"Consider the lilies how they grow, they neither toil nor spin, yet I assure you, even Solomon in all his glory was not arrayed like one of these"
-Luke 12:27

"Good timber does not grow with ease; the stronger the winds, the stronger the trees" – Douglas Malloch

Plant Form and Function

Chapters 17 and 18

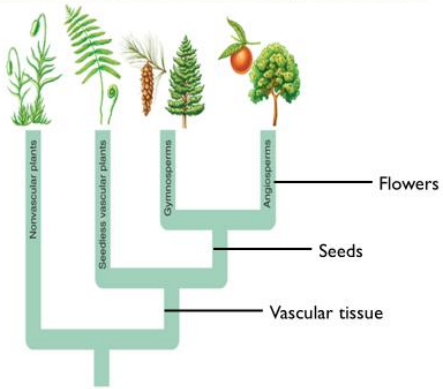
What is a plant?

- Multicellular eukaryote that produces its own food through photosynthesis
  - Mostly terrestrial (land dwelling)
  - _____ (stay in one place)
  - Range from 1 millimeter to 380ft tall!

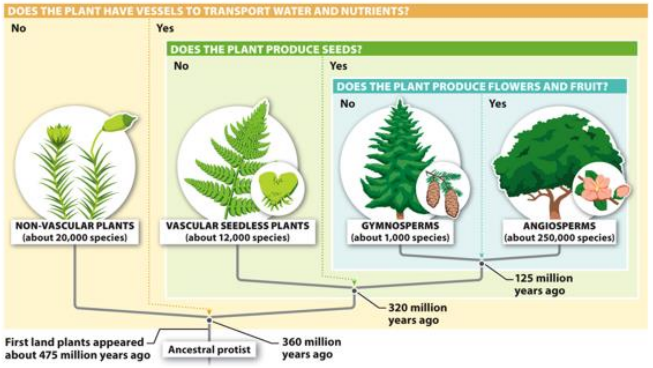
Evolutionary History of Plants

Phylogenetic tree: diagram showing evolutionary _____ among organisms

- Groups organized by their shared characteristics
  - Common _____



Evolutionary History of Plants



Nonvascular Seedless Plants

- Mosses, Liverworts, Hornworts
- Lack vascular tissue
  - Limited vertical growth
  - Water and nutrients enter plant though diffusion
- Lack seeds
  - _____: asexual reproduction
- Haploid generation dominant
- Flagellated sperm
  - Wet environments

Vascular Seedless Plants

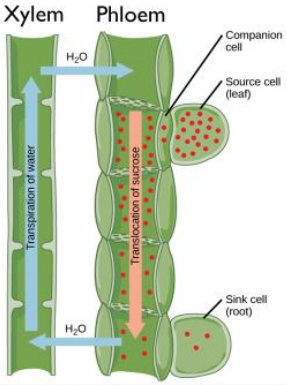
- Ferns, Clubmosses and Horsetails
- Vascular tissue present
  - _____ growth
- Lack seeds
  - Spores: asexual reproduction
- Diploid generation dominant
- Flagellated sperm
  - Wet environments

Evolution of Vascular Tissue

Vascular tissue: tube-like vessels that transport water and nutrients

- _____ – Moves water up a plant
- _____ – Moves food up or down a plant
  - Allowed for vertical growth in plants

Vascular bundles: bundles of xylem and phloem within plant roots, shoots and leaves

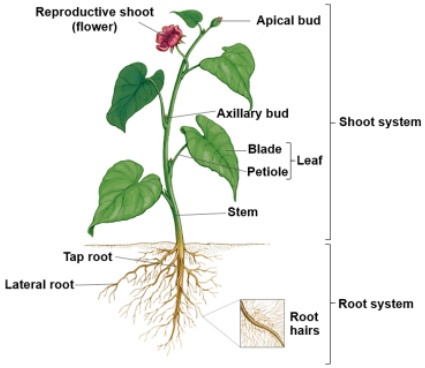


Plant Morphology

Shoot system: photosynthesis and _____

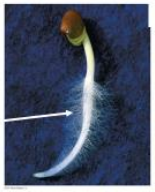
- **Stem**: produce leaves, branches and flowers, transports nutrients and water from roots to leaves
- **Leaves**: primary location of photosynthesis
- **Buds**: undeveloped shoot

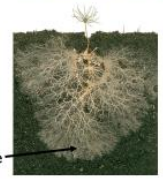
Root System: anchors plant, absorbs minerals and water, and stores carbohydrates



