

# Tree Biology

## Part One

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# Vascular Plants

- 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:

**gymnosperms**



**angiosperms**





## 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)**

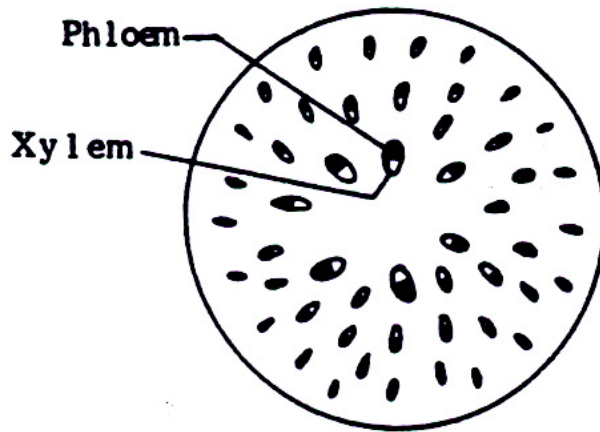
- produce 1 seed leaf (cotyledon)
- flower parts generally in multiples of 3
- leaves long and narrow with parallel veins
- vascular system arranged in bundles (palms - dates, coconuts)



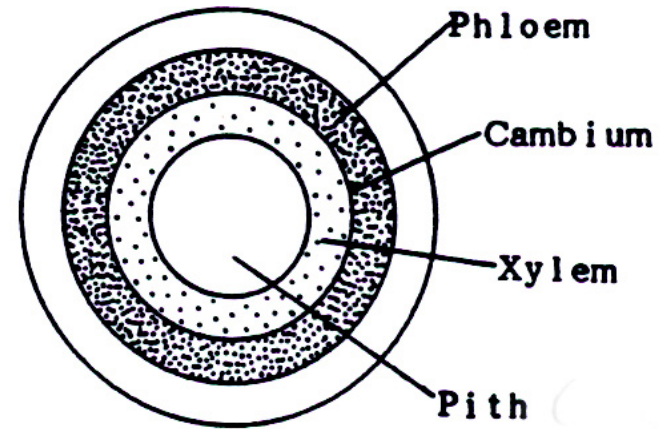
## B. **Dicotyledons (Dicots)**

- 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.)

## Cross-section of a Stem



**Bundle system of a monocot stem**



**Ring system of a dicot stem**

### 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

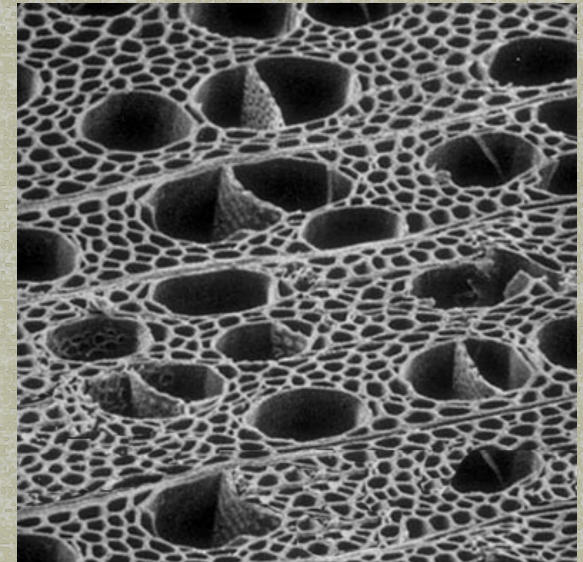




# Tree Anatomy

## 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:**



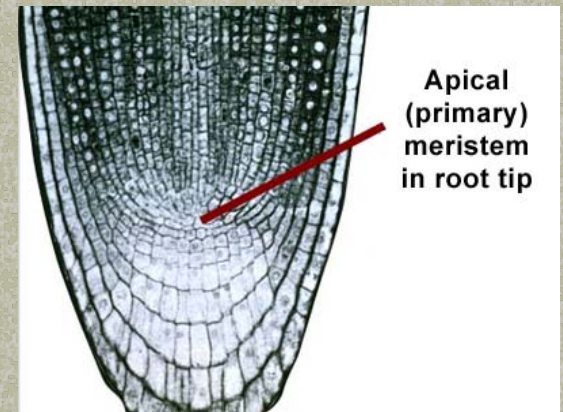
Plant parts are involved in the production of seed.

