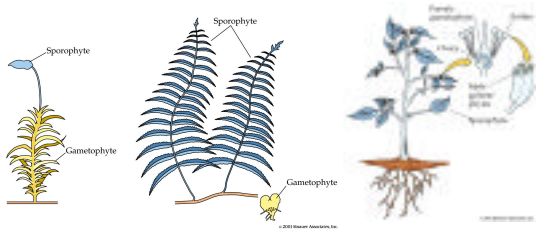
The evolution of seed plants

Chapter 29

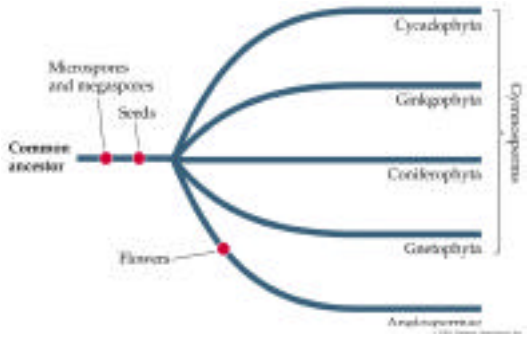
Seed plants

✓ Fertilization without water
- ⇨Internal fertilization
- ✒Homosporous - one kind of spore
- ✒Heterosporous - male & female spores
  - ⇨Microspores - male
  - ⇨Megaspores - female
- ✒Megasporangium - ovule + integument (protective coating)
- ✒Microsporangium - pollen development
- ✒Embryo
- ✒Seed
  - ⇨Zygote - develops into the embryo 2n
  - ⇨food source
  - ⇨Seed coat

Sporophyte - gametophyte relationship



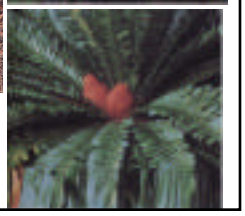
Gymnosperms (Naked Seeds)



Gymnosperms (Naked Seeds)

✓ Cycads
- ✒Palm-like leaves
- ✒ “sago palms”
- ✒Tropical areas
- ✒20 meter tall
- ✒Homosporous
- ✒Large strobili

Cycadophyta



Ginkophyta

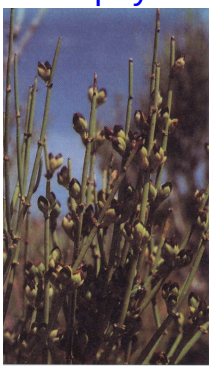
- ✓Ginkos
  - ✒Maidenhair tree - living fossil
  - ✒*Gingko biloba*
  - ✒Fan-like leaves
  - ✒Male and female trees
  - ✒Homosporous
    - ☞Male - strobili
    - ☞Female - fleshy, smelly seeds

Ginkophyta

Gnetophyta

- ✓Three genera
  - ✒*Gnetum*, *Ephedra*, *Welwitschia*
    - ☞Mormon tea
  - ✒strobili

Gnetophyta

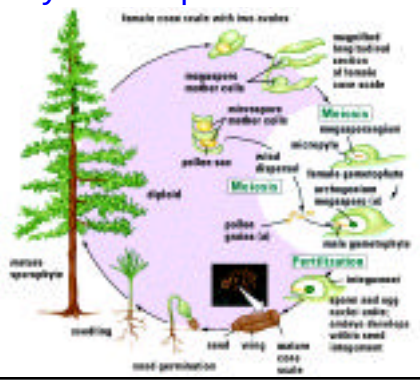


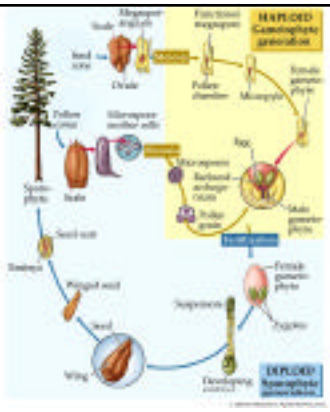
Coniferophyta (cone + carry)

- ✒Pines, furs, spruces, redwoods and cedars
- ✒Needles
  - ☞Megaphylls,
  - ☞Minimize evaporation
- ✒Cones - (no motile cells)
- ✒Secondary growth
- ✒Homosporous & heterosporous

