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☺ The Big Picture: A Review of General Biology ☺

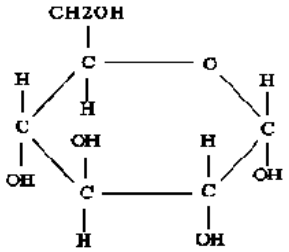
Cells and Their Processes

Organic Compounds

- A compound is a combination of 2 or more atoms
- An organic compound is a compound that contains carbon atoms that have combined with each other
    - Carbon can bond to a number of different atoms so carbon can form many different types of compounds
- An inorganic compound is a compound with no combination of carbon atoms
- 6 most common elements in organic molecules: SPONCH-sulfur, phosphorus, oxygen, nitrogen, carbon, hydrogen

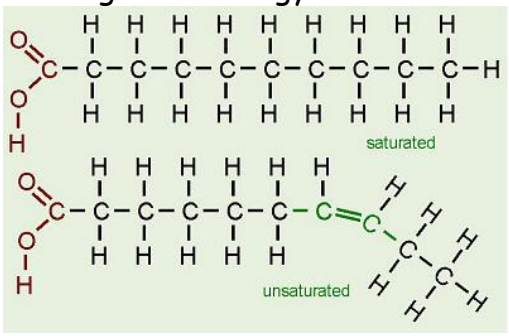
The Four Types of Organic Compounds (The Molecules of Life)

- Carbohydrates: Sugars used for short term energy; Made of monosaccharides

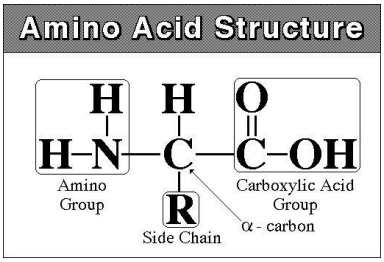


Glucose

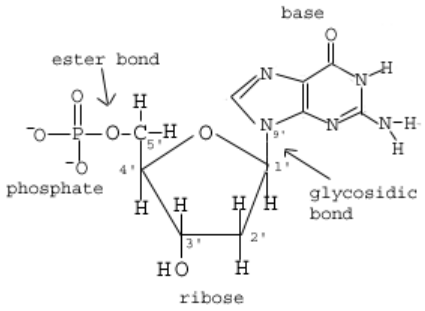
- Lipids: Fats and oils used for long term energy; Made of fatty acids



- Proteins (also called a polypeptide): Made up of amino acids; used for construction materials and chemical reactions in the body
    - Enzymes: Special types of proteins that speed up chemical reactions in the body but are not changed by the reactions



- Nucleic acids: DNA and RNA; contains genetic information; made up of nucleotides

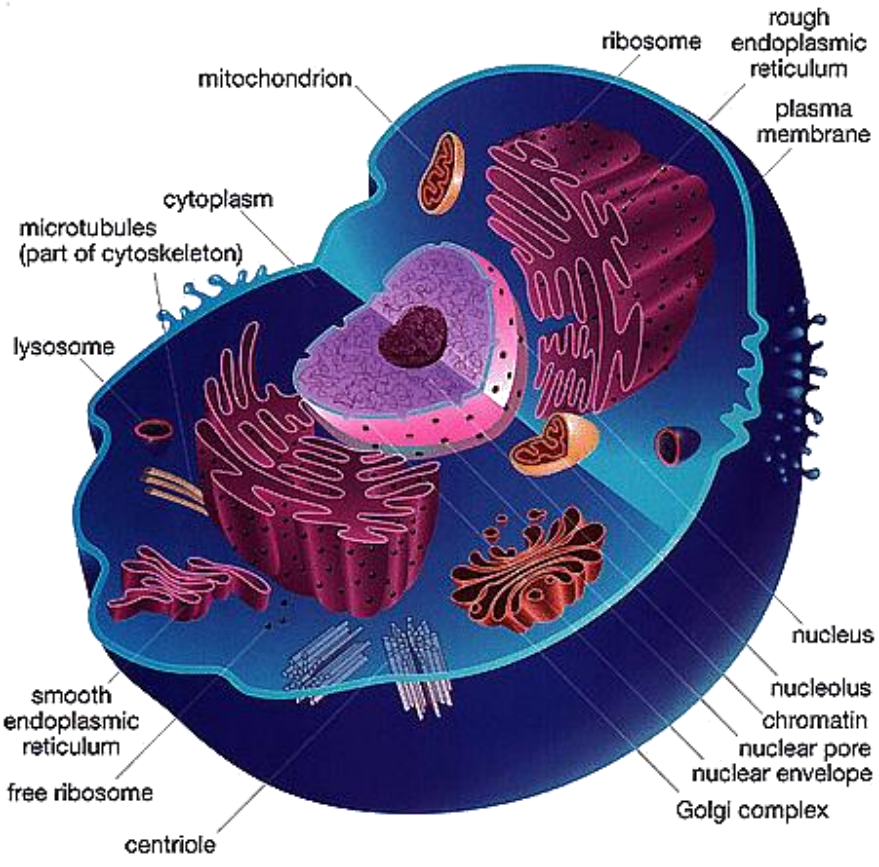


Cells

- A cell is the smallest unit that is alive and can carry on all the processes of life
- Cells make up organisms (living things)
  - Unicellular organisms are made up of 1 cell
  - Multicellular organisms are made up of many cells
- Cells contain organelles, which are specialized compartments that carry out a specific function
- Types of cells
  - Eukaryotic cells contain a nucleus, such as animal and plant cells
  - Prokaryotic cells contain no nucleus, such as bacteria

Animal Cells

- Usually round

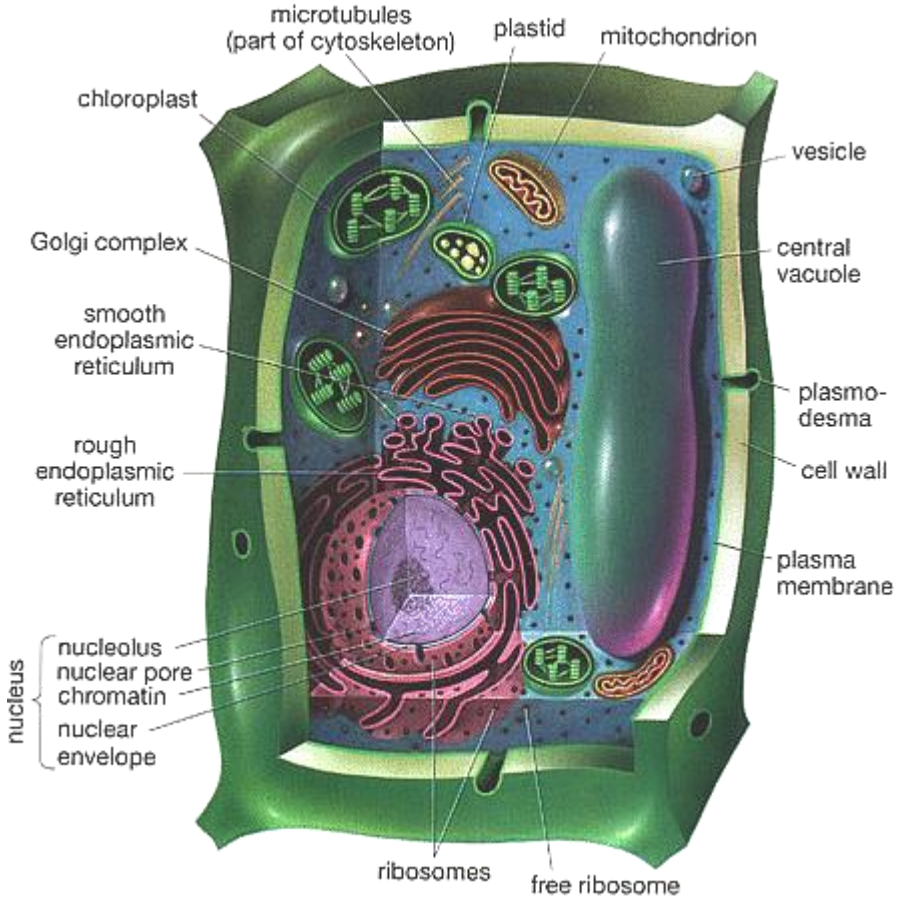


- Organelles include
  - nucleus: controls cell activities
  - cell membrane: controls what enters and leaves the cell and also protects the cell
  - endoplasmic reticulum (ER): tunnels for compounds to move through the cell
  - Golgi body: processes and stores protein
  - Ribosomes: make proteins
  - Mitochondria: Makes energy for the cell
  - Lysosome: Has enzymes that digest waste and old organelles
  - Cytoplasm: Fills the empty space of the cell
  - Vacuole: Stores food, water, and waste
  - Centrioles: Help in cell division and is only found in animal, not plant, cells

Plant Cells

- Usually square

A typical plant cell



- Organelles include
  - Everything that an animal cell has plus more
  - Chloroplast: Traps sunlight to make food for the plant
  - Cell wall: Protects the cell