flowers, fruits, seeds

# Tree Anatomy

## Meristems

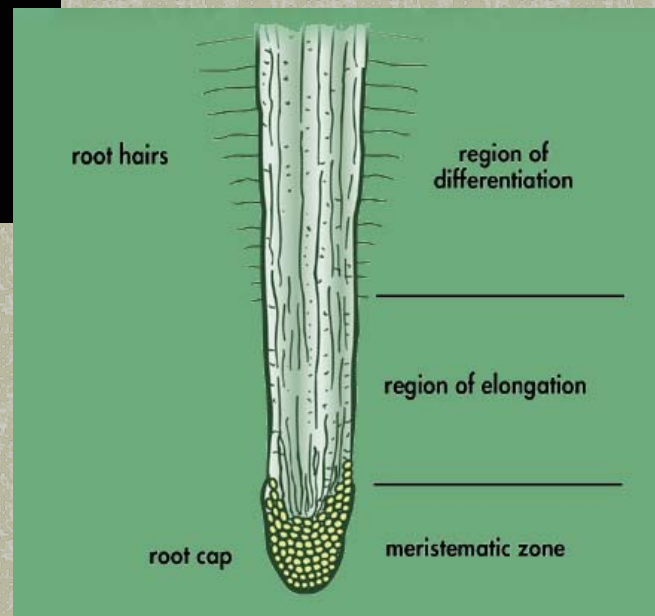
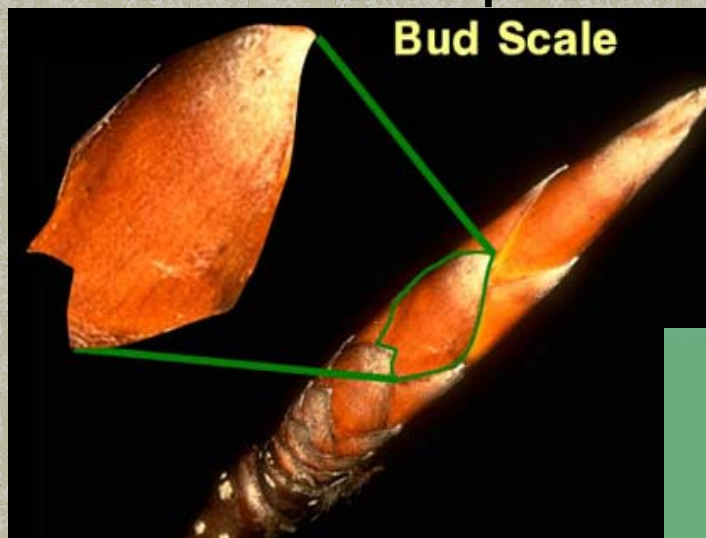
- Two Types
- Primary or Apical meristems- produce the cells that result in elongation of shoots and roots
- Secondary or lateral meristems - which produce cells that result in increase in diameter





# Tree Anatomy

## Apical Meristems

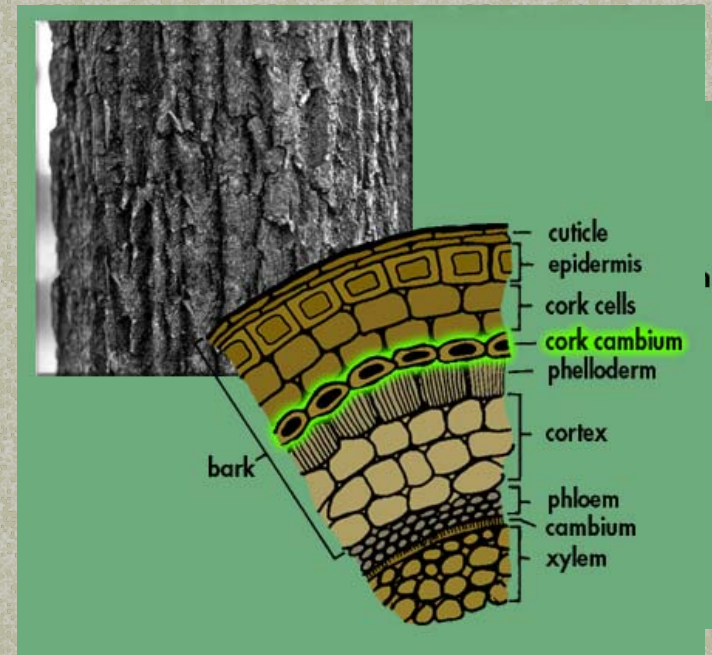


# Tree Anatomy

## Lateral Meristems

### Two Types

- Cambium
  - xylem to the inside
  - Phloem to the outside
- Cork Cambium
  - Bark to outside

