Botany:
Intro to Plant Anatomy & Physiology

John Punches and Chris Rusch
Oregon State University

Botany is...

The study of plants.

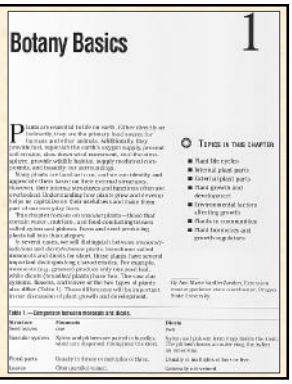
Plants in our Ecosystem

- Capture sun's energy
- Food source
- Replenish atmospheric oxygen
- Participate in water cycle
- Moderate world climate
- Provide shelter
- Source of numerous raw materials

Botany Applied

- Identify plants
- Grow & propagate plants
- Influence flowering & fruit production
- Control unwanted growth
- Maintain plant health
- Modify plant features

Reading Assignment



Botany Basics 1

Topics in this chapter

Vascular Plant Structure & Function

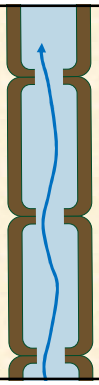
Plant Life Functions

- Transpiration (water movement)
- Photosynthesis (energy capture)
- Respiration (energy release)
- Tissue Synthesis (growth)
- Maintenance, Storage, Defense, Reproduction

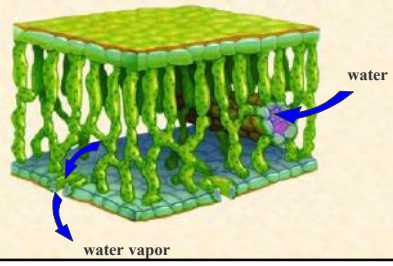
Transpiration = water movement

Xylem = plant plumbing

Water is "pulled" through xylem under negative pressure (tension or vacuum)

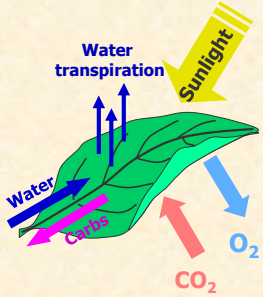


Transpiration in Leaves



Photosynthesis = food production

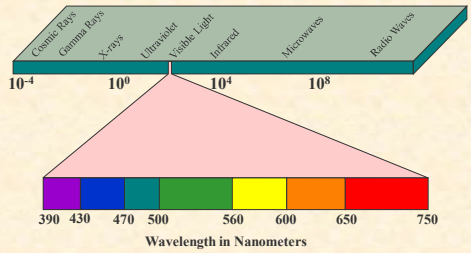
- Water + CO_2 are combined to produce simple sugars
- O_2 is a byproduct