Roots

- Taproot or fibrous root
- Absorb water, minerals, nutrients
- Root hairs
  - Increase _____
- _____: symbiotic relationship between a fungus and plant roots
  - Fungus get carbohydrates
  - Plant gets more water and nutrients





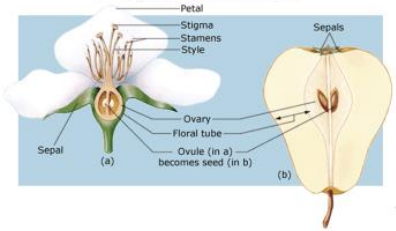
Taproot system

Fibrous root system

Vascular Seed Plants

Gymnosperms: seed bearing vascular plants in which the seed is _____ in an ovary
- "naked seed"
- Cone bearing

Angiosperms: seed bearing vascular plant in which the seed is enclosed in an ovary
- "enclosed seed"
- Flowering plants
  - Fruits

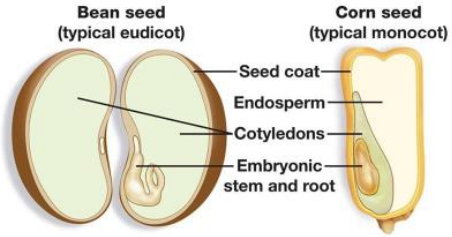


Evolution of Seeds

Seed: _____ and food supply
- Protective layer (seed coat)
  - Longer lifespan

_____: seed leaves

Endosperm: energy rich tissue that nourishes developing embryo

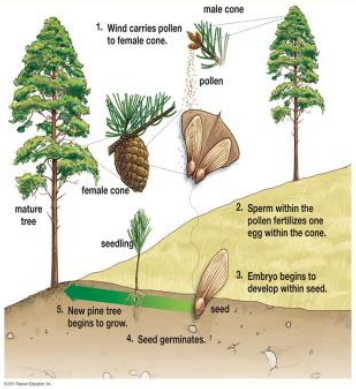


Gymnosperms

Conifers, Ginkgos, and Cycads
- Approximately 1000 species
  - 680 are conifers
- Major _____ importance

Ginkgo biloba

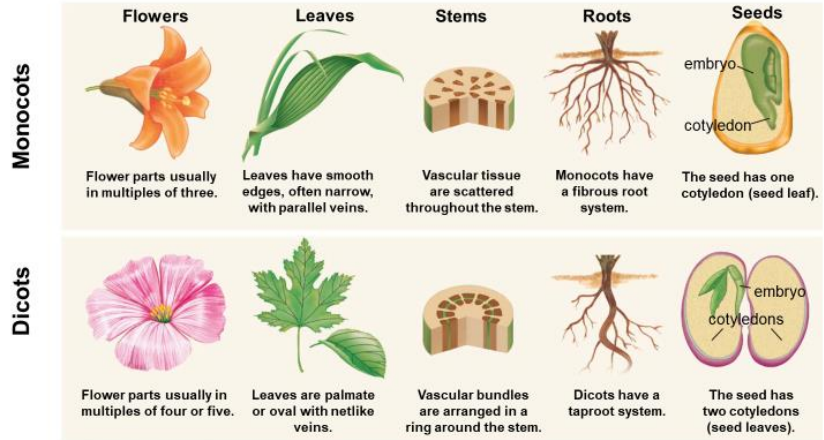
Gymnosperm Dispersal



- _____ of pollen and seeds

Angiosperms

- 300,000 species of flowering plants
  - Food crops (fruits, corn, vegetables, wheat)
  - Most all trees other than conifers
  - Grasses



Flower Anatomy

Sepal: protects developing flower

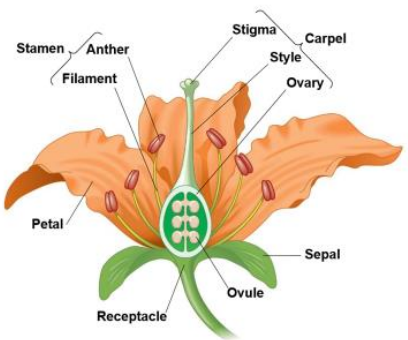
Petals: attract pollinators

_____: Female reproductive part

- Stigma
- Style
- Ovary

_____: Male reproductive parts

- Filament: stalk
- Anther: pollen production



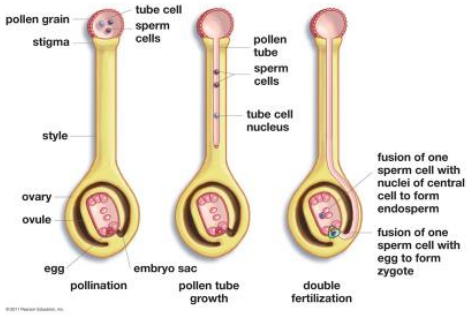
Variation in Flowers

Pollination in Angiosperms

- Each pollen grain contains two sperm cells and one tube cell
  - Tube cell forms pollen tube