Coniferophyta

Life cycle of a pine

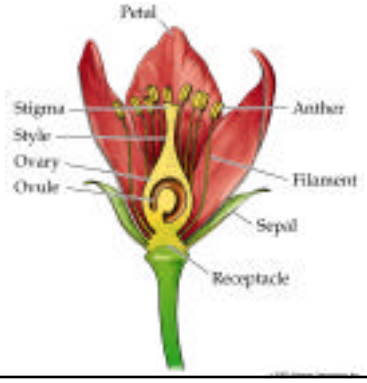




Angeosperms (flowering plants)

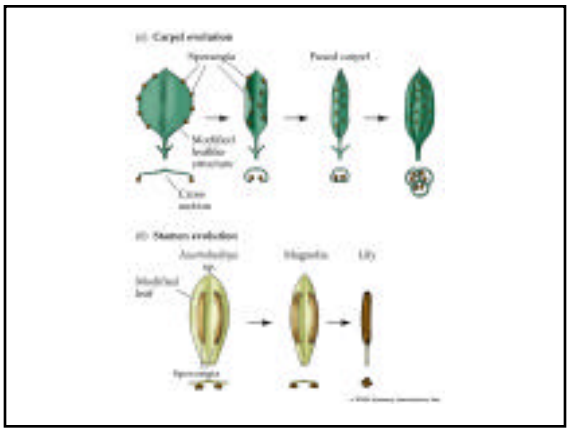
- ✓ Double fertilization
  - ⇨One sperm - nucleus of ovum
  - ⇨One sperm - two nuclei of the central- 3n
    - endosperm
- ✓ 3n endosperm
- ✓ Flowers, fruit, ovules, and seeds in carpels,
- ✓ Pollination
  - animals vectors
    - ⇨Insects (bees, butterflies, moths), birds, bats, beetles, flies,
  - Wind
    - ⇨Grasses, rushes, sedges, birch, poplar, oak
- ✓ Fruits
  - ⇨Seed dispersal
    - Peaches, apples, dandelion, maple, burrs, coconuts

