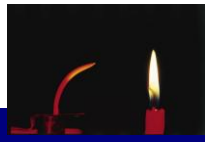


Chapter 39

Plants Response

Plant Reactions

- Stimuli & a Stationary life
  - Animals respond to stimuli by changing behavior
    - Move toward positive stimuli
    - Move away from negative stimuli
  - Plants respond to stimuli by adjusting growth & development

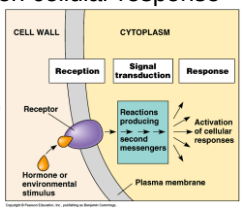
What mechanisms causes this response?

Grown in Dark

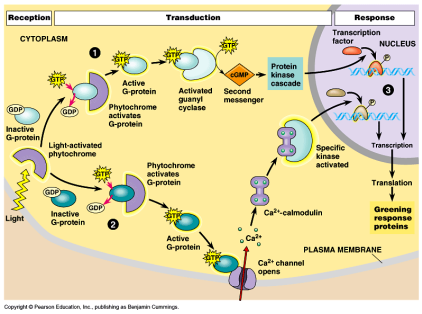
1 week exposure to light

Signal Transduction Pathway model

- Signal triggers receptor
- Receptor triggers internal cellular messengers & then cellular response
  - Receptor
  - Signal pathway (2^o messengers)
  - response



Signal Transduction Pathway example



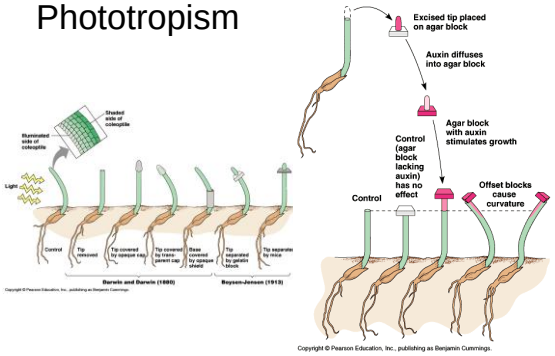
Plant Hormones

- Chemical signals that coordinate different part of an organisms
  - Only minute amounts are required
  - Produced by 1 part of body
  - Transported to another part
  - Binds to a specific receptor
  - Triggers response in target cells & tissues

Plant hormones

- Auxin
- Cytokinins
- Gibberillins
- Brassinosteroids
- Abscisic acid
- Ethylene

Phototropism

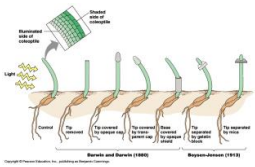


Plant hormones

Jigsaw activity:

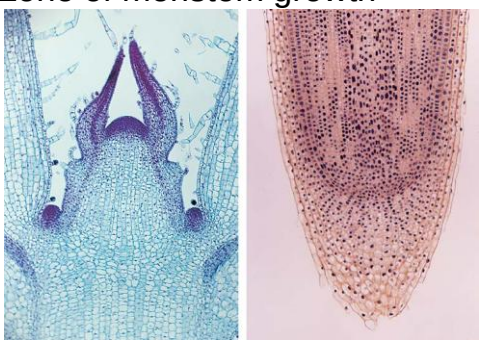
- Auxin
- Cytokinins
- Gibberillins
- Brassinosteroids
- Abscisic acid
- Ethylene

Auxin



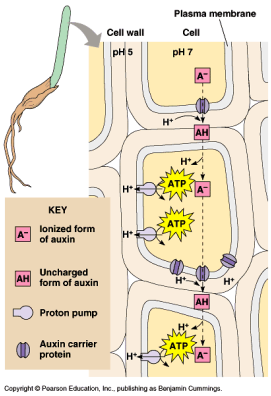
- Indolacetic acid (IAA)
  - Stimulates cell elongation
    - Near apical meristems
  - Enhances explanation of phototropism
    - Asymmetrical distribution of auxin
    - Cells on darker side elongate faster than cells than cells on brighter side

Zone of meristem growth



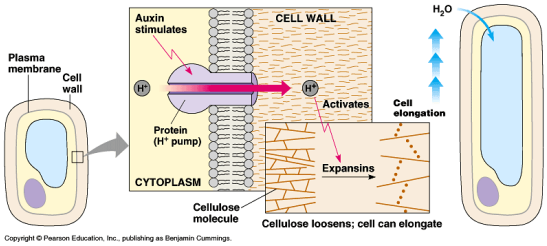
Polarity of Auxin

1. Auxin picks up H+ between cells & is neutralized
2. Neutral auxin passes through membrane
3. Cellular pH 7 causes auxin to ionize & is trapped in cell
4. Auxin stimulates proton pump
5. Auxin leaves through carriers



Auxin response

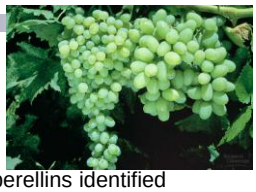
- Acid growth hypothesis



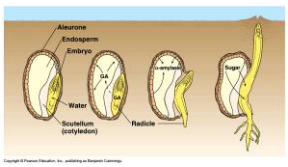
Cytokinins

- Family of hormones
  - Modified forms of adenine
  - Produced in roots, fruits, & embryos
- Effects
  - Control of cell division & differentiation
  - Enhances apical dominance
    - Interaction of auxin & cytokinins

Gibberellins



- Family of hormones
  - Over 100 different gibberellins identified
- Effects
  - Stem elongation
  - Fruit growth
  - Seed germination



