Kingdom Plantae

I. General Characteristics

A. Contain chlorophylls a and b.
B. Cell walls made of cellulose.
C. Have tissues and organs (roots, stems and leaves).

II. Evolution of Plants

A. Evidence that plants evolved from algae

1. Green algae and plants both have chloroplast with chlorophylls a and b
2. Both have cell walls made of cellulose.
3. Both form starch as stored glucose.
4. Both demonstrate alternation of generations

III. Problems with life on land

A. Dehydration

1. Adaptations
   a) Roots, vascular tissue, cuticles and bark

B. Support

1. Adaptations
   a) Stiffer, thick cell walls; wood

C. Distribution of gametes and/or spores

1. Adaptations
   a) Water tight seeds and/or spores.
   b) Spores lighter than air.

IV. Classification of Plants

A. Phylum Bryophyta (page 418 and 419)

1. Primitive
2. Lack vascular tissue
3. Lack true roots
4. Mosses and liverworts (Hepatophyta)

B. Super Phylum Tracheophyta

1. More advanced than Bryophytes
2. Contain vascular tissue
3. *What are the advantages of vascular tissue*?

C. Phylum Pterophyta (page 422 and 423)

1. Reproduce by spores
2. Leaves generally grow from underground stems
3. Ferns and horse tails

D. Phylum Coniferophyta (page 425)

1. Produce naked seeds in cones
2. Many are evergreens
3. Produce soft wood
4. Needle like leaves
5. Redwoods, pines, cypress and junipers

E. Phylum Anthophyta (page 429)

1. Flowering plants
2. Either herbaceous or hardwoods
3. Most advanced of all plant forms

a) Class Monocotyldonae (Monocots)

(1) seeds contain one cotyledon
(2) leaves have parallel veins
(3) flower parts are usually in multiples of 3
(4) lack cambium
(5) in the stem, vascular bundles are scattered
(6) generally wind pollinated
(7) All are herbaceous with a few exceptions

b) Class Dicotyledonae (Dicots)

(1) This class is now called **Eudicotyledonae**
(2) Seeds contain two cotyledons
(3) Leaves have netted veins
(4) Flower parts are usually in multiples of 4 or 5
(5) Have cambium
(6) Vascular bundles are arranged in a cylinder, in the stem.
(7) Generally pollinated by animals
(8) Some are herbaceous and some are woody (produce hard wood)

c) See page 440 figure 25.3

Plant Life Cycles

I. Moss life cycle (page 419)

A. Spore (n) germinates and forms the protonema.
B. Gametophyte (n) plant grows from the protonema and matures
   1. By what process?
C. Male gametophyte forms sperm (n) in antheridia
   1. By what process?
D. Female gametophyte forms egg (n) in archegonium
   1. Are the sperm and egg **haploid** or **diploid**?
E. Sperm fertilizes egg in archegonium
   1. What is necessary for fertilization to occur?
   2. What time of the year would this be?
   3. What do we call the fertilized egg?
   4. Is it haploid or diploid?
F. The zygote (2n) develops within the archegonium and forms a mature sporophyte (2n) which is the stalk and capsule.
G. The capsule produces spores (n)
   1. By what process?
   2. What is the first cell of gametophyte generation?
   3. What is the first cell of the sporophyte generation?
   4. Why is this alternation of generation?

II. Fern life cycle (Page 423)

A. Spore (n) germinates and forms prothallus
   1. By what process does prothallus develop?
B. Prothallus (n) plant grows and matures.
C. On the prothallus antheridia and archegonia develop.
D. On the prothallus sperm (n) form in antheridia
   1. By what process?
E. On the prothallus eggs (n) form in archegonia
   1. Are the sperm and egg haploid or diploid?
F. Sperm fertilizes egg in archegonium
   1. What is necessary for fertilization to occur?
   2. What time of the year would this be?
   3. What do we call the fertilized egg?

4. Is it haploid or diploid?

G. The zygote (2n) develops into the mature sporophyte (2n) and grows into a mature fern.

H. The capsule produces spores

1. By what process?
2. What is the first cell of gametophyte generation?
3. What is the first cell of the sporophyte generation?
4. Why is this referred to as alternation of generation?
5. Which generation more prominent?
6. Which was with the mosses?

Plant Tissues

I. Protective tissues (From what?)

A. Epidermis - secretes the cuticle (fig. 25.4 page 441)

B. Cork - forms the bark

II. Ground (Storage/support) tissue

A. Parenchyma (figure 25.5 page 442)

1. thin walled
2. store food and water
3. in leaves contain chloroplast
4. Potato is mostly parenchyma

B. Collenchyma

1. thicker walled
2. provides support primarily
3. The stuff in celery that gets stuck in your teeth.

