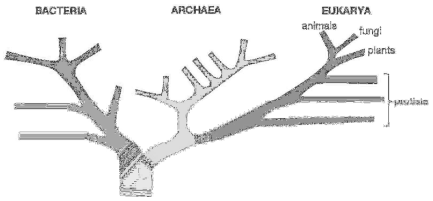
The Diversity of Plants

Chapter 21

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



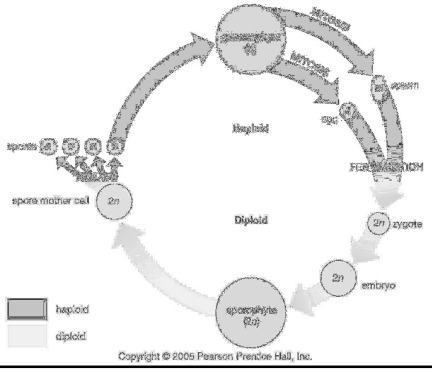
Kingdom Plantae

- **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!

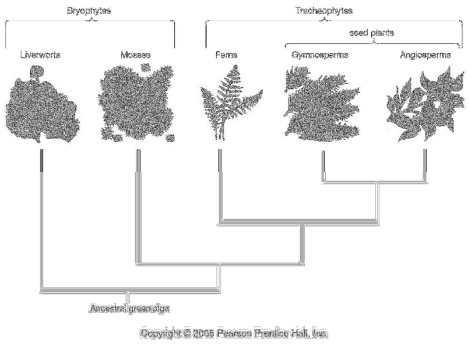
Key feature: Alternation of generations

- 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 developes into the embryo.
  - ❖ Embryo relies on nutrients from parent
- Embryo develops into the sporophyte

Visual picture of plant reproduction

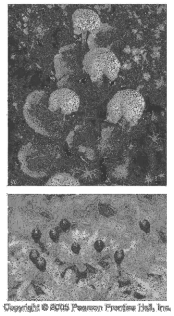


Major groups of plants



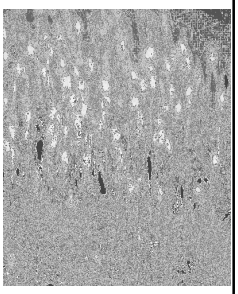
Bryophytes

- 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



Bryophyte reproduction

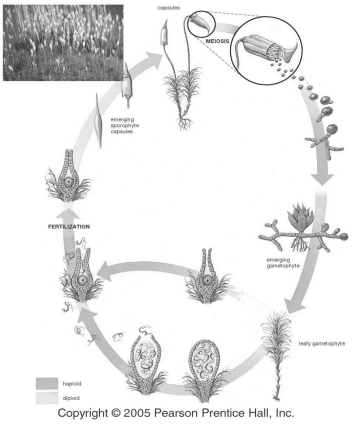
- Haploid gametophyte is dominant (green in photo)
  - ❖ Produces gametes in specialized structures (keep gametes moist!)
- Requires water for sperm to swim to egg
  - ❖ Egg chemically attracts the sperm
    - ➢ Egg stays in its "archegonium" attached to the gametophyte
  - ❖ Fertilization within archegonium
  - ❖ 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



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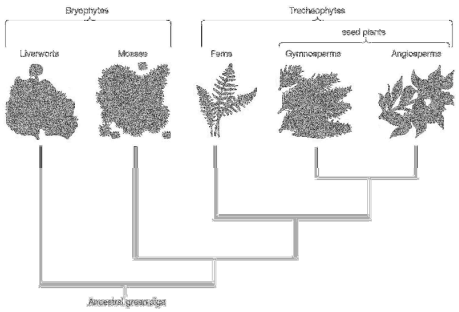
Major groups of plants



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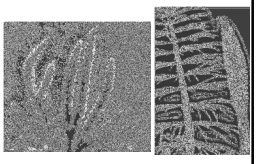
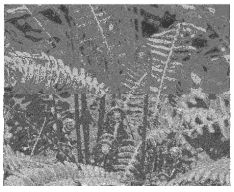
Tracheophytes: vascular plants
1: Seedless vascular plants