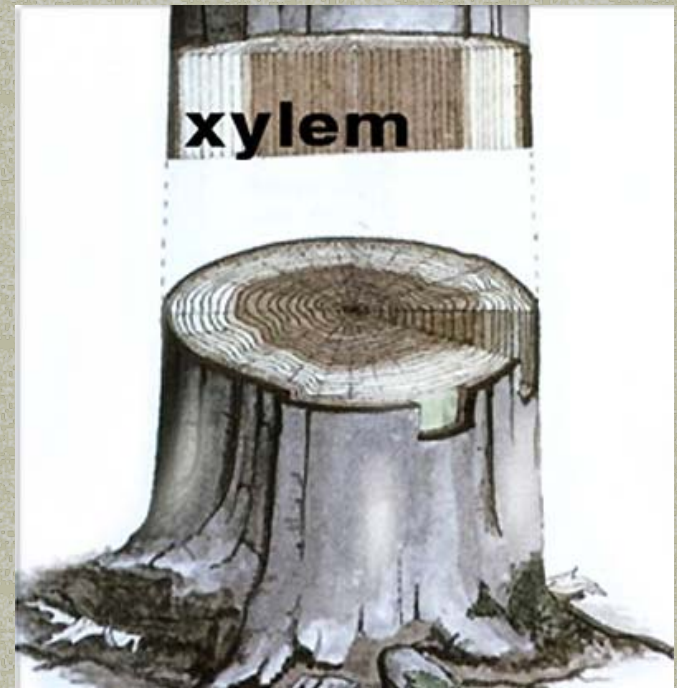




# Tree Anatomy

## 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.

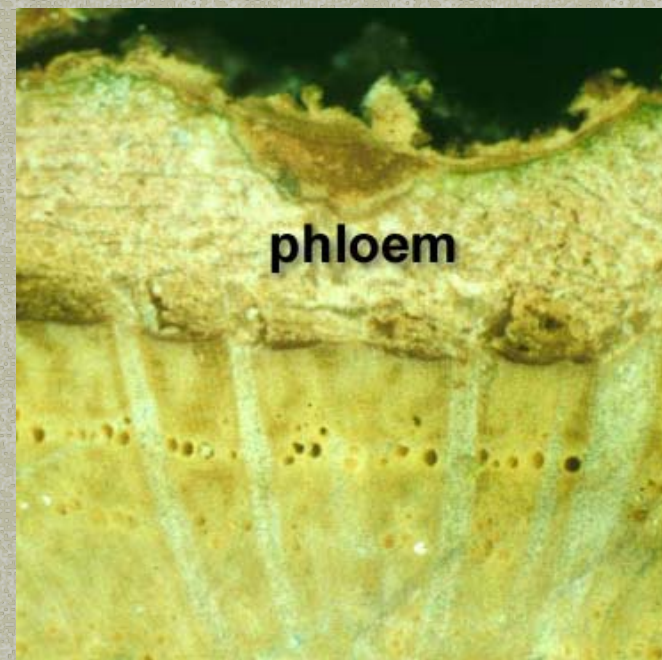




# Tree Anatomy

## 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