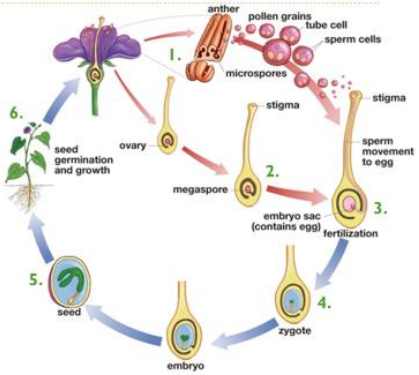
Pollination: the transfer of pollen from the male anther to the female stigma

_____ **fertilization**: one sperm cell fuses with egg forming the zygote, while the other sperm cell fuses with nuclei within the ovule to form endosperm



Angiosperm Life Cycle

1. Microspores in anther develop into pollen grains, with one tube cell and two sperm cells
2. Megaspore in ovary develops into embryo sac with egg.
3. Pollen grain contacts stigma (pollination) and pollen tube forms
4. One sperm fertilizes egg forming zygote, one sperm fertilizes nuclei forming endosperm
5. Embryo and endosperm develop into a seed
6. Seed grows into a mature plant

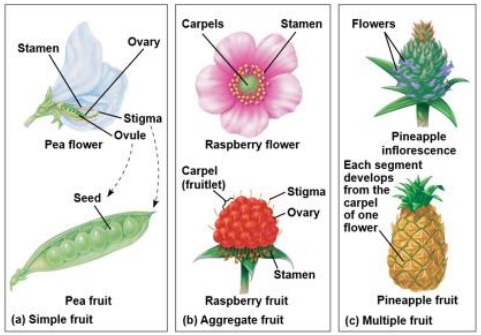


Fruit Development

Simple fruit: develops from _____ ovary

Aggregate fruit: develops from several ovaries (carpels) in the same flower

Multiple fruit: develops from _____ of multiple flowers



Angiosperm Seed Dispersal

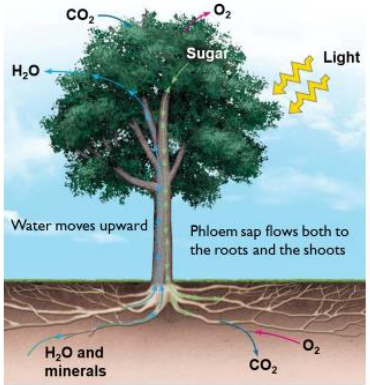
Plant Defenses

- Anatomical structures
  - Thornes and thick bark
- Sticky traps
  - Plant sap traps insect invaders
- _____ compounds
  - Reduce herbivory

Resource Acquisition and Transport in Vascular Plants

Transpiration

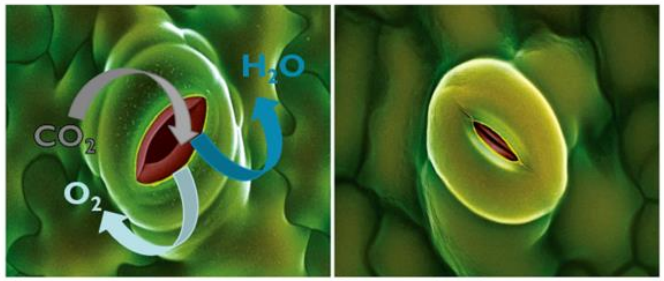
Water and minerals are absorbed by the roots



Photosynthesis uses light energy and CO2 to make sugar and oxygen (byproduct)

Roots exchange gases with air spaces in soil

Stomata



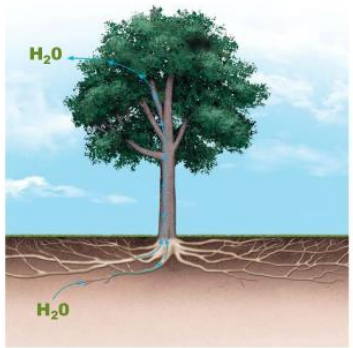
Stomata open

Stomata closed

Water Transport in Plants

Transpiration: _____ from above ground plant parts by diffusion and/or evaporation

