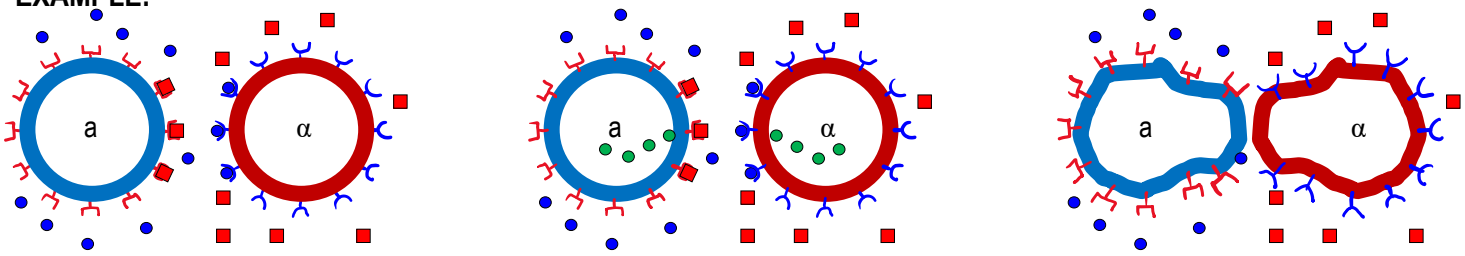
CONCEPT: PHOTOTROPISM

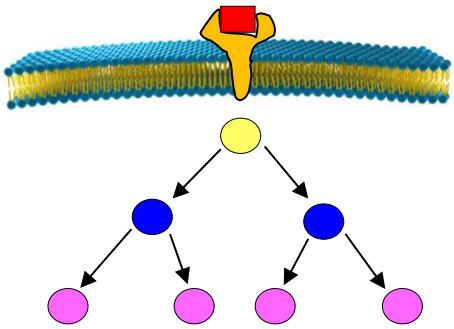
- ***Signal transduction*** – transmission of molecular signals leading to change in metabolism, gene expression, etc.
  - □ ***Reception*** – ligand binds to a receptor effecting a change in the protein, ligands are specific to receptors
  - □ ***Transduction*** – a series of proteins and other molecules interact in response to receptor-ligand binding
  - □ ***Response*** – a change is elicited determined by the cell's receptors and signal transduction pathways

EXAMPLE:



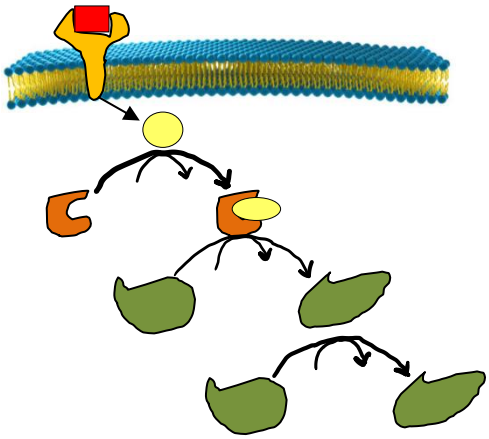
- ***Hormone*** – signaling molecule that affects gene expression, cell division, and growth
  - □ Hormone's structures make them bind only to specific receptors
  - □ The presence/absence of specific receptors for a hormone determine a cell's response to the signal
  - □ ***Signal amplification*** allows for few signaling molecules to exert a widespread and significant effect

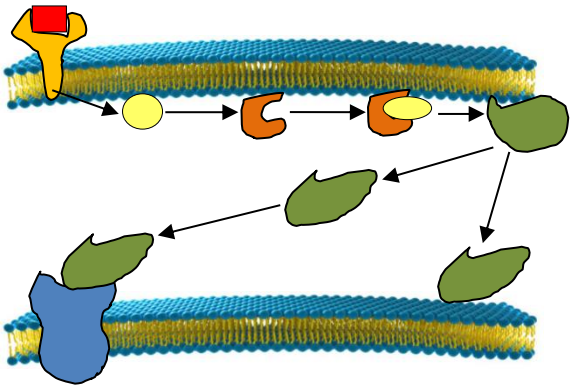
EXAMPLE:



- ***Phosphorylation cascades*** – activate and deactivate a series of proteins through the transfer of phosphate groups
- ***Second messengers*** – intracellular signaling molecules involved in signal transduction pathways

EXAMPLE:





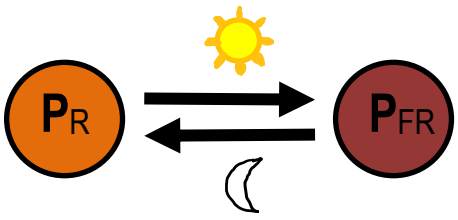
CONCEPT: PHOTOTROPISM

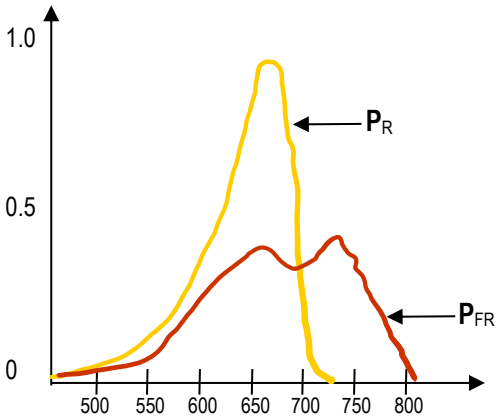
- Etiolation – plant responses to the absence of sunlight: growth toward sun, longer internodes, chlorosis
- Detiolation – plant responses to sunlight, in part regulated by phytochromes
- ***Photomorphogenesis*** – plant growth patterns responding to different spectrums of light
- ***Tropism*** – movement of a plant in response to an environmental stimulus
- ***Phototropism*** – growth toward or away from light
    - □ ***Photoreceptors*** – proteins that respond to stimulation from certain wavelengths of light
        - ***Phototropins*** – blue-light photoreceptor involved in phototropism, involved in stomata opening/closing

EXAMPLE:

- Plants use red (660-700nm) and blue light (430-470nm) for photosynthesis, sensitive to light of those wavelengths
- Far-red light (>710nm) is not absorbed by photosynthetic pigments, passes through leaves, and indicates shade
- Red/far-red switch – red light promotes seed germination, far-red light inhibits it
    - □ Photoreversibility – molecule has two forms that react to different wavelengths of light, changing its conformation
    - □ ***Phytochrome*** – photoreversible photoreceptor sensitive to red and far-red wavelengths of light
        - Light stimulation causes phosphorylation/desphosphorylation inducing conformational changes
- Shade avoidance – far-red light causes plants to lengthen stems or induce branching, attempting to grow into direct light

EXAMPLE:

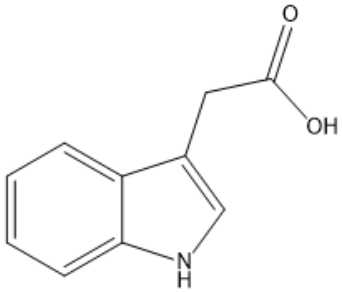


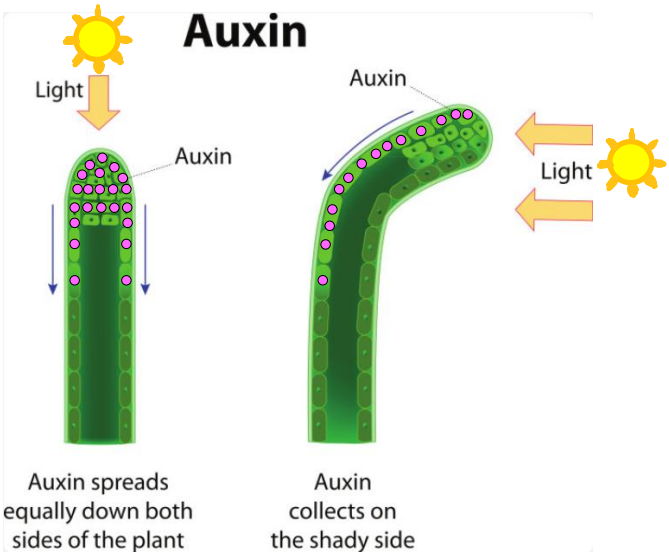


CONCEPT: PHOTOTROPISM

- ***Auxin*** (indoleacetic acid) – hormone responsible for plant growth in response to light
  - □ Coleoptiles release auxin allowing seedlings to bend towards light
  - □ Cholodny-Went hypothesis – auxin produced at the tip moves from light to shade side of the plant
    - Asymmetric auxin distribution causes cells on the shade side to grow more than those in light

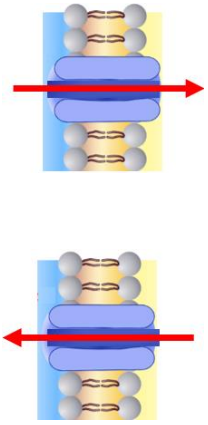
EXAMPLE:

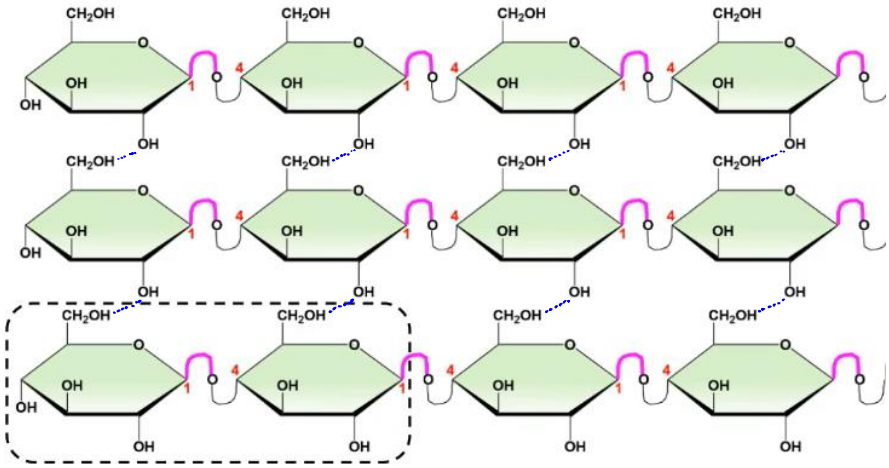




- Acid-growth hypothesis – proton pumps concentrate H^+ in cell wall causing expansins to allow water in
  - □ ***Expansins*** – proteins that loosen H-bonds between cellulose fibers, that are normally water-tight
  - □ H^+ creates electrochemical gradient that brings K^+ into the cell, water moves in based on osmotic gradients

EXAMPLE:





- Auxin plays a central role in many plant functions, and is transported in a polar manner from shoots to roots
  - □ Polar transport – unidirectional transport, transport of auxin is polar and unaffected by gravity
  - □ Pattern formation of developing plants and phyllotaxy (the arrangement of leaves on a stem)
  - □ Abscission – shedding of leaves and fruits
  - □ Apical dominance – central plant stem is dominant over lateral stems, and controls growth

CONCEPT: PHOTOTROPISM

● Circadian rhythms – daily (~24 hour) cycles generated internally, but can be influenced by environment

□ Cryptochromes – blue-light receptor thought to play a role in circadian rhythms

EXAMPLE:

● ***Photoperiodism*** – physiological response to seasonal changes in the lengths of day/night

□ Long-day plants – bloom when days are longest during summer

□ Short-day plants – bloom when days are shorter during spring and late-summer/fall

□ Day-neutral plants – day length has no effect on blooming

□ Vernalization – pretreatment of plant with cold necessary for photoperiod blooming response

● ***Florigen*** – hypothetical hormone that induces flowering