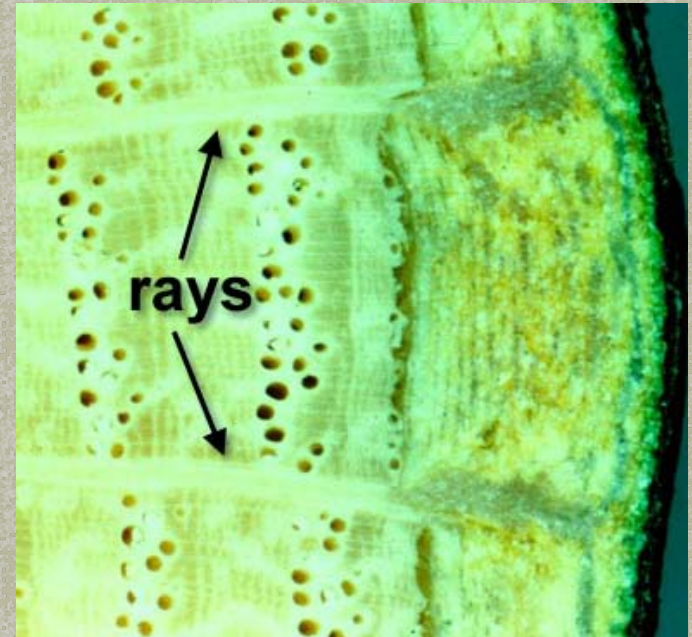




# Tree Anatomy

## Rays

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

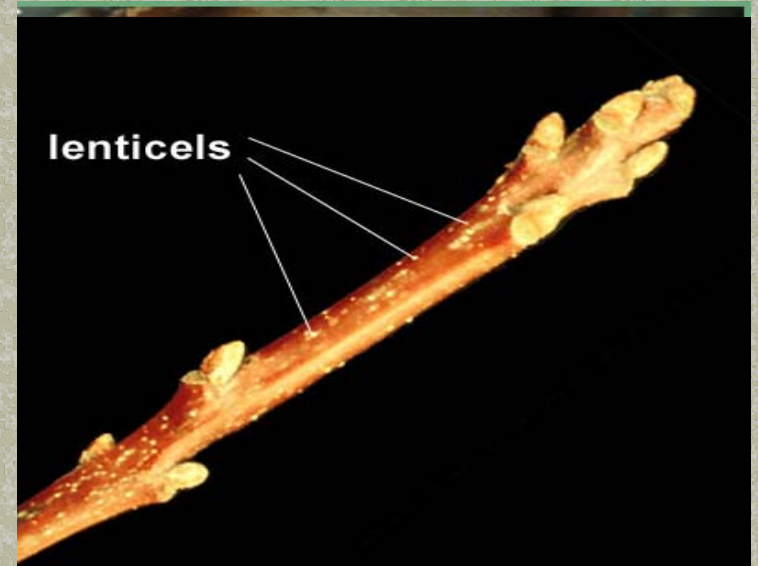




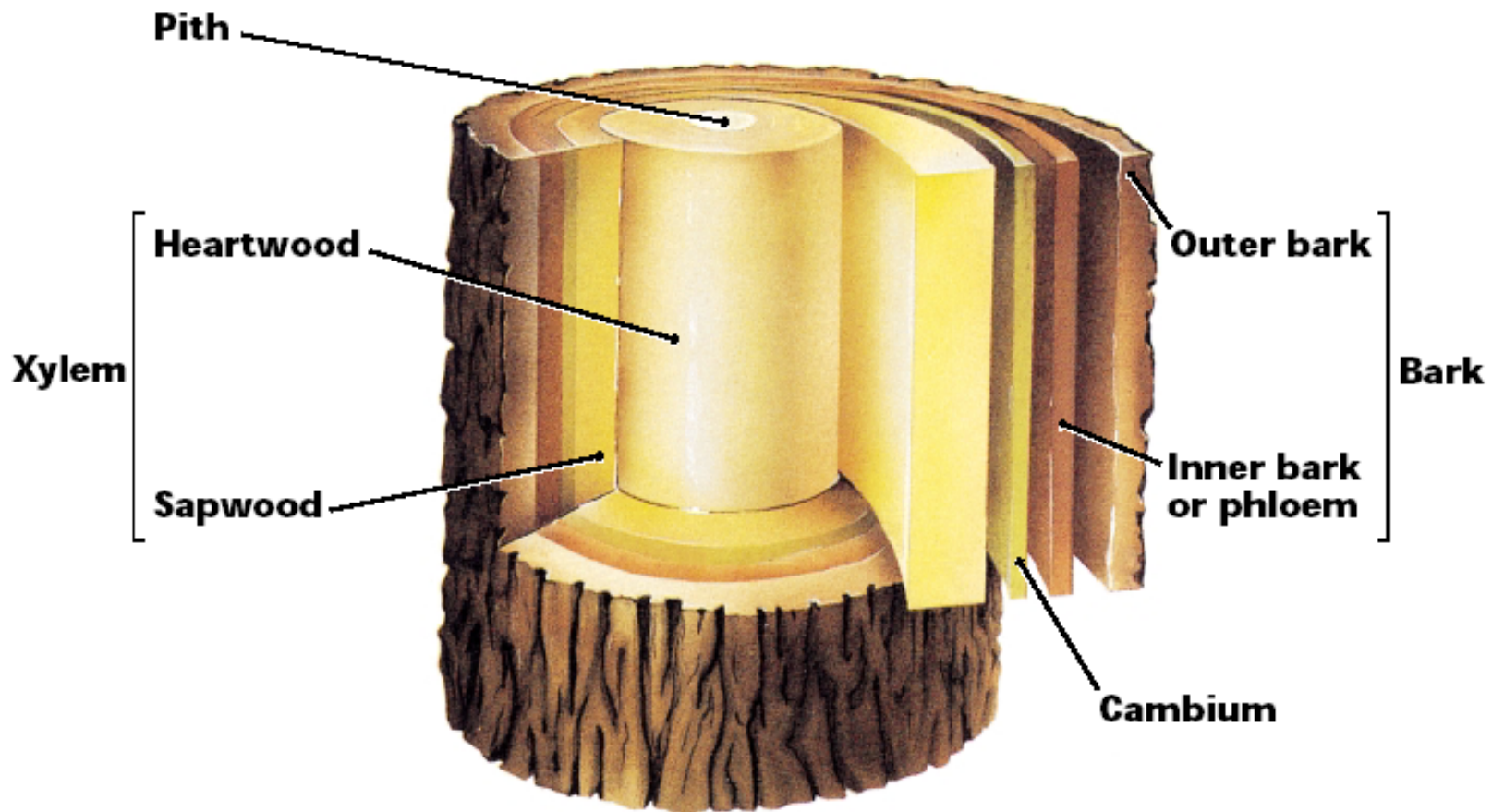