Bacterial cells

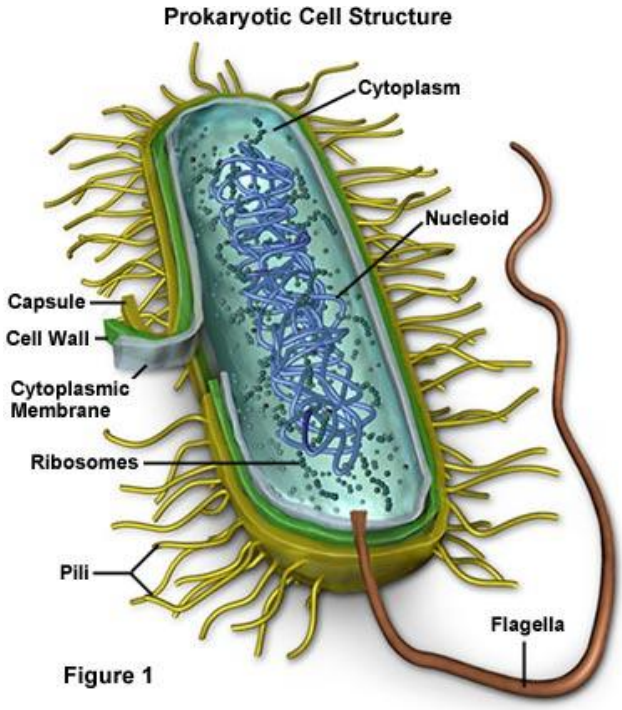
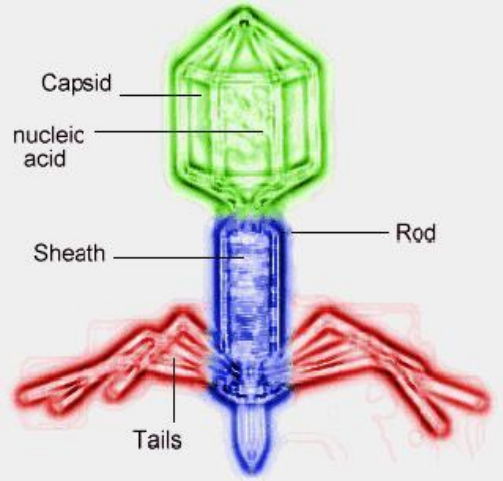
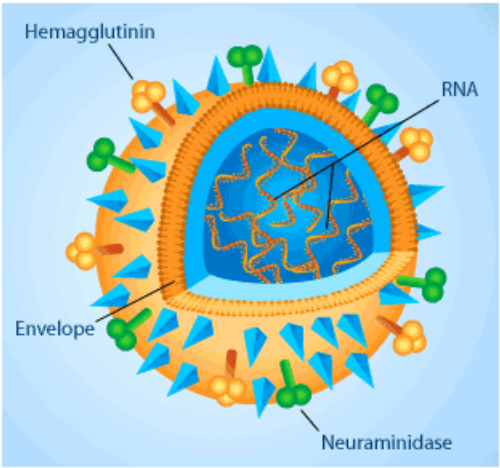


Figure 1

- Smaller and simpler than plant or animal cells
- Bacteria are unicellular
- No nucleus
- Have a single closed loop of DNA, cell wall, cell membrane, cytoplasm and ribosomes
- Some have a capsule (shell for protection), pili (short hair like structures to hold onto host cells), and flagella (whip like structure for movement)

Viruses

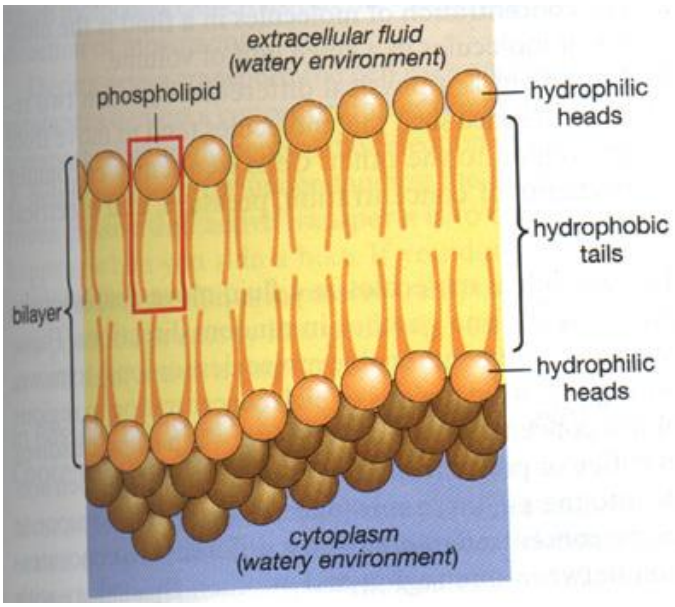




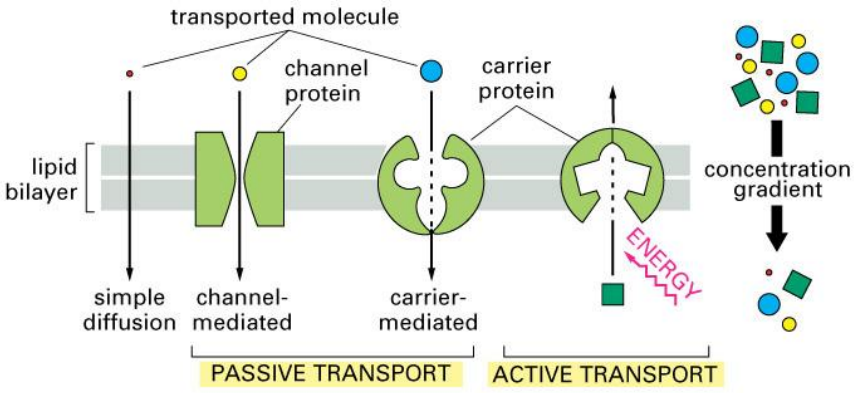
- Noncellular entities with a simple structure and cannot reproduce on their own
- Much smaller than a bacterial, animal or plant cell
- Parts of a virus
    - Nucleic acid inside the virus – can be either DNA or RNA
    - Capsid: protein coat to protect the nucleic acid inside the virus
    - Spikes: help the virus to attach to host cells

- There is much controversy on whether viruses are alive or not because they cannot reproduce on their own—They do not have the organelles needed to reproduce
    - Viruses must invade a living cell and use the cell's tools to reproduce
    - Host cell: An animal, plant or bacterial cell that is invaded by a virus
    - Viruses harm and/or kill the host cell that they infect

Cell membrane

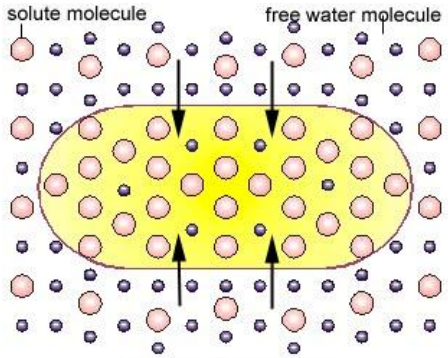


- Made up of molecules called phospholipids
- Phospholipid bilayer is the 2 layers of phospholipids that make up the cell membrane
- Cell membrane is fluid, which means that it is constantly flowing and moving over the cell
- Cell membrane is selectively permeable, which means that it allows small compounds, but not large ones, to pass right through
- There are different ways that materials are transported across the cell membrane



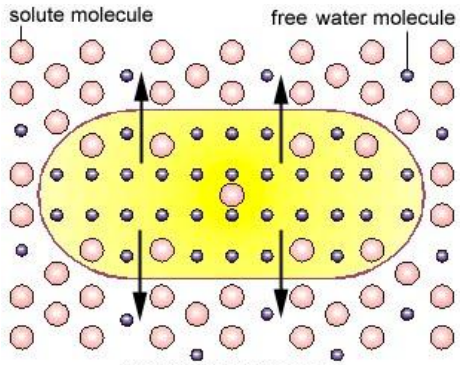
    - Passive transport: requires no energy
        - Diffusion: compounds move from high to low concentration
        - Osmosis: diffusion of water
    - Active transport: requires energy
        - Endocytosis: large compound are brought into the cell
        - Exocytosis: large compounds are exported out of the cell

- Types of solutions
  - Hypotonic solutions cause water to move into the cell so the cell swells up



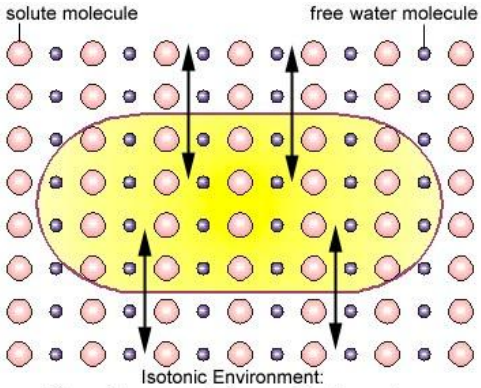
Hypotonic Environment:
The solute concentration is greater inside the cell; the free water concentration is greater outside. Free water flows into the cell.

  - Hypertonic solutions cause water to move out of the cell so the cell shrivels up



Hypertonic Environment:
The solute concentration is greater outside the cell; the free water concentration is greater inside. Free water flows out of the cell.

  - Isotonic solutions cause no net movement of water into or out of the cell



Isotonic Environment:
The solute concentration and the free water concentration are the same inside and outside the cell.
Water flows in and out of the cell at an equal rate.

Photosynthesis

- Process by which organisms use energy from sunlight to make their own food (glucose)
- Glucose is a simple sugar
- Photosynthesis occurs in the chloroplasts of plant cells and some bacteria
- Chloroplasts have a green pigment called chlorophyll

- Steps of photosynthesis
    - 1. Light reaction: chlorophyll in the chloroplasts absorbs sunlight
    - 2. Dark reaction: The energy from the sunlight is used to make glucose
- Light energy is completely changed into chemical energy (glucose)
- Chemical equation for photosynthesis

$$6CO_2 + 6H_2O + \text{light energy} \rightarrow C_6H_{12}O_6 + O_2$$

Cellular Respiration

- Process that breaks down glucose in order to make energy for an organism
- ATP: compound that stores energy in an organism
- Occurs in the mitochondria of the cell
- Two types of cellular respiration
    - Aerobic respiration: requires oxygen to occur
        - Mostly happens in animals and plants
        - There are 3 steps in aerobic respiration
            - Step 1 is glycolysis: glucose is cut in half
            - Step 2 is the citric acid cycle: glucose halves get electrons chopped off of them
            - Step 3 is the electron transport chain: electrons combine with oxygen and are used to make a lot of ATP
        - Chemical equation for respiration

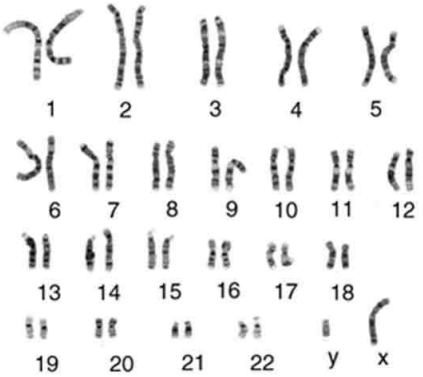
$$C_6H_{12}O_6 + O_2 \rightarrow 6CO_2 + 6H_2O + \text{ATP energy}$$