Brassinosteroids

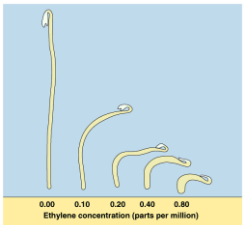
- Steroids
- Effects
  - Similar to auxins
  - Cell elongation & division in shoots and seedlings

Abscisic acid (ABA)

- Effects
  - Slows growth
  - Seed dormancy
    - High concentration of ABA
      - Germination only after ABA is inactivated down or leached out
    - Survival value: seed will germinate only under optimal conditions
      - Light, temperature, moister
    - Drought tolerance
      - Rapid stomate closing

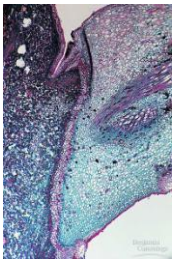
Ethylene

- Ethylene is a gas released by plant cells
- Multiple effects
  - Response to mechanical stress
    - Slow stem elongation
    - Thickening of stem
    - Curvature to horizontal growth
  - Apoptosis
  - Leaf abscission
  - Fruit ripening



Apoptosis & leaf abscission

- Balance of ethylene & auxin
  - Many events in plants involve pre-programmed cell death
    - Death of annual plant after flowering
    - Differentiation of xylem vessels
      - Loss of cytosol
    - Shedding of autumn leaves



Fruit Ripening

- Hard, tart fruit protects developing seed from herbivores
- Ripe, sweet, soft fruit attracts animals to disperse seed
  - Burst of ethylene triggers fruit ripening process
    - Breakdown of cell wall = softening
    - Conversion of starch to sugar = sweetening
  - Positive feedback system
    - Ethylene triggers ripening
    - Ripening stimulates more ethylene production

Applications

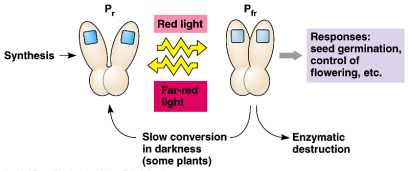
- Truth in folk wisdom!
  - One bad apple spoils the whole bunch
    - Ripening apple releases ethylene to speed ripening of fruit nearby
  - Ripen green bananas by bagging them with an apple
  - Climate control storage of apples
    - High CO2 storage = reduces ethylene production

Respond to light

- Photomorphogenesis
  - Effect of light on plant growth
- Light detection
  - Intensity
  - Direction
  - Wavelength
    - Blue-light receptors
    - Phytochromes (red-light receptors)

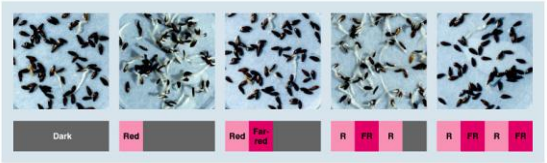
Phytochrome photoreceptors

- Molecular switch reaction to red light
  - Conversion to P_r → P_{fr} in sunlight stimulates germination, flowering, branching…
  - Conversion of P_{fr} → P_r in dark inhibits response, & stimulates other responses: growth & height



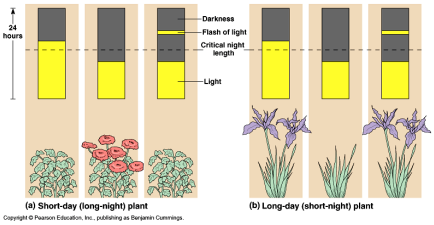
Practical application

- Why do you plant lettuce seeds by scattering them on the ground?
- What is the evolutionary advantage?



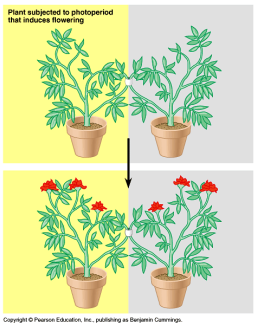
Flowering response

- Triggered by photoperiod
  - Relative lengths of day & night
  - Night length –"critical period" – is trigger



Is there a flowering hormone?

- Plant on left is induced to flower & then grafted onto plant on right
  - Plant on right is triggered to flower

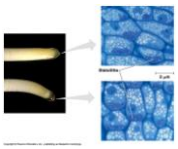


Circadian rhythms

- Internal (endogenous) 24- hour cycle

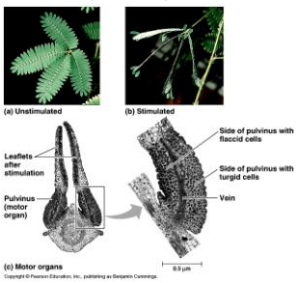
Responses to gravity

- How does a sprouting shoot "know" to grow towards then surface from underground?
  - Environmental cues?
    - Roots = positive gravitropism
    - Shoots = negative gravitropism
    - Settling of statoliths (dense starch grains) may detect gravity



Response to touch

- Thigmotropism

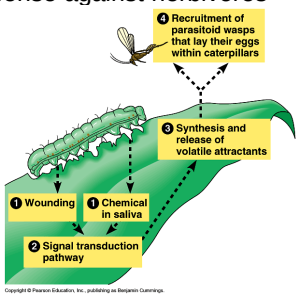


Mimosa (sensitive plant) closes leaves in respond to touch

Caused by changes in osmotic pressure = rapid loss of K+ = rapid loss of H2O = loss of turgor in cells

Plant defenses

- Defense against herbivores



Plant defenses

- Defense against pathogens