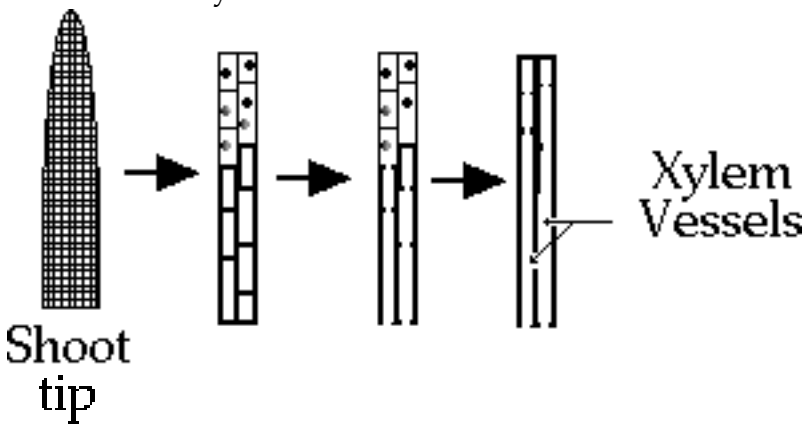
C. Sclerenchyma

1. very thick walls
2. support
3. Surrounds the veins of leaves, stems and roots

III. Vascular tissue

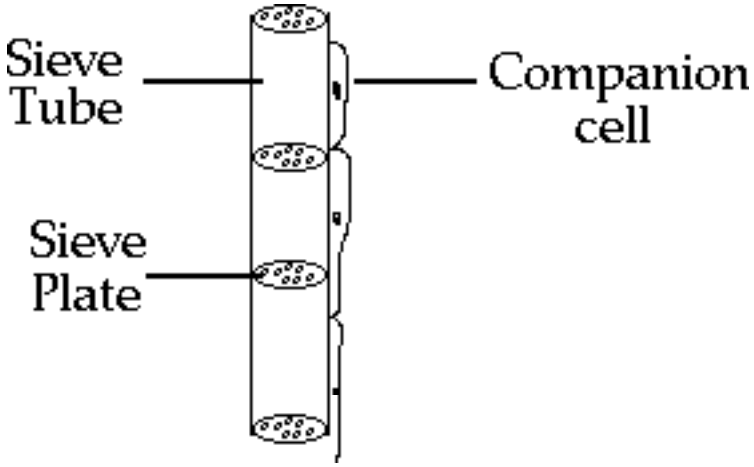
A. Xylem page (page 443 figure 25.6)

1. made of **dead** cells
2. conducts water and dissolved minerals **up** the plant
3. wood is primarily xylem
4. Formation of xylem



B. Phloem (page 617 figure 25.7)

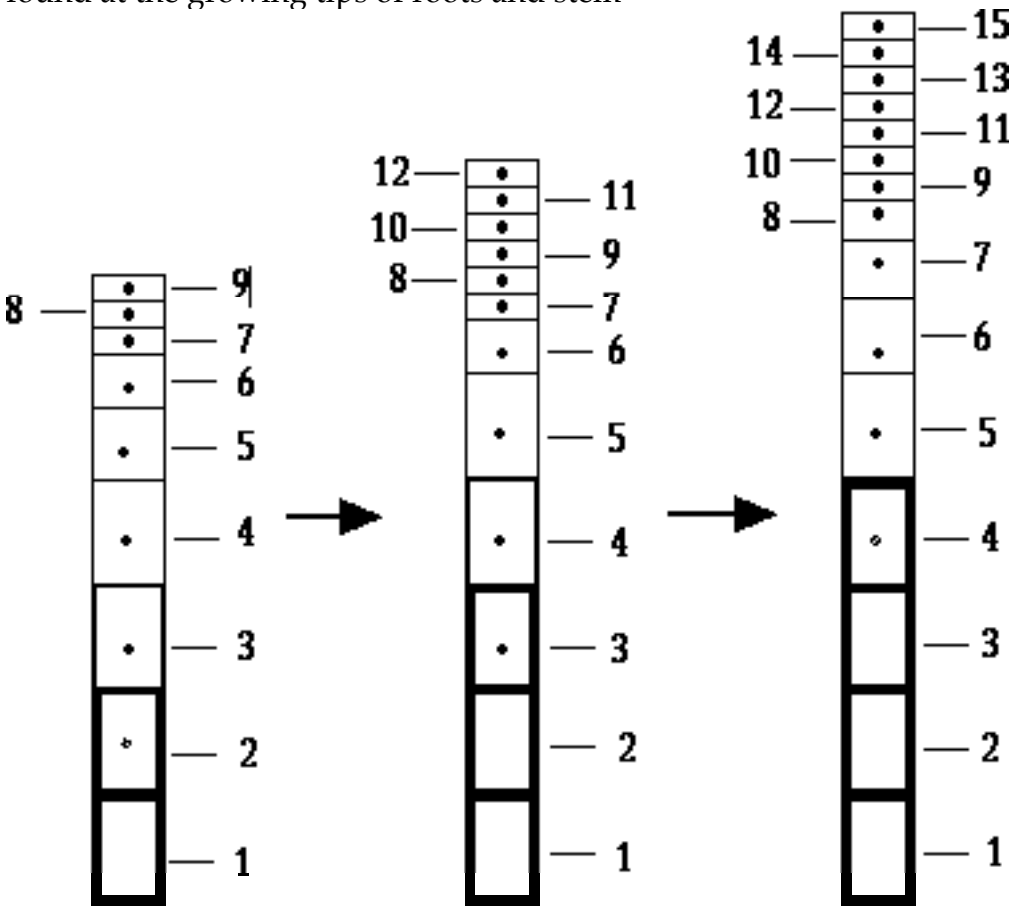
1. composed of sieve tubes (dead)
2. associated with the sieve tube is a companion cell (live)
3. conducts organic material **up** and **down** the stem of the plant