        - Aerobic respiration is the opposite of photosynthesis
    - Anaerobic respiration: does not require oxygen to occur
        - Mostly happens in bacteria and yeast
        - Also called fermentation
        - Makes less ATP than aerobic respiration

Chromosomes

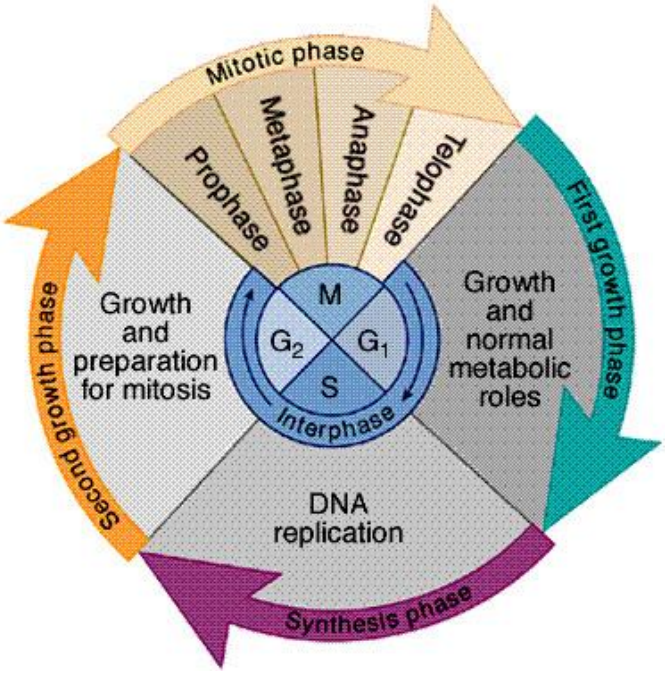
- DNA strands in the nucleus that contain the directions on how to make and keep an organism alive
- Made up of genes, which are traits of an organism
- Cells will die if their DNA is damaged or removed
- Humans have mostly diploid cells, which means that we have 2 of each type of chromosome
    - Homologous chromosomes are 2 of the same type of chromosome
    - We have 23 types of chromosomes but…
    - We have 46 chromosomes in all,
      23 chromosomes from mom + 23 chromosomes from dad
- Human gametes (sperm and egg cells) are haploid cells, which means that they have 1 of each type of chromosome
    - Sperm and egg cells have 23 chromosomes in all
- Autosomes: Chromosomes that do not determine gender

- Sex chromosomes: Chromosomes that determine gender
  - Girls are XX, Boys are XY
- Karyotype: ordered picture of an organism's chromosomes
  - Healthy individuals have 2 of each type of chromosome
  - Individuals with Down Syndrome have three #21 chromosomes



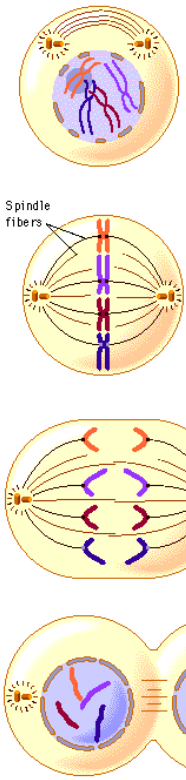
Cell Cycle

- The cell cycle is the phases in the life of a cell



  - M phase: Mitosis (cell division) occurs
  - G1 phase: Cell grows
  - S phase: DNA synthesis (chromosomes are copied)
  - G2 phase: Cell grows
  - M phase begins again

- Chromosomes must be copied before mitosis so that new cells receive the same chromosomes found in the old cells



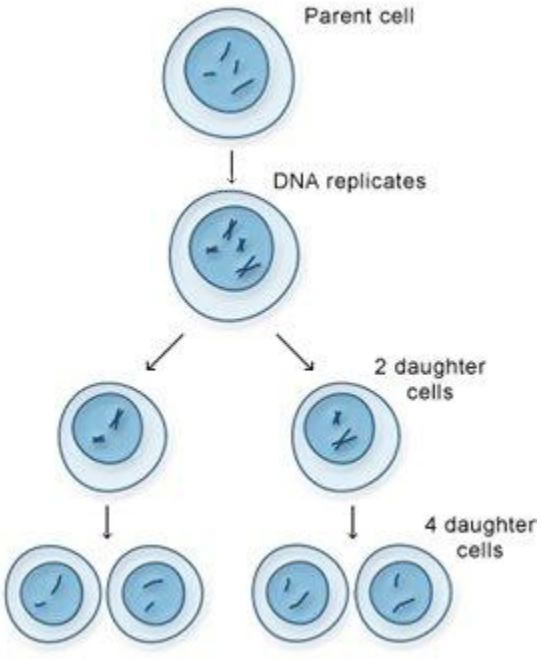
Mitosis

- Division of a cell into 2 identical cells
- Before mitosis: Chromosomes have copied themselves
  - ➢ Sister chromatids: original chromosome and its exact copy are attached to each other
- Phases of mitosis
  - o 1. Prophase: Nuclear membrane falls apart and spindle fibers start to form
  - o 2. Metaphase: Sister chromatids line up along the middle of the spindle fibers
  - o 3. Anaphase: Sister chromatids separate and move to opposite ends of the cell
  - o 4. Telophase: Spindle fibers break down and new nuclear membrane forms around each set of chromosomes
    - ➢ Cytokinesis occurs when the cytoplasm actually divides, forming two new cells

Genetics

Meiosis

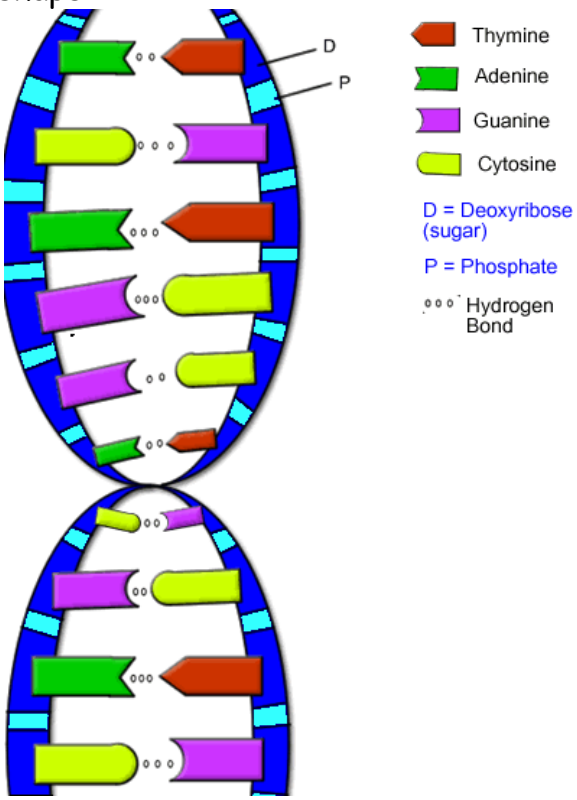
- Cell division that produces gametes (sex cells), such as sperm and egg cells
- Fertilization: Process of an egg and a sperm cell combining to produce a zygote
  - o Zygote: Baby that is only 1 cell big
  - o Egg cell (23 chromosomes) + sperm cell (23 chromosomes) = baby (46 chromosomes)
- Steps in meiosis



  - o 1. Before meiosis:
    - ➢ 2 chromosomes of the same type come together to make a chromosome pair
    - ➢ Each chromosome doubles
    - ➢ This gives 4 chromosomes stuck together
  - o 2. Meiosis I: Chromosome pairs separate into two new cells
  - o 3. Meiosis II: Each chromosome separates from its copy into 4 new cells
- In meiosis, one cell becomes four cells but in mitosis, one cell becomes two cells

DNA

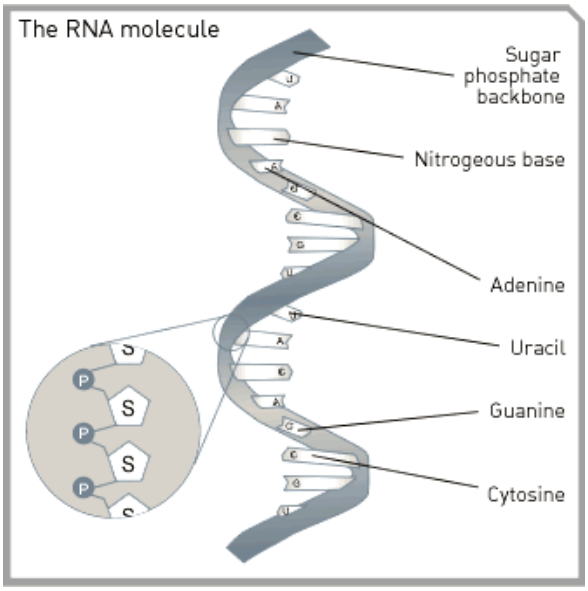
- Deoxyribonucleic acid
- Makes up the chromosomes in the nucleus and never leaves the nucleus
- A chromosome is a chain of different genes
- DNA has a double helix shape



- Has four types of bases: adenine (A), guanine (G), thymine (T), cytosine (C)
- A binds T and G binds C
- DNA is complementary, which means that the bases on one strand match up to the bases on the other strand
  - For example: Strand 1: ATG CCT GAC
    Strand 2: TAC GGA CTG
- Semi conservative replication is the process by which DNA copies itself and each new piece of DNA is made up of 1 old strand and 1 new strand