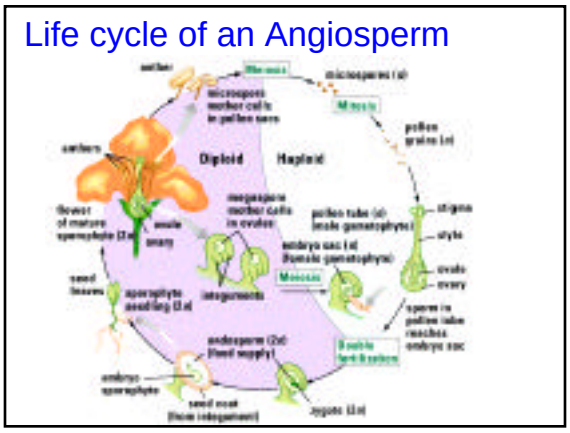
Flower structure

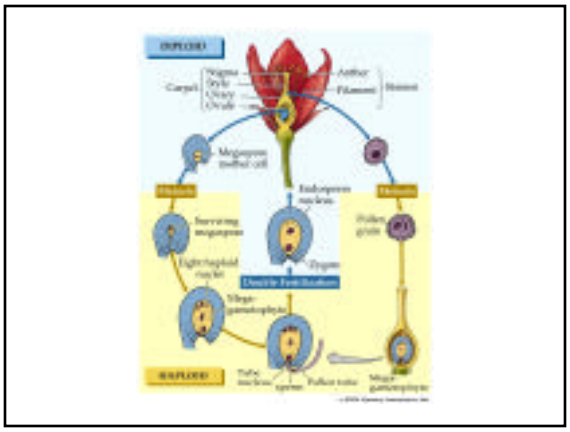


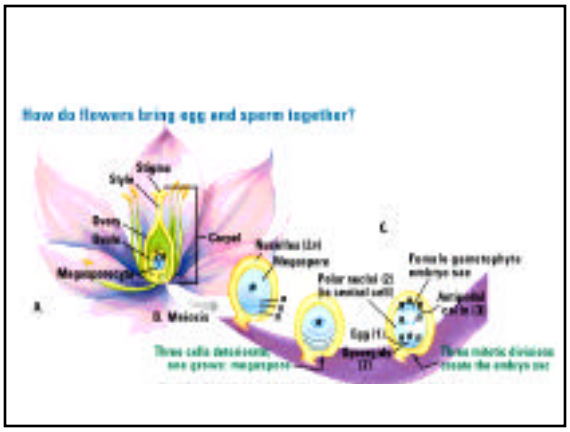
Flower parts

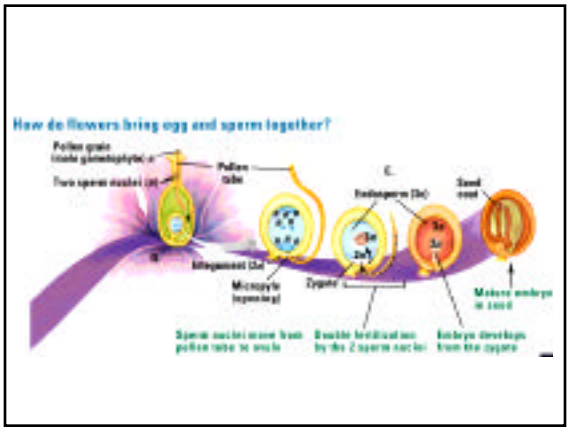
- ✓ Sporangia - modified leaves
- ✓ Male
  - Stamens
    - ⇨Anther, filament
- ✓ Female
  - Carpels (pistal)
    - ⇨Ovary, stigma, style,
- ✓ 4 whorls
  - Pistil - one or more carpels
  - Stamens -- anther and filament
  - Corolla made of Petals -- colored and attract pollinators - 3 to 5
  - Calyx - 4th whorl and outer whorl
    - ⇨Sepals -- leave-like parts -3 to 5

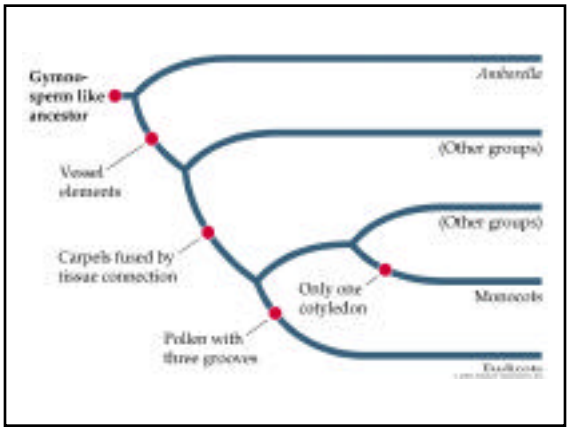



Life cycle of an Angiosperm
Diploid
Haploid
Meiosis
Mitosis
Double fertilization




How do flowers bring egg and sperm together?
Stigma
Style
Ovary
Carpel
Megasporocyte
Nucellus (2n)
Megaspore
Polar nuclei (2)
Egg (1)
Female gametophyte
embryo sac
Antipodal
cells (3)
Meiosis
Three cells degenerate,
one grows megaspore
Three mitotic divisions
create the embryo sac


How do flowers bring egg and sperm together?
Pollen grain
(male gametophyte) (n)
Two sperm nuclei (n)
Pollen
tube
Seed
coat
Endosperm (3n)
Integument (2n)
Micropyle
(opening)
Zygote
Mature embryo
in seed
Sperm nuclei move from
pollen tube to ovule
Double fertilization:
by the 2 sperm nuclei
Embryo develops
from the zygote


Gymno-
sperm like
ancestor
Vessel
elements
Carpels fused by
tissue connection
Pollen with
three grooves
Only one
cotyledon
Monocots
(Other groups)
(Other groups)
Angiosperms

Monocots and dicots

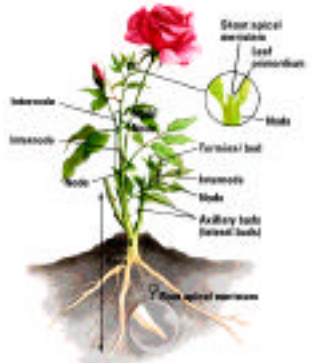
✓ Dicots
- ✒Flower parts in 4s or 5s
- ✒2 codyledons
- ✒Netlike leaf venation
- ✒Primary vascular bundles in a ring
- ✒usually secondary growth - vascular cambium

