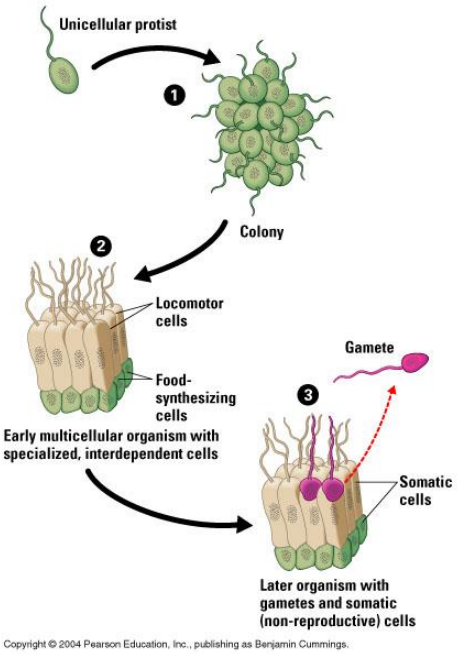
BIO 1101 Lecture 16
Chapter 16: Evolution and Diversity of Plants and Fungi

- Video Intro from Dr. Weyrauch

The Origin of Multicellular Life

- Groups of single-celled organisms may have started living together as colonies (*remember Volvox*)
- Certain cells in those colonies may have become more and more specialized for specific tasks
  - Cells for movement (w/flagella)
  - Cells for ingestion or food synthesis
  - Etc.
- Cells became dependent on each other, to the point of becoming multi-cellular
  - Sex cells (gametes) and body cells (somatic cells)



Plants, Fungi & the Move Onto Land

The Transition to Terrestrial Life

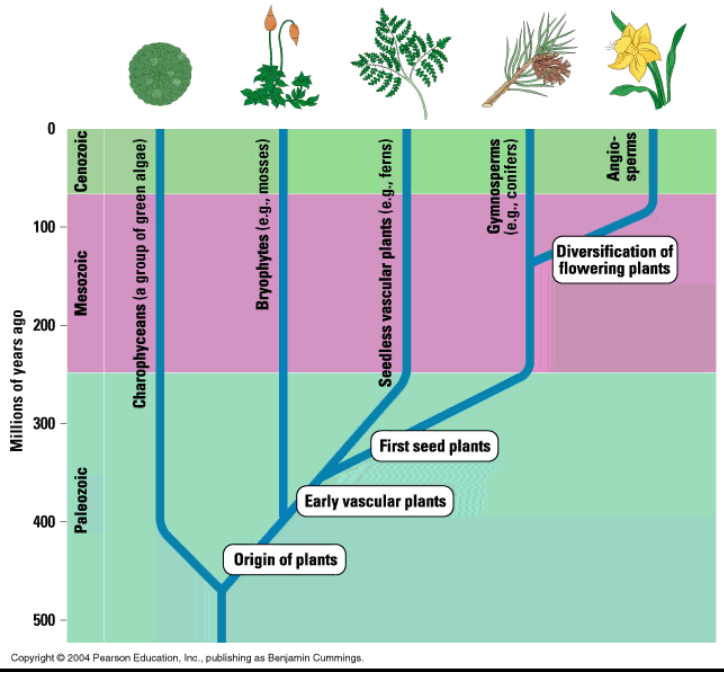
- 500 mya -- life abundant in oceans, but not on land
- 475mya, the first plants appeared on land
- First land plants evolved from a type of green algae (similar to charophyceans)
- ~425 mya begins a period of plant diversification, including vascular plants

Kingdom Plantae

- More complex than plant-like protists
- Mostly photosynthetic organisms
- Adapted for terrestrial life (or, descended from ancestors that were evolved for terrestrial life)
- Plants live in almost every habitat, from the arctic to rainforests
- Variety of sizes, from nearly microscopic duckweeds to giant sequoias

- We will now review the diversity of plants, beginning with more ancient groups to more recently evolved groups

- But first, view this video on the "Alternation of Generations," which will be helpful in understanding plant life cycles:
- https://www.youtube.com/watch?v=SCTNKTfa-s0