# Tree Anatomy

## Bark

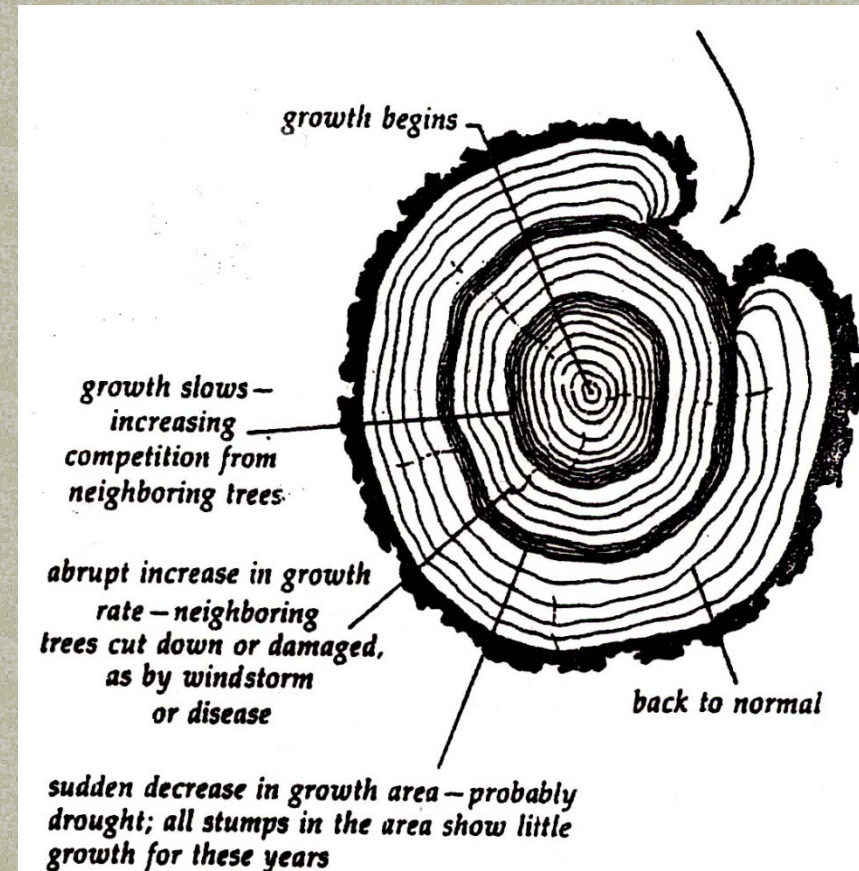
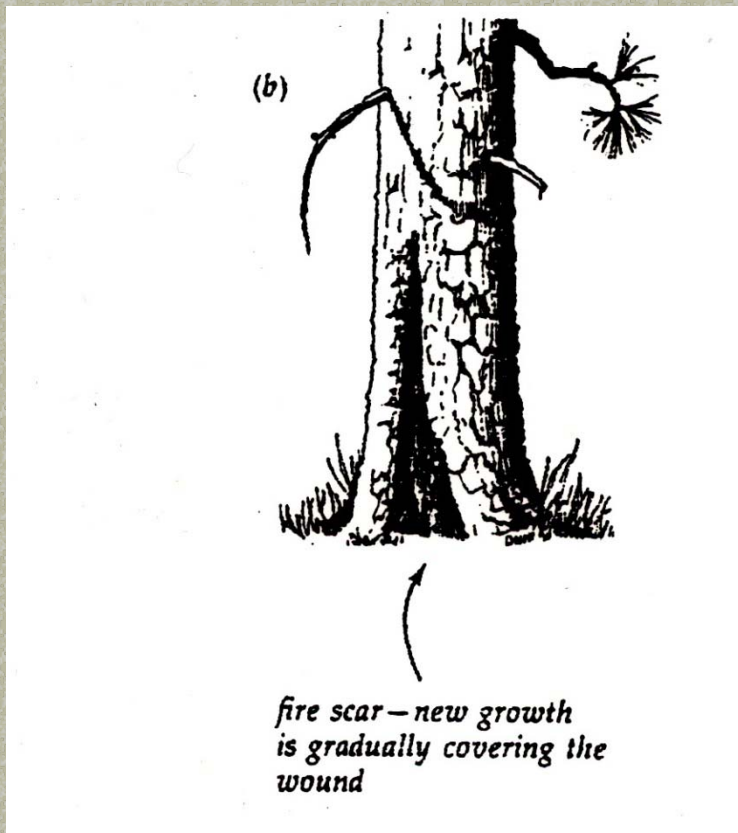
- Protective tissue
  - Moderates temperatures
  - Offers defense
  - Reduces water loss
- Composed of non-functional phloem and corky tissues
- Contains lenticels