✓ monocots
- ✒In 3s
- ✒1
- ✒Usually parallel
- ✒Complex arrangement
- ✒rarely

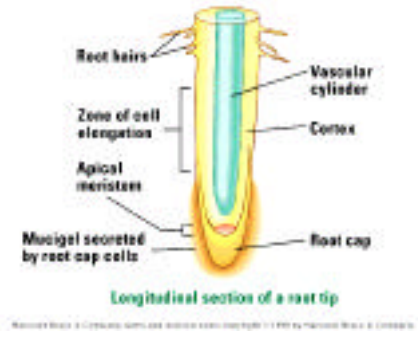
Monocots

Dicots

Apical meristems



Growth in a root

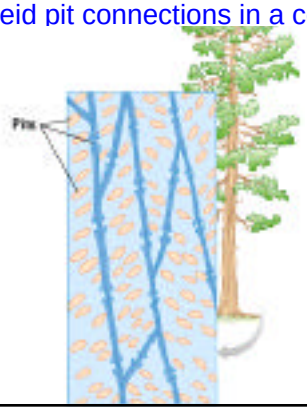


Secondary growth

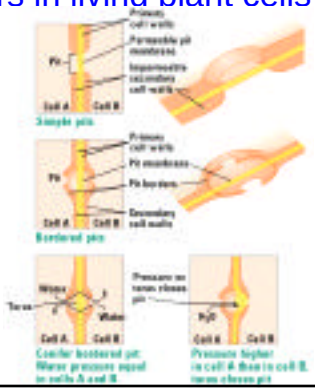
Plant hormones

✓ Auxins - cell elongation, root growth, phototrophism
✓ Ethylene - short fat seedings
✓ Gibberellin - tall, thin seedlings

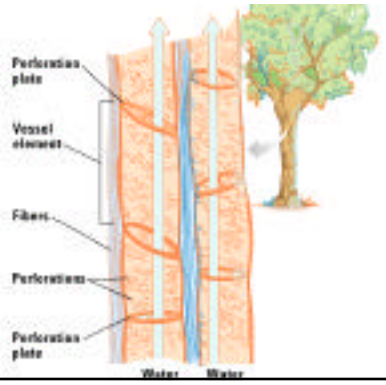
Tracheid pit connections in a conifer



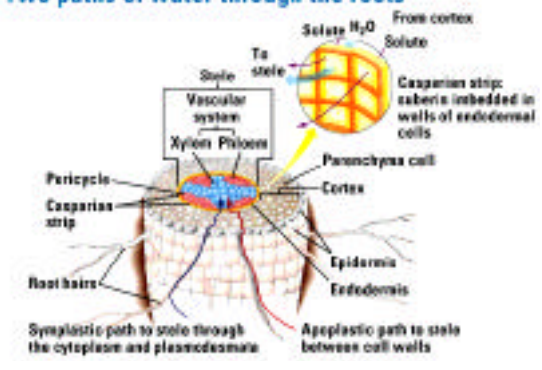
Pit pairs in living plant cells



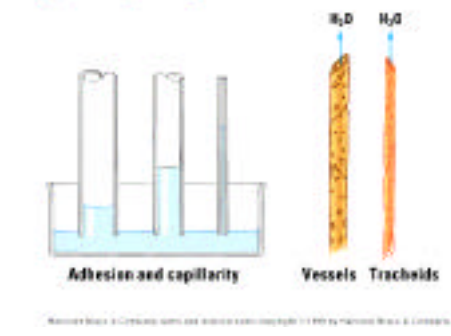
Vessel elements



Two paths of water through the roots

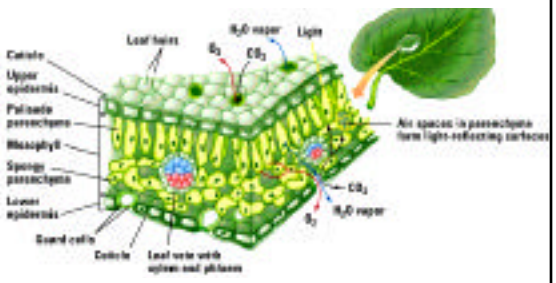


Is capillarity enough?