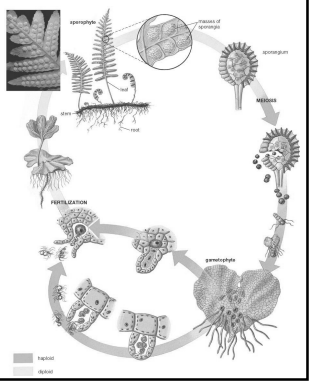
- All vascular plants have <u>vessels</u> reinforced with <u>lignin</u>
  - ❖Movement of materials
  - ❖Support
- All vascular plants have dominant sporophytes
- Examples of <u>seedless</u> vascular plants
  - ❖club mosses ("ground pines")
  - ❖Horsetails
  - ❖ferns
  - ❖All are found in moist woodland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

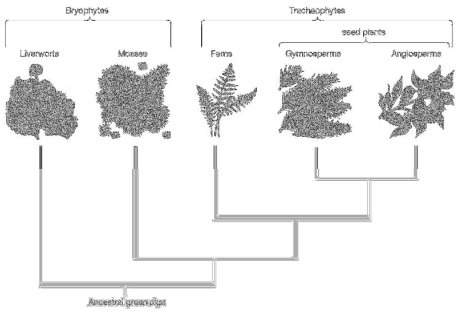


Ferns: sporophyte & gametophyte

Sporophyte

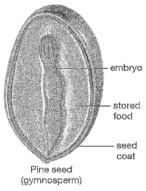
Gametophyte

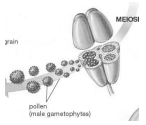
Major groups of plants



Tracheophytes: vascular plants 2: Vascular plants with seeds

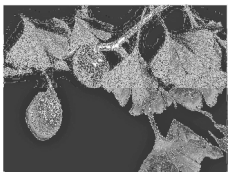
- Different from the seedless vascular plants
  - ❖Produce seeds!
    - ➢Contain developing embryos
    - ➢Contain stored food
    - ➢Protected by seed coat
  - ❖Produce pollen
    - ➢Pollen grains are the sperm-producing (male) gametophytes
    - ➢Can disperse by wind or pollinators
      - – **Fertilization no longer tied to water!**

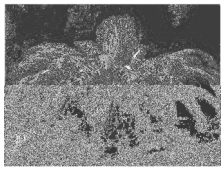




Gymnosperms: non-flowering seed plants

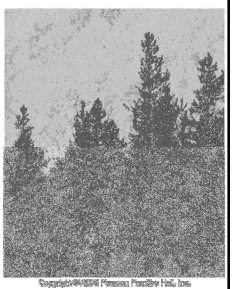
- Examples
  - ❖Ginkgos
    - ➢Probably the first "modern-day" seed plants
    - ➢Maintained by cultivation in Asia
    - ➢Pollution resistant
    - ➢Does *Ginkgo biloba* improve memory?
  - ❖Cycads
    - ➢Resemble large ferns
    - ➢Slow-growing
    - ➢Long-lived
      - – One Australia cycad is ~5000 years old!
  - ❖Conifers (next page)





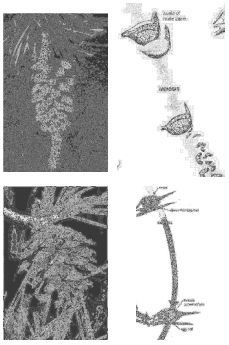
Gymnosperms: non-flowering seed plants

- 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



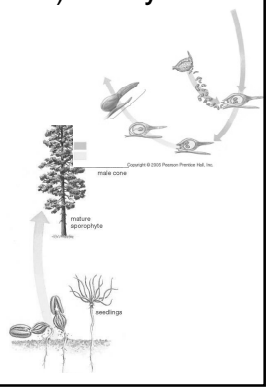
Conifer life cycle

- 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

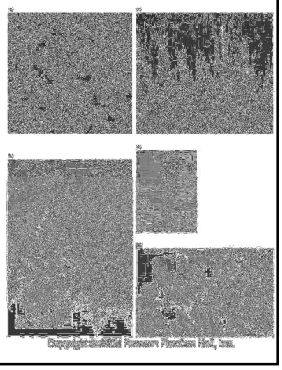


Pinyon nuts

- 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.

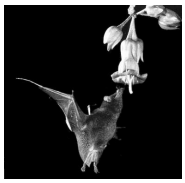
Angiosperms: flowering plants

- 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)

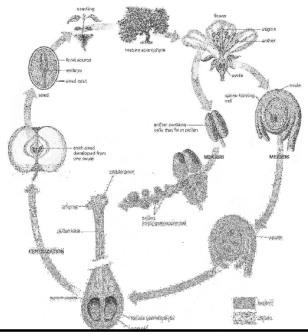
Odor

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

Plant phylogenetic tree