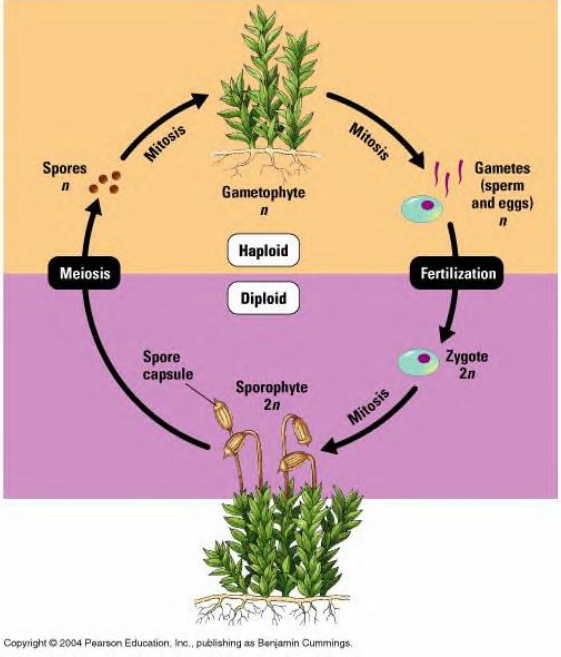
Phylum Bryophyta (Mosses)

- First terrestrial plants
- Simple plants; non-vascular and small
  - Use diffusion and osmosis among individual cells for transport
  - Osmosis and diffusion are slow processes, which means these plants must remain small
- Adaptations for land: they have structures for retaining the developing embryo called gametangia, and some have a waxy cuticle

- Most occur in moist habitats to avoid desiccation and facilitate reproduction
- Usually form dense beds on moist substrates... why?
- Root-like structures called rhizoids (anchoring)
- Also have stem-like and leaf-like structures (not true stems and leaves)
- Need water to reproduce

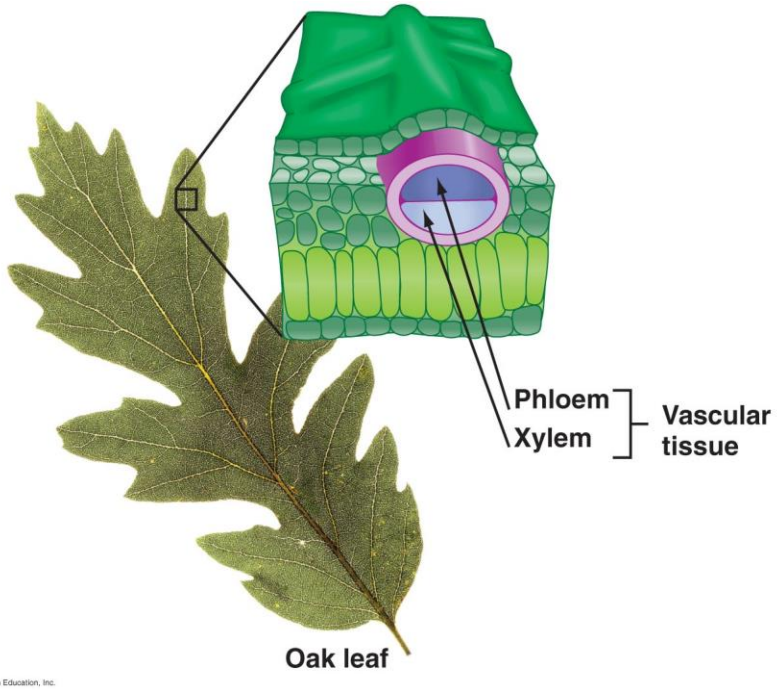
- Life Cycle: "Alternation of Generations"
- Haploid gametophyte is the dominant stage (green leafy plant)
  - Dominant gametophyte only found in mosses and a few other small groups of plants (liverworts and hornworts)
- May have separate male and female plants, producing antheridia and archegonia, respectively; in some, both male and female structures on same plant
- Diploid sporophyte structure is dependent on the gametophyte; consists of a foot, stalk, and capsule