# Parts of a Woody Stem



# Tree Wounds - Compartmentalization





# Tree Anatomy

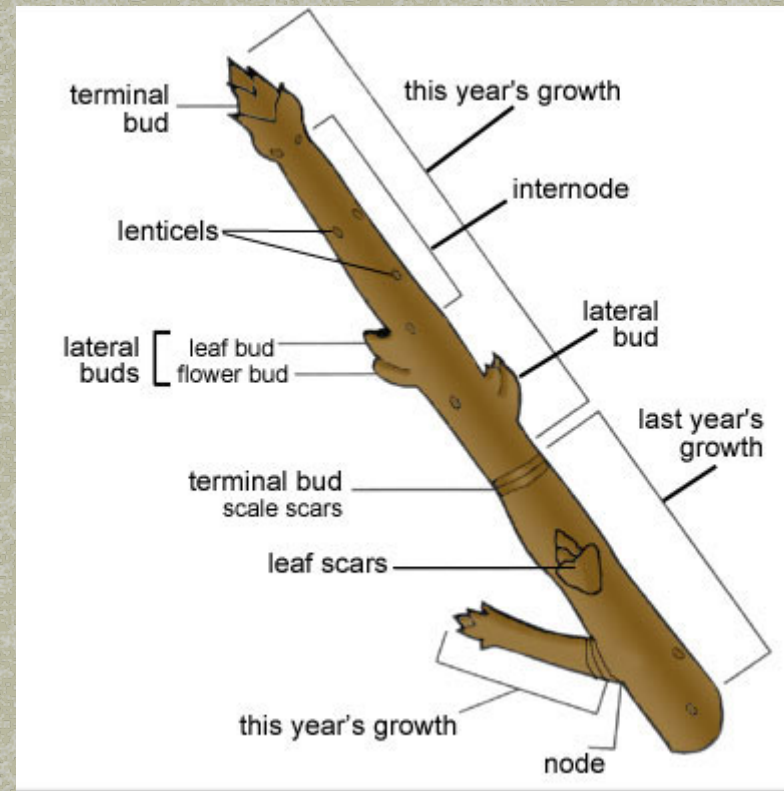
## Structure

- 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



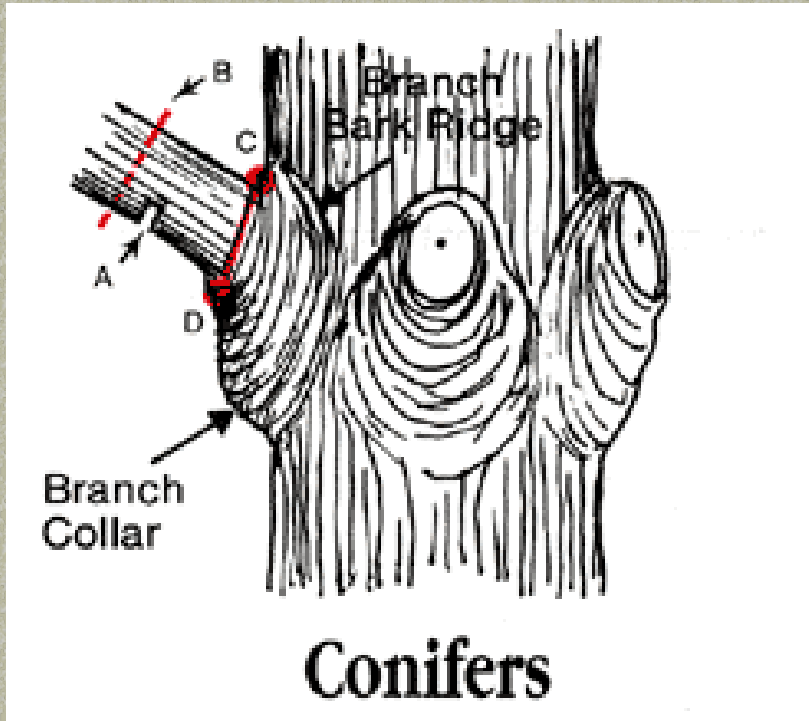