RNA

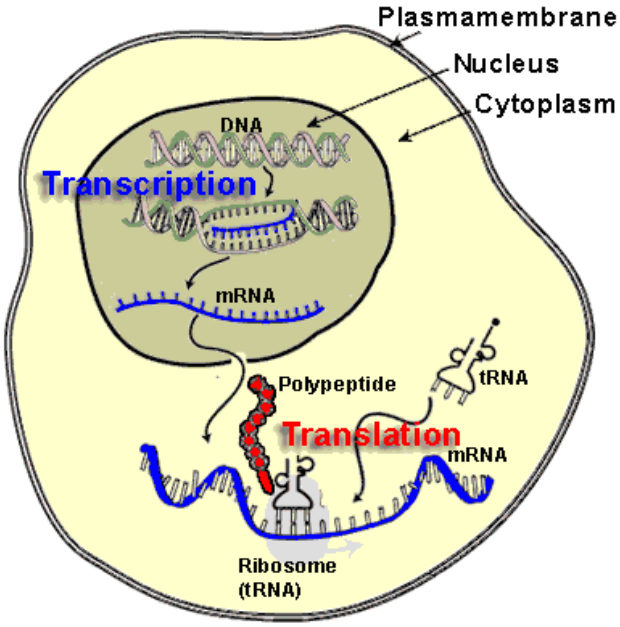
- Ribonucleic acid
- RNA is a copy of DNA that goes out into the cytoplasm to tell the cell what to do in order to stay alive



- RNA is single stranded and has uracil (U) rather than thymine (T)
  - U binds *A* and *G* binds *C*
  - If the DNA is *ATG CCA AAG*
    Then the RNA will be *UAC GGU UUC*

Using DNA to make protein

- 1. Transcription: DNA in the nucleus is used to make messenger RNA (mRNA)
  - DNA has all the directions the cell needs to live
- 2. RNA moves out into the cytoplasm
  - RNA carries the directions to other parts of the cell
- 3. Translation: The RNA attaches to a ribosome and directs the production of a protein
  - Proteins do all the work in the cell
  - Every 3 bases in RNA is called a codon and codes for 1 amino acid



Mutations

- A mutation is a change in a gene or chromosome
- If the mutation happens in a body cell, it only affects the organism that carries it
- If the mutation happens in a sex cell, it can be passed on to offspring
- Mutations can be
  - harmful if they reduce an organism's chances for reproduction or survival
  - helpful if they improve an organism's chances for survival
  - neutral if they do not produce an obvious changes in an organism
  - lethal if they result in the immediate death of an organism
- Mutations can occur spontaneously or be caused by a mutagen, which is a factor in the environment like UV and chemicals

Mendelian Genetics

- Gregor Mendel is an Austrian monk credited with beginning the study of genetics
- Genetics is the study of heredity
- Humans have 2 genes for every trait
  - Alleles: Different forms of a single trait, like blue and brown are two eye color alleles
- Dominant gene: "Stronger" of 2 genes and shows up in the organism
  - Represented by a capital letter
  - B is the dominant gene for brown eyes
- Recessive gene: "Weaker" of 2 genes and only shows up when there is no dominant gene present
  - Represented by a lowercase letter
  - b is the recessive gene for blue eyes
- Homozygous (purebred): When 2 genes are alike for a trait
  - BB is homozygous for brown eyes, bb is homozygous for blue eyes
- Heterozygous (hybrid): When 2 genes are different for a trait
  - Bb is heterozygous
- Mendel's law of segregation states that the 2 genes we have for each trait get separated from one another when we make egg and sperm cells
- Mendel's law of independent assortment states that the gene for one trait is inherited independently of the genes for other traits
  - Only true when the genes are on different chromosomes

Punnett Squares

- Punnett squares are charts that are used to show the possible gene combinations in a cross between 2 organisms
  * Let's say that B is the dominant gene for brown eyes and b is the recessive gene for blue eyes*
- Genotype: The genes of an organism (Bb)
- Phenotype: The physical appearance of an organism (Brown eyes)

Parents
Bb x bb

	B	b
b	Bb	bb
b	Bb	bb

Offspring genotype
50% Bb
50% bb

Offspring phenotype
50% Brown eyes
50% blue eyes

Parents
Bb x B

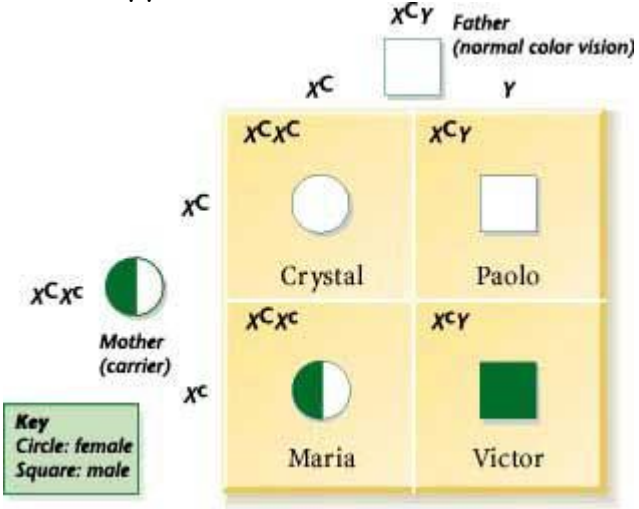
	B	b
B	BB	Bb
b	Bb	bb

Offspring genotype
25% BB
50% Bb
25% bb

Offspring phenotype
75% Brown eyes
25% blue eyes

Human Genetics

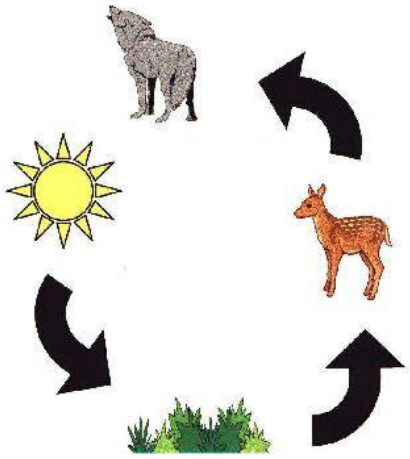
- Multiple alleles are three or more alleles that exist for a single gene
  - For example, A, B, and O are the multiple alleles for blood type
  - The possible blood types are A, B, AB, and O
    - You can be A+ or A-, B+ or B-, AB+ or AB-, O+ or O- depending on whether your blood cells have a special Rh protein
- Codominance occurs when 2 dominant genes are expressed and both genes are seen in the organism
  - AB blood is codominant, a cat with black and white spots is codominant
- Incomplete dominance occurs when 2 dominant genes are expressed and blended together in the organism
  - If the red flower color gene (R) is mixed with the white flower color gene (W) then the offspring will be pink (RW)
- A polygenic trait is a trait that is controlled by more than one pair of genes, like skin color
- A sex-linked trait is a trait that is found on the X chromosome, such as colorblindness
  - Females are XX so have 2 copies of sex-linked traits
  - Males are XY so have 1 copy of sex-linked traits



Ecology

Ecology

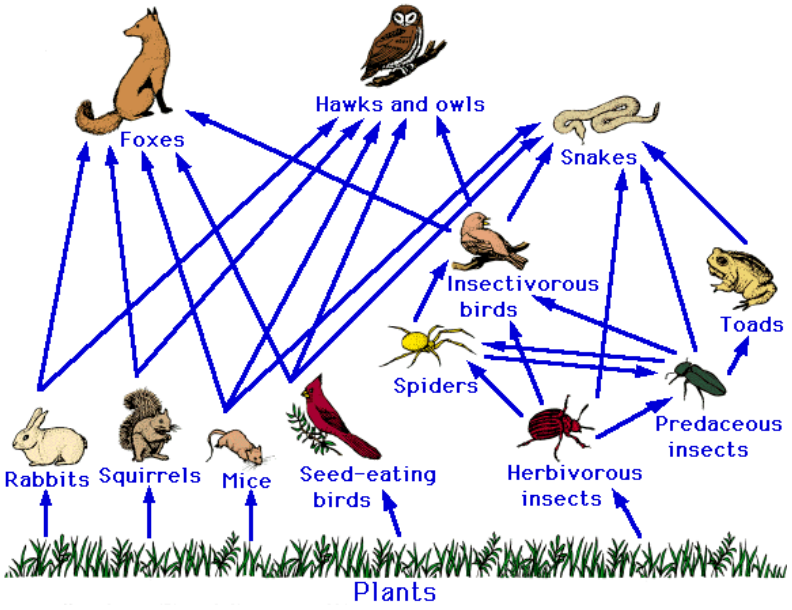
- Ecology is the study of how organisms fit into their environment
- A community is the organisms that live in a particular environment
- A habitat is the physical location of a community
- An ecosystem is a collection of organisms and their physical environment
- The diversity of an ecosystem is a measure of the number of species living there
- There are different feeding groups of organisms
  - Autotrophs: Organisms that make their own food, like plants and some bacteria
  - Heterotrophs: Organisms that cannot make their own food, like
    - Herbivores: Eat plants
    - Carnivores: Eat meat
    - Omnivores: Eat plants and meat
- There are different factors is an ecosystem
  - Abiotic factors are nonliving things
  - Biotic factors are living things, such as
    - Producers: Organisms that take in energy from their surroundings to make their own food
    - Consumers: Organisms that eat other organisms for energy
    - Decomposers: Special type of consumer that eats waste products and dead organisms for energy
- There are different trophic levels in a food chain
  - A trophic level is a feeding level in an ecosystem
  - A food chain is a lineup of organisms that shows who eats who



  - 1st trophic level is usually a producer
  - 2nd trophic level is a primary consumer
  - 3rd trophic level is a secondary consumer
  - 4th trophic level is a tertiary consumer
  - and so on
  - Last trophic level is a decomposer
- Every time an organism eats, it obtains energy from its food