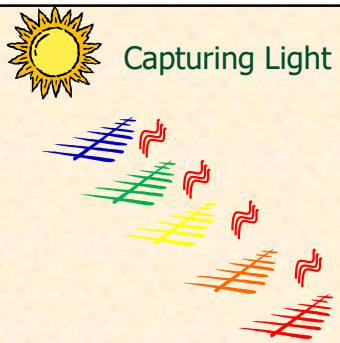
Photosynthesis requires…

- light
- water
- carbon dioxide
- green stuff…

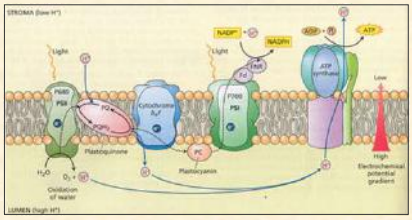
Solar radiation reaching earth



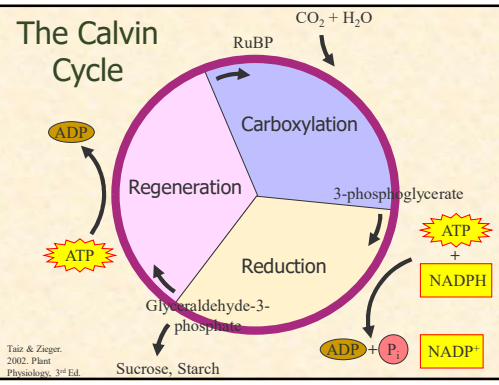
Capturing Light



Photosynthetic Pathway

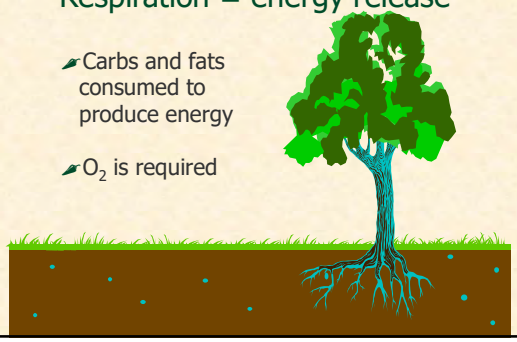


The Calvin Cycle



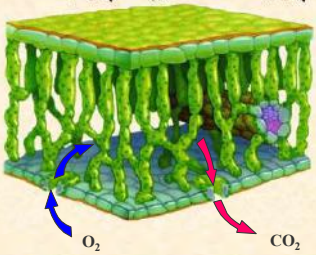
Respiration = energy release

- Carbs and fats consumed to produce energy
- O_2 is required

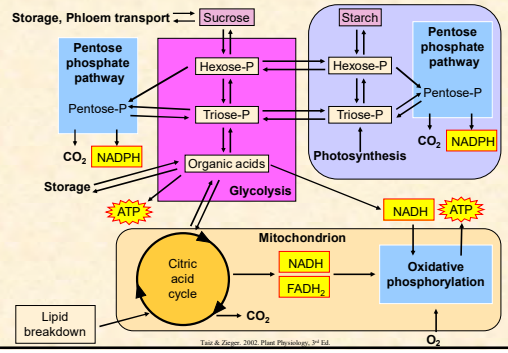


Respiration must occur in all living tissues

Respiration in Leaves



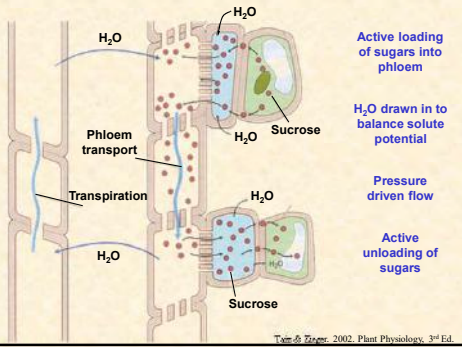
Respiration is Complex!



Respiration requires…

- carbohydrates
- oxygen
- functional carbohydrate transport

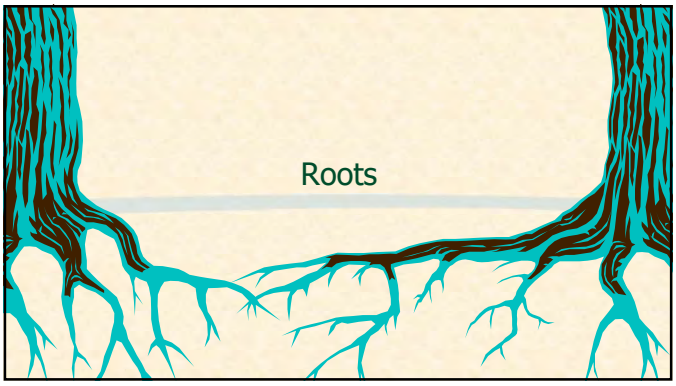
Sugars move through phloem from source to sink