- Spores released from mature capsule; germinate to produce a protonema, from which grows a new gametophyte
- Spores differ from gametes in 2 major ways:
  - Don't have to fuse with another cell
  - Have tough coats (protection in harsh conditions)

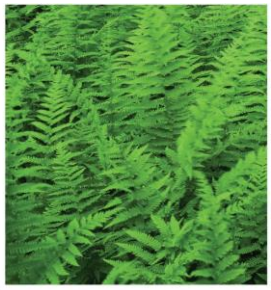


Ferns and Allies -- The Seedless Vascular Plants

- Includes Ferns, Whisk Ferns, Club Mosses, and Horsetails
- Vascular Tissue:
  - Xylem
    - Conducts water and dissolved minerals, usually from root to shoot
  - Phloem
    - Conducts carbohydrates -- mostly sucrose – usually from shoot to root
- Effect of vascularization on plant size is...?
  - Plants could grow larger, because vascular tissue more efficiently conducts materials through body of plant
  - Click on the audio link:



- Ferns still require water for fertilization
  - Sperm swims to egg
- During the Carboniferous period (360-300mya), fern-like plants formed dense forests. Vast amounts of organic matter from these huge ferns and other plants built up and became coal deposits (fossilized plant material)

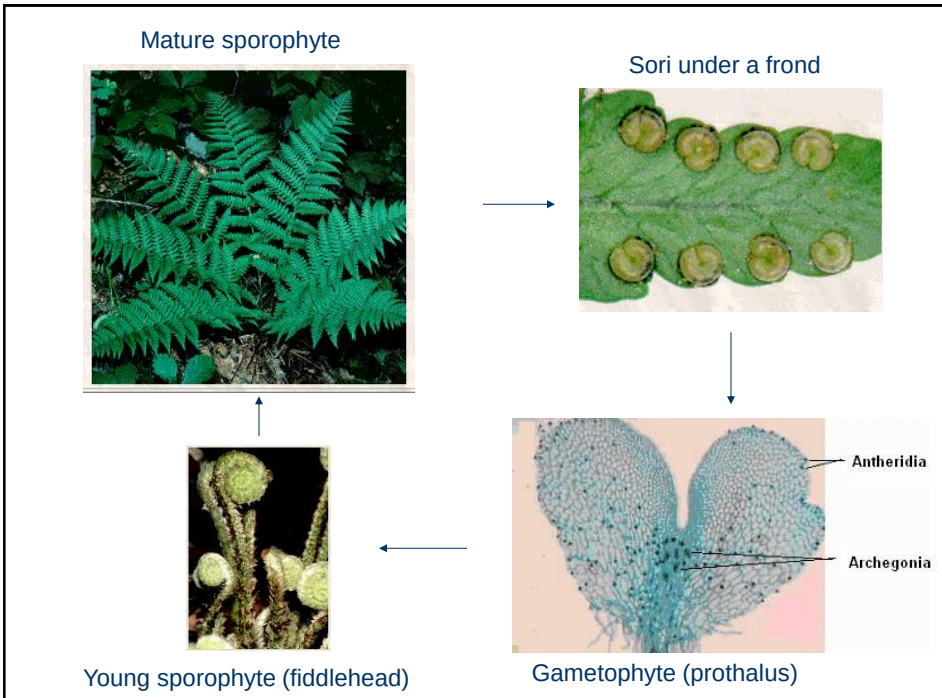


Ferns (Phylum Pterophyta)

- Mostly terrestrial; can be found from the tropics to the Arctic Circle
- A variety of sizes and shapes, from the tiny mosquito fern that floats on water, to the giant tree ferns, which mostly live in tropical rain forests
- Dominant stage = Sporophyte (diploid, or 2N)
- Sporophyte produces haploid spores in structures called sori

Sori = spore capsules in ferns

- The parts of a typical fern (sporophyte): rhizome (underground stem), roots, and fronds (leaves)
- New, young fronds emerge as fiddleheads
- Gametophyte stage is a small, independent, heart-shaped plant called the prothalus



