# Biology I

# 2nd Semester Notes

# January-May 2005

# Thomas, 6th Period

**CHAPTER 18**

VIRUSES AND BACTERIA

- Virus (better known as "germs")
  - Composed of nucleic acids enclosed in protein coat
  - Smaller than the smallest bacterium
  - Are not cells, and need a host cell to reproduce- are not alive
    - Do not respirate, grow, develop; only replicate by host cell
    - "They are obligate endoparasites"
  - Bacteriophage (phage-virus)
    - Virus that infects bacteria
- Viral Structure
  - Has inner core (genome core) of nucleic acid- either DNA or RNA, not both
    - Genome- all genetic information set
  - A surrounding outer protein coat called a capsid
    - Human flu virus- large, have additional layer called envelope around capsids
      - Envelope- made of mostly same material in plasma membrane of cells Made of lipids, carbohydrates, proteins
  - Core of nucleic acid has virus's genetic material
    - DNA/RNA- contains instruction for replication
    - Some have few, others hundreds
  - Arrangement of proteins in capsid determines shape- and what cells it infects and how
    - Polyhedral viruses- like small crystals; papilloma virus causing warts
    - Envelope studded with projections covering the virus; influenza & AIDS
    - Long narrow helical shape; tobacco mosaic virus
    - Polyhedral-shaped head attached to cylindrical tail with leglike fibers; T4
- Viral Groupings
  - Viruses are not classified
    - Grouped by type of nucleic acid- DNA/RNA virus
    - Named after diseases that they cause or for the organ/tissue they infect
      - I.e. rabies viruses, polioviruses- disease they caused
      - I.e. Adenovirus found in adenoid tissue (back of throat/nasal cavity)
    - Has a genus name ending with "virus" and a species name
      - Code # to distinguish among similar viruses i.e. T1-T7 (Type 1-7) bacteriophages infect E. Coli
  - Plant viruses- need wounds to enter or insect bites (or any unusual openings)
    - First virus identified- plant virus- tobacco mosaic
    - No surface recognition; no lytic/lysogenic phases; not all fatal
  - Retroviruses- have RNA genome and use reverse transcriptase enzyme (held in the capsid) to make a DNA copy of itself using host nucleic acids; i.e. HIV
    - DNA integrates into host chromosome and becomes provirus
    - RT enzyme- evidence for retrovirus infection; some stages show no symptom
    - HIV- infect white blood cells, virus released by exocytosis
      - Infected cells still function normal-provirus produces small # virus
      - Infected person may not appear sick- still may transmit virus
      - Doesn't experience AIDS for long time; most AIDS- lytic cycle
  - Viroids- short, single circular strand of RNA without capsid; plant pathogens
    - Are not true viruses- very little RNA compared to other viruses
  - Prions- glycoprotein bits with polypeptide of 250 amino acids
    - Are not viruses either- composed of proteins, no nucleic acid- cause other proteins fold incorrectly for improper function
    - Cause degenerative nerve disorders like Mad Cow Disease
- Viral Characteristics
  - Pathogens- cause disease, release toxins
  - Virulence- ability to cause disease immediately
  - Temperance- delayed disease causing capabilities
- Viral Replication
  - Attachment
    - Virus recognize and attach to receptor site- proteins interlock with molecular shape on receptor site on plasma membrane
    - Recognized and attached by protein in tail fibers of bacteriophage or attachment protein in capsid/envelope
    - Virus- specific shape of attachment protein; cell-type specific (few cell attach)
  - Lytic Cycle- attachment at receptor site, entry of genome into host, replication of virus parts, assembly of virions (parts), release through lysis
    - Host uses its own enzymes, raw materials, and energy to make copies of virus

        - Fig 18.2- in a lytic cycle, a virus uses the host cell's energy and raw materials to make new viruses; a typical lytic cycle takes about 30 minutes and produces about 200 new viruses
            A) Attachment
            B) Entry- the bacteriophage injects its nucleic acid into bacterial cell
            C) Replication- the host's metabolic machinery makes viral nucleic acid and proteins
            D) Assembly- new virus particles are assembled
            E) Lysis and Release- the host cell breaks open and release new virus particles
    - Lysogenic Cycle- attachment, entry, replication, assembly, and lysis
        - Main point of lysogenic cycle is the attachment of viral genome to host chromosome to form a provirus (Viral DNA integrated into host chromosome) for a dormancy period; and replication as host cells divide
        - Every cell originating from infected host cell has provirus copy- lysogenic phase may continue many hears; activation to lytic cycle at any time
        - Fig 18.3- in a lysogenic cycle, a virus does not destroy the host cell at once; rather, the viral nucleic acid is integrated into the genetic material of the host cell and replicates with it for a while before entering into a lytic cycle
            A) Attachment and Entry- A lysogenic virus injects its nucleic acid into a bacterium
            B) Provirus Formation- The viral nucleic acid is called a "provirus" when it becomes part of the host's chromosome
            C) Cell Division- Although the provirus is inactive, it replicates along with the host cell's chromosome
            D) The provirus leaves the chromosome
            E) Viral nucleic acid and proteins are made
            F) The cell breaks open releasing viruses
    - Provirus stage allows the virus to remain undetected by immune systems until triggered to detach from host genome and begin lytic cycle
        - When in lytic cycle, symptoms erupt; activation may be by physical stress (sunburn), emotional stress (anxiety)
        - Many disease viruses have lysogenic cycles; i.e. herpes simplex I (cold sore), II (genital herpes), hepatitis B (hepatitis B), virus that causes chicken pox
            - Sometimes chicken pox virus remain as provirus in nerve cells- later in lytic cycle cause shingles- infection of nerve cells
    - Release viruses by lysis (bursting cell) or exocytosis (active transport by expelling materials from cell- fuses with plasma membrane)
    - Transduction- changes in genetic code of a host cell due to transfer of pieces of other host genomes by way of a virus involved in a lysogenic cycle virus takes part of host 1 to host 2 as it infects host 2, and host 2 may express part of host 1's genes
- Eubacteria/Archaebacteria
    - Prokaryotic cells of bacteria and cyanobacteria (aka blue green algae)
        - Lack membrane-bound organelles or nucleus but do have ribosomes
        - Smaller, and have different RNA and protein than in eukaryotes
        - Antibacteria block proteins synthesis and therefore do not harm our cells
    - Archaebacteria- extreme, early inhabitants
    - Eubacteria- heterotrophs
- Bacterial Structures
    - Peptidoglycon cell wall (not like cellulose of plants)
    - Cytoplasm, cell membrane, and ribosomes
        - Ribosomes- used for protein synthesis
    - Genome is single circular DNA in a nucleoid region
    - Penicillin attacks cell walls and interrupts peptidoglycon- makes hole in cell walls
    - Some have external slimy capsule to protect against the (evironment) immune system or stomach acid
    - Some have plasmids (separate DNA rings that self replicate and convey resistance to antibiotics) etc
    - Some have pili (like long cilia) for attachment (and transport) to food, host, or each other- they may exchange info when they dock on
    - Some have flagella (where the tail can be anywhere), others wiggle around
    - Some form endospores as protective coverings (around the DNA— and only the DNA— while the rest that's falls apart) that allow them to survive harsh conditions, even boiling
        - This is why canned foods are put in pressure cookers
        - Endospores can survive 100 degrees C
        - When conditions are right it rebuilds

- Bacterial Classification
  - Formally grouped by class, genus, etc
  - Nonscientific- by shape and group
    - For example- where they show up, live, shape, etc
  - Coccus (round), Bacillus (rod), and Spirrilum (spiral)
    - If after separation, the coccus and bacillus still stay together
    - The spirrilum is always alone and not hooked together but can come in groups using the sticky stuff to stay together- in other words it cannot be chained
    - Diplo- pairs; staphylo- clusters; strepto- chains
      - I.e. staphylococcus- clusters of round bacteria
- Cell Wall
  - Grouped by type of stain they pick up
    - Gram negative- pinkish (less peptidoglycon) don't respond to many antibiotics- have another layer of lipid polyser due to peptidolycon (coloring); they do not respond well to antibiotics and are harder to kill
    - Gram positive- purple, more susceptible to antibiotics
- Types of Bacteria
  - Some bacteria are photosynthetic, but such are rare and photosynthesis done isn't like what plants do
  - Cyanobacteria do plant-like photosynthesis
  - Mycoplasmas are the tiniest true cells and lack cell walls
  - Spirochetes are very large and some cause lyme diseases and syphilis
  - Archaebacteria are considred ancient, and found in harsh places like swamps (methanogens), salty places, sewers, cow stomachs, hot springs, deep sea vents, where there's the perfect 60-80 degrees C temperature
  - Rhizobium is the bacterium found in root nodules of legumes; aids in nitrogen fixation
- Bacterial Metabolism
  - Autotrophic ones: if they do photosynthesis, they don't use chlorophyll, don't break down water, no oxygen released
  - Chemosynthetic ones break down nitrogen and sulfur inorganic compounds for energy
  - Heterotrophic ones can be saprobes (saprophytes) that are decay bacteria, or are parasites and cuase disase
- Bacterial Respiration
  - Olbigate Anaerobes- poisoned by oxygen; tetanus, botulism, methanogens
  - Obligate Aerobes- need oxygen; TB, diptheria
  - Facultative anaerobes like E. coli can do respiration if oxygen is present or fermentation if it's not
  - Binary fission- replicate genome and split into two cells
  - Conjugation- extra genetic material gained by exchanging plasmas through pili
  - Transformation- pick up extra genetic info from environment; live strain can pick up DNA from dead one
  - Transduction- when virus vector is used to transfer DNA from one host to another
- Algal Blooms
  - Cyanobacteria have a population explosion in a pond or lake due to environmental conditions like phosphates or nitrates dumped by industry
  - Blooms rob water of oxygen and kill other things
- Antibiotics
  - Interfere with cell wall formation or other parts of reproductive cycle
  - Some lyse the bacteria

**CHAPTER 19**

KINGDOM PROTISTA

- Mostly unicellular but can be multicellular; are eukaryotes (always internal metabolism) living independently or in symbiosis; are heterotrophs/autotrophs; may cause disease, may be animal-like, plant-like (algae), or fungus-like
- Subkingdom Protozoa (Protozoans)
  - Animal-like protists; are all unicellular, and are heterotrophs; feed on other organisms/dead organic matter- like protists
  - Also called zooplankton
  - Is mostly asexual though it can be sexual
  - Are mostly classified by the way they move (others by parasitism)
    - Cilia- little tiny hairs/attachments
    - Flagella- long whip/extension moving by whipping
    - Some are sessile-attached to the bottom; they don't move around

        - Pseudopodia- cytoplasm containing extension of cell membrane
    - Four main groups of protozoans (phylums, all animal-like):
    - **Flagellates**
        - Phylum Zoomastigina
            - Have flagella (one or 2) moving back and forth, whipping movements
            - Examples:
                - Trypanosoma- causes disease: African sleeping sickness (found in the blood stream)
                - Trichonympha- in termite in the intestines/guts (flagellates produce enzyme that turns wood to cellulose and carbohydrates which are minerals and nutrients for protists and termites)
    - **Amoebae**
        - Phylum Sarcodina
            - New name- Rhizopodia
            - Move by false feet- pseudopodia; pseudoplamatic extensions of cell used to move and surround food
            - Major groupings of mostly marine amobebas: Radiolarians (made of silica) and foraminiferans (calcium bicarbonate) have shells; most live in moist places where they prevent excess water from diffusion with contractile vacuoles
            - Commonly asexual reproduction
            - Have grainy endoplasm; clear ectoplasm
            - Forms cyst cases (or tiny balls) for protection against predator/bad environment
    - **Sporozoans**
        - Phylum Sporozoa
            - Nonmotile parasites
            - Internal parasites, they form spores without fertilization, where new organisms can grow; need one or more host in order to survive and receive food
            - Goes along the blood stream or intestines (ready food supply)
            - Example:
                - Plasmodium- causes malaria; through bite from Anopheles mosquito to a human
                    - Plasmodium gets inside the mosquito from infected human blood, where sporozoites are released from the gut
                    - Sporozoites are injected into human where they are made in the human liver; makes spore-like cells to enter human's red blood cells and multiply
                    - Blood ruptures, releases both toxins and spores and infect more red blood cells (and multiply)
                    - Some become gametes (in blood) and flow back into mosquitoes
    - **Cilliates**
        - Phylum Ciliophora
            - Move by cilia- which are all over the cell; tiny and hair like, moved by beating
            - Almost 8000 species; most diverse and advanced group of protozoans
            - Found in ponds, springs, streams, oceans (basically everywhere)
            - Have all sorts of organelles within the cell
            - Best example is Paramecium
                - Cilia, Oral groove- outer layer of opening (with cilia), Gullet- where food first enters, Food vacuoles- end of food vacuole with enzymes to break food and diffuse
                - Paramecia have micronuclei that are exchanged during reproduction (conjugation) as macronuclei, or to control the cell; they have contractile vacuoles to pump out water
                    - Divides and separates asexually into two daughter cells after genetic exchange (makes

4)- undergoes when food supplies dwindle or environment changes
    - Some discharge poison darts called trichocysts for defense
- Plant-like Protists: Algae
    - Includes phytoplankton (unicellular)
    - Does photosynthesis
    - Classified by pigment type; or food storage and reproductive method also
    - Are unicellular/multicellular and may be in colonies; produces most of the oxygen in our world; is the base of the food chain in water
    - Six Major Phylums:
    - **Euglena**
        - Most common, unicellular, with animal and plant characteristics
        - Around the cytoplasm membrane is a wall called the "pellicle" made of proteins
        - It has chloroplast and red eyespot to detect light (very sensitive)
        - Can move like inchworms, or moves with flagella
    - **Bacillariophyta**
        - Includes diatoms
        - Unicellular
        - Contains chlorophyll and cerotenoids- cause of gold color; most phytoplankton are clear
        - Lives in marine and fresh water
        - Food stored as oil, which helps their floating
        - Diatoms (algae)
            - Silica (glass) shells harvested in abrasives like toothpaste, or metal polishes, reflective paint
    - **Dinoflagellate**
        - Two flagellates at right angles to help spin
        - Unicellular
        - Some admit light; contain chlorophyll/carotenoids; some are bioluminescent
        - Marine organisms- can be in symbiosis with mollusks, chorals, etc
        - If they bloom— algal blooms— they are red tides that release toxins and kill fish, etc; ex- Gonyaulax
    - **Chlorophyta** (Green Algae)
        - Diverse, unicellular/multicellular, build colonies
        - Mostly live in fresh water
        - Some are also in the plant kingdom
        - Generally green pigment
        - May be ancestors of today's plants
        - Example
            - Chlamydomonas
                - Unicellular, flagellated
            - Volvox
                - Builds colonies of unicellulars
                - Flagellated (especially in sperms)
            - Spirogyra
                - Multicellular
    - Alternation of generations (simple life cycle)
        - It all starts with the sporophyte (diploid) → Forms spores (haploid) → Gametophytes (still haploid) develop → Becomes gametes (males and females- each still haploid) → Gametes come together to form zygote (diploid) → Zygote becomes a sporophyte (diploid)
        - Basically- gametophyte produces gametes; sporophyte develops from zygote: makes 1N spores become gametophytes
    - Fragmentation
        - An alternative form of reproduction
        - Breaks apart a colony or breaks off individuals
    - **Phaeophyta** (brown algae)
        - Multicellular
        - Has members of plant kingdom
        - Mostly brown Algae; lives in salt water
        - Contains chlorophyll and yellow brown carotenoid called "fucoxanthin"
        - Includes Kelps
            - Has thallus- body lacking real stems, roots, leaves

