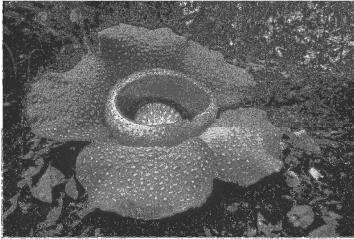


The Diversity of Plants

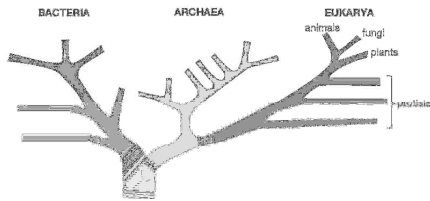
Chapter 21



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Plants are in Domain Eukarya

- Immediate ancestors are green algae, a type of Protista, that lived in fresh water. They share:
 - ❖ Similar DNA
 - ❖ Same photosynthetic pigments (most plants are primary producers)
 - ❖ Store food as starch
 - ❖ Cell walls made of cellulose



Kingdom Plantae

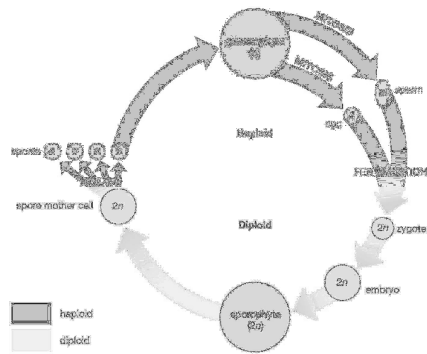
- **All are eukaryotes**
- Cell walls made of cellulose
- Most are primary producers
 - ❖ Carry out photosynthesis!
 - ❖ Chloroplasts are sites of photosynthesis
- Some are parasites
 - ❖ Example: mistletoe!



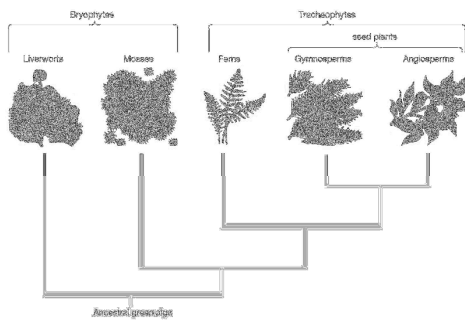
Key feature: Alternation of generations

- A diploid sporophyte produces haploid spores.
 - ❖ The sporophyte is usually the common form of the plant.
- Haploid spores divide to become haploid gametophytes.
- Haploid gametophytes produce haploid gametes (eggs and sperm)
- Egg and sperm unite to form the diploid zygote.
- Zygote develops into the embryo.
 - ❖ Embryo relies on nutrients from parent
- Embryo develops into the sporophyte

Visual picture of plant reproduction

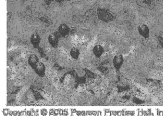
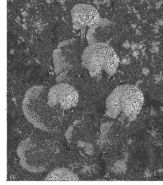


Major groups of plants



Bryophytes

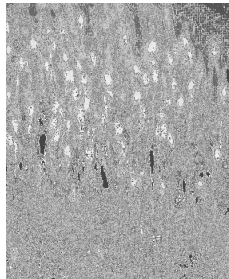
- Examples: liverworts and mosses
- Most similar to ancestral green algae
- Non-vascular: lack special conducting vessels for movement of water and materials
 - ❖ No true roots, leaves or stems
 - ❖ Body size limited



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Bryophyte reproduction

- Haploid gametophyte is dominant (green in photo)
 - ❖ Produces gametes in specialized structures (keep gametes moist!)
- Requires water for sperm to swim to egg
 - ❖ Egg chemically attracts the sperm
 - Egg stays in its "archegonium" attached to the gametophyte
 - ❖ Fertilization within archegonium
 - ❖ Zygote → Embryo → sporophyte
- Sporophyte remains attached to gametophyte (brown stalks)
 - ❖ Develops and produces spores
- Spores disperse; develop into gametophytes