- **The Gymnosperms**
- Seed-producing plants
- Gametophyte generation greatly reduced and dependent on the sporophyte
- Sporophyte generation dominant
- A seed develops from the reproductive structures of the female gametophyte, and consists of an embryonic sporophyte plant and nutritive tissue
- Two groups of seed-producing plants: Gymnosperms and Angiosperms -- the dominant plants in most ecosystems today
- Gymnosperms are mostly evergreen trees

- 3 main adaptations of Gymnosperms:
  - Seeds
  - Pollen
  - Dominance of the Sporophyte generation

- Gymnosperms produce "naked seeds"
  - Seeds not surrounded by a fruit
  - No fruit because Gymnosperms don't have ovaries (like flowering plants do) – only "ovules"

The Economic Significance of Gymnosperms

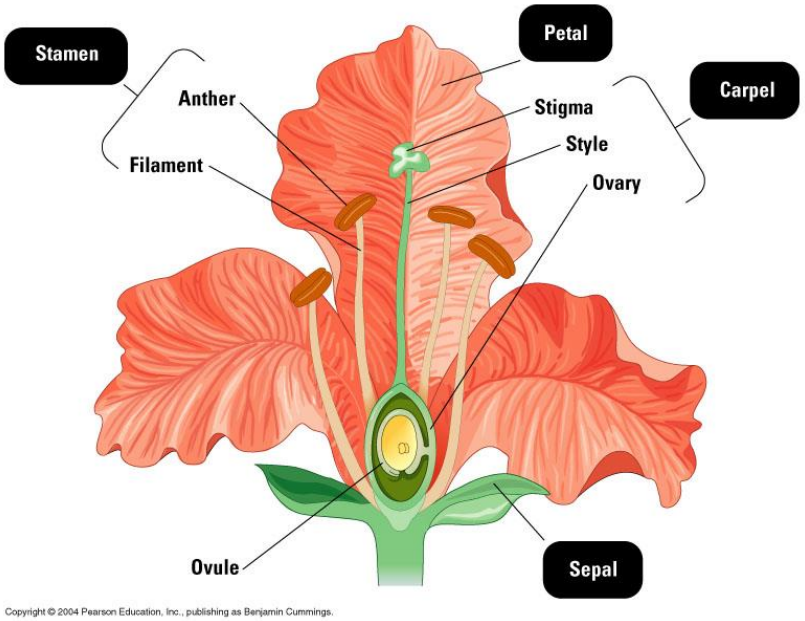
- Conifers are the most common trees in about 35% of the world's forests
- Roots stabilize soil and reduce erosion
- Forests are important in watersheds, helping to absorb and slowly release water, reducing flooding
- Shelter and food for wildlife
- Recreation
- Timber (80% timber crop in U.S. from conifers)
- Landscaping trees

Angiosperms (flowering plants)

- Vascular plants that reproduce sexually via flowers
- Undergo a unique "double fertilization" that results in seeds within fruits
- Main difference from Gymnosperms is that angiosperms' ovules (the structures that develop into seeds) are enclosed within the ovary, which later becomes a fruit
- Flowering plants are the most successful and abundant plants today