# Tree Anatomy

## 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

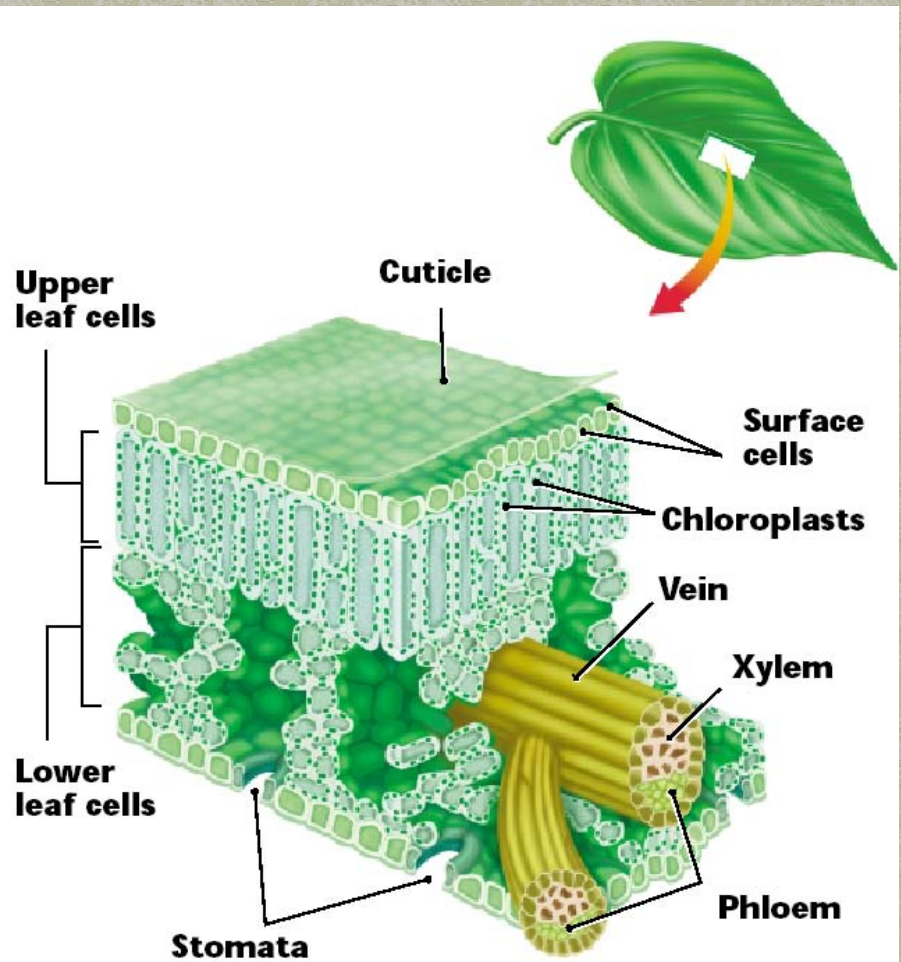




# Tree Anatomy

## Leaves

- Function -
  - Photosynthesis
  - Transpiration
- Structure
  - Chloroplasts
  - Cuticle
  - Stomata
  - Guard Cells