IV. Growth tissue

A. Meristem (page 448 figure 25.12)

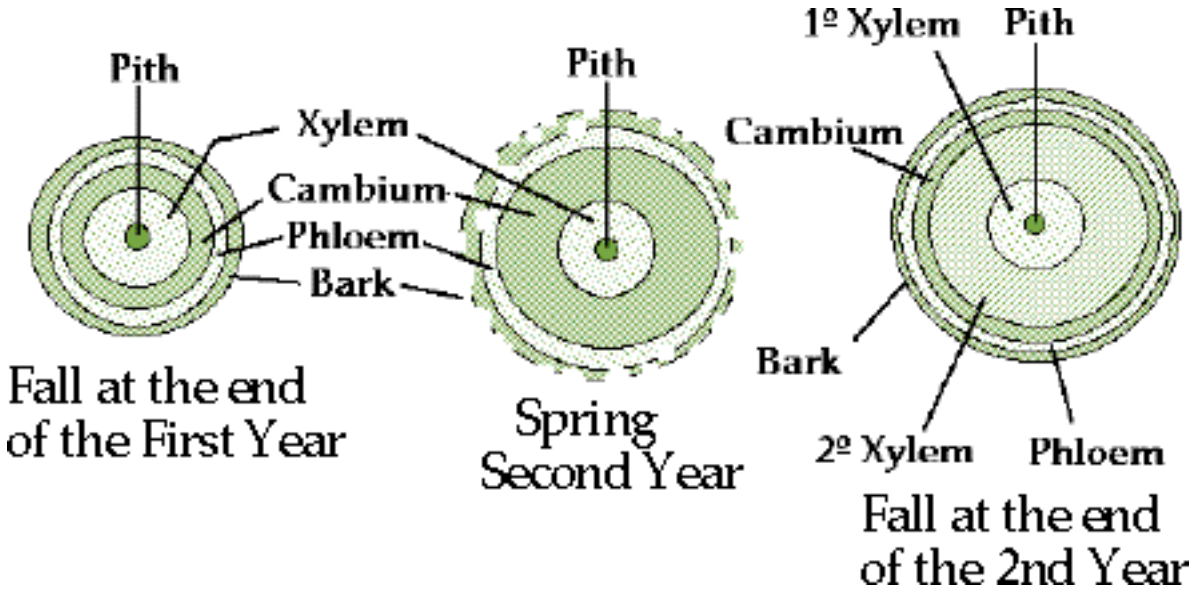
1. responsible for 1° growth (lengthening)
2. found at the growing tips of roots and stem



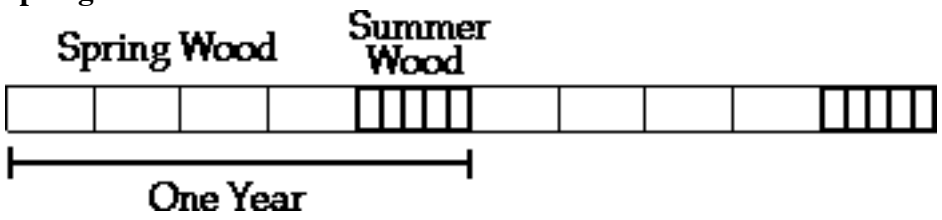
3. *What happens if you cut off the meristem?*

B. Cambium (page 450 figure 25.15)

1. responsible for 2° growth
2. found only in dicots and conifers between xylem and phloem.