Vascular Plant Structure

- Roots
- Stems
- Leaves
- Flowers
- Fruit & Seeds

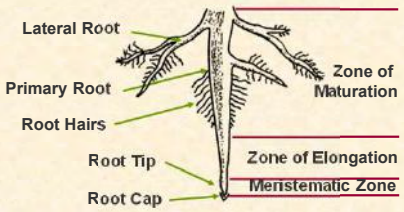
Roots

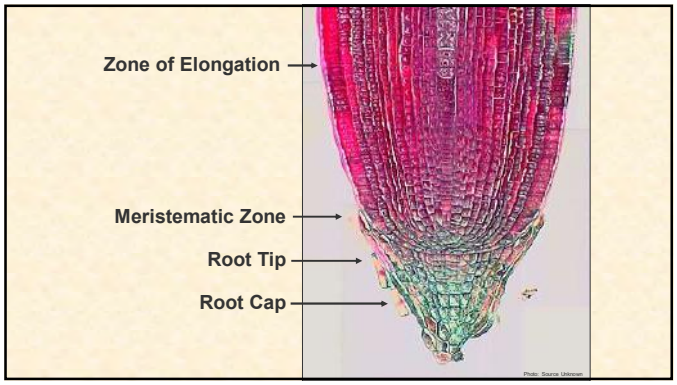


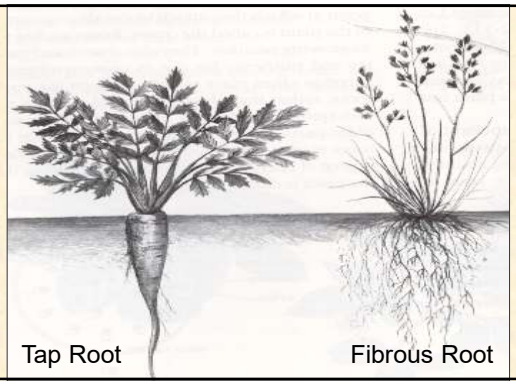
Root Functions

- Absorb nutrients
- Absorb moisture
- Anchor plant in soil
- Support stem
- Store food
- Propagate vegetatively

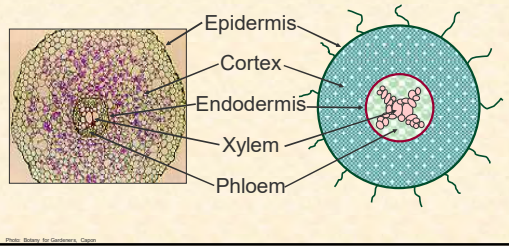
Root Structure





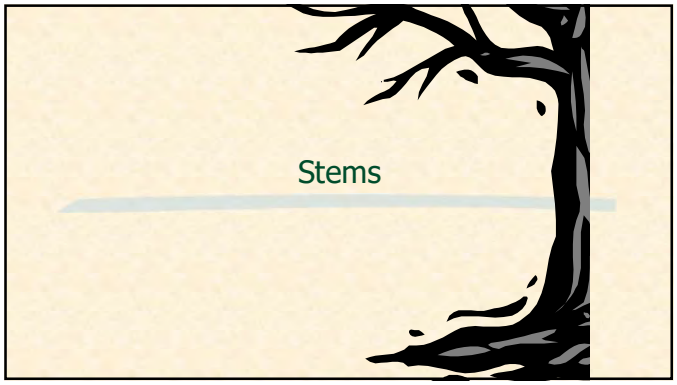


Root Anatomy



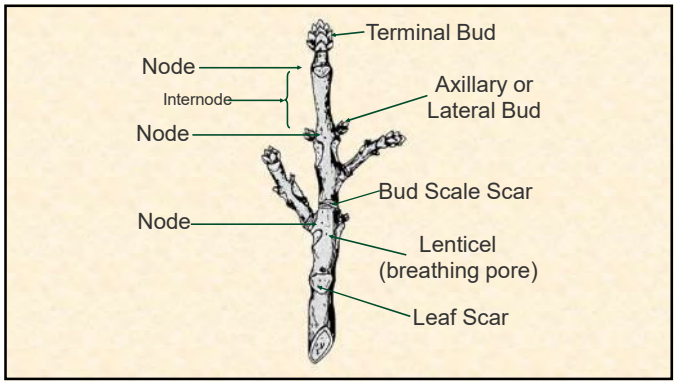
Root Tissues

- Xylem - conduct water & nutrients
- Phloem - carry sugars & starches
- Endodermis - contain vascular tissues
- Cortex - primary tissue surrounding vascular bundle
- Epidermis - outermost layer of plant tissues, protective layer

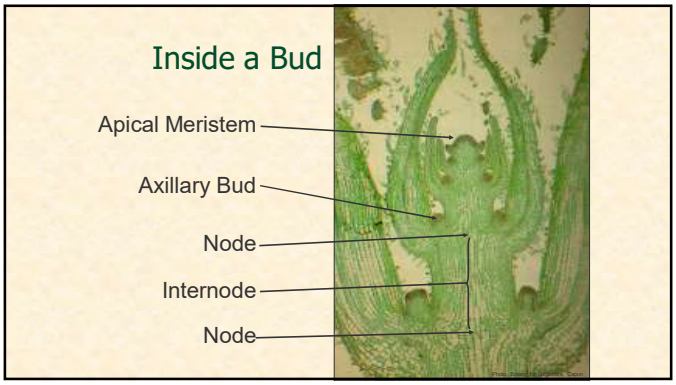


Stem Functions

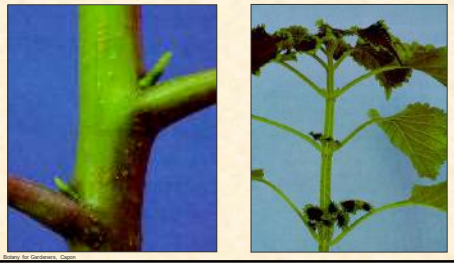
- Support buds
- Support leaves
- Support flowering/fruiting structures
- Carry water & minerals
- Carry food (photosynthates)