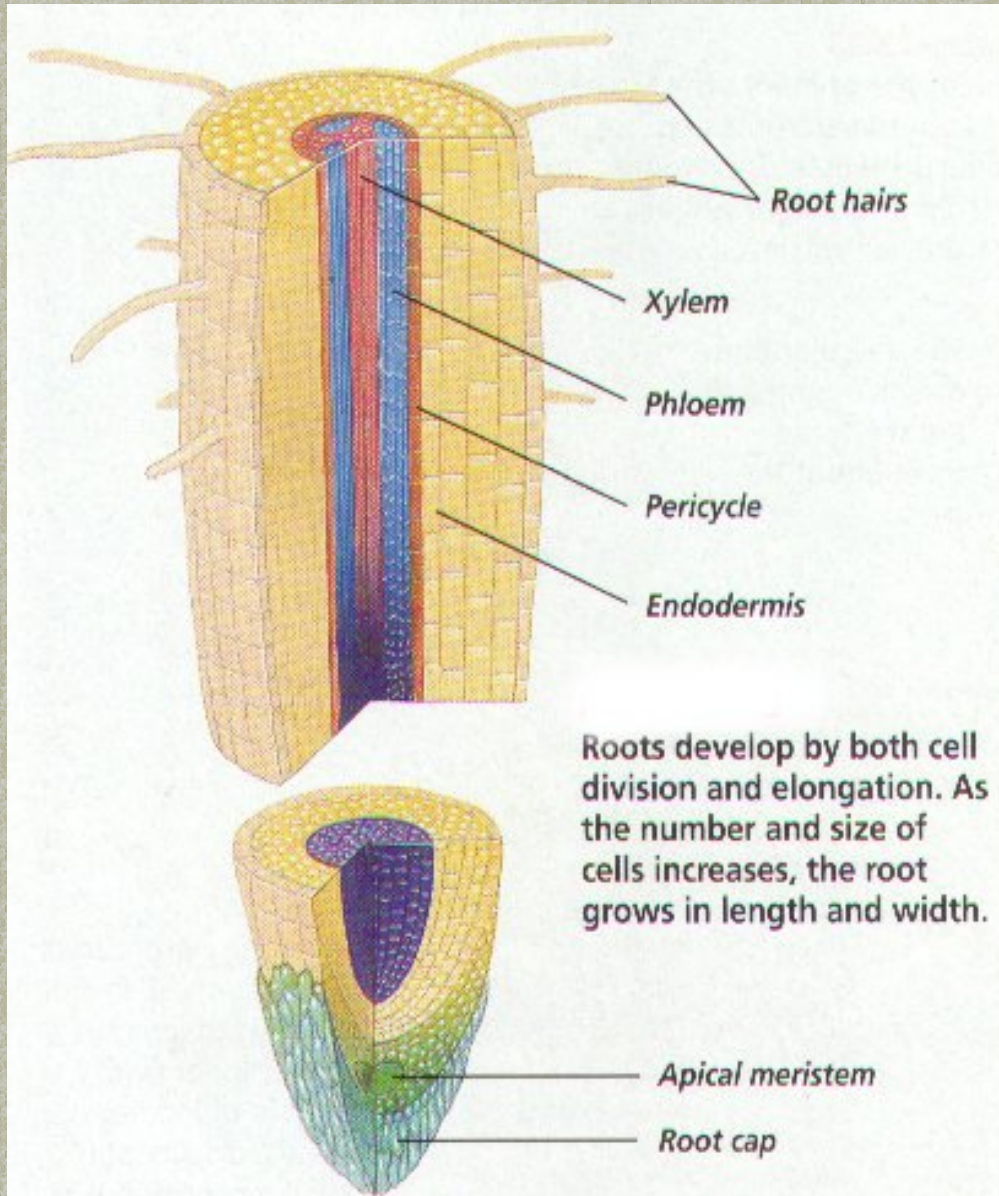


# Tree Anatomy

## Roots

- Primary functions
  - Anchorage
  - Absorption
  - Storage
  - Conduction
- Structural Roots
- Absorbing roots
- Lateral roots
- Sinker roots
- Taproots (seedlings only)





Root hairs

Xylem

Phloem

Pericycle

Endodermis

Roots develop by both cell division and elongation. As the number and size of cells increases, the root grows in length and width.

Apical meristem

Root cap

# Root Structure



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
  - Introduction to Arboriculture – Tree Biology CD-ROM; International Society of Arboriculture, 2003.