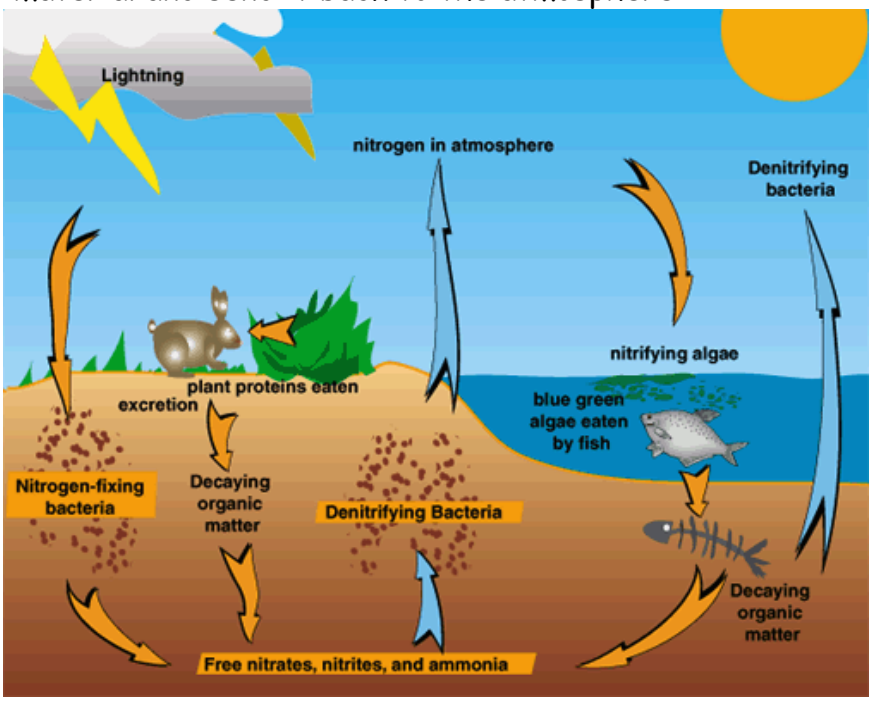
- So energy is transferred from the 1st to the 2nd to the 3rd trophic level and so on (but some of this energy does get lost along the way)
- Energy pyramid: Picture showing how much energy is transferred to the different trophic levels in a food chain

- A food web is a network of connected food chains



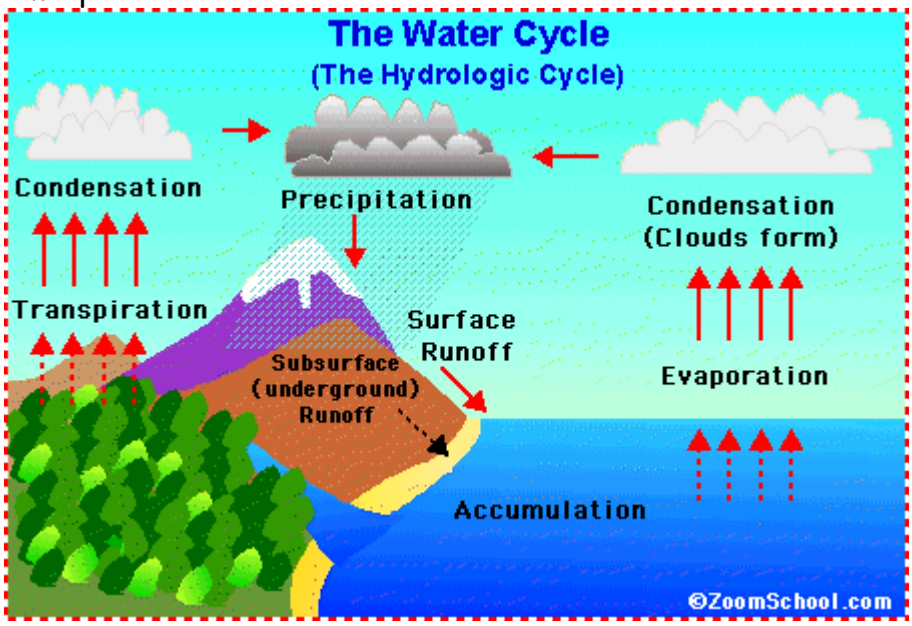
Cycles of Matter

- Water, nitrogen, carbon, and oxygen are recycled in the environment through cycles
- The nitrogen cycle
  - Nitrogen in the atmosphere is taken in by bacteria that live in plant roots
  - The nitrogen is passed onto the plants and any animals that eat the plants
  - Once the plant or animal has died, decomposers (bacteria) again take up the nitrogen in the dead material and send it back to the atmosphere

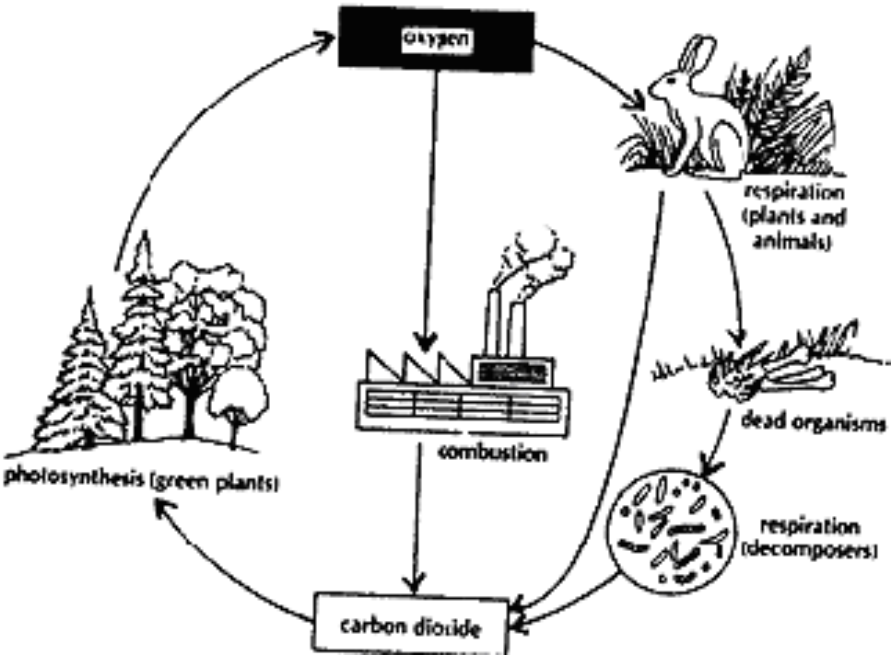


The water cycle

- Precipitation, such as rain and snow, fall to the earth
- The water either
  - seeps into the ground for plants to use and the plants give off excess water back to the atmosphere through transpiration
  - or runs off the land to lower-lying bodies of water where it evaporates back into the atmosphere



- *The oxygen-carbon cycle*
  - Carbon dioxide from the atmosphere is taken in by plants who use it during photosynthesis and release oxygen back into the atmosphere
  - Oxygen in the atmosphere is taken in by animals and plants who use it during respiration and release carbon dioxide back into the atmosphere



Interaction in an environment

- Each organism has a niche, or role, to play in its environment
- Competition is a struggle between organisms for resources, such as food, water, shelter
- Predators are organisms that catch, kill, and eat other organisms called prey
- Symbiosis is a close relationship between 2 organisms in which one organism lives near, on, or even inside another organisms and in which at least one organism benefits
  - There are three types of symbiosis
  - 1. Commensalism is when one of the 2 organisms benefits from the symbiosis
  - 2. Mutualism is when both organisms benefit from the symbiosis
  - 3. Parasitism is when one organism benefits (parasite) and the other organism is harmed (host) from the symbiosis
    - The parasite feeds on the host while it is still alive, weakening but not killing it
- An adaptation is a change in the behavior or physical characteristics of a species that make it better suited to its environment
- Populations of organisms increase and decrease due to overpopulation of a competitor or predator, disease, lack of food or water or shelter, and extreme weather
- Ecosystems are constantly changing due to changing populations of organisms, changing weather, natural disasters, and human activity
- Every time a change occurs, the balance of the ecosystem has to be readjusted

The Theory of Evolution

Evolution

- Evolution is a change in a species over time
- The theory of evolution was stated by Charles Darwin and is based on natural selection
- Natural selection states that organisms with traits well suited to an environment are more likely to survive and produce more offspring than organisms without these favorable traits
- Biodiversity: Organisms become very different from each other as they evolve and become better suited to their environments
- The theory of evolution is supported by evidence that includes
  - Adaptations: structures and behaviors that organisms have evolved in order to survive better in their environments
  - The fossil record which is information about all known fossils
  - Comparative anatomy which is when the bodies of different organisms are compared to see if they are related
    - Homologous structures are body structures on different organisms that are similar
    - Vestigial structures are body structures that may have served a purpose in ancient ancestors but no longer are functional in current organisms
  - The fact that all vertebrate embryos look very similar as they develop before birth
  - The fact that the DNA of closely related organisms looks very similar

Types of Natural Selection

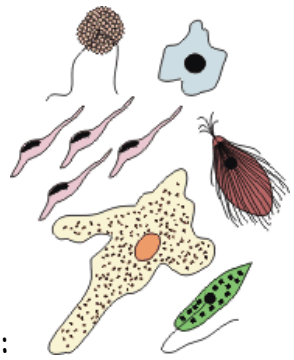
- Stabilizing selection: favors average individuals in a population
- Directional selection: favors one of the extreme variations of a trait
- Disruptive selection: favors individuals with either extreme of a trait

Speciation

- Speciation is the evolution of a new species that occurs when members of similar populations no longer breed with each other to produce fertile offspring
- Occurs when a group of organisms have a reduced gene pool and/or can no longer can breed with members of their original population
  - Gene pool: all the alleles of a gene present in the population
  - Any change in the gene pool will cause evolution to happen
- There are several reasons why similar populations no longer breed, creating new species
  1. Geographic isolation: when a physical barrier (lava from volcanic eruptions, sea level changes, etc.) divides a population
     - Makes the gene pool smaller and each new smaller population adapts to its own environment, creating new species
  2. reproductive isolation: when organisms no longer breed with each other to produce fertile offspring because
     - the genes of the populations becomes too different and fertilization cannot occur

Taxonomy

- Taxonomy is the science of classifying living things
- Organisms are organized into 7 different levels of taxonomy (King Philip came over for good spaghetti)
  - 1. Kingdom – most broad
  - 2. Phylum
  - 3. Class
  - 4. Order
  - 5. Family
  - 6. Genus
  - 7. Species – most specific
- Closely related organisms have more levels of taxonomy in common than unrelated organisms
- There are six kingdoms of living things (Archie eats pretty fantastic apple pies)
  - 1. Archaebacteria: bacteria that live in extreme environments
  - 2. Eubacteria: common bacteria
  - 3. Protista: Single-celled organisms

Pictures of protists: 