Cohesion-tension hypothesis: transpiration provides _____ that pulls water molecules bound by cohesion, from the roots to the leaves

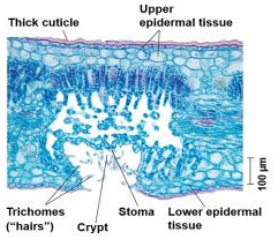


Trade-off between Leaf Size and Transpiration

- Larger leaf size = more light capture, but _____ water loss
  - Tropical environments
- Small leaf size = less light capture, but _____ water loss
  - Dry, exposed environments
    - Deserts
    - Temperate forests

Adaptations to Reduce Transpiration

- Small, thick leaves
  - Reduce _____
- Thick cuticle
- _____ stomata
- Lose their leaves
  - Drought deciduous
- C_4 and CAM plants
  - Grasses, cacti



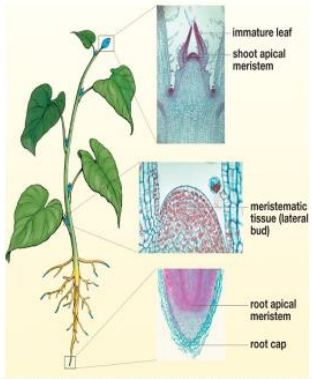
Nutrient Transport in Plants

- Sugar-rich xylem sap rises up the trunk in late winter to fuel leaf and flower production
  - "Real" maple syrup

Plant Growth

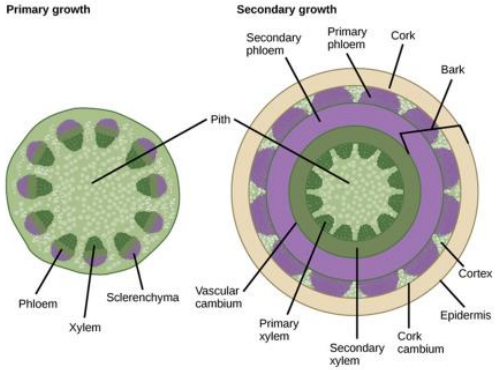
Apical meristem: group of cells located in the root and shoot tips, that give rise to all plant tissues

- Regions of _____ and differentiation



Primary and Secondary Growth

- **Vascular** _____: gives rise to secondary xylem and phloem
  - Secondary xylem = tree rings



Human uses of Seed Plants

- Six crops = _____% of all calories consumed by humans
  - Maize, rice, wheat, potatoes, cassava, sweet potatoes
- Medications
  - 25% of medications come from plants
- Oxygen!
- Wood
- Paper

Table 30.1 Examples of Plant-Derived Medicines

Compound	Source	Use
Atropine	Belladonna plant	Eye pupil dilator
Digitalin	Foxglove	Heart medication
Menthol	Eucalyptus tree	Throat soother
Quinine	Cinchona tree	Malaria preventive
Taxol	Pacific yew	Ovarian cancer drug
Tubocurarine	Curare tree	Muscle relaxant
Vinblastine	Periwinkle	Leukemia drug

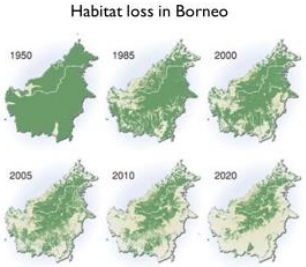
Treats to Plant Diversity: Habitat Destruction

Deforestation

- 14 million acres of tropical rain forest cleared every year!

Causes:

- 48% due to _____ farming
- 32% due to commercial agriculture
- 14% due to logging
- 5% used as wood for fuel



Threats to Plant Diversity: Invasive Bark Beetle

Check Your Understanding

Which of the following are **not** one of the characteristics of monocots?

a. Flower parts in multiples of threes
b. Single cotyledon
c. Taproot
d. Parallel veins in the leaves
e. Vascular bundles scattered in stem

Check Your Understanding

Which of the following parts of the flower are responsible for the production of pollen?

a. Stigma
b. Anther
c. Style
d. Ovary
e. Filament

Check Your Understanding

- Draw the phylogenetic tree for the evolutionary history of plants. Be sure to include the three major adaptations that occurred in plants