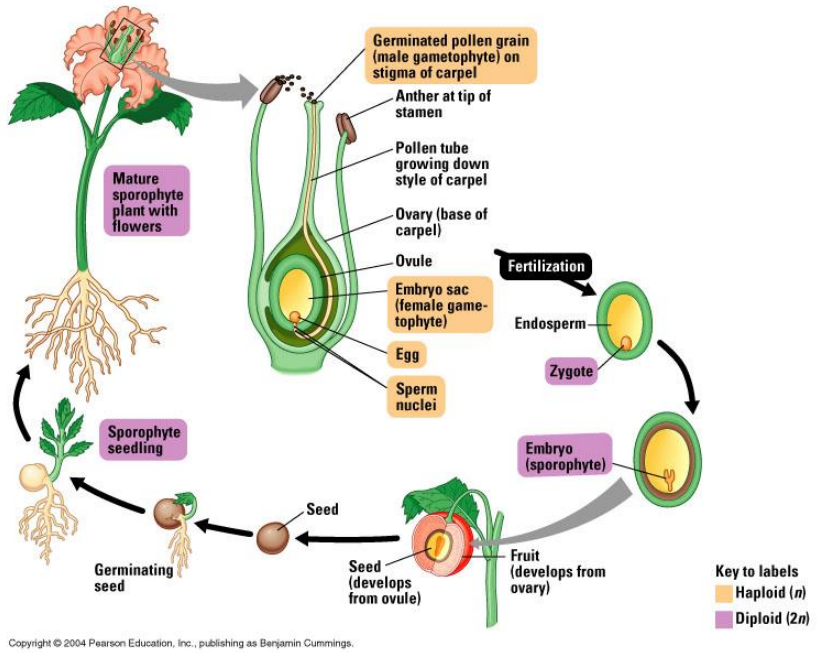
Bleeding heart

- Ovule, ovary, style, and stigma = female part (carpel)
  - Seed develops from ovule
  - Fruit develops from ovary
- Filament and anther = male part (stamen)
- Petals and sepals are modified leaves

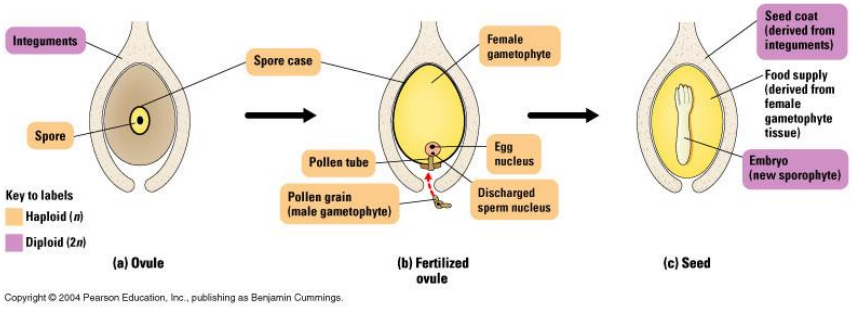


- Alternation of Generations in Life Cycle of Angiosperms
  - As discussed before, an alternation of generations is a life cycle in which haploid and diploid forms alternate
  - In angiosperms, the body of the familiar plant is diploid (the sporophyte stage)
  - Within that diploid plant, there are haploid, gametophyte stages, but they are microscopic and nutritionally dependent on the diploid sporophyte

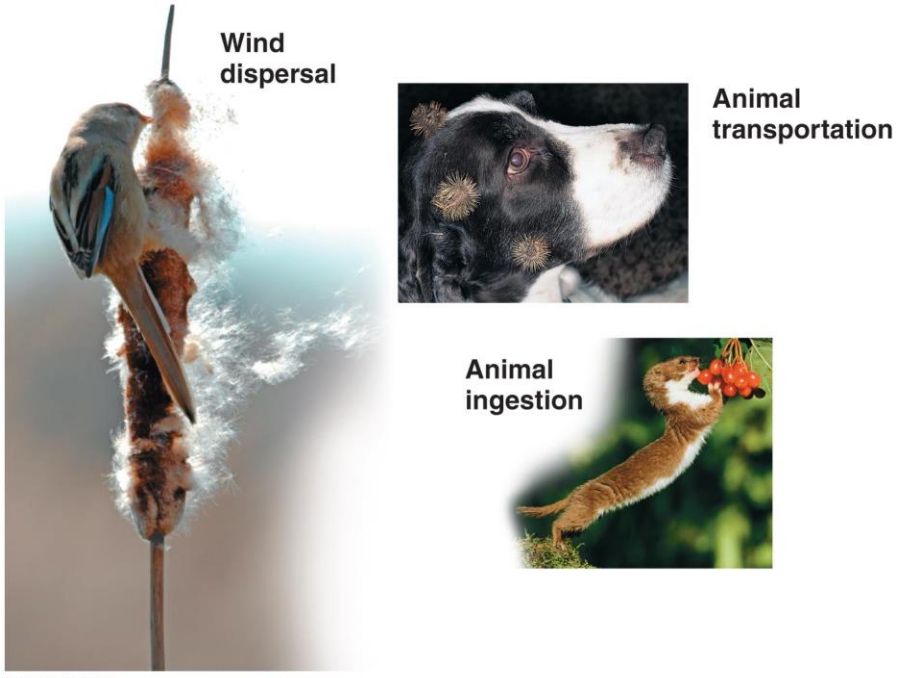
- **Double Fertilization & the Angiosperm Life Cycle**
  - Within the ovary, ovules are produced; within each ovule, there is the female gametophyte (called the embryo sac). The embryo sac contains several cells, including an egg and central cell that contains two nuclei. These are the two cells that are involved in fertilization.
  - Each pollen sac of the anther contains many immature male gametophytes, also called pollen grains. Each pollen grain contains two cells – a large tube cell and a small generative cell. The tube cell grows to form the pollen tube, through which the sperm cells travel.
  - The generative cell of the pollen grain divides by mitosis to form two sperm cells, which travel down the pollen tube toward to ovary after pollination.