- Has holdfasts that are like roots
- Air bladders for buoyancy during high tide
- Stem- the stripe; Leaves- blades
- Produce largest protists up to 60 meters

- **Rhodophyta** (red algae)
  - Generally red- carotenoid; phycobilin (photosynthetic pigment)- absorbs violet, blue and green light
  - Also has multicellular members in plant groups
  - Seen as agar and carageenin (thickening agents in ice cream, jelly, agar, plates, etc)
  - Mostly marine seaweeds (like kelp)
    - Multicellular body called thallus- undifferentiated
    - Thallus has no true roots, stem or leaves, so are not plants
    - Are not different from the kelp, but both are algae and not in the plant kingdom because of the existence of the thallus (and nonexistence of true plant parts like stem, leaves, etc)
    - Has holdfasts to attach to rocks

- Fungus-like Protists
  - Are not in kingdom fungi because- most fungi decompose and make nutrients available to other organisms; also, they have no chitin in their cell walls
  - **Myxomycota**
    - Plasmodial slime molds
      - Multinucleate mass of cytoplasm
      - Lack cell walls, no membrane
      - Quick- move more than 2.5 cm/hr
      - Look like amoebae; produce spores
  - **Acrasiomycota**
    - Cellular slime molds (haploid)
      - Amoebae-like (animal) stage that crawls
      - Mass together to produce slugs that make spores
      - Do not have a diploid stage
  - **Oomycota**
    - Means "egg fungus" but includes water molds
    - First time eggs and sperm are seen
    - Phytophthora Infestans
      - Scientific name for Irish late blights that wiped out potatoes
      - Downy mildews (plant pathogens)
      - "Ick" on fish
      - Wine blight in France
    - Produce flagellated cells

**CHAPTER 20**

FUNGI

- Multicellular (most), heterotrophic absorbers (no chlorophyll)
- Includes yeast- unicellular
- Give out enzyme, digest outside the body; hydrolic exoenzyme breaks down matter into smaller molecules absorbed by fungi
- Body is a mycelium open made of chains/network of interwoven hyphae: threadlike filament developed from fungus spores, made of several cells separated by septors/cross walls
- Cell walls of chitin (flexible molecule)
- Characteristics:
  - Classification by spore production (reproduction doesn't need fertilization); fruiting body type- keep spores inside
  - Most are saprophytes-decomposers, some are parasitic
  - Symbiotic fungi include lichens (fungus+algae/cyanobacteria) and mycorrhizae (fungus+roots)
    - Cyanobacteria form molecules absorbed by fungus; fungus gives protection from the environment, keeping it not too moist or not too dry and providing water at times
    - Fungus absorbs minerals that are taken into roots; roots give the products back to the fungus to use
- Phylums:
  - **Zygomycota**
    - Terrestrial molds (found on land)
    - Produce zygospores; no cross walls

        - Example- Rhizopus (black bread mold) has stolons- tiny anchir penetrators- and rhizoids-nets-
    - **Ascomycota**
        - Sac fungi; ascospores are produced in sac-like structure, "ascus/asci-special sacs with spores in them," in specialized hyphae
        - Includes yeasts and truffles
            - Yeasts are unicellular; don't have hyphae; reproduce by budding; and produce carbon dioxide for rising bread dough; have large chromosomes good for research
            - Truffles have delicate flavor; symbiosis with plants
        - Dutch elm disease- caused by ascomycetus pathogen; wiped out American chestnuts and Dutch elms in the US
        - Ergotism- disease by fungus growing on rye; humans can get it by taking rye products (consuming)
    - **Basidiomycota**
        - Club fungi; club-like structures that produce basidiospores
        - Include mushrooms; amanita
        - Caps- sit on syphe, and gills- tissues
            - Shortlived reproductive parts
            - Gills located with basidia--> basidiospores come out from here
    - **Deuteromycota**
        - Imperfect fungi
        - No sexual stage- but has asexual and growing mold stage
        - Many are molds
        - Examples: penicillium, ringworm, canida albican
        - (Other fungi that aren't deuteromycota have sexual stages)

**CHAPTER 21**

CHARACTERISTICS OF PLANTS
- Multicellular, eukaryotic, photosynthetic organisms
- Have cell walls made of cellulose for support
- Covered by waxy cuticle, this keeps water inside the plant body
- Ancestors – chlorophytes
    - Adaptations for life on land: Cuticle (protection coat), stomata (pores) and guard cells (regulate stomata) that let $CO_2$ in and out
    - Lignin + cellulose = vascular system; cellulose causes it to stay up straight Vascular system is made of xylem and phloem; xylem transports water, phloem transports food
    - Pollen and seeds; embryo is protected in seed and uses pollen to fertilize
- Alternation of generation – 1n gametophyte and 2n sporophyte (← dominate)

➢ Non vascular plants (i.e. mosses, liverworts, hornworts)
- No vascular tissue; limits to size and habitat
- Bryophytes – nonvascular plants
    - Do not have xylem/phloem; no vascular tissue; limits to size and habitat
    - Have rhizoids (stem parts underground) but not true roots
    - Commercial applications – peat mosses and sphagnum moss (used in gardens)
    - Coal is the remains of byrophytes

**CHAPTER 22**

VASCULAR PLANTS

➢ Vascular system (Tracheophytes)
- Xylem: tracheids (long thin cells) and vessel elements (open cells absorbing water); when maturity is reached, these cells die
- Phloem: sieve tubes (has no nucleus or ribosomes) and companion tubes (has both nucleus and ribosome, located next to sieve); both are alive, transport food
- Vascular plants have true roots, stems, and leaves
- Dominant sporophyte generation
- Unlike nonvascular plants, the vascular sporophyte is dominant and larger in size than the gametophyte. The mature sporophyte does not depend on the gametophyte for water or nutrients.

➢ Seedless Vascular plants
- Whisk ferns (have rhizoids; not true fern), horsetails (contain silica), club mosses, and spice mosses

- Ferns: sori (brown spots, spores), fronds (fern leaves)

- Seed plants
  - The seeds have a plant embryo (seed leaves storing food), cotyledons (first leaves), seed coat, and radicle (embryonic root that grows into regular roots)
  - Dispersal adaptations for seed plants: helicopter thing on an oak & the dandelion umbrella thing
  - Germination requires – a good environment and lots of water
- Types of seed plants
  - Gymnosperms: seeds in cones: Conifers, cycads, ginkgoes
  - Angiosperms (anthophytes) – flowering plants: seeds in fruits
    - Grouped by number of cotyledons in seeds: monocot or dicot
  - Monocots: parallel leaf veins, fibrous roots, flower parts in groups of 3, scattered vascular bundles in stem
  - Dicots: net leaf veins, tap roots, flower parts in groups of 4-5, ring of vascular bundles in stem; wooded plants
  - Anthrophtes also grouped as having wooded stem (showing secondary growth of xylem and phloem) or herbaceous/green stems

**CHAPTER 23**

ROOTS, STEMS, LEAVES

- Plant tissues:
  - Meristem tissue w/ parenchyma (stores photosynthesis energy, fast metabolism, no 2nd walls) and sclerenchyma cells (used for transport; 2nd thick wall cells; irregular shape, used for transport, usually dead; also used for support)
  - Cork cambrium tissue: bark
  - Vascular tissue –xylem and phloem(build secondary growth tissue)
  - Pericycle: only activated when new cells are needs → turn into roots
  - Epidermal tissue – protective cells
  - Ground tissue: inbetween epidermal and epidermis; parenchyma cells
    - photosynthesis, storage, and support
    - contain large vacuoles that store starch grains and water.
  - Pith – cortex, middle (center) of vascular bundles, inside of roots of monocot ; inside stem of a dicot
- Root functions
  - Anchor, absorb water, food storage
  - Types of roots: tap (dicot), fibrous (monocot)
  - Root (epidermal) hair increase surface area
  - Dicot root zones: Zone of maturation – self explanatory
    Zone of Elongation – longer maturing cells
    Zone of cell division w/apical meristem: where highest rate of cell division is located
  - Casparian strip – waxy coat of endodermis that regulates water exchange
  - Roots absorb inorganic essential nutrients from soil
    - Macronutrients – nitrates (taken up from soil in inorganic nitries; ones listed below are forms in which nitrogen can be converted and used) and phosphates (needs large amount of)
      - KNO3 – Potassium Nitrate
      - CaNO3 – Calcium Nitrate
      - NH3 H2 PO4 – Ammonium phosphate
    - Micronutrients – chlorides, sulfates (need a smaller amount of)
  - Stem – transport and support
  - Buds: -Terminal stems (at end of stem near top, makes internodes between leaves) and
    -Axial/axillary/lateral stem (dormant, makes side shoots/side branches, occurs when terminal is removed or something else triggering it)
  - Herbaceous stems – primary growth only, no tree rings (like a tree) or outer growth, only grows vertically due to continuous growth all year long
    - Growth due to added xylem and phloem
    - Turgor pressure - water pressure in vacuoles of cells pushes against cell wall, causing it to be plumb and straight for support
  - Woody stems - primary and secondary growth: found on dicots usually
    - 2nd xylem & phloem made by vascular cambium for stem; by pericycle for roots
      - Vascular cambium – divides into xylem and phloem
      - Pericycle – secondary growth and roots

        - Cork cambium replaces the epidermis with bark (everything outside of the VC)
        - If vascular cambium is removed, then it starts growing like habaceus
        - Wood are the rings on 2nd xylem
            - sapwoods conducts water (xylem = up; phloem = down)
            - Center is called heartwood (pith)
        - If the phloem is removed, the tree will die
    - Leaves – organs of photosynthesis
        - Parts – blade (photosynthesis in vascular plants), petiole (connects blade to stem), cuticle (wavy covering), stomata (holes in cuticle holding $CO_2$ in) with guard cells opening and closing for stomata ($H_2O$ can leave)
        - Monocots do not have many leaves; blade/leaf is usually directly on stem
        - Leaf mesophyll (has palisade and spongy layers with veins; aka parenchyma cells)
            - 1st layer: upper epidermis
            - 2nd layer: elongated cells, photosynthesis takes place
            - 3rd layer: spongy; air spaces of $CO_2$ and $H_2O$
    - C3 vs. C4 arrangement
        - C4 plants include such crop plants as sugar cane and corn, and C3 plants are everything else; C3 plants have palisade and spongy layers (←test material)
        - During the first steps in $CO_2$ assimilation, C3 plants form a pair of three carbon-atom molecules. C4 plants, on the other hand, initially form four carbon-atom molecules
    - Transpiration – loss of water through open stomata
    - Most stomata is on lower epidermis; plants with stomata on top epidermis live in a very wet environment)
    - Opening stomata mechanism
        - Guard cells take potassium ions from neighbor cells with intake of water
        - Cell swells, stomata opens and leaves take in $CO_2$
    - Closed stomata mechanism:
        - Potassium goes back to neighbor cells
        - Concentration lowers; $H_2O$ leaves
        - Cell shrinks and Stomata close and prevent water loss
    - Cohesion: tension theory of water transport (also known as transpiration); pull theory –water molecules bond to xylem so it makes it easy to pull (lose) $H_2O$ in a chain

    - Translocation – transportation of organic nutrients; pressure flow theory
        - Pressure flow theory (source to sink) – photosynthesis makes sugars in the sink (roots/bulbs) until needed in source (leaves) ➔sugars are actively transported to phloem➔water follows by osmosis into xylem➔high concentration of $H_2O$ creates pressure that allows for flow to rest of the plant, when it goes up, concentration lowers and water goes back to xylem
        - Sugars are pumped out of phloem where they are needed
        - Reversal of flow in spring when sap "rises" with starch from sink

**CHAPTER 24**

- Flowering Plant Production
    - Organs of reproduction are flowers
    - Essential flower parts are those needed to make gametes: stamens and pistils
        - Stamen parts: filaments and anther
        - Pistil (carpel) parts: stigma, style, ovary (female part)
    - Nonessential – sepals (protect bud) and petals (attract insects)
- Flower types
    - Complete (all 4 parts): has sepals, petals, (male) stamens, (fem) pistils i.e. morning glory
    - Incomplete – lacking 1 or more of the organism i.e. grass, walnut, sweet corn
    - Perfect – has both stamen or pistils (complete can be perfect) i.e. tulips
    - Imperfect – lacking stamen or pistil (all imperfect are incomplete)
    - Monoccious – male and female flower on the same plant; male is upstairs, female is downstairs; corn
    - Dioecious – two different plants of two different genders must mate to create plant; date
    - Incomplete – can be both perfect or imperfect
    - An imperfect flower is always incomplete; a complete flower is always perfect
- Pollination – wind or insects, contains sperms (2 sperms per pistil usually)

- Double fertilization (in ovalries): 1 sperm + 1 egg form zygote then 1 sperm and 2 polar bodies for a 3N endosperm that provides nutrients to the zygote

- Seeds need $H_2O$ to break seed coat and oxygen to create roots and germinate
- Seed develops in the ovals
- Fruits – ripened ovaries (protect seeds) and fused parts; contain seeds
- Vegetative propagation – when plant parts are used to make more plants
  - Always asexual but not always natural (cutting and grafting)
- Runners (strawberries) – horizontal on surface
- Zhizomes (monkey grass) – underground stems
- Bulbs – storage; develops into other bulbs
- Cuttings (African Violets) – take a part of a leaf and grow it into another plant
- Graftings (roses) – roots have to live with another plant to become stronger and resist disease, also to stimulate plants to help make it grow
- Photopeniodism – response to light or dark (use pigment/hormones)
- Photochrome: $P_r$ (← does not bloom, absorbs 660 nm)– $P_{fr}$ (← blooms, 750 nm)
- Flowering depends on hormones, amount of light, and phytochrome (r/fr pigment)
- Short day plant – critical dark periods, need 6 hours or dark; if $P_{far\ red}$ is present, it will bloom) example: poinsettias
- Long day plant – seen in spring and summer where nights are short; example: spinach
- **If a flash of red light is the last flash of light given to a short day plant during the night, the plant will not flower**

➢ Other factors affecting plant growth:
- Moisture:
  - Xerophytes – plants adapted to dry environments
    - Has short leaves, small surface area, reduce transpiration
    - Most stomata appears on bottom of leaf
  - Hydrophytes – plants that live in water/wet environment
    - Most stomata appear on top of leaf
  - Mesophytes – everyday common plants (normal conditions/env.)
  - Epiphytes – grow on higher levels on other plants, not parasitic, does this to receive more light, never touches ground, i.e. rainforests
- Guttation: high water pressure in roots pushes water through xylem and out the top of leaves and comes out as dew ($H_2O$ moves too fast; no time to evaporate)
- Optimal temperature in 10-38 Celsius (depending on temperature)
- Vernalization – will not germinate until it has passed through a period of cold; some don't germinate until winter