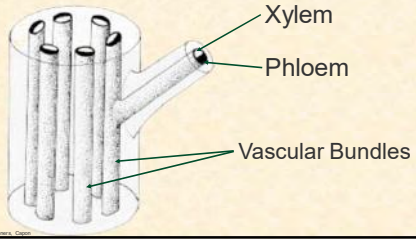
Inside a Bud



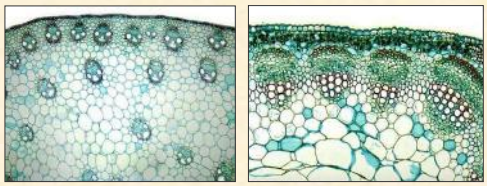
Stem Structure Quiz



Herbaceous Stem Anatomy



Vascular Arrangements in Stems

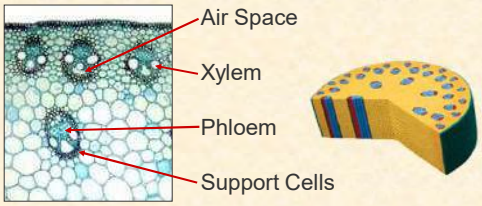


Herbaceous Monocot Herbaceous Dicot

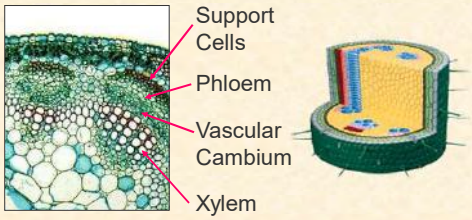
Monocots vs Dicots

Structure	Monocots	Dicots
Seed Leaves	One	Two
Vascular System	Xylem & phloem in bundles, dispersed in stem	Xylem & phloem in rings; xylem inner ring, phloem outer ring
Floral Parts	Usually threes or multiples of three	Usually in multiples of four or five
Leaves	Often parallel-veined	Generally net-veined

Monocot Vascular Arrangement

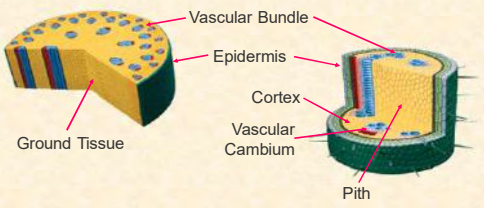


Dicot Vascular Arrangement

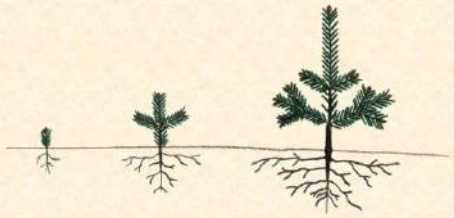


Stem Tissues

Herbaceous Monocot Herbaceous Dicot

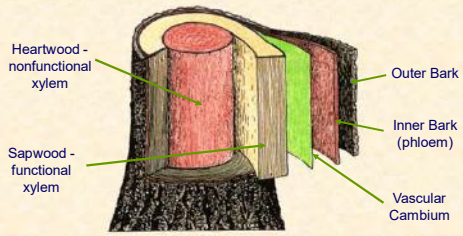


Woody Stem Growth

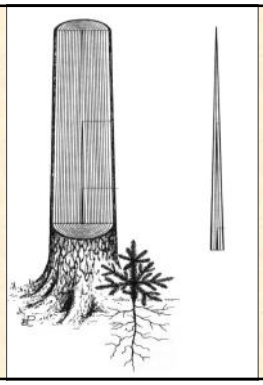


Woody Stem, Secondary Growth

Woody Stem Anatomy



Woody Stem Anatomy



Adapted from Panshin & DeZeeuw, 1980, Textbook of Wood Technology, 4th edition, p17.