C. Spring verses winter wood



1. In spring, the cambium (which will become xylem) grows rapidly and the cells are large and thin walled.
2. During summer and fall, there is less water and the cambium(which will become xylem) grows slower and the cells are smaller and thicker.
3. This growth pattern produces the light and dark annual rings in wood.

Plant Organs

I. The leaf

A. Functions:

1. Trap light for photosynthesis
2. Control transpiration
3. Release Oxygen and absorb Carbon dioxide

B. How does the shape of the leaf maximize these functions?

C. Stomates

1. Regulate the flow of gasses into and out of the leaf. Which gasses? In which directions?
2. Why are they usually found on the underside of the leaf?
3. **Draw and understand how stomates controlled (page 470 figure 26.12)**

D. Internal Structure

1. Study lab drawings and pages and page 454 figure 25.18

E. Plant pigments

1. Do all plants contain Chlorophyll?
2. Chlorophyll - ???
3. Xanthophyll - Yellow
4. Carotene - Orange
5. Anthocyanin - Red
6. Brown - Tanic acid, found in dead leaves

F. Modified leaves (page 455 figure 25.20)

1. Needles on cactus
2. Succulent leaves
3. Tendrils on peas and beans
4. Leaves can be modified for catching food.
    a) **pitcher plants, cobra lily, Venus fly trap and sundew**

G. Stems

1. Functions of the stem
    a) **Conduct materials from root to leaves and visa versa**
    b) **Support the plant and place leaves in light**
2. **Draw and label the external structure of a dormant woody stem**
    a) **Buds,**
    b) **Bud scale scars,**
    c) **Lenticels,**
    d) **Leaf scars**
3. Internal stem structure (Study lab drawings and page 449)

H. Modified stems

1. Tubers - underground stem used for storage - Potato
2. Stolons - runners on top of ground
3. Rhizomes - thick fleshy underground runners
4. Bulbs - dwarf underground stems

I. Roots

1. Functions of roots:
    a) **anchorage**
    b) **store food**
    c) **absorb water and minerals**
2. **Draw longitudinal** view of root page 444 figure 25.8 **a**.
3. Know the cross sectional view page 444 figure 25.8 **b and c.**
4. **Draw a root hair** and list its function(page 441 figure 25.4**a**).

Plant Reproduction

I. Sexual reproduction (Anthophyta)

A. Drawing of a flower (page 495 figure 28.2)

B. Female structures make up the **pistil (carpel)**

1. **Stigma**
    a) at the top of the carpel
    b) it is sticky **Why?**
2. **Style**
    a) long and slender **Why?**
3. **Ovary**
    a) Contains one or more ovules which contain an egg.

C. Male structures make up the **stamen**

1. **Filament**
    a) long and slender it supports the anther. **Why?**
2. **Anther**
    a) Stores and produces pollen

D. Perfect (complete) vs imperfect (incomplete) flowers

1. **Perfect** flowers have **both** male and female flower parts. **Imperfect** flowers have **one** or the other.

E. Accessory flower structures

1. Have nothing to do with sex
2. **Petals**
    a) Attract pollinators.

3. Sepals

a) Protect and support the flower.

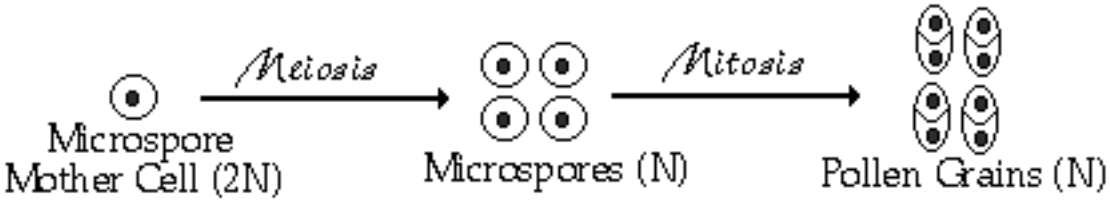
4. Receptacle

a) Forms the fruit in some plants.