➢ Plant Hormones
- Auxins (a.k.a. IAA) – cell elongation, inhibits adscission (leaves falling to the ground)
  - Will only fall if there is more Ethylene then Auxine
  - Cell elongation: Auxine moves away from sun so the cells lengthen and tilt since cells nearest to the sun get shorter and cells farthest from sun are longer
  - Apical dominance: high tip grows most; induces cell elongation in sides/shoots
  - When in high concentration, interrupts the normal dicot growth; serves as an herbicide in grain fields
- Gibberellins
  - Stem bolting (when a stem shoots up and flowers)
    Germination (water activates Gibberellins in seeds to start growth)
- Cytokinins
  - Cell division won't differentiate into specialty cells (i.e. stem cells for plants)
  - Stimulates protein synthesis and RNA
  - Will not grow into xylem or phloem because it keeps reredividing as one thing
  - Also is a anti-aging hormone and used as a preservative
- Abscissic acid
  - Dormancy in seeds until conditions are good, trees won't flower when its cold
  - Organic nutrients stored in roots, makes plans for storing them
  - Protects against stress, signals guard cells/stomata to close when $H_2O$ isn't there
  - Signals to close stomata when water is taken in and this inhibits water loss
- Ethylene – always in gas form
  - Helps ripening/maturation (thins and dies- causes leaf drop in the fall)
  - When someone has a bad apple, the Ethylene is given off to other apples and increases speed of ripening in others too
  - Slows down in cold temperature

➢ Plant Movements
- Tropisms – movement to and from stimulus (one part of plant always grows faster)
  - "-" away from stimulus; "+" towards stimulus

- Phototropism: movement to/from light (small cells: light; long cells: no light)
- Geotropism or gravitropism – plants way up knowing which way is up or down
    - Necessary for root and stem development; has sense of gravity
    - Statoliths move to bottom of cell and tell it which way is down
        - Plants grown in Zero-G grow roots in all different directions
- Thigmotropism – react to touch (vines going up a pole)
- Hydrotropism – plant will move toward or away from water course
- Nastic movements are related to turgor pressure changes, not to stimuli

**Plant Study Guide**

Chapter 21

1. List the characteristics that land plants share with green algae.
    a. Cell walls contain cellulose
    b. Chlorophyll-photosynthesis
    c. Store food in the form of starch
2. List the land plant adaptations that solved the problems of dehydration, gas exchange, support, and reproduction.
    a. Dehydration- cuticle (waxy coating layer acts as barrier to prevent evaporation)
    b. Gas exchange- leaf (all photosynthesis takes place here)
    c. Support- stem (and transport)
    d. Reproduction- seed (plant organ that contains an embryo, along with food supply and is covered by a protective coat)
3. Define rhizoids.
    a. Rhizoids- thick, underground stem of a fern and other vasucular plants; often functions as an organ for food storage; root-like but has not true roots
4. Describe alternation of generation and know the dominant form exhibited by nonvascular and vascular plants.
    a. Lives of plants in two stages:
        i. Gametophyte generation (haploid-n)- spores from meiosis develop into male and female gametes; gametes fertilize, which ends the haploid generation
        ii. Sporophyte generation (diploid-2n)- occurs right after fertilization; the diploid sporophyte cells are produce by mitosis and cell division for growth, then this ends when it undergoes meiosis
    b. Nonvascular plants- gametophyte is dominant form (haploid generation); Vascular- sporophyte is dominant form in the life cycle
5. Name the examples of bryophytes.
    a. Peat mosses and sphagnum moss
6. Describe the environmental and commercial importance of peat moss.
    a. Peat moss is used as a valuable garden product, it's a soil conditioner (water retention- hydroseeding)
7. Name the major advance of tracheophytes (vascular plants) over bryophytes.
    a. Vascular tissue- xylem and phloem, through which food, water, and other materials are transported; structural adaption- allwed them to survive in many habitats on land, can live farther away from water because vascular tissues include thickened cells called fibers that help support growth and allow them to grow larger

Chapter 22

1. Name and Describe the functions of the two types of vascular tissue.
    a. Xylem- vascular plant tissue composed of tubular cells that transport water and dissolved minerals from the roots to the rest of the plant
    b. Phloem- vascular plant tissue made up of tubular cells joined end to end; transports sugars to all parts of the plant
2. Name four examples of seedless (spore producing) vascular plants. (use common Names if possible)
    a. Club mosses
    b. Spike mosses
    c. Horsetails
    d. Ferns
3. Name the unique feature of horsetails.
    a. Name refers to the bushy appearance of some species
    b. Also called scouring rushes because they contain silica, an abrasive substance
4. Define sori, and know the type of plant they are found on.
    a. Sorus- clusters of sporangia that produce fern spores
    b. Found on the underside of fern fronds look like brown or rust-colored dust
5. Name the basic parts of a seed, and Define cotyledon.
    a. Contains embryo, along with food supply, and is covered by a protective coat

b. Cotyledons- usually store or absorb food for the developing embryo; in many, the leaf like structures on the plant's stem when the plant emerges from the soil

6. Name two groups of seed plants. (check chapter 26 also)
    a. Gymnosperms- naked seed, seeds are not protected by fruit
    b. Angiosperms- seeds enclosed within a fruit, which provides protection and dispersal
7. Name the four types of gymnosperms. (common Names where possible.)
    a. Cycads
    b. Gingko
    c. Gnetophyta
    d. Conifers

Chapter 23

1. Describe the main method of classification of angiosperms.
    a. Number of cotyledons in the seed (monocot/dictot)
2. Compare and contrast monocot and dicot characteristics. (root type, vascular bundle arrangement, leaf vein pattern, flower part arrangement)
    a. Monocots- have one seed leaf (cotyledon), usually parallel vascular bundles in leaves, scattered vascular bundles in stems, flower parts are multiples of 3
    b. Dicots- have two seed leaves (coteyledons), usually netlike vascular bundles in leaves, vascular bundles in stems arranged in ring, flower parts are multiples of 4-5
3. Define meristematic tissue (see apical meristem for a clue) and know its relationship to growth in plants.
    a. Meristematic tissue- tissue found at regions of actively dividing cells (differently shaped than parenchyma cells with large nuclei)
    b. Helps produce new cells for plant growth in areas called meristems; ex- apical meristems help growth near the tips of roots and stems (they produce cells that allow the roots and stems to increase in length)
4. Name the type of tissue found in root and stem tips.
    a. Apical Meristem
5. Name the basic functions of meristem, vascular, and parenchyma tissue.
    a. Meristem-regions of actively dividing cells
    b. Vascular cambium- produces new xylem and phloem cells in the stems and roots (lateral meristems- cylinders of dividing cells increasing diameter)
        i. Cork cambium- produces cells with tough cell walls; these cells cover the surface of stems and roots; the outer layer of a tree is produced by cork cambium
    c. Parenchyma tissue- groups of cells that are the most abundant kind of plant cell; found throughout the tissues of a plant; spherical cells with thin, flexible cell walls; have large central vacuoles in individual cells, which sometimes contains a fluid called sap
        i. Functions: storage and food production
6. Describe the function of xylem and the nature of its two types of conducting cells. (vessels cells and tracheids)
    a. Xylem-transports water and dissolved minerals from the roots to the rest of the plant (composed of four types of cells- tracheids, vessel elements, fibers, and parenchyma)
        i. Tracheids- tubular cells tapered at each end; cell walls between adjoining tracheids have pits through which water and dissolved minerals flow
        ii. Vessel elements- tubular cells that transport water throughout the plant; wider and shorter than tracheids and have openings in their end walls
7. Describe the function of phloem and know the nature of sieve cells.
    a. Phloem-carries sugars and other organic compounds throughout the plant; or transport materials from roots to leaves
        i. Sieve tube members-long cylindrical cells that are alive at maturity; contain cytoplasm but do not have nucleus or ribosomes
            1. Accompanied by Companion Cells- help transport sugars and other organic compounds through sieve tubes
            2. End walls are called sieve plates- have large pores that allow sugar and organic compounds to move from sieve tube member to sieve tube member
8. Define pith.
    a. Pith – cortex, middle (center) of vascular bundles, inside of roots of monocot ; inside stem of a dicot; the center or heartwood
9. Name the three main functions of roots.
    a. Anchors a plant
    b. Usually absorbs water and dissolved minerals
    c. Food storage
10. Distinguish between primary and secondary growth.

a. Primary growth- no rings or outer growth (diameter doesn't increase) only grows vertically
    i. Increase of length due to production of cells by the apical mersitem, which lies a the tip of a stem
    ii. Meristems located at intervals along the stem, called nodes, give rise to leaves and branches
b. Secondary growth- the added thickness of growth (increased diameter) as well as height
    i. Results from cell divisions and production (of xylem and phloem) in the vascular cambium (or lateral mersitem) of the stem
    ii. Layers of vascular tissue produced each year by secondary growth are the rings on trees
    iii. Vascular tissues often contain slerenchym fibers that provide support for the growing plant
    iv. Has pericycle- tissue from which lateral roots arise as offshoots of older roots

11. Define the functions of vascular cambium and cork cambium. What would happen if both were missing?
    a. Vascular Cambium- lateral meristem that produces new xylem and phloem cells in the stem and roots; divides into xylem and phloem rings
        i. If it is removed, stem grows like hebaceous (primary growth)
    b. Cork Cambium- lateral meristem that produces a tough protective covering for the surface of stems and roots (ex- bark on a tree)
        i. If it's removed, there would be no bark or anything that could protect the stem
12. State the function of root hairs.
    a. Increase the surface area of a root that contacts the soil
    b. They absorb water, oxygen, and dissolved minerals
13. Name the root region in which the highest rate of cell division occurs.
    a. Zone of cell division (with apical meristem)
14. Know examples of different types of roots.
    a. Taproots- carrots and beets (single, thick structures with smaller branching roots; accumulate and store food)
        i. Dicot with root hair- long central root with secondary roots growing out
    b. Fibrous roots- grass (have many, small branching roots that grow from a central point)
        i. Monocots, like net of roots that diffuse
15. Contrast herbaceous and woody stems in terms of covering and support.
    a. Herbaceous- grows vertically, has epidermis and cuticle to protect from drying
        i. Only has primary growth
    b. Woody stems- grows vertically and horizontally with bark produced by cork cambium on its outer portion (tough, corky tissue that protects the stem from damage), or everything outside of vascular cambium
        i. Secondary growth
16. Distinguish between terminal and lateral bud locations.
    a. Terminal bud- tip of a stem or branch
    b. Lateral bud- situated along the sides of a branch and not at the tip
17. State the main function of a leaf and the process by which this is accomplished.
    a. Main function: photosynthesis
    b. Sunlight passes through the transparent cuticle and epidermis into the photosynthetic tissues just beneath the leaf surface
18. Describe the cohesion-tension theory of transpiration
    a. Cohesion- tension theory of water transport: aka transpiration- pull theory with water from the roots
        - H bonds of water and xylem flows
        - Taken out of stream/flow from the roots
        - As one's pulled in another's pulled out (the water)
        - It creates a circular flow throughout
    - Transpiration= plants lose water vapor through open stomata, or just water
        - Most stomata on lower epidermis
        - Stomata opening and closing mechanism
        - Open:
            - Guard cells take potassium, or K+, ions from neighbor cells with intake of water
            - Cell swells
            - Stomata opens and leaves take in $CO_2$
        - Close:
            - K+ goes back to neighbor cells
            - Concentration lowers
            - $H_2O$ also leaves

- Cell shrinks
- Stomata closes (and prevents water loss)

19. Describe the pressure-flow model of translocation
    - Translocation- transport of organic nutrients; pressure flow theory (source to sink): photosynthesis makes sugar
        - Important things are stored in the sink (roots/bulbs) until they're needed in the source (leaves/whatever)
        - Mostly transporting sugar
        - Sugars actively transported past phloem--> water follows (into xylem) by osmosis- high concentration of H2O--> flow down to sink--> taken up--> lowers concentration--> water goes back to xylem and pockets
        - Creates pressure that allows for flow to rest of the plant
        - Sugar's pumped out of phloem (reorganized and places the organic nutrients and creates flow due to pressure of concentration)
    - Reversal flow in spring- "sap rises" with starch from sink
        - From sink to source through phloem
20. Define the function of stomata, the cells responsible for their opening and closing, their normal general location, and reasons for their opening
    a. Stomata- lets in CO2 for photosynthesis
    b. Guard cells surround the stomata
    c. They open when plant needs CO2 and closes when they don't need it
    d. For example, when there's not enough water, the cell shrinks, and the guard cell closes
    e. Look at transpiration
21. Describe the mesophyll layers of a typical C3 plant
    a. Made up of two types of parenchyma cells- palisade mesophyll and spongy mesophyll
    b. Palisade- made up of column-shaped cells containing many chloroplasts, these are found just under the upper epidermis and receive maximum exposure to sunglight; most photosynthesis takes place here
    c. Below palisade is spongy, which is composed of loosely packed, irregularly shaped cells, which are usually surrounded by many air spaces that allow carbon dioxide, oxygen, and water vapor to freely flow around the cells; gases can also move in and out of a leaf through the stomata, which are located in the upper and/or lower epidermis
22. *Describe the form by which nitrogen is taken up by plants, Define micronutrients and macronutrients, know examples of each type of nutrient, and sources of nutrients needed to form plant proteins
    - Nitrate
        - Taken up from the soil in inorganic nitrates
        - KNO3, CaNO3, or NH4H2PO4 are all forms which nitrogen's taken and converted into the roots (to xylem)
    - Macronutrients= - essential nutrients needed in large amounts- nitrates, phosphates
    - Micronutrients= - essential nutrients needed in smaller amounts -chlorides, sulfates
    - Roots absorb inorganic (essential) nutrients from soil
23. Know the relationship between turgor pressure and water in plants
    - Turgor pressure (water added to tissue) support
        - Water pushes against cell wall
        - Makes cell wall plump and straight
        - It helps plant grow straight and upright

