GROWTH AND DEVELOPMENT

VEGETATIVE GROWTH AND DEVELOPMENT

- Shoot and Root Systems

- Root functions
  - Anchor
  - Absorb
  - Conduct
  - Store

  As the shoot system enlarges, the root system must also increase to meet demands of leaves/stems

MEASURING GROWTH

- Increase in fresh weight
- Increase in dry weight
- Volume
- Length
- Surface area

MEASURING GROWTH

- Classifying shoot growth
  - **Determinate** – flower buds initiate terminally; shoot elongation stops; e.g. snap beans
  - **Indeterminate** – flower buds born laterally; shoot terminals remain vegetative;

SHOOT GROWTH PATTERNS

- Annuals
  - Herbaceous (nonwoody) plants
  - Complete life cycle in ***one growing season***

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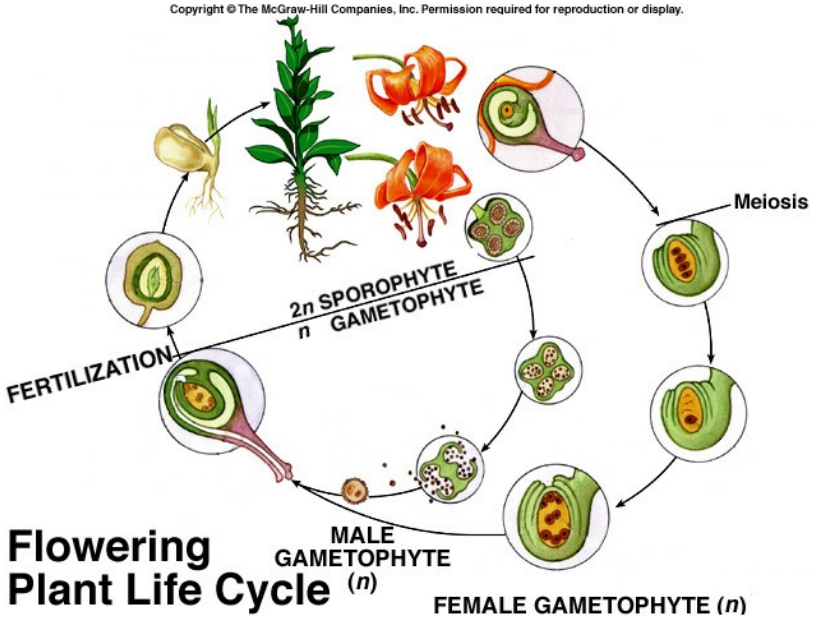

Flowering Plant Life Cycle

SHOOT GROWTH PATTERNS

- Biennials
  - Herbaceous plants
  - Require ***two growing seasons*** to complete their life cycle (not necessarily two full years)
  - Stem growth limited during first growing season;

    see fig. 9-4; Note vegetative growth vs. flowering

    e.g. celery, beets, cabbage, Brussels sprouts

SHOOT GROWTH PATTERNS

- Perennials
  - Either herbaceous or woody
  - **Herbaceous** roots live indefinitely (shoots can)
    - Shoot growth resumes in spring from adventitious buds in crown
    - Many grown as annuals
  - **Woody** roots and shoots live indefinitely
    - Growth varies with annual environment and zone
    - Pronounced diurnal variation in shoot growth; night greater

ROOT GROWTH PATTERNS

- Variation in pattern with species and season
- Growth peaks in spring, late summer/early fall
  - Spring growth from previous year's foods
  - Fall growth from summer's accumulated foods
- Some species roots grow during winter

HOW PLANTS GROW

- Meristems
  - Dicots
    - Apical meristems – vegetative buds
      - shoot tips
      - axils of leaves
    - Cells divide/redivide by mitosis/cytokinesis
    - Cell division/elongation causes shoot growth
    - Similar meristematic cells at root tips

HOW PLANTS GROW

- Meristems (cont)
  - Secondary growth in woody perennials
    - Increase in diameter
      - due to meristematic regions
    - vascular cambium
      - xylem to inside, phloem to outside
    - cork cambium
      - external to vascular cambium
      - produces cork in the bark layer

GENETIC FACTORS AFFECTING GROWTH AND DEVELOPMENT

- DNA directs growth and differentiation
  - Enzymes catalyze biochemical reactions
- Structural genes
  - Genes involved in protein synthesis
- Operator genes
  - Regulate structural genes
- Regulatory genes
  - Regulate operator genes

GENETIC FACTORS AFFECTING GROWTH AND DEVELOPMENT

- What signals trigger these genes?
  - Believed to include:
    - Growth regulators
    - Inorganic ions
    - Coenzymes
    - Environmental factors; e.g. temperature, light
  - Therefore . . .
    - Genetics directs the final form and size of the plant as altered by the environment

ENVIRONMENTAL FACTORS INFLUENCING PLANT GROWTH

- Light
- Temperature
- Water
- Gases

Signal transduction pathways link signal reception to response

- All organisms received specific signals/respond to them in ways that enhance survival/reproductive success
- Plants have cellular receptors that detect changes in their environment (molecule affected by stimulus)
  - *For stimulus to elicit response, certain cells must have appropriate receptor*
  - *Stimulation of receptor initiates specific signal transduction pathway*

(a) Before exposure to light

Tall, spindly stem/nonexpanded leaves (morphological adaptations called etiolation enable shoots to penetrate soil, including short roots due to little need for water absorption from little water loss by shoots)

Expanded leaves hindrance as shoots push through soil/chlorophyll waste of energy (underground)

(b) After a week's exposure to natural daylight

Begins to resemble typical plant w/broad green leaves, short sturdy stems, long roots (transformation begins w/reception of light by specific pigment, phytochrome) by undergoing changes (de-etiolation) by reception of signal (light) which is transduced into responses (greening)

ENVIRONMENTAL FACTORS INFLUENCING PLANT GROWTH

- Light
  - Intensity
  - Quality
  - Duration

ENVIRONMENTAL FACTORS INFLUENCING PLANT GROWTH

- Light (cont)

  narrow band affects plant photoreaction processes

  PAR (Photosynthetically Active Radiation)

  400-700nm

  stomates regulated by red (660nm), blue (440nm)

  - **photomorphogenesis** – shape determined by light
    - controlled by pigment **phytochrome**
    - phytochrome absorbs red (660nm) and far-red (730nm) but not at same time