Stem Tissues

- Xylem - conduct water & minerals
- Phloem - carry sugars & starches
- Epidermis - Outermost layer of plant tissue, protective layer
- Cortex - primary tissue surrounding vascular bundles
- Pith - thin-walled cells at center of stem

Specialized Above-Ground Stems

- Crowns - compressed stems with leaves and flowers on short internodes
- Stolons - fleshy or semiwoody, elongated, horizontal stems, often at soil surface
- Spurs - short side stems arising from main stem, often bear fruit on trees

Specialized Underground Stems

- Rhizome - horizontal underground stem, may be compressed and fleshy or slender with elongated internodes
- Bulb - short, compressed, underground stem with central bud at tip of stem, surrounded by fleshy scales (leaves)
- Corm - solid, swollen underground stem with dry, scale-like leaves

Specialized Underground Stems

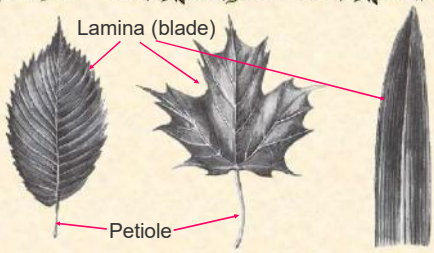
- Tuber - enlarged, short, fleshy underground stem tip
- Tuberous stem - short, flat, enlarged underground stem with buds and shoots at top and fibrous roots at bottom

Leaves

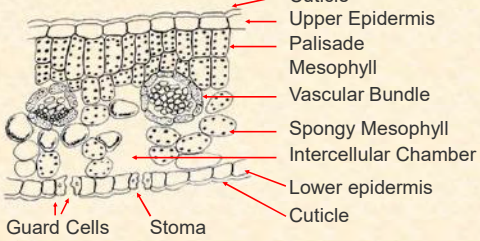
Leaf Functions

- Photosynthesis - use sunlight to make food
- Respiration - use food to make energy
- Transpiration - lose water (as vapor) to atmosphere

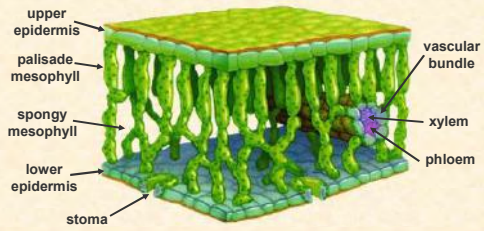
Leaf Parts



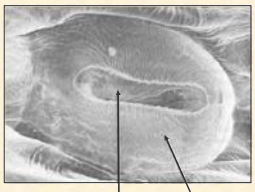
Leaf Anatomy



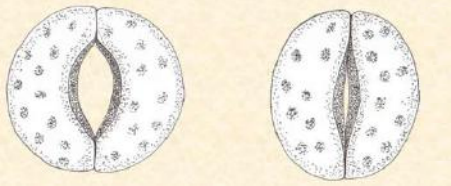
Leaf Model



Stoma & Guard Cell

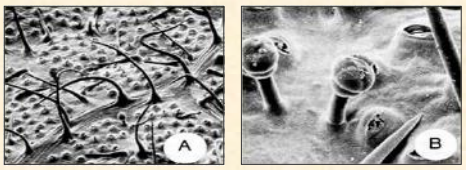


Stomatal Control



Open Closed

Leaf Surface



Leaf Forms

Types of Leaves

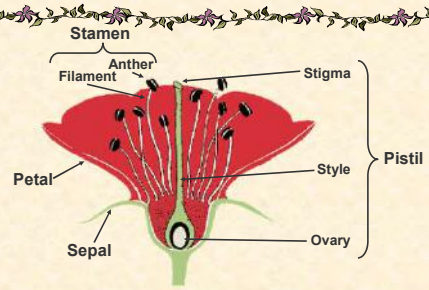
- Scale leaves (cataphylls) - enclose and protect rhizomes and buds
- Seed leaves (cotyledons) - store food for seedlings
- Spines & Tendrils - protect or help support
- Storage leaves - found on bulbous plants & succulents, store food
- Bracts - modified, often brightly-colored leaves around flowers