Chapter 24

1. Distinguish between essential and nonessential flower parts; Name the two types of essential flower parts. (other sources)
    a. Essential flower parts are those needed to make gametes: stamens and pistils
        - Stamen parts: filaments and anther
        - Pistil (carpel) parts: stigma, style, ovary
    a. Nonessential: sepals (protect bud) and petals (attract insects); they are not truly needed but they are "helpful" additions
2. Name the parts of stamen and pistils, and Describe their functions as they relate to sexual reproduction
    a. Stamen- pollen is produced in the anther at the tip of a thin stalk called a filament; male reproductive organ
        i. Anther
        ii. Filament
    b. Pistil- female reproductive organ; at the top is the stigma that receives the pollen; the style is a slender stalk that connects the stigma to the ovary in which ovules grow; each ovule can produce an egg; if fertilized, the ovule develops into the seed
        i. Stigma
        ii. Style

iii. Ovary

3. Distinguish between complete and incomplete, and perfect and imperfect flowers. (other sources + your text)
    a. Complete- (sepals, petals, male stamens, and female pistils) have all four parts
    b. Incomplete- lacks one of the parts
    c. Perfect- has both stamen and pistil
    d. Imperfect- either stamen/pistil
4. Define pollination
    a. Pollination- from male reproductive organs to female reproductive organs of plants, usually within the same species– wind or insects, contains sperms (2 sperms per pistil usually)
5. state the function and result of double fertilization in angiosperms. Know the location of male and female gametophytes; Define endosperm
    a. Double fertilization- process in which one sperm fertilizies the egg and the other sperm joins with the central cell; Double fertilization (in ovalries): 1 sperm + 1 egg form zygote then 1 sperm and 2 polar bodies for a 3N endosperm that provides nutrients to the zygote
        i. Inside each pollen grain are two haploid nuclei; the tube nucleus and the generative nucleus; the tube nucleus directs the growth of the pollen tube down through the pistil to the ovary; the generative nucleus divides by mitosis, producing two sperm nuclei; the sperm nuclei move through the pollen tube to a tiny opening in the ovule called the microphyle
        ii. Within the ovule is the female gametophyte; one of the sperm unites with the egg forming a diploid zygote, which begins the new sporophyte generation; the other sperm nucleus fuses with the central cell, which contains the polar nuclei, to form a cell with a triploid nucleus
        iii. The triploid nucleus will divide many times, eventually forming the endosperm of the seed, which is the food storage tissue that supports dvelopment of the embryo
    b. Male gametophyte- formed in the anther
    c. Female gametophyte- formed inside the ovule within the ovary
    d. Endosperm- food storage tissue in an anthrophyte seed that supports development of the growing embryo
6. Name the part(s) of a plant that develop into a fruit
    a. Ovary- enlarges and becomes the fruit
    b. Sometimes it's the structure that contains the seeds of an anthophyte
    - Fruits – ripened ovaries (protect seeds) and fused parts; contain seeds
7. Define germination, and know what it is dependent upon
    a. Germination-the beginning of the development of the embryo into a new plant
    b. Dormancy ends when the seed is ready to germinate- the absorption of water and the presence of oxygen and faborable temperatures usually end dormancy but there are other requirements:
        i. Water-activates embryo's metabolic system
        ii. Most germinate at temperatures between 25-35 degrees Celsius
        iii. Some requirements are specific- ex. Some germinate more readily after they have passed through the acid of animal's digestive system, others want a period of freeze, some must have fire
        iv. Typical dicot must have- water (must soften)
8. Define radicle
    a. First part of the embryo to appear; an embryonic root- grows down into the soil and develops into a root
9. Define vegetative propagation and Describe runners (other sources)
    - Vegetative propagation- when plant parts are used to make more plants; using vegetative reproduction to grow numerous plants from one plant
        - Always asexual but not always natural (cutting and grafting)
    - Runners (strawberries) – horizontal on surface;Runners are above ground stems that grow horizontally and produce new plants at nodes
10. Define phytochrome and photoperiodism
    a. Phytochrome- the photoreceptor that responses to red light; red/farred pigment
    b. Photoperiodism- flowering plant response to differences in the length of day and night
    - Photochrome: $P_r$ (← does not bloom, absorbs 660 nm)– $P_{fr}$ (← blooms, 750 nm)
    - Flowering depends on hormones, amount of light, and phytochrome (r/fr pigment)
11. Distinguish between short-day, long-day, and day neutral plants
    - Short day plant – critical periods (specific daylight darkness conditions), need 6 hours or dark; if $P_{far\ red}$ is present, it will bloom); flowers when number of daylight hours is shorter than that of its critical period

- Long day plant – seen in spring and summer where nights are short; flowers when the number of daylight hours is longer that that of its critical period
- Day neutral- when proper growing conditions exist, flower over a range in the number of daylight hours; mostly normal plants

12. *Define critical dark period, and know the effect of a flash of light on a short-day and long-day plants
    a. Critical dark period- specific daylight darkness conditions that will initiate flowering
    b. In long day plants, even if your day is short, flashes of light at night will still make the flowers bloom; in short day plants a flash of red light at night prevents it from flowering, but if it is followed by a flash of far red light it will still flower
13. *Know the ratios of red light and far-red light by day versus by night
    a. Photochrome: $P_r$ (← does not bloom, absorbs 660 nm)– $P_{fr}$ (← blooms, 750 nm)
14. State the best temperature range for plant germination and growth, and the effects of extreme temperatures on growth enzymes
    a. Temperature: 10-38°C (optimal- depending on area)
    b. At temperatures above or below, they won't germinate at all
15. Know the functions of auxins (and how they produce their phototropic effects) and their role in abscission (leaf drop)
    a. Auxins (IAA)
        - Cell elongation
            - Auxin moves away from the sun so the cells get longer and tilt because cells near the sun gets shorter
        - Inhibits abscission
            - Inhibits leaves from falling, except in the fall (another hormone)
16. Define apical dominance and know auxin's role in this
    a. Apical dominance
        i. High tip grows the most- induces cell elongation in sides/shoots
        ii. When in high concentration- interrupts the normal dicot growth, serves as an herbicide in grain fields
17. Define the role of gibberellins and their relationship to bolting (when a new plant suddenly breaks the soil surface)
    a. Giberellins- starts growth, causes them to grow taller because they simulate cell elongation; transported to vascular tissue; increase rate of seed germination and bude development
        i. Stem bolting- stem shoots up and flowers
        ii. Germination- getting things to start growth
18. Define the function of abscissic acid and ethylene
    a. Absissic Acid
        - Induces dormancy in seeds/buds (like until winter etc)
        - Organic nutrients stored in roots-it makes plans ordering to store them
        - Protects against stress- sends signals to guard cells/stomata to close when it doesn't have enough water
    b. Ethylene
        - Always in gas form
        - Helps ripening/maturation (thins and dies- causes leaf drop in the fall)
        - When someone has a bad apple, the Ethylene is given off to other apples and increases speed of ripening in others too
        - Slows down in cold temperature
19. Define nastic movements and give an example
    a. Nastic movements- responsive movement not regulated by direction of the stimulus; related to turgor changes
    b. (ex. Mimosa pudica- leaves shrink when they are touched- caused by a change in water pressure in the cells, pressure drops dramatically and leaflets become limp and close in)
20. Define tropism, state why it occurs, and know the difference between a positive and negative tropism
    a. Tropism- plant's response to an external stimulus
        **i.** It does this because on part of the plant growth is always faster than the other sometimes
    b. The tropism is called positive if the plant grows toward the stimulus, negative if the plant grows away from the stimulus

**CHAPTER 25**

INVERTEBRATES

- General Animal characteristics
    - Multicellular; heterotrophic; eukaryotic

- Store food as fat/glycogen for energy (ingestion)
- Body Plans
  - Sac- one opening (food and wastes go in and out same hole)
  - Tube- two openings; greater specialization: develop into primitive tube opening, more complex
- Symmetry- pattern, like porifera
  - Radial symmetry- appears same in all directions (usually one opening), no anterior/posterior, or head/tail-end
  - Bilateral- Humans, butterflies
    - Have a head; "cephalization"- senses are located at anterior
    - Dorsal side (back), Ventral side (belly)
- Asymmetry- irregular, no pattern, like sponges
- Sessile animals- attached to objects, no movement
- Germ Layers (what body's made of mostly in the embryonic stage):
  - Two
    - Endoderm- develops into primitive gut/digestive system
    - Ectoderm- develops into skin/nervous system from embryonic stage
    - Develops at the tissue level only
    - Primitive animals, with no body cavity
  - Three
    - Endoderm + Ectoderm in the middle and
    - Mesoderm- develops into muscles, circulatory system, excretory system, some become respiratory system
    - Develops at the organ level
- Body cavity (coelom):
  - Acoelomate- group of animals (goes with sac body plan)
    - No cavity; bilateral with 3 layers
  - Pseudocoelomate- have 3 layers
    - Has a Hydrostatic skeleton- filled with fluid water
    - Lined on the outside by the mesoderm
    - Roundworms and rotifers are examples
  - Coelomates- have true body cavity with 3 layers
    - Lined with mesoderm completely around the body wall and gut (inside and outside)
    - Formed in 2 ways:
      - Schizocoelom, "Protostomes"- coelom formed by splitting mesoderm (making a body cavity cleavage)
        - Blastospore—first embryo opening— becomes mouth for food
        - At the 8 cell stage- the cells know what they are so if cut off, they cannot regenerate a new organism
        - Makes a spiral cleavage
      - Entercoelom, "Deuterostomes"- body cavity develops from the endoderm
        - Anterocoelum- develops from the endoderm
        - Blastospore- develops to anus
        - Division stays the same and does not change, so if cells are taken away, they can regenerate
        - Makes radial cleavage
- Segmentation- leads to more specialization
  - Embryo develops → zygote divides to two/four/so on until 8 cell stage occurs → cleavage
  - Embryo develops into "blastula"- hollow ball filled with fluid (single cell layer) →
  - "Gastrula" stage occurs: endoderm cells grow/divide inward, mesoderm develops, tissues are developed → an opening called "blastospore"- first embryo opening, is developed

**CHAPTER 26**

PRIMITIVE INVERTEBRATES

- Poriphera- sponges
  - Primitive animals, sac body
  - Asymmetry- no half alike; sessile
  - Lives in marine
  - Filter feeders- have collar cells in body in inner layer is flagellated: moves waste in and out, are thin and flat epidermal cells
  - Choanocytes- flagellated collar cells which creates currents in filtering for waste and eating

- Amoeboid movement cells- between inner and outer cell layers (pockets)
- Needle like spicules- help provide support
- Acculum- large opening at sponge top; lets water in and waste out

- Cnidarians-
  - Radial symmetry; sac like body
  - Epidermis- outer layer, Mesoglea- middle, Gastrodermis- inner
  - Have tentacles- with nematocysts and cnidocysts sting cells
  - Alternation of generation: 2 stages
    - Polyps- sessile stage, mouth at top
    - Medusa- free moving, mouth at bottom
  - Classes:
    - Hydrozoa- includes hydra and manowar
    - Schyphozoa- jellyfish
    - Anthozoa- sea anemone
- Planarians
  - Platyhelminthes- flatworms with sac body
    - Acoelomate- no body cavity
    - Hermaphroditic- both genders oranges
    - Cephalization- senses at anterior
  - Tubellaria
    - Nonparasitic
    - In marine environment
  - Cestoda- parastic tapeworm
    - No shaped head
    - Covered with hooks: "scollex" to attach to host
    - Proglotids- section with muscle, flame cells, and hermaphroditic organs
  - Trematoda- parsitic flukes
    - Flame cells- remove excess water
    - "Schistasomiasis"- disease by flukes
  - Nematoda
    - Tube body
    - Cytcoelom- body cavity lined with mesoderm on the outside
    - Hydrostatic skeleton- filled with water for support
    - Roundworms, pinworms
    - Parasitic examples
      - Hookworms have ascaris (hooks)
      - Trichinosis- characterized by incisted nematodes at muscles by consumption of raw pork
      - Elephantiasis- thick legs
  - Rotifera
    - Pseudocoelomates
    - Parthenogenesis- reproduction by development of an unfertilized usually female gamete that occurs especially among lower plants and invertebrate animals
    - Transparent, free swimming, main food source in aquatic food chain

**CHAPTER 27**

ADVANCED INVERTEBRATES (PROTOSTOMES)

- Mollusca
  - Trocophore Larvae- common form of larvae
  - Body parts:
    - Mantle- excretes the substance that creates its shell
    - Visceral mass- tissues
    - Muscular foot- head foot
  - Bilater with cephalization
  - Types:
    - Chitons- polypolocophora
      - Marine, oval shape, divided into 8 parts
    - Bivalves- mussles, two shells
    - Gastropods- snails, slugs
      - Has radula- rasping tongue structure; scrapes algae from aquarium sides
    - Cephalopods- squid and octopus
      - Closed circulation with heart
- Annelid
  - Worms, leeches

- Segmented- ↑ specialization in body
- Clitellum- organ secretes stuff as a cocoon and moves along with worm to collect eggs for fertilization
- Classifed by setae (tiny bristles), no setae or palapodia (fleshy headlike flaps for movement)
- Closed circulatory system

**CHAPTER 28**

ARTHROPODA

- Have jointed appendages; segmented exoskeleton of chitin
- Hemocoel- cavity spaces between organs to circulate blood
- Ventral nervous system
- Open circulation
- Respiratory structures:
  - Book lungs- in spiders, air fill up chambers
  - Gills- in crabs
  - Tracheal tubes- most arthropods
- Crustaceans- cephalothorax (fusion of head and chest)
  - Nonsegmented caraspace- dorsal shield for protection
  - Hemoycanin in crawfish and clams; calcium carbonate endoskeleton
  - Ex- ispods, pill bugs, copepods/krill, lobsters, crabs, shrimp, barnacles
- Arachnids- spiders, ticks, scorpions
  - 2 segments- 4 leg pairs
  - Unaramians
    - Includes millipedes- diplopoda
    - Centipedes aka miriapods- chilopoda (one pair of legs per body segment)
- Insects
  - Head, thorax, abdomen
  - 3 pairs of legs, most have wings
  - Entomologists- study insects
  - Complete and Incomplete metamorphosis
    - Incomplete- has intermediate nymph stage
  - Defense mechanisms- camouflage, mimicry
    - Pheramones- for mating, defense, and territory

**CHAPTER 29**

DEUTEROSTOMES

- Echindodermata
  - Marine invertebrates with spiny skin
  - Radial symmetry with adults
    - Diplanuera larvae are bilateral
  - Water vascular system with tube feet
  - Regeneration
  - Endoskleton is unjointed calcium carbonate
  - Ex- sea urchins, star fish, sea cucumbers, sand dollar
- Chordata
  - Characteristics:
    - Dorsal hollow nerves cord
    - Notochord between dorsal nerves cord and digestive system
      - Long rodlike structure replaced by backbone at embryonic stage
    - Gill slits at embryo stage
    - Tail or mystomes
    - Primitive invertebrate chordates:
      - Lancelets- small streamline marine fish
        - Filter feeders
        - Cephalocordates
      - Tunicates- marine fish near shore or grave depths
        - Filter feeders
        - Sessile with free larvae; like tadpoles
        - Urochordata

**CHAPTER 30-33**

VERTEBRATE ANIMALS

(phylum is chordata, vertebrates is the subphylum)