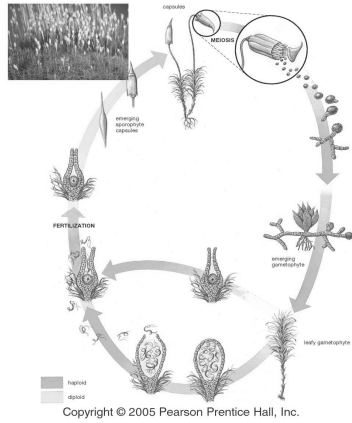


Mosses live in wetlands

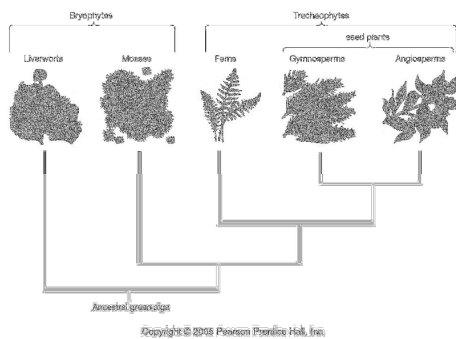
- Especially bogs



Moss life cycle



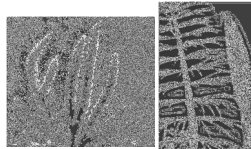
Major groups of plants



Tracheophytes: vascular plants

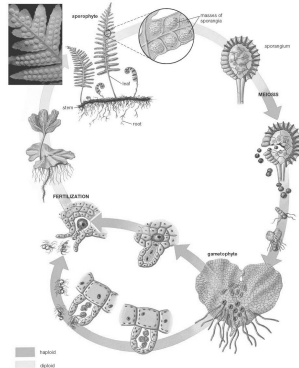
1: Seedless vascular plants

- All vascular plants have vessels reinforced with lignin
 - ❖ Movement of materials
 - ❖ Support
- All vascular plants have dominant sporophytes
- Examples of seedless vascular plants
 - ❖ club mosses ("ground pines")
 - ❖ Horsetails
 - ❖ ferns
 - ❖ All are found in moist woodland habitats



Fern life cycle

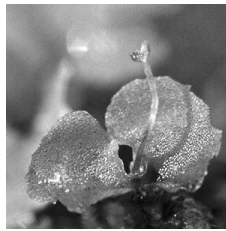
- Sporophyte dominant
 - ❖ Diploid sporangia on leaf underside produce haploid spores.
- Gametophyte tiny
 - ❖ Has specialized, egg and sperm producing structures (just like bryophytes (i.e. mosses!))
 - ❖ Eggs retained in archegonium
 - ❖ Sperm swims to egg; fertilization within archegonium
 - ❖ Zygote → Embryo → sporophyte



Ferns: sporophyte & gametophyte

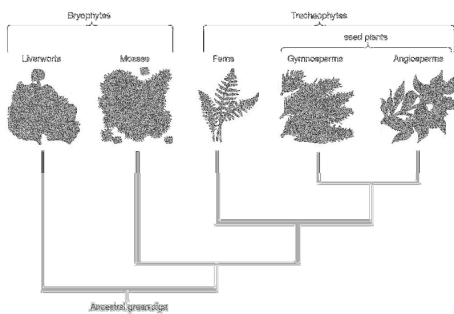


Sporophyte



Gametophyte

Major groups of plants



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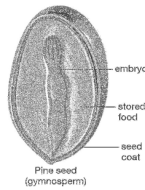
Tracheophytes: vascular plants

2: Vascular plants with seeds

- Different from the seedless vascular plants

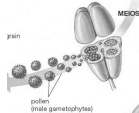
- ❖ Produce seeds!

- Contain developing embryos
 - Contain stored food
 - Protected by seed coat



- ❖ Produce pollen

- Pollen grains are the sperm-producing (male) gametophytes
 - Can disperse by wind or pollinators
 - **Fertilization no longer tied to water!**

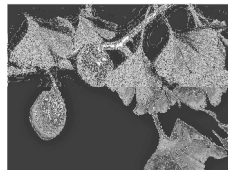


Gymnosperms: non-flowering seed plants

- Examples

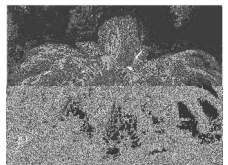
- ❖ Ginkgos

- Probably the first "modern-day" seed plants
 - Maintained by cultivation in Asia
 - Pollution resistant
 - Does *Ginkgo biloba* improve memory?



- ❖ Cycads

- Resemble large ferns
 - Slow-growing
 - Long-lived
 - One Australia cycad is ~5000 years old!