5. Pedicel

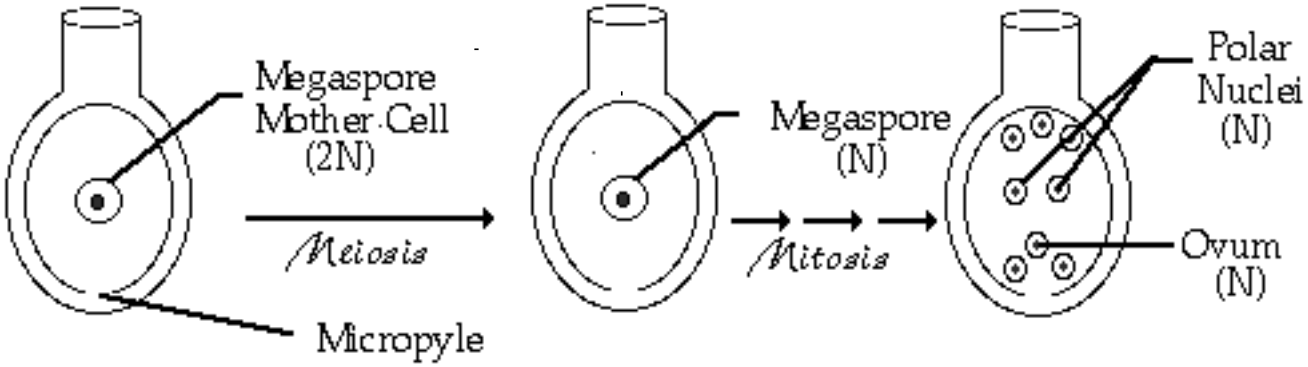
a) Connects the flower to the stem.

F. Pollen formation



1. Pollen grains have two nuclei, a tube nucleus and a generative nucleus.

G. Ovule formation



1. The five other nuclei are not important.

H. Pollination

1. Definition - the transfer of pollen from an anther to a stigma.
2. Cross vs. self pollination
   a) Advantages and disadvantages.
   b) How do plants with complete flowers prevent self pollination?

I. Agents of Pollination

1. Wind and water ***For what class of plants?***
2. Insects, birds and small mammals.

J. Fertilization (page 496 figure 28.5)

1. Pollen grain lands on the stigma of the carpel.
2. The tube nucleus forms a tube down through the style and ovary to the micropyle.
3. The generative nucleus travels down the tube & splits to form two sperm nuclei (**N**).
4. Both sperm nuclei enter the ovule through the micropyle.
5. One sperm nuclei fertilizes the egg cell forming the zygote (**2N**).
6. The other sperm nuclei combines with the two polar nuclei to form the endosperm nucleus (**3N**).
7. The zygote divides to form the plant embryo.
8. The endosperm nucleus divides to form the endosperm (stored food).
9. **How many ovules does a peach have? An apple? A watermelon?**

II. Fruit

A. Definition of a Fruit

1. Develops from a flower and usually has a seed or seeds.

B. Function of Fruit

1. Seed dispersal
2. Protect the seeds.

C. Types of Fruit

1. Fleshy Fruits

a) The fruit develops from the ovary or receptacle. It is filled with a sugar rich fluid. Why?
b) We usually eat the fruit and throw away the seeds
c) Pome
(1) Develop from the receptacle
(2) Ovary wall forms the core
(3) Apples and pears
d) Drupe
(1) Outer ovary wall is very juicy with thin skin
(2) Inner ovary wall becomes hard and forms the pit
(3) Peach, plum and apricot
e) Berry
(1) Ovary swells forming juicy fruit with thin skin and usually many seeds.
(2) Tomato and grape
f) Hesperidium
(1) Outer ovary wall becomes a thick spongy layer
(2) Inner ovary is very juicy with several seeds
(3) Citrus
g) Pepo
(1) Outer ovary wall forms a dry rind
(2) Inner ovary wall forms a solid fruit with many seeds
(3) Cantaloupe and ????
h) Aggregate Fruit
(1) Develop from a multi-pistilate flower
(2) Many small drupes cluster around a single receptacle
(3) Boysenberry, raspberry
i) Accesory Fruit
(1) Grows from a multi-pistilate flower
(2) Receptacle grows into a juicy fruit and ovary wall withers and seeds are pushed to the outside of fruit
(3) Strawberry
j) Multiple Fruit
(1) Many flowers fused together forming one fruit
(2) Pinapple

2. Dry Fruits

a) The fruit is called the husk or shell.
b) We eat the seeds and throw away the fruit.
c) Examples: pea pods, nuts etc.