- Vertebrate Characteristics:
  - Bilateral
  - 2 pairs of appendages (arms or legs)
  - Cephalization
  - Closed circulation
  - Bone/cartilage endoskeleton
  - Post anal tail
  - At the embryo stage:
    - Notochord becomes backbone
    - Gill slits- mostly develop into something else afterward
  - General Fish traits:
    - Muscles are zigzagged
    - Eyes- detect light; ex-Lamprey
    - Two chambered heart
    - Sexual reproduction
    - Mostly external fertilization
      - Class Agnatha (lamrepy, hagfish)
        - Jawless fish (Agnatha means jawless)
        - Cartilage (soft skeleton)
        - Evolutionary significance of jaws- they used to have them but not anymore
      - Class Chondricthyes (sharks, rays)
        - HAVE jaws
        - Cartilage skeleton
        - Advantage of jaws: consume large food particles
        - Paired fins
        - Lateral line system- detect water movements (like hair)
        - Internal fertilization
      - Class Osteicthyes
        - HAVE jaws
        - Bones- 95% of fish in this class
        - External fertilization; guppies and mollies-internal
        - Divide into two sub classes:
          - Lobe finned fish-
            - Have only gills
            - Maybe amphibian ancestors
            - Coelacanths- fossil fish, still living
            - Lung fish- have lungs and gills
          - Ray finned fish
            - Fins are like fans
            - Membrane support- spine
            - Swim bladder- thin internal sac to regulate water depth: buoyancy
            - Have scales- bony, thin plates protect skin
  - Amphibians (means double life- part land part water)
    - Complete metamorphosis
    - Larval stage- it must be tadpole at one point in life
    - Neoteny- condition where the amphibian stays in juvenile stage (stops growing) because of the lack of tyrosine/iodine
    - Thin and moist skin
    - Adaptation to land:
      - Dense skeleton
      - Lungs and skin for breathing
      - 3 chambered heart- 2 atria 1 ventricle
      - Exception: tadpoles have fins, gills, and 2 chambered heart
    - Reproduction limited to water (external fertilization like most fish): eggs don't have protective membrane so **must** be in water
    - Ectothermic- amphibian gets heat— their energy— from external sources; amphibs can't live in arctic circles (too cold- no heat)
    - Hibernation- in cold winter, and Estivation-in intense heat, reduces metabolism
    - 3 Orders:
      - Anura- frogs (smooth skin) and toad (rough skin)
        - No tail, jaw and teeth
        - Adults are predators
        - Can give chemicals to defend

        - Vocal chord
        - Dendrobatidae family: poison arrow frog
            - Very colorful, a warning
            - Secretes neuromuscular toxin
            - Used to develop a drug like morphine but without the same side effect, a pain killer: frog drug
    - Apoeda- cecilian
        - No limbs
        - Small eyes or no eyes- hard to see or blind
        - Lives in tropic environments
        - Short
        - No tail
        - Internal fertilization
    - Urodela- salamanders
        - Larva are same as adults except with gills (adults use lungs)
        - Neck
        - Tail
- Reptiles
    - First true land vertebrates
    - Characteristics:
        - Amniotic egg- (contains the embryo)
            - Protects embryo from environmental changes
            - Keeps the embryo moist
            - Contains yolk sac- for food
            - Alantoise- collects waste
            - Charion membrane- keeps fluid in, and helps gas exchange
        - Internal fertilization- eggs are laid after fertilization
        - Keratinized skin
        - Guano- bat waste, used by reptiles to keep the skin moist and conserve water
        - 3 chambered hearts; exception- crocodiles have 4
        - Lungs
        - Ectothermic- basks in the sun, and finds other sources to cool down- water, shade
        - Live in warm climate areas
        - 4 Orders:
            - Chelonia- turtles, tortoise
            - Crocodilia- most advanced reptiles: 4 chambered heart
            - Phyncocephalia- tuatara (fossil reptile)
            - Squamata- snakes and lizards
                - Oviporous- lay eggs outside and hatch them outside
                - Ovoviviparous- eggs hatch in the body; ex- snakes
                - Jacobsen's Organs (sensory adaptation)
                    - In snakes- detect chemicals when tongue probes the air (see pg 821)
                - Vipers have pits: detect body heat in animals
- Class Aves
    - Archaeopteryx (dinosaur ancestry) –earliest bird, had feathers
    - Flight adaptations:
        - Wings- evolved from front limbs
        - Feathers- have oily glands at tail to waterproof (they preen)
        - Hollow bones
        - Bony legs- no flesh on them
        - Air sacs- navigate flight height
        - Sternum- helps support pressure when bird takes off
    - Endothermic- regulate own internal temperature
    - Homeothermic- maintain constant temperature
        - Fluff up in the winter- reduces heat loss
        - Spreads out wings or pants when it's hot
    - 4 chambered heart
    - Types of development:
        - Precocial- active after hatching (there's many eggs); ex-duck
        - Altricial- blind, featherless and helpless (few eggs); ex- eagle
    - Voice box of song birds is "surine"- located at trachea which regulates flow of air; this warns other males and attracts females
    - Radiation of orders of birds and their relationships: pg 832

- (Extra info- don't need to memorize)
- Theropod dinosaur
    - Archaeopteryx
    - Modern birds
        - Woodpeckers, toucans, and honey guides (383 species)
        - Owls (146)
        - Perching birds (5200)
        - Parrots, lories, and cockatoos (340)
        - Herons, bitterns, and ibises (114)
        - Hawks, eagles, and falcons (288)
        - Swans, geese, and ducks (150)
        - Penguins (18)

- Mammals
    - Characteristics: (no air sac, no wing)
        - Dominant in Cenozoic era: ancestors may be reptilian theropods
            - Habitat was open for mammals after dino extinction
            - Dramatic ↑
        - Mammary glands- group of cells secreting fluid
            - Produces milk- for young
        - Live birth
        - Hair or fur- main distinction and difference
        - Largest brain sizes
        - Outer ear
        - Vibrissae- sensitive to touch, gathers info through touch (ex- whiskers)
        - Diaphragm- separates thoracic—chest—and abdominal cavity
            - ↓ and ↑ pressure for breathing
        - Endothermic
        - 4 chambered heart
            - 2 atria, 2 ventricals, separates oxy and deoxy blood
        - Scent, sweat, oil, milk glands
        - Classified by development in young:
            - Monotremes- lay eggs
                - Ex- platypus and echidna; retain cloaca
                - Closest to theropsid ancestor
            - Marsupial- have pouches: early development occurs in pouch
                - Ex- kangaroo, koala, possum
            - Placental mammals- embryo develops in ovule, at birth the baby is fully developed; live birth
                - 95% of all animals
                - Ex- humans, cats, dogs
        - Mammalian Orders:
            - Common ancestor
                - Invertebrates
                - Fishes
                - Amphibians
                - Reptiles
                - Therapsids: mammal-like reptiles
                    - Monotremes (3 species)
                    - Marsupials (280)
                    - Placental mammals (4400)
                        - Primates (230)
                            - Lived in trees- arboreal
                            - 3D vision
                            - Opposable thumbs
                            - Special teeth
                            - Biggest brain
                        - Carnivores (270)
                            - Meat eaters
                        - Chiropterans (925)
                            - Only flying mammals- bats
                        - Perissodactyls (18)- horses
                        - Artiodactyls (220)- camels
                        - Cetaceans (79)- whales

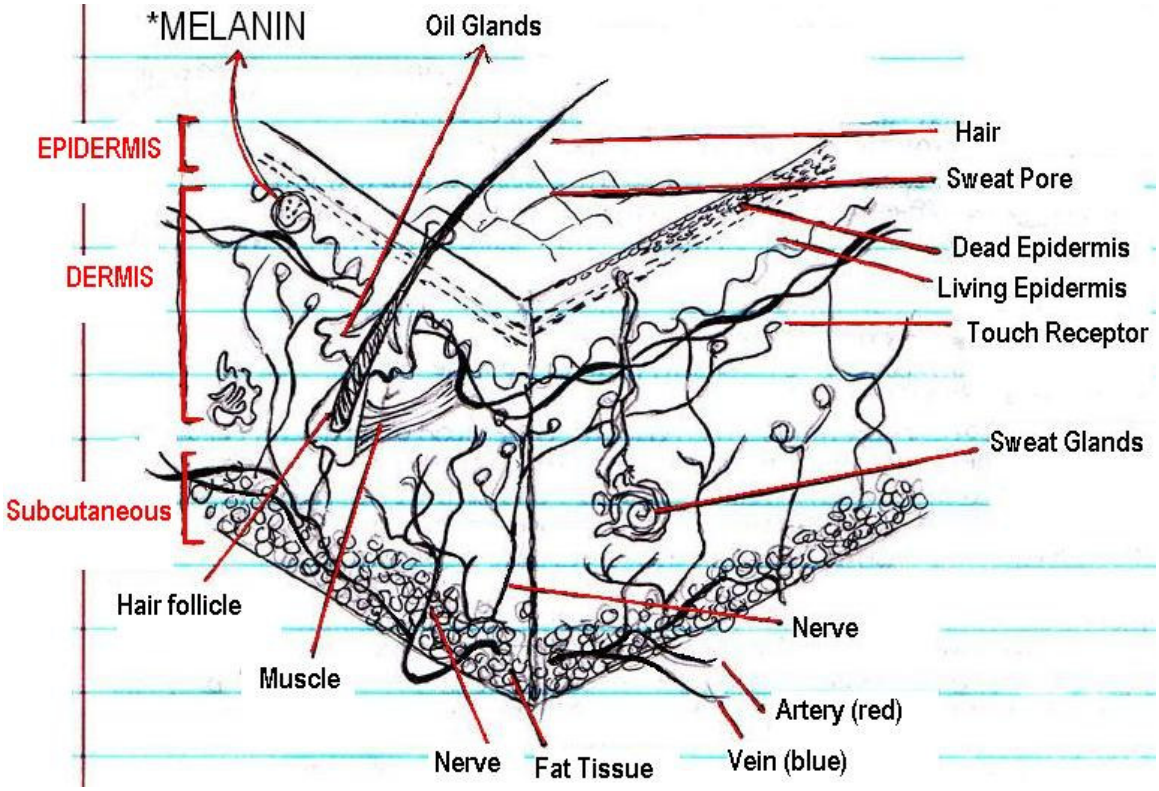
- Rodents (2000)- rodents
- Insectivores (375)- maybe shrew
- Proboscids (3) elephants

**CHAPTER 34**

EPITHELIAL TISSUE
- Function: It covers/lines things, protective
- Types:
  - 1. Squamous epithelial- flat, irregular in shape (cheek, skin)
  - 2. Cuboidal epithelial- cube, squares, 3D (ducts, glands)
  - 3. Columnar epithelial- long and skinny like columns, cilial (respiratory, digestive tract)
- Simple- one cell layer
- Stratified- many cell layers

CONNECTIVE TISSUE
- Function: connects things, binds and support tissues, organs, etc
- Criteria: cells (embedded in a nonliving matrix- protein fiber filling, filler)
- Collagen (most common large, thick, and strong when put together) and
- Elastin (stretchable and elastic fiber for flexibility) are found in matrix
- Types:
  - 1. Loose: fibers not woven tightly (burlap), includes adipose tissue
  - 2. Fibrous: many collagen, tight packing (like duct tape)- tendons and ligaments
  - 3. Blood: living cells living in matrix (plasma)
  - 4. Dense: bone/bone cells, living stuff, living in collagen mineralized matrix
  - 5. Cartilage: in the nose, ears, etc, similar to bone but not mineralized; collagen, is tough

INTEGUMENTARY SYSTEM DIAGRAM




INTEGUMENTARY SYSTEM (Skin, hair, nails)
- Functions: protects from injury and infection, homeostasis- regulating balance
  Controls body temperature and chemicals
- Includes: Epidermis, dermis (thickest), and subcutaneous (lowest) layers
- Epidermis- stratified, squamous epithelium
  - Basal cells- creating epidermis when divided- attaches epidermis to derms
  - Keratin- water proofing protein, makes top layers, prevents evaporation, withstands, toughens up epidermis

- Melanocytes- pigment cells, about the same number in everyone, but diff numbers functioning is variated
  - Melanin is produced in darkening color (or more color)
- Dermis- fibrous connective tissue; tougher, thicker, lots of collagen
  - Collagen- lots and lots to make tough
  - Glands- the follicle nearby, or connected to in oil glands, sweat glands- opens up through pores
  - Hair follicles- tip of the root of the hair
  - Receptors- detect temperature, pain, and touch on the ends of nerves
  - Nerves, blood vessels
- Subcutaneous layer- loose connective tissue, like fat
  - Functions: prevents heat loss- acts as cushion

BURNS

- First Degree- epidermis pinkens, no really hot damage
- Second Degree- through epidermis into dermis, blisters
- Third Degree
  - Very serious, into subcutaneous layer (2 layers gone)
  - Past epidermis and dermis, may not be painful
  - Nerves, barrier gone, vulnerable to bacteria, loss of body heat (dangerous)
- Fourth Degree- into the bone, no tissue BUT bone, usually electrical problems
- Sunscreens- extra protection against UV light, prevents wrinkly skin! (And strong pigmentation by melanin)

SKELETAL SYSTEM

- Main Parts:
  - 1) Axial Skeleton- skull, vertebra, ribs, sternum (80 bones)
  - 2) Fontanels- membranes, soft spot in babies (they fuse later)
  - 3) Sinuses- air spaces equalize air pressure from outside and inside
    - Sinus Infection- air pressure HIGH inside
  - 4) Appendicular Skeleton- pelvic and pectoral girdles: 126 bones
    - All vertebrates have- axial skeleton + girdles
- Long Bone Structure
  - Compact Bone- dense, cells close together
    - Yellow Marrow- stores fat; nutrient dense
  - Osteocytes- bone cells; living
  - Haversion Canals- openings in compact bone for blood vessels and nerves
  - Spongy Bone- cells spaced far apart, porous, air pockets
    - Red Marrow- stem cells, produces red and white blood cells
  - Epyphesial Plates- like cartilage (end of long bones- growth plates)
  - Periostium- nourishes and protects, gives blood flow
- Bone Development
  - Ossification- creating bone, making/forming bone, converting cartilage to bone
  - Osteoblasts- make new bones; Osteoclasts- break down bones
  - Osteocytes- bone cells
  - Osteoporosis- mineral loss from bones; bones become brittle and less dense; occurs more for women
- Joints
  - Synovial Joints- freely moveable joints (ball and socket, hinge, pivotal)
  - Slightly Moveable Joints- back bones, limited range of movement
  - Immoveable joint- skull, don't move
  - Types and Functions:
    - Long Bones- support
    - Short Bones- small, precise delicate movement
    - Flat- protection

MUSCLES

- Skeletal Muscle
  - Voluntary, Striated
  - Multi nuclei- one long cells with many nuclei, undergoes mitosis but not cytokinesis- capable of rapid contraction rate
  - Skeletal muscle is made of protein threads called myofibrils
  - Myofibrils are made of Actin and Myosin
  - The contraction unit of skeletal muscle is the sarcomere
  - Skeletal muscle follows the all-or-nothing rule and requires a threshold of stimulus
- "Muscle Contraction" in detail…
  - The long strands of myofibrils are made of many sarcomeres
  - There is thin and thick area's and a z-plate, thin is attached to z-plate....
  - Actin's in the middle of the sarcomere and is like a strand of beads

- When calcium's introduced, actin winds up, using ATP
- Myosin connects to the actin, to contract the bonds between myosin and actin
- They are broken with ATP
- Myosin (there are many heads that are connecting to the actin) move down to another bead of the actin and the process stars again- this is the contraction
- When the tension wants to be released, the bonds are broken and the actin returns to its normal state...it is the mix of (thick --> thin --> z plate --> thin -->thick) that makes the cell striated...