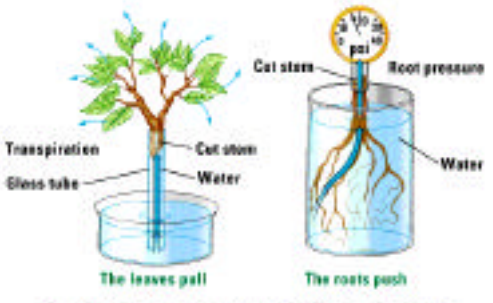


Transpiration - cohesion theory

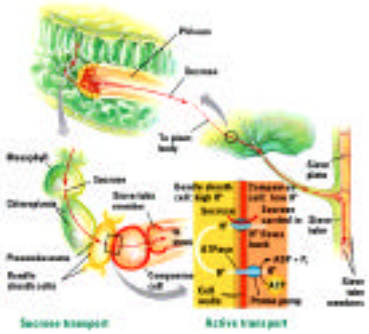
Pathway of water in the leaf



Root pressure



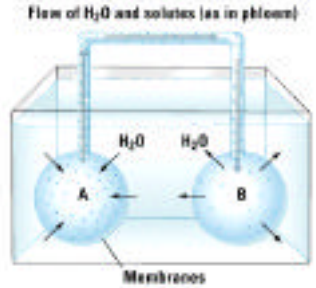
Loading up on sugar

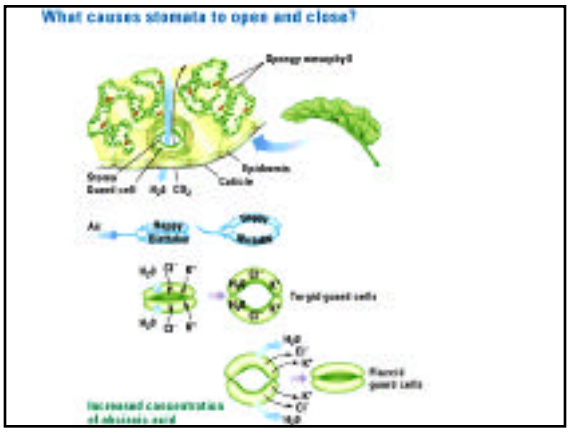


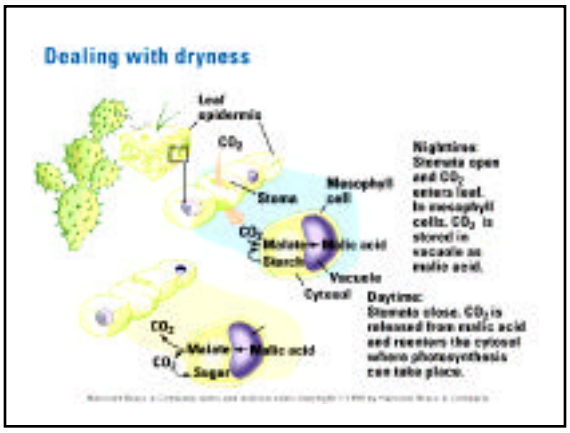
Sugar on the outside

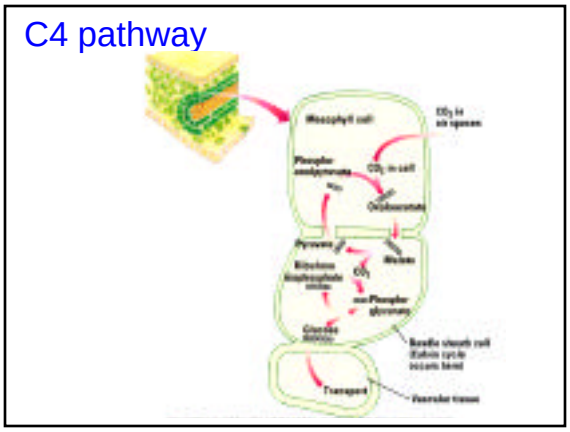
B. Girdling a living tree kills it by breaking off the flow of sugars from the leaves to the roots.

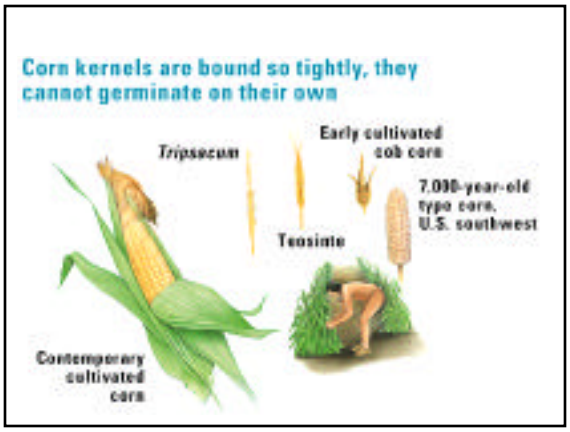
Munch's model for the pressure flow hypothesis




What causes stomata to open and close?


Dealing with dryness
Leaf epidermis
Stoma
Mesophyll cell
Vacuole
Cytosol
Nighttime: Stomata open and CO2 enters leaf. In mesophyll cells, CO2 is stored in vacuole as malic acid.
Daytime: Stomata close. CO2 is released from malic acid and reenters the cytosol where photosynthesis can take place.


C4 pathway


Corn kernels are bound so tightly, they cannot germinate on their own
Tripsacum
Early cultivated cob corn
7,000-year-old type corn, U.S. southwest
Teosinte
Contemporary cultivated corn