guard Cells
Tree Anatomy

Roots

- Primary functions
  - Anchorage
  - Absorption
  - Storage
  - Conduction

- Structural Roots
- Absorbing roots
- Lateral roots
- Sinker roots
- Taproots (seedlings only)
Root Structure

Roots develop by both cell division and elongation. As the number and size of cells increases, the root grows in length and width.
1. **Root cap**: Covers and protects the root tip or meristem which manufactures new cells.

2. **Meristem (root tip)**: Area of cell division and growth.

3. **Zone of Elongation**: Cells increase in size through food and water absorption; cells responsible for pushing the root through the soil.

4. **Maturation Zone**: Where cells change into specific tissues like epidermis and vascular tissue.

Root hairs perform much of the nutrient and water uptake.
Credits

- Pictures and diagrams