- Sliding filament Theory of Muscle Contraction (same explanation as above)
  - Nerve impulse-> calcium release->calcium helps actin change shapes->ATP changes myosin shape->myosin hooks onto Actin->actin is pulled past myosin->Sarcomere shortens so muscle contracts-> ATP used to make cross bridges between Actin-Myosin is released by ATP to relax the muscle
  - Muscles only contract, or pull
  - When signaled, the actin filaments within each sarcomere slide toward one another, shortening the sarcomere, in a fiber and causing the muscle to contract; The myosin filaments, on the other hand, do not move
  - Rigor mortis is when bodies stiffen, the body doesn't have enough ATP to release bonds...but after a day or two it starts decaying and the bacteria produce ATP to loosen it
  - Types of Contractions:
    - -Isotonic- contractions and shortening, defined as work, helps build up muscle
    - -Isometric-contraction but no shortening, ex. Putting arm on desk and tensing up, but not doing work, builds tone
  - Tone vs. Atrophy- tone is the ability of muscle's to be identified and seen, atrophy is how it loses tone and sometimes size ex. You broke your leg got a cast and you leg is not much after that
- Mechanics of Muscle Action
  - Flexors-bicep, these are flexing muscles they pull?
  - Extensors- triceps, extend
  - Origin-anchor position of muscle (normally above the bone they move)
  - Insertion-where the movement occurs (such as at the joint)
  - Strength=number of fibers and the width of the fibers
- Smooth
  - Organs and Blood Cells
  - Involuntary and Unstriated
  - One nucleus
  - Slow Contraction Rate
  - Made up of sheets of cells that are ideally shaped to form a lining for organs such as the digestive tract and reproductive tract; Most common function: to squeeze, exerting pressure on the space inside the tube or organ it surrounds in order to move material through it
- Cardiac Muscle
  - Heart Only
  - Involuntary but striated
  - Contracts slowly but constantly
  - It is told to beat by the sinoatril node, but is told at what rhythm to beat by the CNS (Central nervous system) depending upon what the body is doing
  - Cardiac muscle fibers are interconnected and form a network that helps the heart muscle contract efficiently; adapted to generate and conduct electrical impulses necessary for its rhythmic contraction

**CHAPTER 35**

NUTRITION

- Proteins
  - Good for growth and repair
  - Enzymes, Antibodies, many hormones, and substances that help the blood clot are all proteins
  - Broken down into amino acids, most used for protein synthesis
    - 12 Nonessential (body can manufacture on its own- without the food)
    - 8 Essential (body can't manufacture them- comes from food that you eat)
  - Protein Types
    - Complete- has all 8 essential, mostly from animals
    - Incomplete- missing one or more, typically plant proteins
  - 10% of your diet

- Carbohydrates
  - Quick energy source (body's fuel), most typically complex, like starch
  - Carbohydrates are starches and sugars (these break down fast)
  - Starches- complex carbohydrates (like bread cereal, potatoes, rice)
  - Sugars- simple carbohydrates (mainly in fruits)
  - Complex are broken down into simple sugars- ex glucose, fructose, galactose
  - 50-60% of your diet should be carbohydrates, preferably complex
- Fats (Lipids)
  - Energy storage source molecule and building material
  - Broken down into fatty acids and glycerol
  - Types
    - Saturated- nothing but single carbon bonds with hydrogen- animal fat
    - Unsaturated- plant fat oils- healthy, better for you (olive oil or safflower are best)
  - Up to 30% of your diet
- Vitamins and Minerals
  - Necessary, serve as coenzymes (organic, vitamins) and cofactors (inorganic, minerals)
  - Minerals are:
    - Inorganic substance that serves as a building material or takes part in a chemical reaction in the body (not for energy)
  - Vitamins are:
    - Organic nutrients required n small amounts to maintain growth and metabolism
    - Water Soluble- can't be stored in the body, must be included regularly in diet (B1, B2, Niacin, B6, Pantotheric Acid, Folic Acid, Biotin, C)
    - Fat Soluble- can be stored in the liver, but mostly can't be stored for a while so gets into fat, accumulation of excess amount may be toxic (A, D, E, K)
- Water
  - Water in the diet has no nutritional value
  - Every chemical reaction in the body occurs in water
  - Maintains your body's internal temperature- water absorbs and releases heat slowly

CALORIES AND METABOLISM

- Calories- units of heat in which the energy content of food is measured
  - Each Cal represents a Kilocalorie, or 1000 calories
  - A calorie- the amount of heat required to raise the temp of 1 mL of water by 1°C
  - Number of calories needed each day varies from persons, depending on metabolism, or rate at which energy is burned
- Major regulator of metabolic rate is a hormone from the thyroid gland
  - Body mass, age, gender, and level of physical activity also affect metabolic rate

DIGESTION AND DIGESTIVE CENTER

- Main function- to disassemble food into component molecules so that it can be used as energy for your body
  - Digestion Process:
    - All take place in the alimentary canal (one way tube for digestive tract)
    - System takes ingested food and begins moving it through the digestive tract
    - It digests- or breaks down mechanically and chemically- the complex food molecules
    - System absorbs the digested food and distributes to cells
    - Eliminates undigested materials
  - Oral Cavity- mouth, where food enters
    - Tongue moves food and position in teeth for chewing
    - Mechanical Digestion- teeth chewing it (physical breaking of big to small pieces), prepares food for chemical digestion
    - Chemical Digestion- using enzymes and breaks bonds down to monomers and changing food on a molecular level
      - Salivary glands- 3 per side, 6 total, secreting through duct, producing saliva
      - Saliva- water + mucus + amylase (enzyme)
      - Amylase- a digestive enzyme in saliva which breaks down something like starch into smaller molecules such as di- or monosaccharides
      - Digestion of starches by salivary amylase (ptyalin) to maltose level (double sugar level)
    - Tongue shapes a Bolus- wad of food and saliva you swallow
    - Swallowing forces food from mouth into throat
    - Pharynx- passage of food (back of the throat- common passageway)
    - Food goes into esophagus- muscular tube in swallowing where food goes down, is thin

            - Peristalsis- series of involuntary smooth muscle contractions along the walls of the digestive tract, or wave-like contractions pushing food down, squeezing
        - Epiglottis- flap of tissue in back of throat, swing over trachea when you swallow food, so food goes down the right tube
            - When you swallow, food enters esophagus
            - A flap of cartilage closes over the opening to the respiratory tract as you swallow
            - Prevent food from entering the respiratory tract
            - After food passes into esophagus, epiglottis open again
    - Stomach- muscular, pouch like enlargement of the digestive tract
        - Physical and chemical digestion take place here
        - Cardiac splinter- opening (valve) to the stomach which is close to the heart, the gurgle sound when swallowing
        - Three layers of involuntary stomach muscles contract
            - Churn and squeeze stomach to perform mechanical digestion
            - Physically breaking down swallowed food
            - Continue to work the food pieces, mixing them with digestive juices (chemical)
        - Chemical Digestion
            - Inner lining glands secrete gastric juice chemicals: contains pepsin and hydrochloric acid
            - Pepsin- enzyme that begins the chemical digestion of proteins in food to polypeptide level
            - Hydrochloric acid- increases acidity for effective pepsin activity
    - Small Intestine
        - Muscular tube with narrow diameter where digestion is completed
        - Muscle contractions –mechanical- further break down food
        - Duodenum- first 25 cm, ducts collect juices from pancreas, liver, gallbladder
        - Pancreas- soft, flattened gland secretes both digestive enzymes and hormones
            - Mixture of enzymes secreted breaks down carbs, proteins, and fats
            - Alkaline pancreatic juices help neutralize acidity of food, stopping pepsin action
        - Liver
            - Produces bile- chemical substance breaks down fats (stored in gallbladder)
            - From gallbladder, bile passes into duodenum
            - Gallstones- bile too concentrated due to high cholesterol, or gallbladder inflamed
        - Villi- tiny fingerlike structures- single projection on small intestine lining; absorbs digested food
            - Greatly increase surface area of small intestine
            - Allows great absorption rate
            - Digested food can be absorbed directly in the cells of the villi
            - Food molecules diffuse into blood vessels of the villus and enter bloodstream
            - Villi link digestive and circulatory system
    - Large Intestine
        - Muscular tube, also called colon where indigestible material passes
        - Appendix- tubelike extension off the large intestine, vestigial structure
        - Intestinal walls absorb water and salts, leaving solid material
        - Anaerobic bacteria synthesize vitamins (also prevents intestinal infections)
        - Feces reach rectum- last part of digestive system, eliminated through anus

ENDOCRINE SYSTEM

- Endocrine System:
    - Made up of series of glands, endocrine glands, that release chemicals directly into bloodstream
    - The chemicals act as messengers, relaying info to other parts of the body.
    - Functions of all body systems are controlled by nervous and endocrine systems
- Nervous and Endocrine System
    - They maintain homeostasis in body
    - Hypothalamus- portion of the brain connecting endocrine and nervous systems
        - Receives message from other areas of brain and organs
        - When homeostasis changes, it stimulates pituitary gland
        - Pituitary gland- main gland of endo sys
            - Connected beneath hypothalamus by nerves and blood vessels

- Receives messages from hypothalamus to release chemicals or stimulate release from other glands (ex- thyroid, adrenal, reproductive)
- Endocrine Glands
  - Hormones- chemical secreted into bloodstream by endo glands
    - Carry instruction to other body cells on mtblsm, growth, dvlpmnt, bhvr
    - Attaches to binding sites on plasma membranes, or in the nuclei, of target cells

- Negative Feedback Control
  - Regulation of endo sys controlled mostly through negative feedback system- internal feedback mechanism
    - Homeostasis disrupted
    - Hormones, or their effects, are fed back to inhibit original signal
    - Homeostasis reaches, signal's stopped and hormone no longer released (ex- thermostat)
    - Hormone/effect info is fed back to hypothalamus or pituitary gland
  - *Product inhibits reaction and minimizes fluctuations in homeostasis*
- Positive Feedback Control
  - *Product increases reaction*
- Hormones- control activity in target cell
  - Steroid Hormones/Lipid Hormones
    - Made from lipids
    - Are lipid-soluble and diffuse freely into cells through plasma membranes
    - Bind to hormone receptor inside cell
    - Hormone-receptor complex travels to nucleus to activate mRNA synthesis
    - mRNA move to cytoplasm for protein synthesis
    - One messenger system- goes thru cell directly to give instruction
  - Amino Acid Hormones/ Protein Hormones
    - Chains of amino acids
    - Bind to receptors embedded in plasma membrane of target cell
    - Open ion channels in membrane OR
    - Route signals from membrane surface to activate enzymes inside cell
      - Enzymes alter behavior of other molecules in the cell
    - Two messenger system related to ATP
- Adrenal Glands
  - Located on top of kidneys
  - Inner Portion
    - Secretes amino acid hormones: epinephrine (adrenaline) and norepinephrine
    - Increase heart rate, blood pressure, respiration, muscle contractions, blood sugar levels
    - Fight-or-Flight response, adrenaline rush
  - Outer Portion
    - Secretes steroid hormones: ex- glucocorticoids and aldosterone
    - Increase glucose supply, raise blood pressure
    - Combats stress from fright, extreme temps, bleeding, infection, disease, anxiety
- Thyroid and Parathyroid Hormones
  - Thyroid gland- located in neck
    - Regulates metabolism, growth, development
    - Thyroxine- main metabolic and growth hormone of thyroid gland; needs iodine, lack of it causes a "goiter" or the swelling of the thyroid gland
      - Hyperthyroidism
        - Too much thyroxine
        - Bulging bloodshot eyes, ↑metabolism ↑heart rate (jittery) ↑blood pressure (heart attacks, strokes)
        - Eliminate problem by destroying a little bit of the thyroid gland through radiation
      - Hypothyroidism
        - Too little thyroxine
        - ↓metabolism (↑weight) ↓heart rate (sluggish) ↓blood pressure ↓circulation (always cold)
    - Calcitonin- hormone regulating calcium levels in blood
      - Calcium- mineral for blood clotting, formation of bones and teeth, normal nerve and muscle function
      - Binds membranes of kidney cells and causes increase in calcium excretion

- Binds to bone-forming cells, causing increased calcium absorption and synthesize new bone
- LOWERS BLOOD CLACIUM LEVEL AND STORES IT IN BONES

- Parathyroid gland- attached to thyroid gland
  - Parathyroid hormone (PTH)- involved in mineral regulation
    - Leads to increase calcium, phosphate, magnesium absorption in intestines
    - Causes release of calcium and phosphate from bone tissue
    - Increase rate at which kidneys remove calcium and magnesium from urine and return them to blood
    - RAISES BLOOD CALCIUM LEVEL AND TAKES IT OFF THE BONES

- Pancreas
  - Islets of Langerhan cells- produce hormones
    - Alpha Cells- has glucagons to raise glucose levels in blood to keep you mobilizing until refill
    - Beta Cells- make insulin to lower glucose levels in blood to get sugar to cells, stores glucose as glycogen in livers and muscles
  - Diabetes Mellitus (AKA Hyperglycemia)- high blood sugar level
    - Type 1-
      - Insulin dependent (don't make any by yourself- must inject)
      - Autoimmune disorder- body destroys insulin-producing cell
      - Juvenile onset
    - Type 2-
      - Not insulin dependent
      - Adult onset
      - Body makes too little insulin OR cells do not recognize insulin
      - Controlled by diet/exercise- no daily dose or injection
  - Hypoglycemia- low blood sugar level
    - Too much insulin, using up blood sugar too fast
    - Diet controlled (avoiding sugar)

**CHAPTER 36**

NERVOUS SYSTEMS

- Neurons (nerve cells)
  - Sensory (affectors)- pick up info from environment (incoming) and take it to central nervous system
  - Motor (effectors)- muscles and glands (brain and nervous systems) affected/moved; takes messages to muscles for response
  - Interneurons- middlemen, situated in between other two, coordinates info between
- Structure
  - Cell body- where nucleus, cytoplasm, etc located; has special fibers for receiving and transmitting info
    - Dendrites- fiber; receive info, take in to cell body branches
    - Axon- fiber; unbranched; out cell body to contact next neuron- must have insulating layer, or Myelin Sheath
      - Myelin sheath of Schwann cells- protecting axon
      - Nodes of Ranvier- gaps in myelin sheaths where signals travel a lot faster than in entire axon (jumping from gap to gap)
- Impulse Transmission through Axons (creating action potentials)
  - Axon is polarized (at rest): inside is neg and outside is pos
  - Threshold stimulus (min level of voltage or mass change for action to occur) causes depolarization (reversal of charges- sodium flood inside)
    - Area of signal travel has reversed charge (- → +), opens gates, once it leaves, it moves on and changes charge of others
    - Once signal's over, repolarization occurs and everything's normal
  - All or none response- if you meet minimum level, you feel it, if you don't you don't
  - Repolarization occurs after action potential leaves area of axon- like a dominoe when it continually stands up after falling
  - Momentary refractory period (delay- waiting for dominoe to stand back up) where axon is insensitive- fraction of a second delay
- Synapses (gap in between nerve actions)
  - Synaptic buttons- tail end of axons, contains:
    - Vesicles- storage bubbles containing neurotransmitters that carry the signals
  - Synaptic cleft bordered by pre (before gap) and post (after gap) synaptic membrane (on axon)