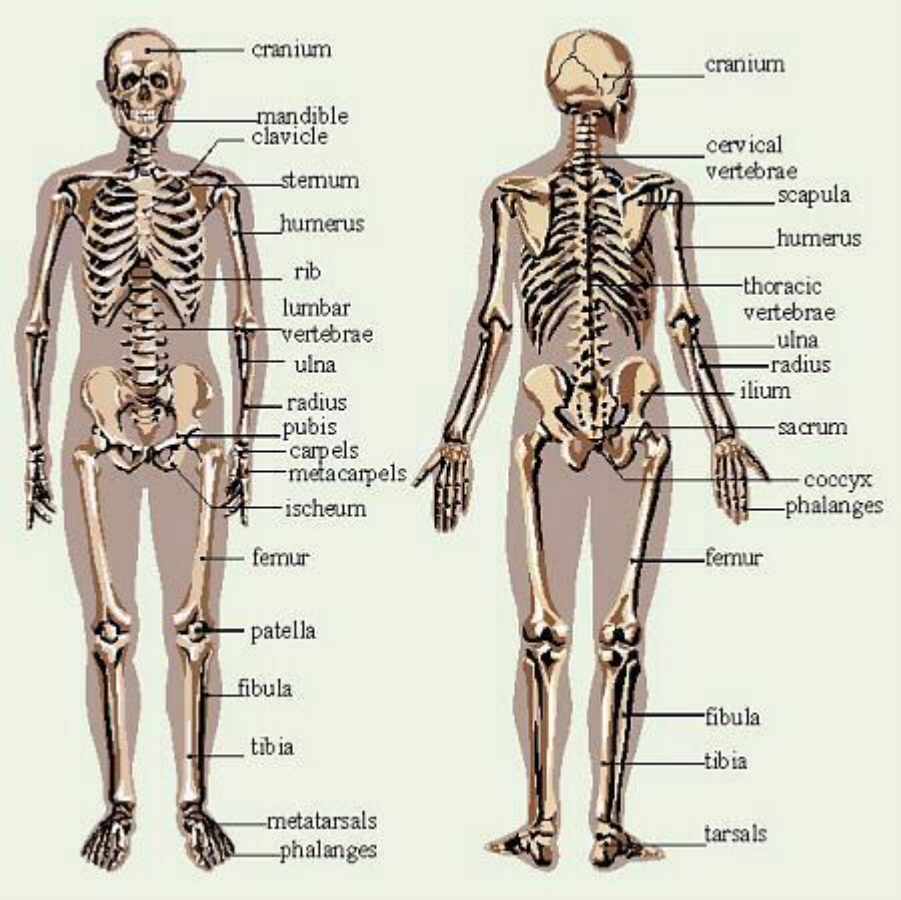
- 4. Fungi: Mushrooms, yeasts, molds
- 5. Animalia: animals
- 6. Plantae: plants

- Every organism has a unique two-word scientific name that is written in Latin
  - The first word is the genus, the second word is the species (Humans are *Homo sapiens)*
- Some scientists prefer to organize organisms into domains rather than kingdoms
  - There are three domains (Archie eats eels)
  - 1. Archaea: Bacteria that live in extreme environments
  - 2. Eubacteria: Common bacteria
  - 3. Eukarya: Organisms whose DNA is in a nucleus

Anatomy and Physiology

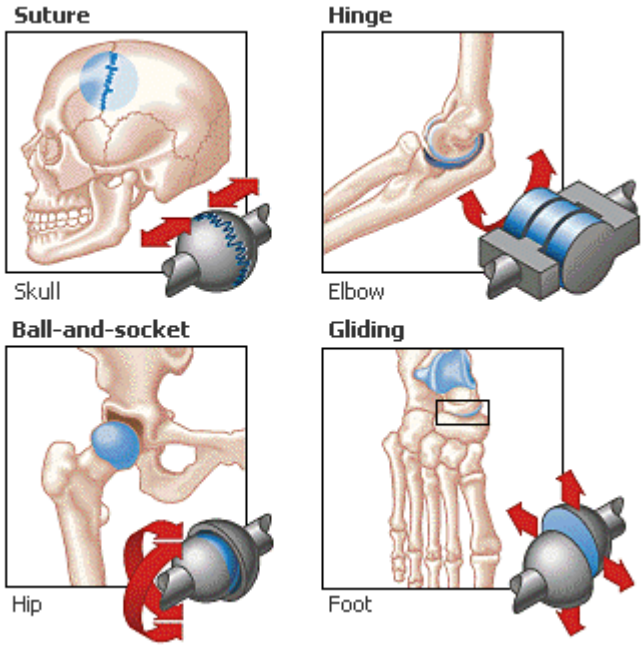
Skeletal System

- Functions
  - Provides a framework for the tissues of your body
  - Protects your internal organs
  - Provides attachment points for muscles
  - Stores minerals
  - Produces blood cells

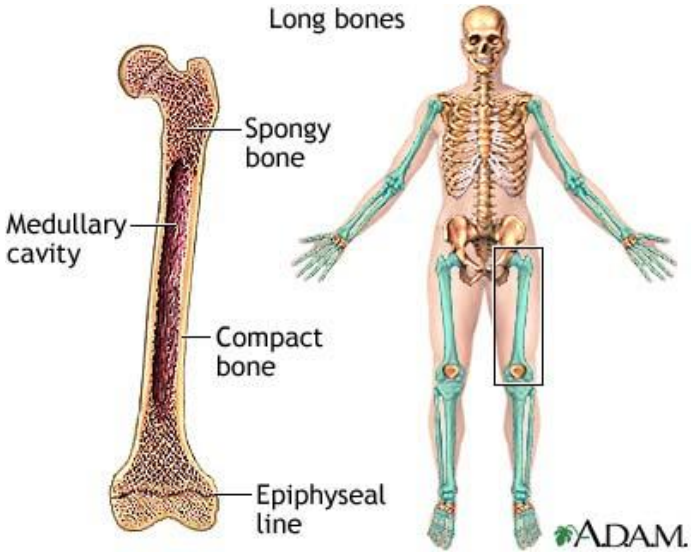


- Made up of
  - Axial skeleton: skull, vertebral column, sternum, ribs
  - Appendicular skeleton: arms, legs, shoulders, pelvis
- Ligaments: tough band of connective tissue that attaches one bone to another bone
- Tendons: thick bands of connective tissue that attach muscles to bones

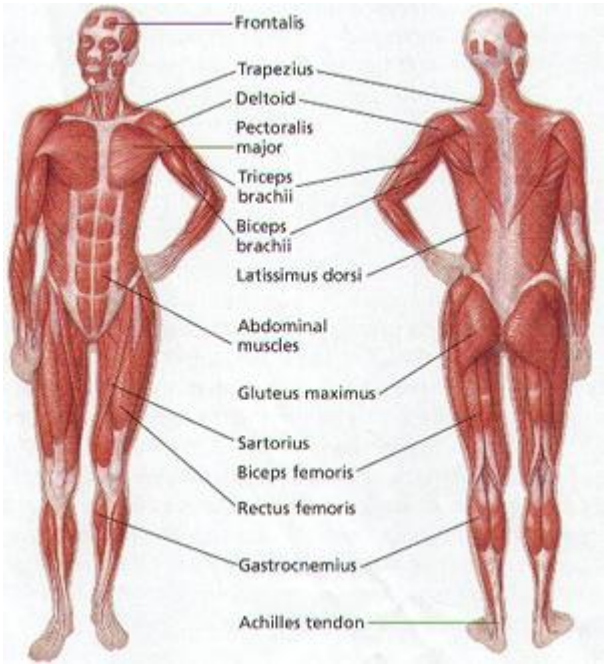
- Joints: where two or more bones meet
  - Ball and socket joint: allows movement in all directions
  - Pivot joint: allows bones to twist around each other
  - Hinge joint: allows back and forth movement
  - Gliding joint: allows bones to slide past each other



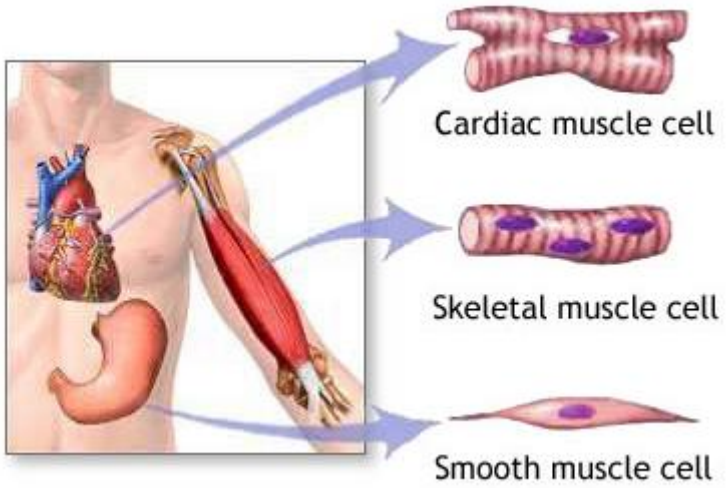
- 2 types of bone tissue
  - Compact bone: hard and found on the outside of bones
  - Spongy bone: soft with holes and is found on the inside of bones



Muscular System

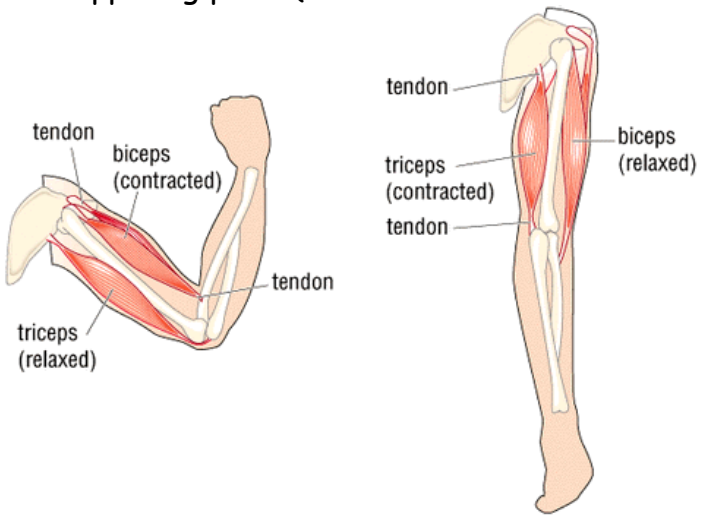


- Muscles can be
  - Voluntary: under conscious control
  - Involuntary: not under conscious control
- Three types of muscles