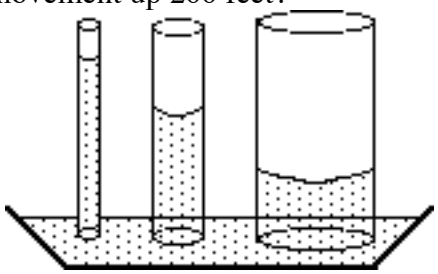
Translocation in Plants

I. Water transport through **xylem**

A. Several Theories

B. Theory of Capillarity

1. Will this account for movement up 200 feet?



2. How can math test this theory?

$$h=1/r^2$$

C. Root pressure theory

1. Will this account for movement up 200 feet?

D. Cohesion Tension Theory (page 469 figure 26.11)

1. You better have some notes and a diagram.

II. Water flow through the root *page 464 fig. 26.5* *** All water enters the root through the root hairs.

A. Appoplastic pathway - water flows through nonliving structures and spaces.

B. Symplastic pathway - water flows through root cells by osmosis

C. Which way is fastest?

D. What is the function of the **Casparian strip**?

III. <u>Mineral Absorption</u>

A. Many minerals (they are all in solution) pass into the root by simple diffusion.

B. However, many minerals are in higher concentration inside the root than in the soil water surrounding the root. **How must the ions be transported into the root?**

C. Ion exchange (a possible mechanism for the absorption of cations.)

1. The process is driven by cellular respiration

2. $CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$

D. In the soil solution, cations are attracted to soil particles due to their charge.

E. As the carbonic acid is formed, the hydrogen ions generated are exchanged with the cations in the soil.

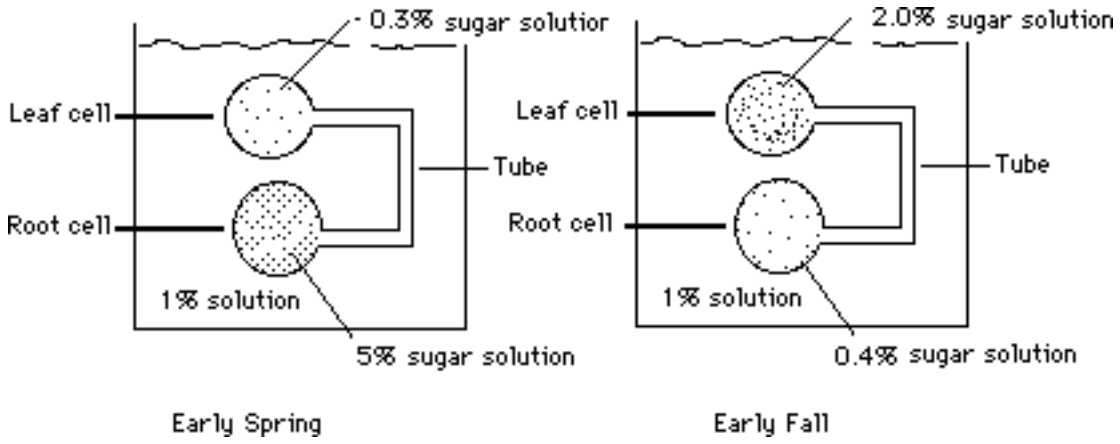
F. What will happen to the soil as this process continues?

G. How does this relate to liming (Calcium carbonate) soil and acid rain?

1. $CaCO_3 \rightarrow Ca^{+2} + CO_3 + H^+ \rightarrow HCO_3^-$

IV. Organic transport through the phloem

A. Pressure flow theory (Page 472 and 473)



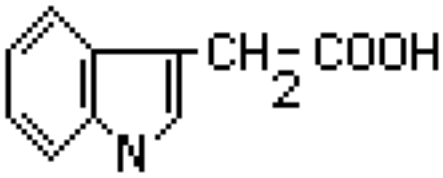
Plant Hormones

I. Definition: A plant growth hormone is an **organic** substance which in **small** amounts helps to **control growth**. Found **naturally** in the plant and is **produced** in one part and acts to **effect** another.

II. Auxins

A. Site of production: Meristematic tissue

B. Structure:



Indole Acetic Acid.

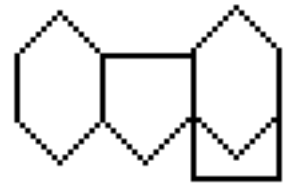
C. Physiological effects:

1. stimulates cell elongation in the **stem**
    a) **stimulates increased cell wall elasticity**
2. stimulates root initiation
3. inhibits root growth
4. stimulates fruit development/ production of seedless fruit
5. stimulates the production of ethylene
6. In high concentrations its a selective herbicide
    a) **2,4-Dichlorophenoxy Acetic Acid (2,4-D)**

