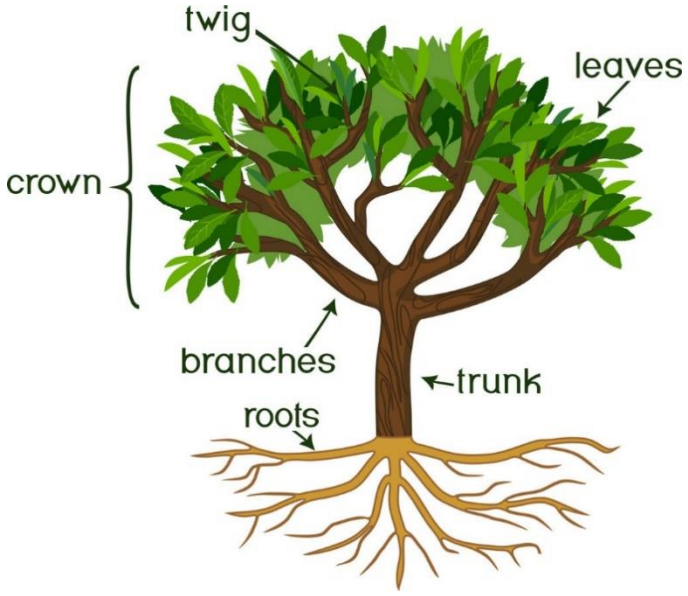
Lecture 1: Why Study Tree Morphology and Anatomy?

Introduction: Why Study Tree Morphology and Anatomy?

Tree anatomy and morphology provide essential insights into how trees grow, survive, and interact with their environment. Understanding these structural components is crucial for fields such as forestry, ecology, conservation, and horticulture. Today, we'll discuss the external (morphology) and internal (anatomy) structures of trees and how these structures contribute to their function and ecological roles.

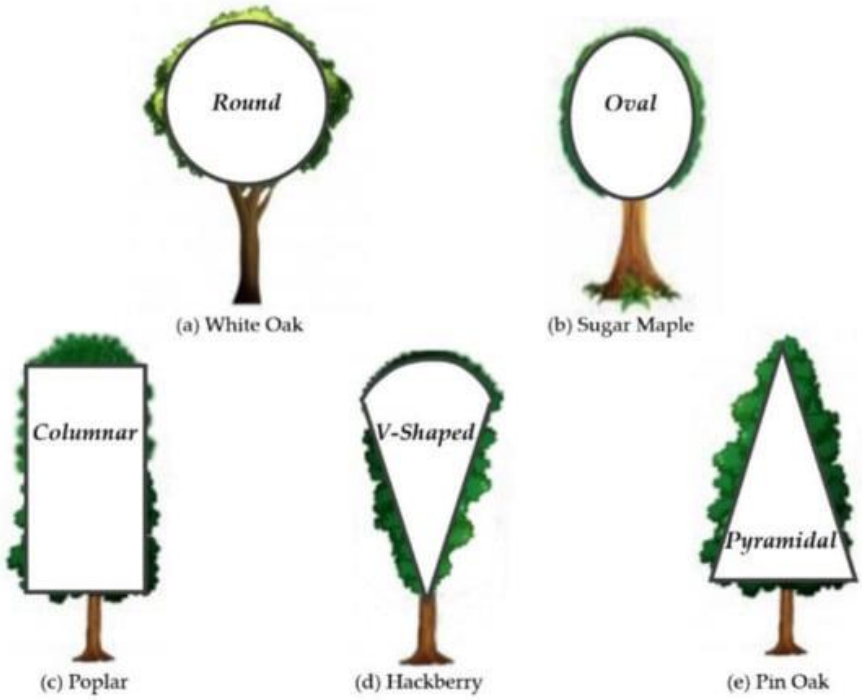
I. Tree Morphology (External Structure)

Tree morphology refers to the outward physical form of trees, including features such as the trunk, branches, leaves, and roots. Each of these components has evolved to serve a specific function related to growth, reproduction, and adaptation.