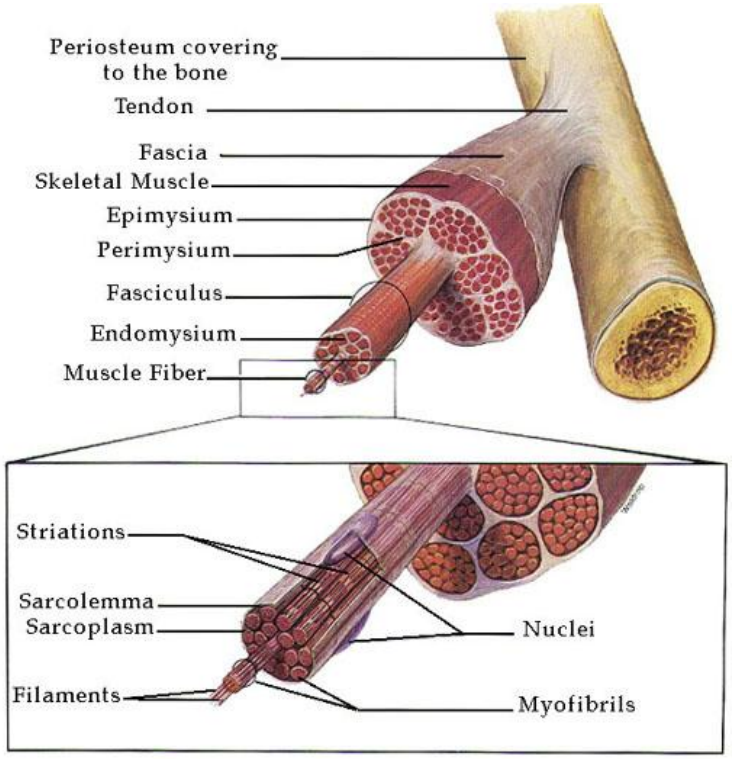


  - Smooth muscle: squeezes and exerts pressure on the space inside a tube or organ to move material through it (involuntary)
  - Cardiac muscle: make up the heart (involuntary)
  - Skeletal muscle: attaches to and moves bones (voluntary)

- Skeletal muscles work in opposing pairs (one muscle contracts while the other relaxes)

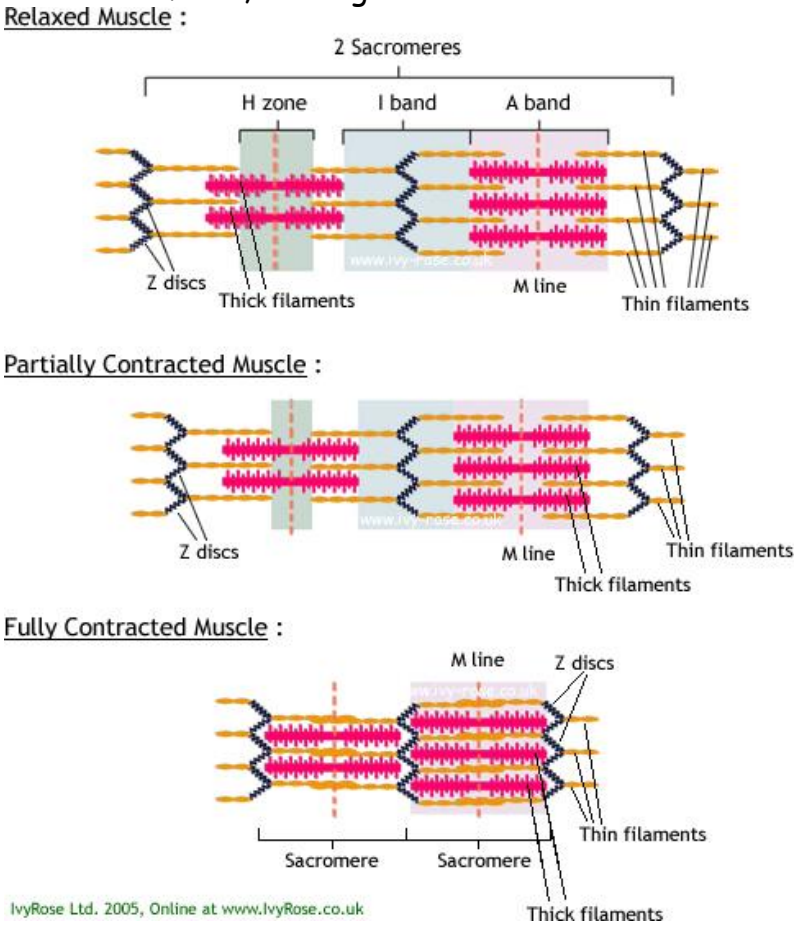


- Skeletal muscles are made of the following pieces
  - Skeletal muscle is made of bundles of muscle fibers
  - Muscle fibers are made of myofibrils
  - Myofibrils are made of filaments



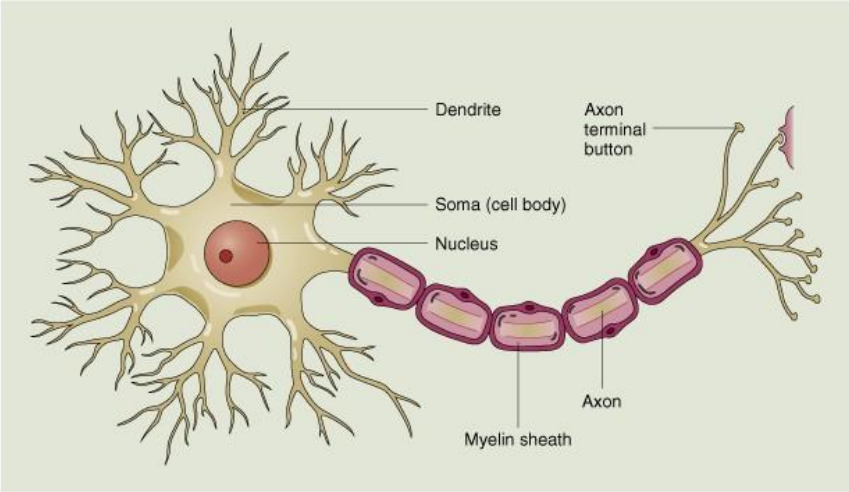
  - Myofibrils are divided into sarcomeres
  - Sarcomeres are made of myosin and actin proteins

- Sliding filament theory: actin filaments in sarcomeres slide toward one another, shortening the sarcomeres in a fiber, causing the muscle to contract

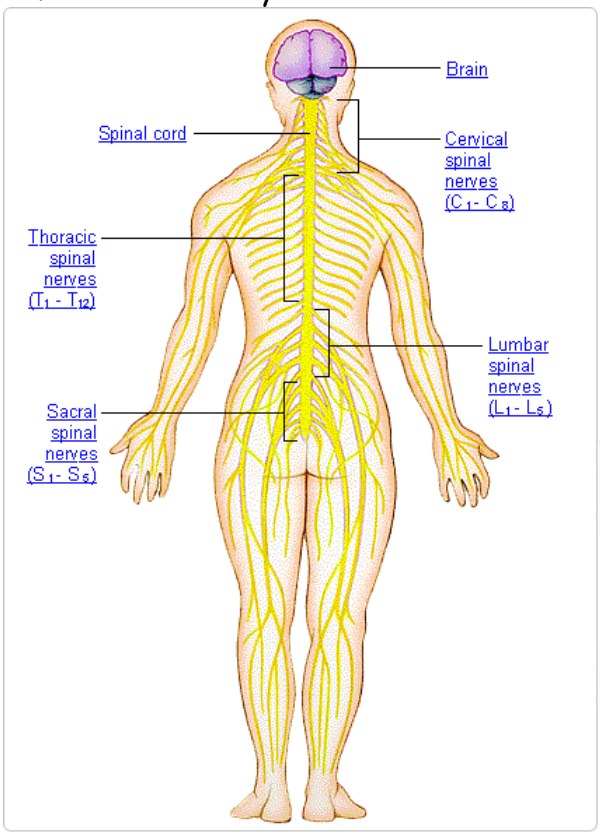


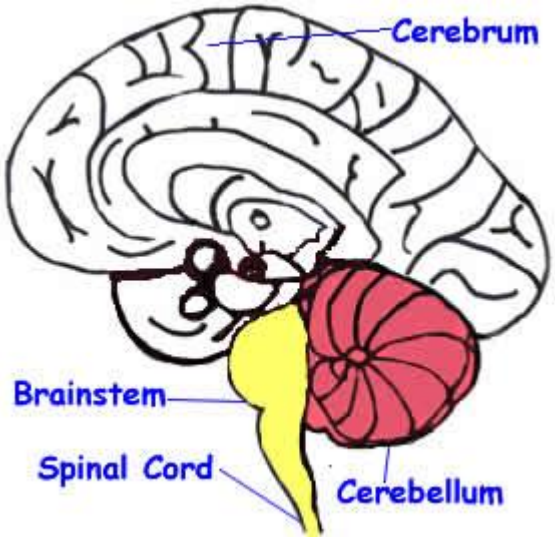
Nervous System

- Function: allows the body to response to internal and external stimuli
- Neuron: cell that conducts impulses through the nervous system
    - Made up of a cell body, dendrites (receives impulses), and an axon (carries impulses away from the cell toward other cells)



- 3 types of neurons:
  - Sensory neurons carry impulses from the body to the spinal cord and brain
  - Interneurons are found within the brain and spinal cord
  - Motor neurons carry the response impulses away from the brain and spinal cord to a muscle or gland
- Parts of the nervous system





  - Central Nervous System: brain and spinal cord
    - Brain: made up of the cerebrum, cerebellum and brain stem
  - Peripheral Nervous System: all the nerves in the rest of your body