III. Gibberellins or Gibberellic Acid (GA)

A. Site of Production: Meristematic tissue

B. Structure



Gibberellin Skeleton

C. Physiological Effects

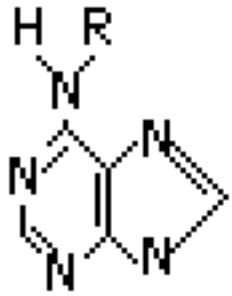
1. stimulates cell elongation
2. stimulates seed germination
3. stimulates the breaking of bud dormancy
4. stimulates production of seedless fruit

D. Cold temperatures stimulate production, warm temperatures inhibit its production

IV. Cytokinins (CK)

A. Site of Production: Roots and developing fruit

B. Structure



Cytokinin Skeleton

C. Physiological Effects

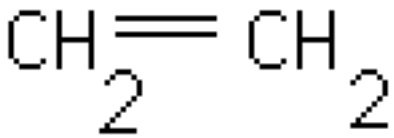
1. stimulates cell division
2. stimulates seed germination
3. stimulates the breaking of bud dormancy
4. overcomes senescence

D. Cold temperatures stimulate production, warm temperatures inhibit its production.

V. Ethylene

A. Site of production: Outer layer of the fruit

B. Structure



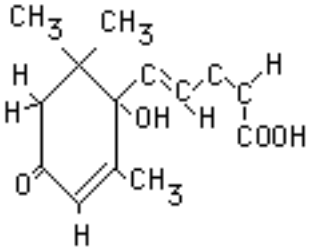
Ethylene

C. Physiological effects

1. Stimulates fruit ripening.
2. Inhibits lateral bud growth
3. Inhibits leaf abscission

VI. Abscissic Acid (ABA)

A. Site of production: Mature green leaves, fruits and root caps
B. Structure



Abscisic Acid

C. Physiological effects

1. inhibits cell division
2. inhibits seed germination
3. stimulates bud dormancy
4. counter acts auxin

D. Cold temperatures inhibit production, warm temperatures stimulate its production.

The role of plant hormones in plant behavior

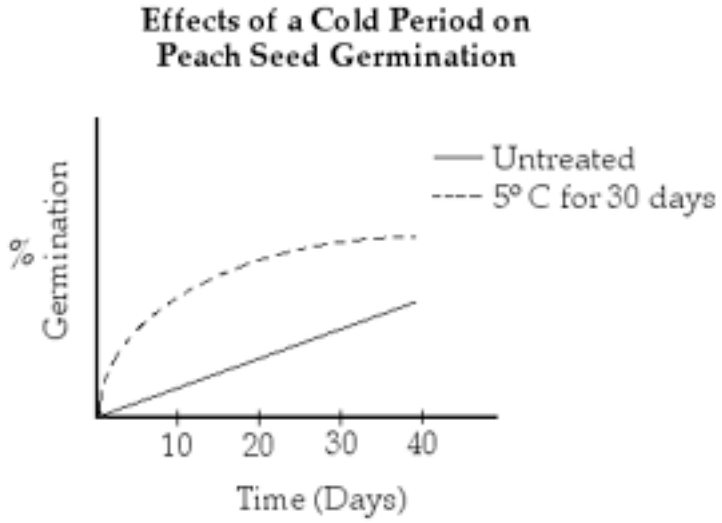
When do seeds start growing? When do trees lose their leaves? Which way do roots grow? Shoots? How does a plant tell time? Find its direction?

I. Seed germination

A. Requirements: oxygen, correct temperature, moisture
B. What time of year do most seeds germinate?
C. How do plants tell the time of year?

1. What is the weather like when seeds are formed?

2. So what hormones should be high in the seeds? *GA and CK low and ABA is high*



D. As the seeds sit through fall and winter, what happens to the hormone levels?

1. Other seeds sensitive to temperature; Dogwood, hazel, ash, walnut and apple.

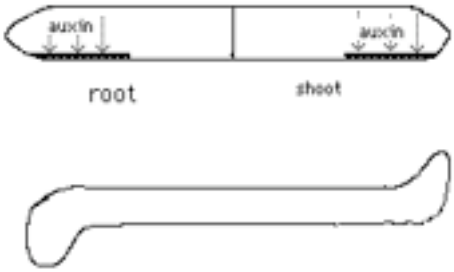
II. After the seed germinates, what is the next problem?