        - Axon → gap → dendrite
        - Fuse, dump → Neurotransmitters get into air → open voltage gates
        - Neurotransmitters (chemical) transport signal across cleft
        - Nervous impulses are electro-chemical messages (pos/neg charges)
- Neurotransmitters
    - Seratonin- implicated in moods, sleep (sleep quality) attention span
        - If you have too little → depression
        - Associated with Marijuana
    - Epinephrine and Norepinephrine- found in CNS (brain/spinal chord); excites/inhibits signals; adrenaline used for fight/flight response; diverts blood away to the areas that need it
        - Made from amino acid derivatives
    - Dopamine- works 2 ways:
        - 1) Follows motor pathway (muscle action) **and**
        - 2) Behavior (depression)
        - Associated (influenced) by Cocaine
        - Parkinson's disease- too little dopamine in motor pathway
    - Acetylchocine- voluntary muscle action → released by motor neurons; make skeletal muscle work
        - Insecticides and nerve gases have acetylchocine
        - May cause seizures
    - Endophines- pain killers, create feelings of well being; analgesics: Asprin, Tylenol
        - Associations- Opium drugs: Ecstasy, Heroine, etc
        - Body gets used to it and depends on drugs to make endophines, body refuses to naturally make it
- Central Nervous System
    - Brain/Spinal Chord- main
        - Meninges- membranes that surround brain and spinal chord; feeds brain, gets rid of wastes, protects
        - Cerebrospinal Fluid- buffering layer, watery fluid surrounding brain and spinal chord, cushions
        - Matter:
            - White matter- mylenated axons with mylean sheath
            - Gray matter- have dendrites and cell bodies
            - In nervous actions in spinal chord- goes in gray, out white; vice versa for brain
- Cerebrum of Brain (personality)
    - 2 Halves:
        - Left hemi- logical brain (academics- schoolwork)
        - Right hemi- artistic (muscle, art, spatial) skills and intuition
    - Corpus Callosum- connect both hemispheres, group of fibers running back and forth
    - Cerebral Cortex- outer layer of cerebrum
- Hemisphere Lobes
    - Frontal- front half- personality, complex reason (judgment), abstract thinking, some language (brain has redundancies in order to prevent disaster when some parts of the brain fail to function)
    - Parietal- top back- taste, speech center, light touch pressure (skin sensation)
    - Temporal- side above ears- hearing, smell, long term memory
    - Occipital- vision, sensory info from here, very back of the brain
    - Thalamus- center switchboard- relays all info to diff parts of the brain (relay station)
    - Hypothalamus- under thalamus- maintains homeostasis, thermostat for body temp, hunger and thirst, primitive emotions (ex- fear, happiness)
- Cerebellum
    - Coordination and balance
    - Rhythmic movements
- Brain Stem- above spinal chord
    - Medulla oblongata- big part- breathing and heart rate- controls automatic things such as digestion
    - Pons- roundish part of brain stem, medulla assistant, physically connects cerebrum to cerebellum, may turn on dream state
    - Mid brain- regulate size of pupils
- Brain Systems
    - Limbic- translates drives or emotions into actions, develops long term memory (there are several scattered all over the place)
    - Reticular activating system or RAS- (reticular formation) for consciousness, makes you awake and aware to your surroundings, also puts you to sleep, filters sensory info

(doesn't bring minor noises to your attention)- you don't notice things until it's coming to your attention

- Peripheral
  - Cranial Nerves- through arms and legs; 31 pairs; to and from CNS
  - Spinal Nerves- found in head; 12 pairs
  - Somatic Nervous System-
    - Voluntary skeletal system muscles- controlled, voluntary
    - Reflex arc- skeletal muscles, happen without control; speed better than perception; protection against damage
  - Autonomic
    - Homeostatic life function- breathing, heartbeat, life needs, etc
      - Controlled by autonomic nervous system; regulated by medulla
    - Sympathetic NS- stress response, fight/flight (epinephrine use, adrenaline release)
    - Parasympathetic NS- operations in your normal condition, returns you to normal; counters sympathetic
- Effects of Drugs
  - Increases neurotransmitter release or slow down their breakdown or interfere with receptors
  - Analgesics- pain relief (Advil, Tylenol, etc) Narcotics work on CNS- block pain receptors; induces sleep; depress NS- sluggish, sleepy; side effects probable after long term use
  - Stimulants- increases effects of CNS- speed ↑
  - Depressants- decreases effects of CNS- slow ↓
  - Addiction-
    - Psychological dependence- craving, moods
    - Physical dependence- chemical dependence; body uses as substitute for certain naturally made chemicals- i.e. endophine
  - Tolerance- body is accustomed to certain level of drugs, must have higher dosage or stimulus for same effects
  - Withdrawal- physically ill side effects- fever, convulsions, throwing up, pain, sickness; drugs- what kind, how much, how long- determines withdrawal time
- Stimulants
  - Cocaine- ↑ Dopamine- mood elevation, effects hunger and pleasure pathways giving false satiation; vasoconstriction (narrow blood vessel) and depress immunity
  - Amphetamines- vasoconstriction; raise heart rate, breath rate, pressure of blood effects, wears out blood vessels → ↑ blood pressure
  - Caffeine (coffee) and Nicotine (cigarettes)- raise heart rate, blood pressure, without it→ sluggish; 2-3 cup needs- addiction, step down slowly for withdrawal; serious addiction withdrawal effects→ jitters, no concentration; heart attack and stroke risks
- Depressants
  - Alcohol- blocks movement of Na+ and Ca+, slower motion (nerve impulse block), prevents muscle contraction→ slow reflex
  - Barbiturates- sleep pills, can get depressed
- Other Drugs
  - Hallucinogens- altar moods, thoughts and perceptions, hallucinations
    - LSD, PCP, mushrooms
    - Affect heart rate, blood pressure, lung failure, permanent emotional alteration, lose control of muscles
  - Narcotics- pain relievers, very similar to natural endorphins
    - Opiates, poppy plant, heroine, morphine, methadone, oxyconton
  - Anabolic Steroids- synthetic testosterone, more body mass and strength
    - Females- grow beard and chest hair, deep voice, bald
    - Males- testicles shrink, bald, breast growth
    - Liver, kidney, heart damage, acne, Roid rage- aggressive
- Sense, Vision, Hearing, Taste, Smell, Touch
  - Parts of the Eye
    - Conjuctive- lining of eyelids (inside)- pink stuff in eyes
    - Lacrinal gland- produces tears; located above eyebrow, comes out of duct
    - Outer Layer
      - Sclera- tough, whites of the eyes
      - Correa- clear covering over pupil and iris
    - Choroid- pigmented middle layer; traps light rays; colored part- iris; has muscles to control the size of the pupil
    - Lens- bends light; is the disc behind the pupil; flatten/bulges, refracts light waves so it can be focused in the back of the head
    - Humor- fills out the shape of the eye

- Aqueous humor- in front of lens; water like liquid
- Ultereous humor- jelly like, behind lens

- Retina- innermost layer; photo receptors
  - Rods- detect black and white in dim light (at night time)
  - Cones- motion detection; color receptors working in bright light; main colors- red, blue, green
    - Fovea- concentration of cones in the back of the retina, gives brightest image

- Vision
  - Accomodation- ability of lens to bend in order to help see close up
  - Optic Chiasma- part of optic nerves cross for 3D vision; point of partial crossing over into different hemispheres
  - Optic Disc- no photo receptors; the blind spot; optic nerve attaches to retina
  - Optic nerve to occipital lobe- action/signal of vision from eye to brain
- Vision Disorders
  - Myopia- nearsightedness; shape abnormality- eye ball is too long front to back; focus point is further back than normal
  - Hyperopia- farsightedness- focal point too far in front, must have object further to see; squished eye
  - Astigmatism- wavy cornea- blurry vision from multiple focus; blurry edges
  - Glaucoma- aging problem; too much aqueous humor; not drained properly- puts too much pressure on retina- may blind; also known as "tunnel vision"
  - Cataracts- clouding of lens, milky opaque stuff in center of the eye; these people see little to no color, things are not focused
- Parts of the Ear
  - Pinna where earring goes
  - Auditory canal- channel going into ear
  - Middle ear- sound waves receiver, amplify for more vibration
    - Tympanic membrane→vibrate→Ear bones (malleus, incur, stapes) or (hammer, anvil, stirrup)→vibrate→oval window (separate eardrum, vibrate into inner ear)
  - Eustachian tube- creates balance for inside and outside air pressure of ear, connects middle ear and throat (when you're on a plane, and the altitude increases, the Eustachian tube collapses- when you pop your ears, you're hearing the reinflation of the Eustachian tube)
  - Inner ear (actual hearing part): cochlea (round shell) + organ of corti (inside cochlea- organ of hearing); round window- vibrates fluid in cochlea
    - Semicircular canals and vestibules control balance
      - Saccule and Utricle chambers (part of vestibules)
- Hearing Disorders
  - Auditory nerve deafness- prevention of action potential along nerves- brain doesn't receive; mostly congenital
  - Conductive deafness- preventing vibrations of eardrum- caused by defective earbones, the ear's hair is broken off
  - Tinnitus- ringing in the ears; brain gets used to high stimulus sound→ in total silence, the brain tries to adjust to it by making its own humming sounds
- Balance
  - Static balance- body motion head stays in same place
    - Otoliths of saccule and utricle; gravity
  - Dynamic Balance- semicircular canals; rotation- semicircular tells you about different rotations and what your heads doing- the liquid keeps going if you spin too fast

- Smell, Taste, Touch
  - Smell and taste involve chemoreception (chemicals)- must dissolve chemicals to liquid in order for reception
  - Olfactory receptors- pick up smell (neurons); is very small; top of the nose
  - Gustatory- picks up taste; not nerve cells-->is specialized epithelial; grouped in bundles called papillae
  - Other receptors in the skin: light, touch, pressure, pain, temperature- all specific receptors for any sensation

**CHAPTER 37**

RESPIRATORY SYSTEM

- Respiration
  - External- exchanging gases between air and lungs

- Internal- exchanging gases between blood and cell tissues
- Cellular- using oxygen to make ATP (breaking glucose)

- Ventilation- inflating the lungs, breathing process
  - Inspiration- negative pressure breathing; inhaling
    - Stimulus to inhale is CO2 in plasma
    - Medulla Oblongata (controls breathing) has a breathing center
      - It sends signal to ribs (intercostals) and diaphragm to contract
      - Makes chest cavity larger
      - Creates negative pressure
  - Expiration- positive pressure
    - Medulla signal is inhibited by lung stretch receptor
    - Muscles relax
- Respiratory Structures
  - Nasal Cavity Jobs
    - Filters air- dust, bacteria, etc
    - Warms the air you breathe
    - Add moisture to the air to diffuse in the lungs
  - Pharynx (back of the throat) + Larynx
    - Larynx is over the pharynx, it's the voice box
    - Vocal chords are located in the larynx
    - The longer the chord- the deeper the voice
  - Passageways/Tubes
    - Trachea- windpipe
    - Bronchi- branches off and divides
    - Bronchioles- further branches
  - Alveoli- grapelike air sacs
    - Millions in lungs
    - Site of gas exchange
  - Pleura- double membrane around lungs
- Gas Exchange Process
  - $CO_2$ + $H_2O$ from respiration converts to
  - $H_2CO_3$ (carbonic acid) which dissociates, or breaks apart, to form
  - $HCO_3^-$ + $H^+$ (bicarbonate ion) in blood in lungs
  - Reconvert to carbonic acid and exhale $CO_2$ and $H_2O$ at lungs
  - Summary:
    $CO_2$ + $H_2O$ (cells resp- exhale at lungs) --> $H_2CO_3$ (blood) --> $HCO_3^-$ + $H^+$ (blood at lungs)
- Lung Capacities
  - Tidal Volume (350-500mL) – fluctuations of normal in normal out breathing
  - Vital Capacity= tidal + reserves, (above-normal inhaling + above-normal exhaling level)
    - Reserves
      - Inspiration reserve- an above normal inhale tidal (when you take a deep breath)
      - Expiration reserve- an above normal exhale tidal (when you let out a lot of air)
  - Residual Volume (1L)- partial air pressure
    - When you get the "air knocked out of you" when you get punched, you still have a little bit of air in the lungs- it's the "partial air pressure" to help maintain the expansion of the lungs and to re-inflate it
    - If you lose the residual volume, your lungs will collapse and will fail to re-inflate, you're then only left to get air pumped into your lungs because you can't breathe on your own
- Circulation
  - Open Circulation- invertebrate; the blood will leave vessel at some point--> go to tissues (muscle actions return blood)
  - Closed Circulation- blood always inside blood vessel no matter if there's injury or not; vertebrate
- Liquid Connective Tissue (blood)- plasma matrix has red and white blood cells
  - Functions:
    - Transport nutrients, waste, respiration gases
    - Clotting, seal wound
    - Fight Disease- antibody, white blood cells
  - Blood cells are made in bone marrow
    - Types:
      - Erythrocytes- red blood cells
        - With hemoglobin (red with iron), carries oxygen

        - No nucleus; lives 120 days
        - Broken down in the liver and spleen (recycled)
    - Leukocytes- white blood cells (phagocytes) live 3 days
        - Have nuclei; amoeboid movement (free movement)- traveling
    - Lymphocytes- B and T cells- specialized
        - Keyed to one foreign marker
        - Specific immunity; make antibodies
    - Platelets (thrombocytes)- coagulation process, cell fragments
        - Clots blood to seal wound
- Blood also has plasma proteins, respiratory gases (bound to cell or dissolved in plasma), nutrients (DNA, RNA acids, etc), wastes, hormones, salts

- Intercellular (Tissue) Fluid- blood is a connective tissue consisting of cells suspended in an intercellular fluid (the blood plasma); tissue narrows and pushes nutrients out for use
- Coagulation Process
    - Damaged Vessel--> platelets (cell fragments with jagged edges) clump at the site of damage- get caught on jagged edges of the torn skin edges --> Fibrin threads wind around platelets to form a net (wind and crisscross) --> red blood cells get trapped in the net (dam the "river" with the "net") --> cell dries out to clot (forms a scab when it dries with air)
- Blood Types
    - Antigens- protein markers on surface of red blood cells; determine blood type
        - Stimulates antibody production (against what you have)
    - Agglutination- red cells clump due to antigen- antibody reaction- bad clotting
    - Type O- has no antigens,
    - AB+ has both antigens, no antibodies
    - RH factor- presence or absence of an antigen is called "RH," or Rhesus factor; RH is inherited; RH+ means people have RH antigen factor on their red blood cells; RH- means people don't have RH antigen factor
    - RH disease- mother is RH-, baby is RH+; mother's blood detects the negative factor in the baby's blood, she makes antibodies, this baby may be born without harm, but if a second baby is RH+, it could be harmed quickly by agglutination in its blood because the mother has antibodies already readily made to attack it