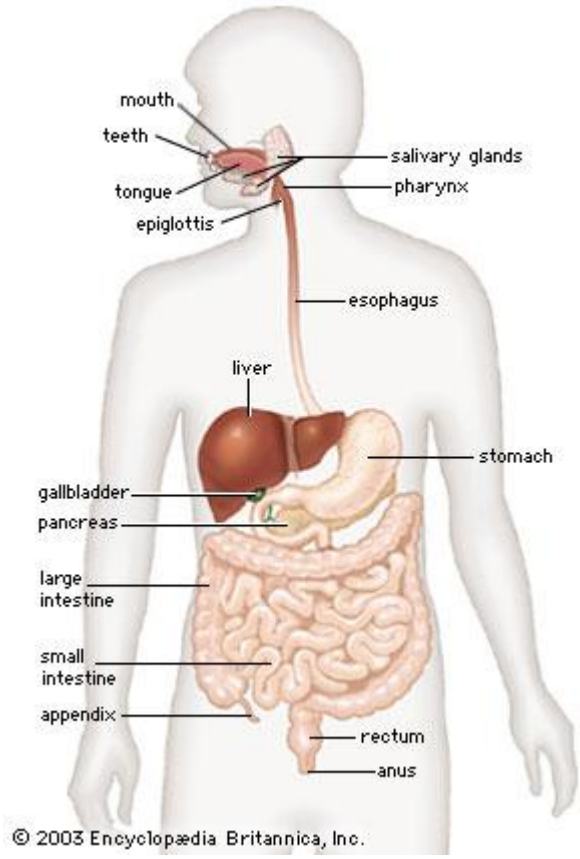
- Made up of the somatic and autonomic nervous system
  - Somatic nervous system: voluntary (you decide whether you want to move body parts controlled by this system, like your skeletal muscles)
  - Autonomic nervous system: involuntary (the impulses that travel through this system are not under your control, they automatically happen, like muscles that help you breath)
    - Autonomic nervous system is made up of the sympathetic system (controls internal functions during stress) and the parasympathetic system (controls internal functions during rest)

- Control of the body is done by the nervous system and the endocrine system (release hormones into the bloodstream to control bodily functions)

- Negative feedback control: hormones, or their effects, are fed back to inhibit, or stop, the original signal
  - Once homeostasis is reached, the signal is stopped and the hormone is no longer released

Digestive System

- Function: to break apart the food you eat into smaller parts so that it can be used as energy for your body

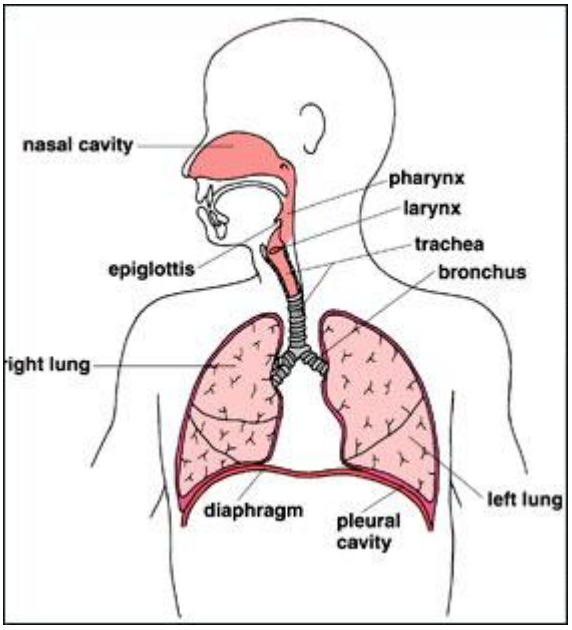


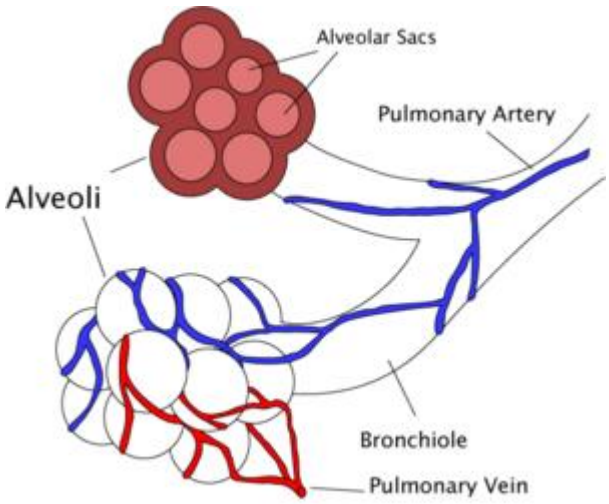
- Digestion (The path food takes when you eat)
  - Mouth: mechanical (teeth) and chemical (saliva) digestion

        - Saliva contains the enzyme amylase that begins the chemical breakdown of starch
    - Esophagus: muscular tube that connects your mouth to your stomach
    - Stomach: Physical and chemical digestion
        - Stomach contains hydrochloric acid that lowers the pH of the stomach so that the enzyme pepsin can chemically break down protein
    - Small intestine: mechanical digestion completed; chemical digestion of proteins, carbohydrates, and fats completed; digested nutrients enter the bloodstream through the villi in the small intestine
        - Pancreas secretes enzymes to the small intestine to chemically break down fats, proteins, and starch
        - Liver produces bile (that is stored in the gall bladder) which is secreted into the small intestine to chemically break down fats
        - Starches are digested to monosaccharides; fats are digested to fatty acids; proteins are digested to amino acids

Respiratory System

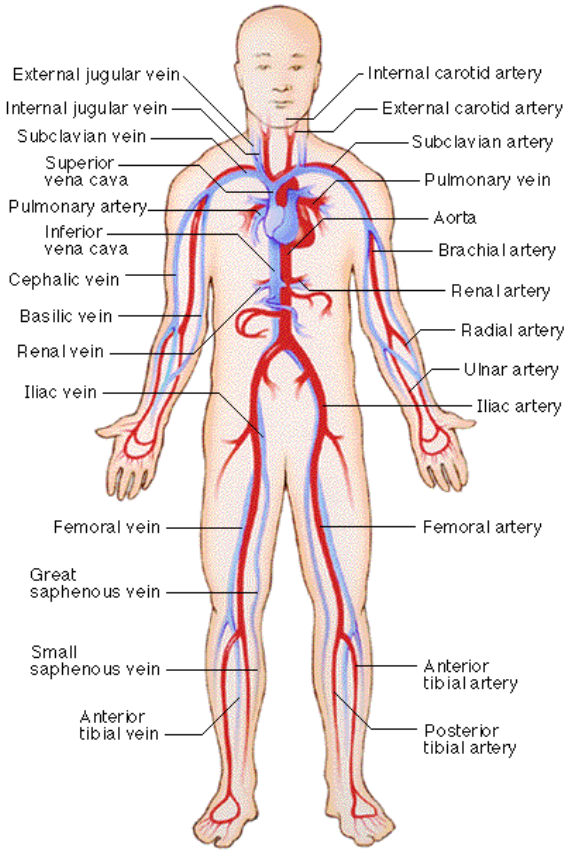
- Functions:
    - Breathing
    - respiration (the process of gas exchange)
- The path air takes during respiration
    - Taking air into your body through your nose or mouth
    - Air flows into the pharynx (throat) and moves through the larynx
    - Air travels down the trachea (windpipe) to the lungs
    - In the lungs, each bronchus branches into bronchioles which branch into alveoli covered in capillaries
    - In the alveoli covered with capillaries, oxygen and carbon dioxide are exchanged by diffusion between the air and the blood
    - Once oxygen from the air diffuses into the blood vessels surrounding the alveoli, it is pumped by the heart to the body cells, where it is used for cellular respiration
    - Carbon dioxide from the body diffuses from the blood into the air spaces in the alveoli
    - During exhaling, this carbon dioxide is removed from the body



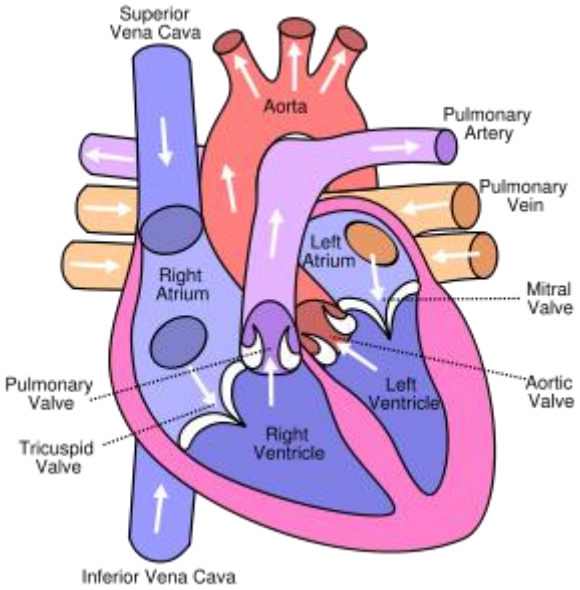


Circulatory System

- Blood is composed of
  - Red blood cells: transport oxygen to parts of the body using the hemoglobin protein
  - White blood cells: defend the body against disease
  - Platelets: needed for blood clotting
  - Plasma: the liquid portion of the blood
- Blood types: A, B, AB, O
  - Determined by antigens (proteins) on the surface of red blood cells
- Three types of blood vessels
  - Arteries: carry blood away from the heart; large
  - Veins: carry blood toward the heart; large
  - Capillaries: connect arteries to veins; very small



- Heart: muscle needed to pump blood to all parts of the body
  - Two upper chambers: left and right atria (atrium is singular)
  - Two lower chambers: left and right ventricles
  - Blood enters the heart through the atria and leaves the heart through the ventricles



- How blood travels through the heart
  - Right atrium: receives oxygen-poor blood from the head and body
  - Left atrium: receives oxygen-rich blood from the lungs

- The two atria fill with blood and then contract, pushing the blood into the ventricles
- Right ventricle: pushes the oxygen-poor blood out of the heart toward the lungs
- Left ventricle: pushes the oxygen-rich blood out of the heart toward the rest of the body
- The two ventricles fill with blood from the atria, then contract at the same time, pushing blood out of the heart
- Valves in the heart prevent blood from flowing in the wrong direction

- Kidneys: filter the blood to remove nitrogenous wastes from it, thus maintaining homeostasis of body fluids
  - The waste fluid is urine and is excreted from the body
  - Bladder: makes urea (main substance in urine)
  - Liver: filters harmful substances from the blood(ex.Alcohol)