1. Crown

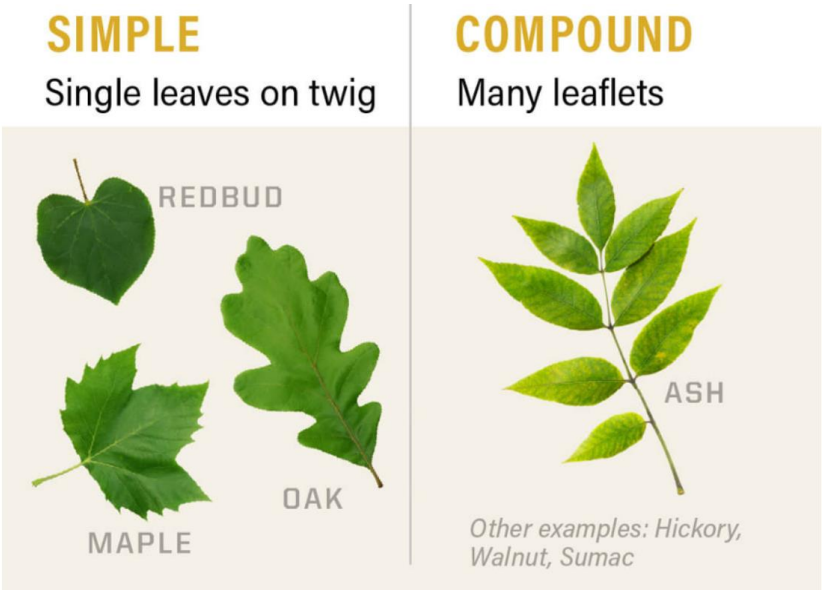
- The crown is the upper part of the tree, consisting of branches and leaves.
- **Function**: The crown maximizes the exposure of leaves to sunlight, aiding in photosynthesis, and acts as a shelter for wildlife.
- **Variations**: Tree crowns can be broad, conical, or open, depending on the species and environmental factors. The shape of the crown often affects how the tree competes for light.



2. Leaves

- **Structure**: Leaves are the primary photosynthetic organs of trees. Their shapes vary greatly, from needle-like in conifers to broad and flat in deciduous trees.
    - **Blade**: The flat, photosynthetic surface of the leaf.
    - **Petiole**: The stalk that connects the leaf blade to the branch.

- **Function**: Leaves capture light and facilitate gas exchange (CO_2 intake and O_2 release) via small openings called stomata.
- **Variations**: Leaves can be simple (one blade) or compound (divided into leaflets). Deciduous trees shed their leaves annually, while evergreen trees retain their leaves for multiple years.



3. Trunk

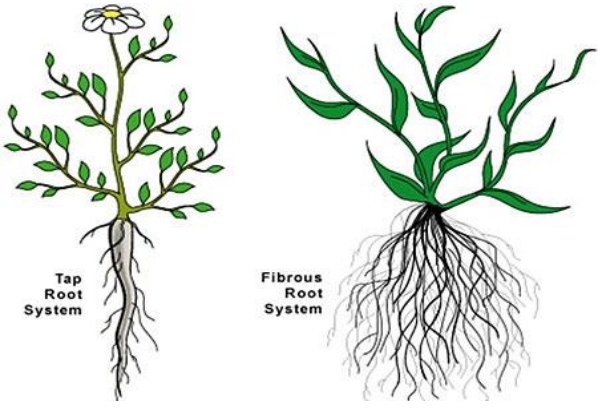
- **Structure**: The trunk is the main supporting structure of the tree, consisting of bark, cambium, and wood.
- **Function**: It provides structural support, allowing the tree to grow tall and reach sunlight. It also houses the vascular system that transports water, nutrients, and sugars between the roots and leaves.
- **Bark**: The outermost layer of the trunk serves as protection against physical damage, pests, and diseases.
- **Wood**: The inner part of the trunk, composed of xylem tissue, conducts water and provides structural support.

4. Branches and Twigs

- **Description:** Branches are the thicker, woody offshoots of the trunk, while twigs are thinner, newer growth from the branches.
- **Function:**
  - Support the leaves, flowers, and fruits.
  - Facilitate efficient photosynthesis by spreading leaves out for maximum light exposure.
  - Transport nutrients, water, and sugars to and from the leaves and the rest of the tree.

5. Roots

- **Structure:** Roots anchor the tree in the soil and absorb water and nutrients. There are two main types:
  - **Taproot System:** A primary central root that goes deep into the soil (common in young trees).
  - **Fibrous Root System:** A network of fine roots spreading horizontally (common in mature trees).



- **Function:** Roots absorb water and essential minerals from the soil and also store nutrients during dormancy. They play a critical role in stabilizing the tree.

5. Reproductive Structures

- **Flowers:** Trees reproduce sexually, and flowers are the reproductive organs. Some trees are monoecious (having both male and female flowers), while others are dioecious (having separate male and female trees).
- **Fruits/Seeds:** After fertilization, flowers develop into fruits containing seeds, which are dispersed through wind, water, animals, or gravity.

1. Fruits in Trees

Definition:

- **A fruit** is the mature ovary of a flower, containing seeds. After fertilization, the flower's ovary swells and develops into a fruit.

Function of Fruits:

- **Protection:** Fruits protect the developing seeds from environmental factors like wind, rain, and herbivores until they are mature.
- **Seed Dispersal:** Fruits help disperse seeds to new locations. Depending on the type of fruit, seeds may be spread by wind, water, animals, or gravity.
    1. **Wind**: Lightweight fruits with wings or other adaptations (e.g., maple seeds) can be carried by the wind.
    2. **Animals**: Many fruits are fleshy and attractive to animals, which eat them and excrete the seeds elsewhere (e.g., apples, cherries).
    3. **Water**: Some fruits are buoyant and adapted to float, allowing seeds to be dispersed by water (e.g., coconut).
    4. **Gravity**: Larger fruits, such as acorns, may simply fall to the ground, dispersing the seeds nearby.

