Kingdom Plantae: Non-vascular Plants

The Plant Life Cycle: Alternation of Generations
- Haploid generation = *Gametophyte*
- Diploid generation = *Sporophyte*

“male and females”

Plant Life Cycle

Gametangia and Sporangia
Different dominant stages in different types of plants.
Two adult forms (although for most land plants gametophyte is parasitic)
The Bryophytes: Mosses, Hornworts and Liverworts
- Unique, dominant generation is gametophyte (conspicuous)
- Flagellated sperm (need water)
- Small, compact, close to ground
- Lacks transport vessels and supportive tissue
- No true leaves, stems or roots
- Absorb nutrients + water from surroundings
- Rhizoids
- Asexual + sexual reproduction
- (not a monophyletic group)

Moss Life Cycle:
1. Gametes develop in Gametangia on gametophyte
   a. Archegonia
   b. Antheridia
2. Fertilization
3. Mitosis = Sporophyte development
4. Meiosis in sporangia at tips of Sporophyte
5. Spore released and undergo mitosis

Bryophyte Diversity:
A. Liverworts
   1. Most similar to green algae
   2. 6,000 species
   3. Gemmae
B. Hornworts
   1. 100 species
   2. Horn-shaped, single chloroplast
C. Mosses
   1. 10,000 species
Kingdom Plantae: Seedless Vascular Plants

Seedless Vascular Plants: The Ferns
- true ferns, whisk ferns, horsetails, club mosses

• dominant Sporophyte, highly reduced gametophyte
• gametophyte and Sporophyte still separate
• once dominant plant form
• live in drier habitats
• flagellated sperm (require water)
• fossil fuels and coal forests

Life Cycle:
1. gametes produced in Gametangia on underside of gametophyte
2. sperm swim to egg, fertilization, zygote on gametophyte
3. Sporophyte develops on gametophyte (grows out of)
4. sporangia produce haploid spores
5. spores released (50 million per season)

Fern Structure:
1) roots and rhizomes
2) nonvascular stems
3) leaves = fronds
4) sori = clusters of sporangia on underside of frond
5) fiddleheads

Fern Diversity:
- 250,000 species
Kingdom Plantae: Angiosperms – The Flowering Plants

- Produce flowers (modified leaves)
- Produce fruit
- Dominant plant form
- Most foods and materials

Division Split into Two major Groups
1) Monocots
   a. one cotyledon
   b. veins usually parallel
   c. dispersed vascular bundles
   d. floral parts in multiples of 3
   e. fibrous root system

2) Dicots
   a. two cotyledons
   b. veins usually branched
   c. vascular bundles usually in ring
   d. floral parts in multiples of 5
   e. taproot system

Plant Body:
1. Roots
2. Shoots

ROOTS:
- Roots Systems
  - Taproot
  - Fibrous root
Root Hairs

SHOOTS:

Stems and Leaves

Stem structure
  o Nodes
  o Internodes
  o Terminal buds
  o Axillary buds and axillary regions
  o Leaf scars
  o Leaves
    ▪ Blades
    ▪ Petioles

Apical Dominance

Root and Shoot Modifications
1. tubers
2. rhizomes
3. rhizoids
4. stolons (runners)
5. grasses
6. flowers
7. needles
8. thorns
9. nodules: auxiliary organisms = symbiots
   a. bacterial
   b. fungal

Plant Organs

1. Leaves
2. Stems
3. Roots

**Plant Cells and Tissues**

I. Plant Cells

1) Parenchyma
2) Collenchyma
3) Sclerenchyma
   a) Fibers
   b) Sclereids
4) Water conducting cells
   a) Tracheids
   b) Vessel Elements
5) Food conducting cells
   a) Sieve-tube Members
   b) Companion Cells

II. Plant Tissues

1) Simple tissues: composed of only one cell type
   a) Parenchyma
   b) Collenchyma
   c) Sclerenchyma

2) Complex Tissues: composed of many cell types
   a) epidermal tissue system (epidermis)
   b) vascular tissue system
   c) ground tissue system

Root and Stem Structure
Epidermis
- skin of plant
- protection and defense
- cuticle

Vascular Tissue
- vascular bundles or rings
- change from young to old
- two types:
  1. Xylem: water and dissolved nutrients; composed of water conducting cells, parenchyma, + Sclerenchyma
  2. Phloem: sugar; composed of sieve-tube members, parenchyma, + Sclerenchyma

Ground Tissue
- Collenchyma and parenchyma
- Storage and support
- Cortex
- Endodermis
- Pith

Monocots and Dicots Compared

Leaf Structure

- Cuticle
- Upper epidermis
- Mesophyll (ground tissue)
  - Palisade mesophyll
  - Spongy mesophyll
Veins (or vascular traces)
  o Xylem
  o Phloem
  o Sheath cells

Lower epidermis

Stomata and guard cells

Cuticle

Plant Growth

Indeterminate vs. Determinate Growth

Annuals and Perennials

Meristems = actively dividing cells

I. Primary Growth

Lengthwise growth in a plant

Apical meristems = tips of roots and shoots

Root caps

Primary xylem and primary phloem

Leaf primordial

II. Secondary Growth

Increase in girth

Lateral meristems: vascular cambium and cork cambium
Secondary xylem + secondary phloem
Wood and direction of growth
Cork: dead with thick wax walls

**Structure of Wood**
- Wood (everything internal to vascular cambium)
  - Heart wood
  - Sap wood
  - Wood rays
  - Wood rings
- Bark (everything external to vascular cambium)
  - Secondary phloem
  - Cork cambium
  - Cork
  - Epidermis (in some)

**The Life Cycle of a Flowering Plant**
- Alternation of generations
- Overview of life cycle
- Sporophyte is dominant stage

**The Flower:**
- Specific part of angiosperm for reproduction
- Flower structure:
  - Sepals
  - Petals
  - Stamens (male organs)
    1. Anthers
    2. Filaments
  - Pistils (female organs)
1. Stigma
2. Style
3. Ovary
   o Carpels
   o Ovules

Pollen grains = male gametophyte

Embryo sac = female gametophyte

Pollination and Fertilization

Double Fertilization

Germination

Ovules = seed development
   - Endosperm
   - Seed coat
   - Seed dormancy

Fruit = a maturated ovary
   - Simple (one carpel, one flower)
   - Aggregate (many carpels, one flower)
   - Multiple (many flowers)

**Plant Nutrition and Transport**

Nutrients from air and soil:
   - water, minerals and oxygen from soil
   - carbon dioxide from air
Solute Uptake by Roots:
- *Intracellular Rout*
- *Extracellular Route* and the Casparian strip (endodermis)

All nutrients must pass through the cell membrane of the endodermis before entering the xylem

**Water Movement**
- Xylem sap
- Root pressure
- Transpiration
- Transpiration-cohesion-tension mechanism (siphon)

**Transpiration and Guard Cells**

**Food Movement**
- Phloem sap
- Pressure-flow mechanism (diffusion)

**Nutrients and Soil**
Topsoil
Humus
Fungi and Bacteria