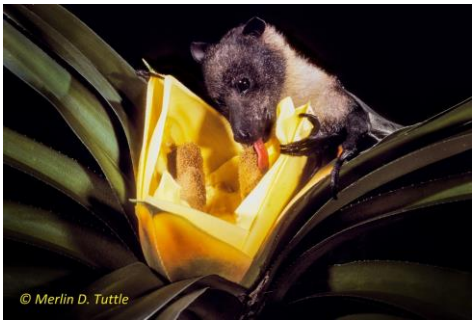
- When sperm reach the ovary, one fertilizes the egg to form the zygote
- The other fertilizes the polar nuclei of the central cell, to form the endosperm
  - The endosperm is thus triploid (3N), because it is the combination of three haploid cells
- Integuments around the ovule become the seed coat; the endosperm provides nutrition to the developing zygote



- **Seeds and Fruits Develop After Fertilization**
- After fertilization, a seed develops from the ovule and fruits develop from the ovaries
- The ovary wall surrounding the ovule enlarges and forms a fruit.
- Fruits have two main functions:
  - Protect the developing seeds.
  - Aid in dispersal of the seeds.
- The various adaptations of flowering plants have allowed them to become the most successful group of plants.

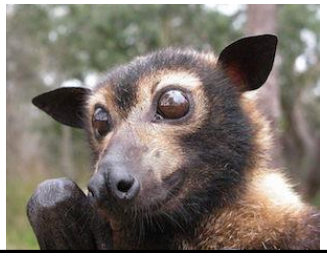


- **Pollination: flowers evolved to attract animals**
- Bee pollinated flowers: open during day; vivid colors such as purple, pink, or yellow; fresh, sweet scent; provide nectar and pollen as food for the pollinator
- Butterfly pollinated flowers: similar characteristics to bee pollinated flowers; nectar often deep within flower where only the tongue of the correct butterfly pollinator can reach it. Many moth pollinated flowers open at night; white or light green in color; sweet-scented
- Hummingbird pollinated flowers: open during the day; bright red in color; little odor, but produce a lot of nectar deep within flower
- Bat pollinated flowers: open at night; drab coloring; musty odors; nectar and pollen readily available to visitors
- Wind pollinated flowers: open during day; green; no odor or nectar; usually very small



Random Animal of the Day!

- The Flying Fox!
- Also known as fruit bats or megabats, they are the largest bats in the world
- 60 species of flying foxes are found in Asia, Australia, East Africa, and some remote islands
- Adorable!



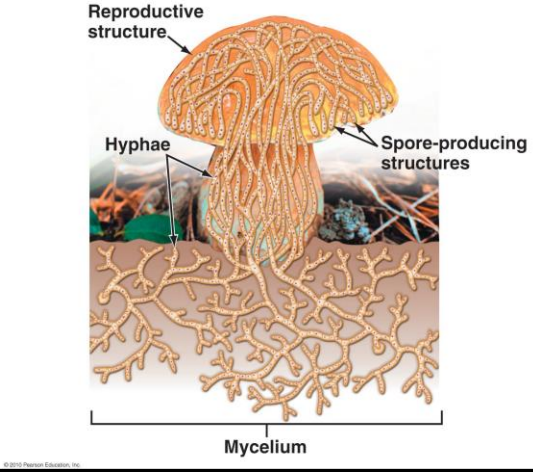
- Some Biology Trivia
  - What is the oldest living organism on earth?
    - The King's Holly?: a 40,000-year-old clonal shrub in Tasmania
    - Just one individual plant, but clones itself and forms a giant colony – over 1.6 kilometers (~1 mile)