Types of Trees Fruits:

Tree fruits can be classified into several categories based on their structure:

- **Fleshy Fruits:** These are soft and often edible. The flesh surrounds the seeds.
    - Examples: Apples, cherries, mangoes, peaches.
- **Dry Fruits:** These fruits do not have a fleshy outer layer. They may be further divided into dehiscent (splitting open to release seeds) and indehiscent (not splitting open).
    - **Dehiscent** Examples: Peas, beans**.**
    - **Indehiscent** Examples: Acorns, nuts.

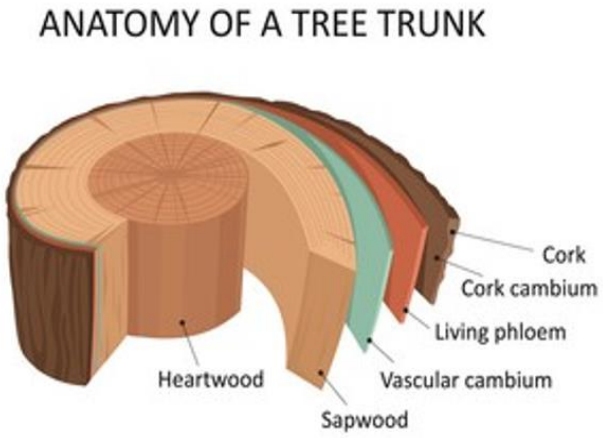
“*Dehiscence is a natural mechanism that aids in seed dispersal, helping the plant propagate its offspring. Non-dehiscent fruits, by contrast, do not split open, and seeds are usually dispersed by other mechanisms”*

Fruit Development:

- After fertilization, the flower’s ovary grows and develops into the fruit. The other parts of the flower (such as petals and stamens) wither and fall away. Inside the ovary, seeds begin to form and mature, and the ovary walls often thicken to become the fruit flesh or shell.

II. Tree Anatomy (Internal Structure)

Tree anatomy focuses on the internal structures that enable trees to grow, transport water, and nutrients, and reproduce.



1. Bark

- The outer protective layer of the trunk, branches, and roots.
- Outer Bark (Periderm): Made up of dead cells, it provides insulation and protection from environmental damage, pathogens, and herbivores.
- Inner Bark (Phloem): The inner layer of the bark transports sugars (products of photosynthesis) from leaves to the rest of the tree.

2. Vascular Tissue: Xylem and Phloem

- Trees have two main types of vascular tissue that facilitate nutrient and water transport.
    - **Xylem**:
        - **Structure**: Xylem vessels are made of dead, hollow cells that form tubes throughout the tree.
        - **Function**: Transports water and dissolved minerals from the roots to the leaves through capillary action and cohesion-tension.
        - **Growth Rings**: Xylem forms annual growth rings in temperate trees, which can be used to estimate a tree’s age and environmental conditions during its growth.
    - **Phloem**:
        - **Structure**: Phloem is made of living cells and is located just under the bark.
        - **Function**: It carries sugars and other metabolic products from the leaves to the roots and growing tissues.

3. Cambium

- A thin layer of actively dividing cells between the xylem and phloem. This is responsible for the tree's secondary growth (thickening of the trunk and branches).

- **Vascular Cambium**: Produces new layers of xylem and phloem.
- **Cork Cambium**: Produces the outer bark (cork).

4. Rays

- **Structure**: Horizontal lines of parenchyma cells running through the xylem and phloem.
- **Function**: Rays transport nutrients and water laterally across the tree and store starch and other compounds.

III. Functional Adaptations of Tree Structures

1. Tree Growth

- Trees grow through primary (length) and secondary (thickness) growth.
    - **Primary Growth**: Occurs in the apical meristems at the tips of roots and shoots, resulting in elongation.
    - **Secondary Growth**: Occurs in the lateral meristems (vascular cambium), thickening the tree.

2. Adaptations to Environment

- **Leaf Shape**: Coniferous trees have needle-like leaves to minimize water loss, while broadleaf trees maximize light absorption.
- **Root Systems**: Trees in arid regions often have deep taproots to access groundwater, while trees in wetter areas may have shallow, fibrous roots to absorb surface water.

3. Defense Mechanisms

- **Bark**: Protects against physical damage, insects, and disease.
- **Secondary Metabolites**: Trees produce chemical compounds like tannins, resins, and alkaloids to deter herbivores and pathogens.

Discussion/Questions:

1. How does the structure of xylem contribute to water transport in trees?
2. What are some adaptations in tree morphology that help trees survive in drought-prone environments?