- ❖ Conifers (next page)

Gymnosperms: non-flowering seed plants

- Conifers

- ❖ Pines, firs, spruces, hemlocks, cypresses

- ❖ Many are well-adapted to cold, dry conditions

- Retain green leaves year round; can photosynthesize and grow all year
 - Waterproof coating of needles (leaves) prevents water loss
 - Contain an "antifreeze" in their sap that allows for nutrient transport in sub-zero temperatures

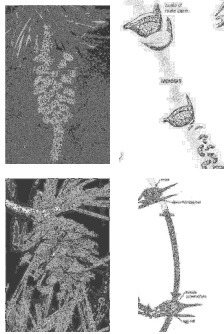


Conifer life cycle

- Sporophyte has male and female cones

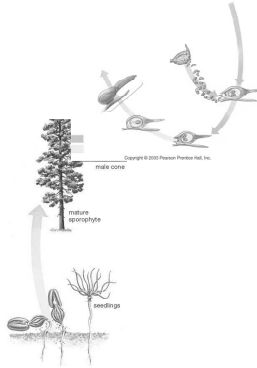
- ❖ Male gametophytes (pollen) produced in male cones
 - Pollen grains have "wings" and disperse on the wind

- ❖ Female gametophyte is within scale of female cone
 - The "ovule" contains spores that divide (meiosis) to become the gametophyte
 - Gametophyte produces the eggs.



Conifer (gymnosperm) life cycle

- Fertilization within female cone
 - ❖ Pollen lands on cone; pollen tube extends slowly to ovule
 - Tube takes 14 months to grow, deposit sperm
- After fertilization, the ovule develops into the seed with
 - ❖ Embryo
 - ❖ Nutrients
 - ❖ Seed coat
- Seed germinates →
- Seedling → mature sporophyte



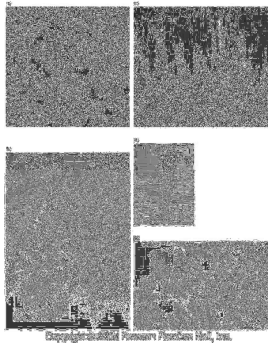
Pinyon nuts

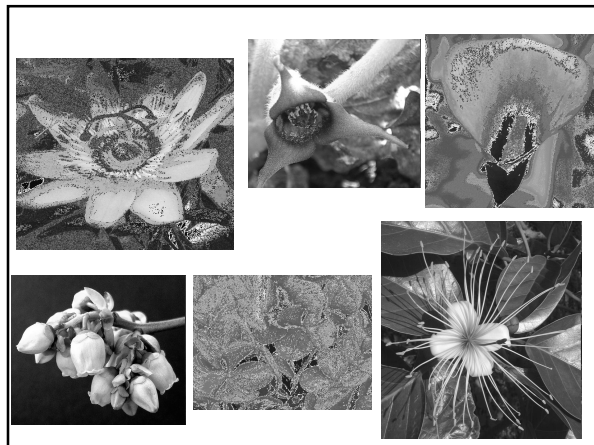
- Pinyon nuts (pine nuts) are the seeds of pine trees.
 - ❖ Found only in female cones.
- ❖ Edible, but you have to beat the squirrels to them.



Angiosperms: flowering plants

- Flowers attract pollinators (mutualistic)
 - Pollinators move pollen (and thus sperm!) from flower to flower
 - Pollinators gain food
 - Flower features evolved to be attractive to the pollinators
- Fruits (containing seeds) promote seed dispersal (How?)
- Broad leaves capture sunlight effectively
 - Some flowering plants don't have broad leaves, though... (Why not?)
 - May also have toxins to prevent being eaten







Nectar - Insects



Nectar - Birds



Nectar - Mammals

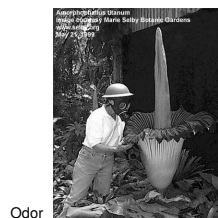
Pollinators locate flowers via:



Vision



(Ultraviolet)



Odor

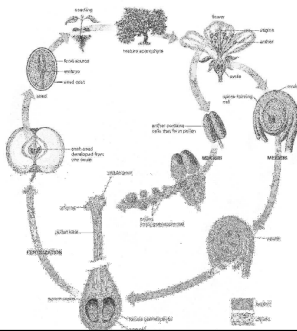
How do they attract pollinators?

- Food (nectar)
- Color
 - ❖ Bees like yellow flowers
 - ❖ Hummingbirds like red flowers
- Odor
 - ❖ Flies like smelly plants



Angiosperm life cycle (unique features): Compare to others...

- Pollen produced on anthers of flower
- Lands on stigma
 - ❖ Via wind or pollinator
- Builds pollen tube to ovary that contains ovules
- Fertilization in ovule
- After fertilization
 - ❖ Ovule develops into the seed
 - ❖ Ovary develops into fruit.



Trends in plant evolution

- Increased prominence of sporophyte; reduction of gametophyte
- Development of lignin-supported vessels (support on land; larger sizes reached)
- Development of alternate (non-swimming) methods for sperm to reach egg.
- Development of seeds (embryo protection)
- Development of flowers/fruits: pollination and seed dispersal by animals