  - But recently, an even older plant has been discovered
  - A Seagrass in the Mediterranean Sea may be 200,000 years old!
    - Different patches of the grass ranged in age from 12,000 to 200,000 years old, most of it being around 100,000 years old!
    - This area of sea grass extends 10 miles, but has been in decline in recent years due to declining water quality, construction on the shoreline, and global warming

Kingdom Fungi

- Cell walls contain chitin (same material in exoskeletons of insects)
- Heterotrophic -- secrete digestive enzymes and absorb the remains
- Grow best in dark, damp places
- When environment dries out, enter resting stage or produce resistant spores
- May be single-celled (yeasts) or multicellular (common mushrooms)
- Most fungi can reproduce both sexually (by spores) and asexually (by budding/fission)

- Body consists of filaments called hyphae. An underground, interwoven network of hyphae is a mycelium.
- Mushroom is just the above ground reproductive structure



- Cells are usually haploid
- Hyphae may be coenocytic (multinucleate; no cellular divisions) or septate (cross walls between cells)
- Sexual reproduction: + and - mating types come together and nuclei fuse (diploid cell) → meiosis → haploid spores

- Fungi very important ecologically as decomposers (recycling nutrients)
- Some fungi are parasitic and cause diseases
- Some are mutualistic: live closely w/another organism, and both benefit: example = Mycorrhizae, fungi that live in association w/plant roots; plant provides food & shelter; fungus helps plant absorb water, minerals, & nutrients
- Lichens = a mutualistic relationship between a fungus and algae

Importance of Fungi

- Damage due to breaking down stored foods, building materials, etc.
- Yeasts used in alcohol and bread production
- *Penicillium* spp. used to make Roquefort and Camembert cheeses
- *Aspergillis tamarii* used in fermentation of soybeans to create soy sauce
- Many edible mushrooms
- Many poisonous fungi, as well (ex: Destroying Angel)
- Some hallucinogenic, producing chemicals related to LSD
- Antibiotic production (*Penicillium* – a mold)
- Diseases of various plants and crops

Salem Witch Trials

- In 1691 in Salem, Massachusetts
- Several young girls began exhibiting unusual behaviors
  - Screaming
  - Contortions
  - Violent acts

- Accused of witchcraft
- Ultimately 19 people were hanged to death, and many others imprisoned
- Were these people really “witches” or possessed by demons?

Fungi & The Salem Witch Trials?

- Ergot: a disease of grains such as rye, caused by the fungus *Claviceps purpurea*
- Fungus produces chemicals including lysergic acid (from which LSD is made) and ergotamine.
  - Affect central nervous system
  - Symptoms of ergotism include muscle spasms, vomiting, hallucinations, and a crawling sensation on the skin
  - These were characteristics of women accused of being witches in 1691
  - Wet growing season likely resulted in contamination of the rye crop
  - Growing season in 1692 was dry; no more ergot disease; "strange" behaviors ended
  - Video: http://www.youtube.com/watch?v=Mp2j2K_FYOA

Some more biology trivia:

- What is the largest living organism?
  - Answer: a humongous fungus!
  - The honey mushroom, growing in eastern Oregon
  - The individual fruiting bodies themselves are not unusually large
  - A large part of the body of a mushroom remains underground, and in the case of the honey mushroom, it now covers 2,200 acres
  - 3.5 miles across, 3 feet deep into ground

Plants and Fungi Activity

- Under “Quizzes” in Carmen Canvas, complete the “Plants and Fungi” Quiz for 5 activity points
- You will have 15 minutes to complete the quiz once you begin
- You may complete the quiz any time between 8:00am-11:59pm on Wednesday, April 1

- **All for today…**
- **Next time, Animal Evolution & Diversity**