CIRCULATORY SYSTEM

- Heart
    - Vertebrate types:
        - Fish- 2 chambered (1 atrium, 1 ventricle)
        - Amphibians and most Reptiles- 3 chambered (2 top, 1 bottom- mixing of bloods)
        - Birds and Mammals- 4 chambered (best one- separates oxygenated and deoxygenated blood)
    - Structure
        - Pericardium- sack around the heart
        - Atria- top upper chambers (retrievers of blood- dumps into Atria)
        - Ventricles- lower, exit pumpers (to rest of the body)
        - Septum- muscular wall between the ventricles, divides the ventricles
        - Valves- separate atria from ventricles
            - Tricuspid- right side
            - Bicuspid (Mitral)- left side
        - Semilunar valves- half moon shape, opening for blood to flow out to rest of the body (in the aorta)
    - Blood Vessels and Heart Circulation
        - Arteries, Aterioles, Capillaries- carry oxygenated blood
            - Pulmonary Artery carries deoxygenated blood
        - Veins and Venules- carry deoxygenated blood to the heart; have valves to keep blood flowing in one direction
            - Pulmonary Vein carries oxygenated blood
        - Blood Circulation Path:
            - (Deoxy blood) Superior Vena Cava (big blood vessels serve top of body) + Inferior Vena Cava (lower) → below the heart → (carry deoxy blood) Right Atrium → Tricuspid Valve → Right Ventricle → Pulmonary Artery → LUNGS (oxygenated) → Pulmonary Veins → Left Atrium → Bicuspid Valve → Left Ventricle → AORTA
    - Hyper Beat and Blood Pressure
        - Systole- ventricular contraction; Systolic pressure
        - Diastole- ventricular relaxation; Diastolic pressure
        - Lubb Dubb sounds- closing of heart valves

        - Sinoatrial Node- heart's pace maker at right atrium- generate electrical signal to make heart beat
        - Heart Rate Control- medulla oblongata in brain (control heart pulse speed and PH of blood, body redirects blood flow to control CO2- away from limbs and head to ointestines to get rid of CO2- extra CO2 is biproduct in compensation AKA sleepiness)
        - Blood Pressure Control- diameter of blood vessels
        - Vaso constriction- if blood vessel's constricted to increase blood pressure somewhere in the body; ant- vaso dilation (keeps homeostasis in both conditions)
        - Hypertension- high blood pressure
    - Electrocardiogram
        - P wave- atria contract
        - QRS- ventricles contract
        - T- ventricles relax
    - Circulatory Subsystems
        - Pulmonary circle- between heart and lungs, taking blood there
        - Systemic circle- everything else; includes renal, hepatic-portal (liver, digestive tract) and coronary (heart) circle

EXCRETION

- Getting rid of metabolic wastes
    - Ammonia- When you metabolize protein it is one of the by-products; it is a nitrogenous waste (most of the others are too), it is highly toxic and if it built it could kill you in a matter of hours, your body changes it into another form so as to not kill you
    - Urea- Ammonia + carbondioxide, it is manufactured in the liver, 10,000x less toxic than ammonia
    - Uric acid, not very water soluable, but not much in body...such as bat guano
    - Bile pigments, $CO_2$, water, salts
- Urine is Urea, water, and salts
    - Organs
        - Kidneys: cortex(outer layer of the kidneys), medulla(middle layer of kidney, dont confuse for brain), pelivs(inner layer)
        - the functioning unit of the kidney is a nephron- composed of a bowman's capsule around a glomerulus, which goes on a tubule(which has a loope of Henle) to a collecting duct from there it is off to the bladder
        - accesory organs- skin(sweat contains some urea and salts), lungs(water and CO2 are exhaled), and liver are all involved in excretion
- Urine Formation
    - Pressure filtration system for blood at glomerulus and bowman's capsule
    - pressure forces glucose, amino acids, salts,water, urea to form filtrate
    - it goes to tubule and there is selective reabsorbtion there and in the loope: they are surronded by cappilaries to absorb what it wants
    - reabsorbs all of the glucose, most of the water, Na, Cl, amino acids
    - Tubular secretion:
        - move urea, H+, NH3(no subscripts). drugs from blood and deposit into filtrate
        - the concentrating urine goes to collecting duct(last chance to reabsorb water) and the duct is  hypertonic makeing more water go back into blood
    - Regulatory Function(homeostasis) of kidneys
        - maintains and adjust blood volume
        - Antidiuretic hormone(ADH), it forces body to retain more of water in nephron
        - Aldosterone-does the same job as ADH but in a back door manner, it forces body to absorb more salt in turn forcing it to take more water
        - maintains and balances pH

**CHAPTER 39**

IMMUNITY

- Nature of Diseases
    - Pathogens- anything that causes diseases
        - Viruses- pathogens
            - Not alive; reproduce by host cell
            - Disrupt cell interworkings; parasitic
        - Bacteria, fungi, microorganism; Athlete's foot
    - Disease Reservoirs- carry pathogens; can be humans, insects, animals
        - Carriers- organisms spreading disease; can be other unaffected humans spreading infectious diseases (i.e. animals carrying rabies)

        - Soil- bacteria in dirt
        - Water- bacteria in contaminated water; cholera
- Disease Transfer
    - Direct contact- man to man; cold; HIV
    - Object contact- solid object transfer involved; cold (i.e. young kids getting sick because they touch toys teeming with germs)
    - Air- droplets of saliva or other body fluids carrying pathogens; Strep Throat- coughed into the air and breathed by others
    - Vector- intermediate transfer host; insects (i.e. Lyme- tick bite; West Nile- mosquito transfers bird disease to humans)
- Disease Symptom (own body actions)
    - Damage by toxins- i.e. diarrhea
        - Produce toxins, poisonous chemicals by product that is poisonous
        - Salmonella- give off toxin/chemical to evoke bodily reactions
        - Throw up, coughing, sneezing
    - Fever
        - Raise temperatures to kill a bacteria or virus
- Endemic VS Epidemic; Pandemic
    - Endemic- such as colds; year round and affecting very small % at any one time
        - Common, present in population frequently, routine; Cold
    - Epidemic- determined by number and timeframe; very large population % sick at the same time; outbreak in a short time frame
        - Certain time period, large number at the same time; Flu
    - Pandemic- global sickness; Black Plague
- Koch's Postulates
    - 1. Identify pathogen
        - Found in the host in any case
        - Tissue sample observed under the microscope
    - 2. Isolate pathogen and grow in culture
        - Doesn't work for viruses- unless it's grown in a cell
    - 3. Place in healthy animal
        - Animal must then become diseased
    - 4. Reisolate pathogen and identify as original pathogen
        - Compare the two pathogens (grown and original)
- Defenses Against Disease
    - Antibiotics
        - Medicines manufactured from different disease organisms; i.e. fungi
        - Work against bacteria, not viruses
        - Prevents production of new cell wall when bacteria tries to reproduce
        - Viruses don't have cell walls (and can't be grown in culture)
        - Continual use without actual cure kills natural bacteria in your body and produces bad side effects
        - Penicillin- prevents the making of a new cell wall
    - Resistance to Antibiotics
        - So much of the same antibiotics are taken that the few bacteria that survive, who have the perfect mutation to make them immune, reproduce and eventually make an entire population of bacteria adapted to resist antibiotics
        - Shouldn't be taken unless you *know* you know your sickness is bacterial
    - Lymphatic System- separate circulatory system carrying tissue fluid/plasma and white but not red blood cells; parallel circulatory system
        - Circulates tissue fluid/lymph;
            - When plasma's forced out of the capillaries by high blood pressure, this system takes the tissue fluid (leaked out from the circulatory system) and circulates it by lymphatic vessels to make its way back to the blood stream
            - Lymph- IN lymphatic system
        - Lymphatic veins with valves converge to form ducts that dump lymph into blood at subclavian veins
            - Puts plasma back into circulatory system
        - Edema- swelling due to excess tissue fluid; extra lymph; is temporary/natural; i.e. getting off the plane after a long trip with swollen feet
        - Lymph Nodes- balls of tissue of lymphatic tissues grouped together
            - Appear in armpits, groin, up in the throat, digestive tract
            - Tonsils- big "glorified" lymph nodes
            - Spleen- has lymphatic tissue

- Swells because bacteria's grabbed by the immune system and hauled into lymphatic system, which houses many white blood cells ready to attack
- Thymus gland- training ground for lymphocytes (immune system); middle of the chest

- Nonspecific (anything foreign) Diseases- innate (born) immunity
  - Body tries to kill whatever it doesn't recognize
  - Mechanical barriers: wall
    - Serve as block
    - Skin-outer wall, mucus membranes- sticky, traps things
  - Secretions- enzyme Lysozyme
    - In tears and saliva, even sweat
    - Prevent formation of cell walls
    - Also breaks open cell walls (busts open)
  - Phagocytes- white blood cells/ Macrophages- big phagocytes: uses phagocytosis to engulf and digest
  - Interferon- fights off viruses; artificial given to people fighting cancer
    - Cell gets infected by virus- gives off interferon to neighbor cells just before it bursts/dies
    - Interferon diffuses to surrounding cells preventing more reproduction when new viruses burst out
    - Only works in local, small areas
  - Complement- group of proteins help take out bacteria
    - Lyses- act of poking holes in invaders and make them collapse (bacteria); most common procedure
    - Assist antibodies immobilize
  - Inflammatory- response- histamine
    - Damaged tissue releases histamine to make blood vessel dilate/swell
    - The blood vessel then swells to the point where the plasma leaks out
    - This causes the entire area to swell
    - More white blood cells from the plasma are then able to go to the area of damage
- Specific, Adaptive Defense (working on one thing)
  - Adapts by making new antibodies
  - Lymphocytes- T and B cells (white blood cells) manufactured in bone marrow
    - One matures in the bone, the other doesn't
    - T- leaves and goes to the thymus and matures there
      - It is trained to recognize self from nonself in the thymus
      - It recognizes foreign antigen
      - It stimulates other immune cells (targets to tell who the "bad guy" is)
      - Types of T Cells:
        - Helper T Cell- middleman; stimulates other actions when its stimulated; helps activation
        - Cytotoxic T Cell- killer; kills infected cells taken over by bacteria/virus
        - Suppressor T Cell- switch off cytotoxic cell; without it, the cytotoxic cell might make mistakes and keep killing even healthy cells
    - B- stays and matures in the bone
      - Form plasma cells- the B cells are like "Clark Kent" and when info is given to go into action, it transforms to plasma cells "Superman"
      - Plasma cells make antibodies
  - Antibody (Humoral) Immunity
    - Page 1037: Figure 39.12- Antibody immunity utilizes B cells and antibodies in defending your body against invading pathogens
      - A. Pathogens enter tissues through a wound
      - B. They are attacked by macrophages at the infection site.
      - C. Antigens of the pathogen are displayed on the surface of the macrophage.
      - D. Helper T cells have receptor sites that recognize and bind to the antigens on the macrophage.
      - E. B cells can bind to antigens directly
      - F. Helper T cells bind to antigens on B cells
      - G. T cells release chemicals that cause B cells to produce clones of plasma cells

                - H. Each plasma cell secretes more than 2000 antibodies per second in the blood. Memory B cells and antibodies remain in the blood and respond to future invasions by the same pathogen.
            - 1. Macrophage recognizes foreign antigen (marker) on pathogen, and engulfs as well as destroys the invader
            - 2. Macrophage displays hybrid antigen on its surface (like displaying a wanted poster for recognition)
            - 3. Macrophage transmits foreign marker info to helper T cell (chemical activation of helper T cell) Helper informs everybody else about the "bad guy"
            - 4. Helper T cell transmits foreign antigen info to B cell
            - 5. Activated B cell forms plasma cell and clones itself (divide and divide its "Superman" version)
            - 6. Plasma cell make antibodies that immobilize pathogen; the antigens clump pathogens together and link them up like putting handcuffs on them
            - 7. Macrophages engulf and destroy the pathogens
    - Cellular Immunity/Cell Mediated Immunity
        - Page 1038: Figure 39.13- Cellular immunity involves T cells that transform into cytotoxic T cells. These T cells release perforin, which pokes holes in cells invaded by pathogens.
            - Pathogen engulfed by Macrophage
            - Macrophage displays antigens on surface and stimulates T cell (Helper T cell)
            - Helper T cells stimulate Cytotoxic T cell
            - Cytotoxic T cell attacks infected cells
            - Cytotoxic T cell finds the infected cell (or cells) with the correct foreign antigen it's seeking and releases the perforin enzyme into the cell
            - The cell lyses then dies
        - (1-3 is identical to Humoral Immunity)
        - 1. Macrophage recognizes foreign antigen on pathogen
        - 2. Macrophage dispolays hybrid antigen on surface
        - 3. Macrophage transmits foreign marker info to helper T Cell
        - 4. Helper T Cell transmit foreign antigen info (the pattern) to Cytotoxic T cell (to activate)
        - 5. Cytotoxic T Cells are activated and lyses (busts) infected cells using perforin
        - 6. Suppressor T cell deactivate Cytotoxic T Cells to prevent the killing of good cells

- Immunity
    - Primary Immunity
        - Occurs with first time exposure to a pathogen
        - Process of learning, identifying, activating, and then cloning antibodies for the defense mechanisms- takes a long time
        - Vaccine- weakened form of antigen with a protein coat and little to no DNA that tricks the body into making antibodies
    - Secondary Immunity
        - Any immunity after the primary
        - Memory cells are created during primary unity, which retains antigen info for B, Helper T, or Cytotoxic cells
        - This immune response is faster and stronger because antibodies are already created and ready to respond
    - Acquired Immunity- makes antibodies
        - Active- involves getting first hand experience (getting sick) or receiving a vaccine; body got direct exposure and made antibodies on its own; is usually lifelong
        - Passive- involves receiving antibodies made by another person or animal; temporary- only a few months; may be passed from mother to baby during the month of gestation up to the first year of life in order to protect the baby until its immune system is ready
    - Immunity Problems
        - Allergies
            - The body treats an antigen as though it is harmful
            - Sometimes involves the release of strong histamines when the body attempts to throw liquid onto its own system to shake off the "bad" antigen, resulting in bad side effects
        - HIV - Human Immunodeficiency Virus
            - Causes AIDS- acquired immunodeficiency syndrome

        - Virus attacks immune system- helper T cells, B cells, Cytotoxic cells, which are all crucial to the immune system and
        - Disables and reproduces more viruses in the immunity cells
- Autoimmune Diseases- body works against itself, accidentally mistaking a good cell for a bad cell
    - Diabetes- viral infection; suppressor T cell can't turn off the Cytotoxic from killing the islet cells in the pancreas which in normal cases produce insulin in response to increased blood sugar level
    - Rheumatoid arthritis- immune system attacks joints, alters and twists into gruesome shapes
    - Lupus- attacks connective tissues
    - Multiple Sclerosis- attacks myelin sheaths, resulting in the shut down or slow down of the nervous system