III. Geotropism

A. The growth of a plant toward or away from the force of gravity.

B. Is the root positively or negatively geotropic?

C. How does the root respond to gravity?

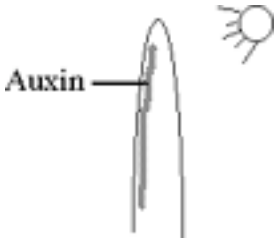


1. Amyloplasts settle on the ER on lower side of the cells of both the stem and root tips.
2. This stimulates the ER to release calcium ions.
3. Calcium ions activate calmodulin.
4. Calmodulin activates membrane bound enzymes.
5. These enzymes pump calcium and auxin across the membrane.
6. There is a cascade of auxin and calcium to the lower side of the plant.
7. Auxin inhibits elongation in the cells on the lower side of the root tip.
8. Auxin stimulates elongation in the cells on the lower side of the shoot tip.

IV. Phototropism

A. What is the definition?

B. Explain the mechanism

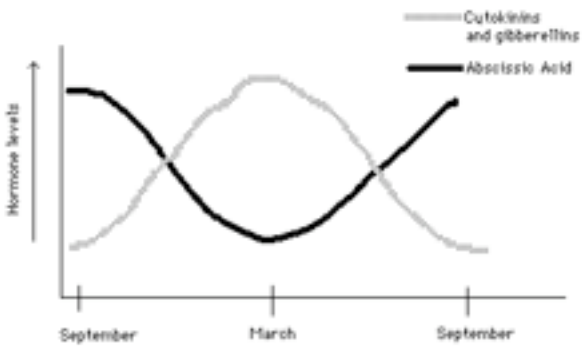


V. As the plant grows is it more advantageous to grow up or out?

A. Apical Dominance

1. The dominance of growth by the apical bud.
2. As you move down the stem the amount of auxins decrease. **Why?**
   a) **Auxin stimulates the production of ethylene and ethylene inhibits lateral bud growth**
3. Cytokinins stimulate lateral bud growth and are produced in the roots.

VI. Bud dormancy



A. Can you explain this?

Photoperiodism

I. Which is more consistent from year to year, temperature or length of day?

II. The photoperiod is the length of the light period.

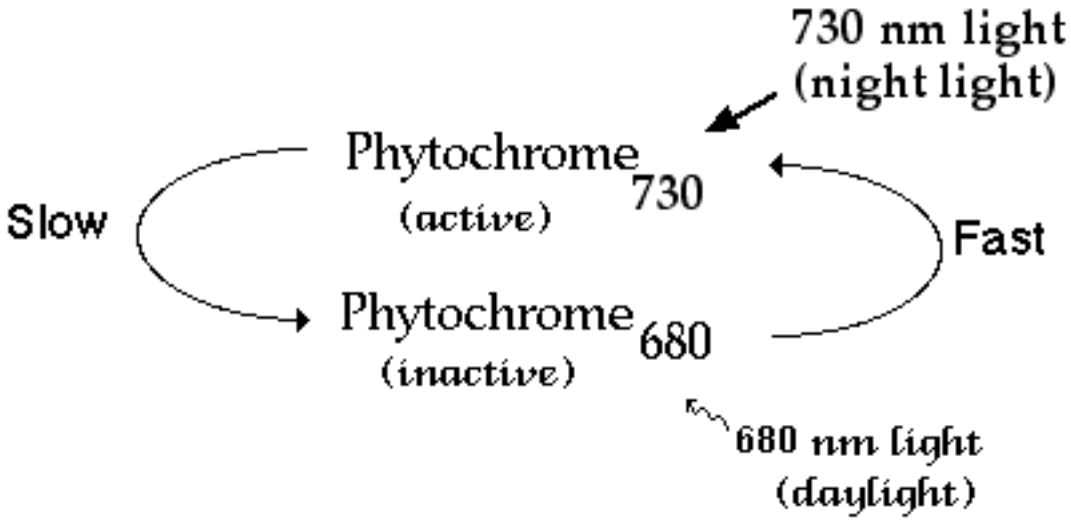
III. Flowering in plants is influenced by the photoperiod

A. Day neutral plants
1. Flowering is <u>not</u> effected by length of day

B. Short day plants
1. Flower when length of day is shorter than critical period.
2. Cocklebur, chrysanthemums, goldenrods, poinsettias, and soybeans.

C. Long day plants
1. Flower when the length of day is longer than the critical period.
2. Irises, clover, spinach and potato.

IV. Phytochrome is a hormone that helps the plant measure length of day.



A. In **long** day plants, P730 **stimulates** flowering.

B. In **short** day plants, P730 **inhibits** flowering.

1. What happens if a long day plant is exposed to 16 hours of light and 8 hours of darkness? A short day plant?
2. What happens if a long day plant is exposed to 16 hours of darkness and 8 hours of light? A short day plant?
3. What happens if we interrupt the 16 hours of darkness with a short period of light?