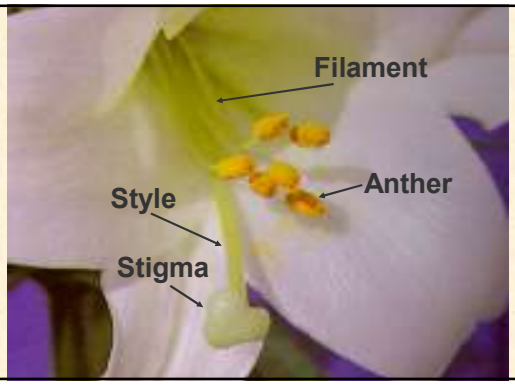
Flowers

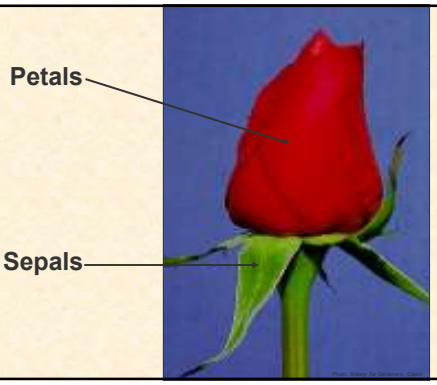
Flower Functions

- Exchange pollen
- Achieve fertilization
- Produce seed

Flower Anatomy







Flower Types

- Complete
  - all floral organs present (sepals, petals, stamens, pistil)
- Incomplete
  - flower lacks 1 or more of the 4 organs

Flower Types

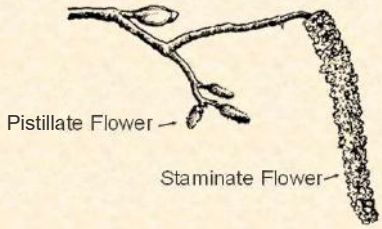
- Perfect - has both stamen (male organs) and pistil (female organ)
- Imperfect - having only one type of organ
  - Staminate - male organ present
  - Pistillate - female organ present

Imperfect Flowers


Staminate


Pistillate

Imperfect Flowers



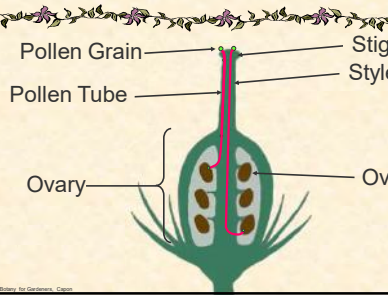
Species with Imperfect Flowers

- Monoecious
  - both pistillate and staminate flowers occur on same plant
    - birch, pecan, squash
- Dioecious
  - pistillate are on one plant, staminate on a different plant
    - ginkgo, holly, pistachio, kiwi

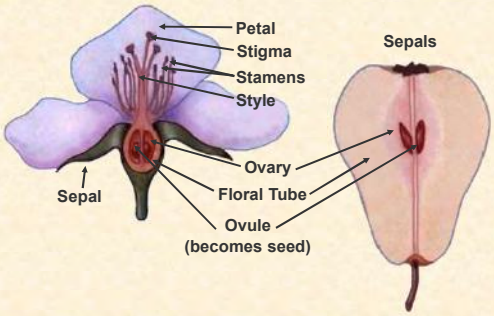
Pollination

- Exchange of pollen
- Numerous mechanisms
  - insects, birds, bats, wind, rain
- Flowers are optimized for their pollination vector

Fertilization



Fruit



Types of Fruit

- Simple - develop from one ovary (may have multiple seeds)
- Aggregate - develop from a single flower with multiple ovaries
- Multiple - develop from a tight cluster of separate flowers

Seeds

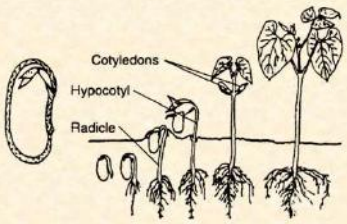
Seed Anatomy

- Embryo - miniature plant in an arrested state of development
- Endosperm - food supply (can be comprised of proteins, carbohydrates, fats)
- Seed coat - hard outer covering that protects from disease and insects; also repels water

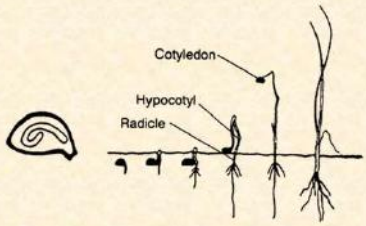
Germination

- Activation of embryo within seed
- Preceded by water penetrating seed coat
- Oxygen, favorable temperature, and (in some species) light required

Germination of a Dicot



Germination of a Monocot



The Incredible Vascular Plant