

Biology Review

- **Characteristics of Life**
 - **All living things:**
 - Have cells
 - Respond to stimuli
 - Grow
 - Have a stable internal environment
 - Reproduce
 - Use energy
 - Adapt
- **Cell theory**
 - **Cell-** basic unit of structure and function in living things
 - Cell theory developed by Theodor Schwann and Matthias Schleiden
 - All living things are made of cells
 - All cells come from other cells of the same kind
 - Cells are the basic unit of living things
- **Cell Structure**
 - **Cell membrane-** thin membrane around the cell
 - Semi-permeable (lets some things in/out but not others)
 - Made of phospholipids, proteins and carbohydrates
 - **Cell Wall-** rigid membrane around plant cell
 - **Cytoplasm-** (cytosol)—jellylike substance that supports the organelles (little organs of the cell)
 - **Genetic material-** DNA found in the nucleus
 - **Plastids-** storage structures for pigments---only in plants (chloroplasts)
 - **Vacuoles-** storage tanks for water and food
 - **Golgi bodies-** flattened membrane sacs that are the packaging and distribution centers
 - **Mitochondria-** Rod shaped organelle where cellular respiration takes place---powerhouse of the cell
 - **Microfilaments and microtubules-** Fibers and tubes of protein that help move internal cell parts
 - **Endoplasmic Reticulum (ER)-** Folded membranes that either have areas with ribosomes (Rough ER) and are places where proteins are made OR do not have ribosomes attached to them (Smooth ER) and are found in areas like the liver cells that help remove toxins from the body.
 - **Nucleus-** control center of the cell; where DNA is found
 - **Nucleolus-** organelle inside the nucleus; site of ribosome production
 - **Ribosomes-** structures that make proteins; found on rough ER and floating in cytoplasm
 - **Centrioles-** (animal cell only); short tubes necessary for cell reproduction
 - **Lysosomes-** Sacs that contain digestive enzymes; clean up crews
 - **Cilia-** Short hairlike extensions on cell surfaces that help them move and gather food
 - **Flagella-** long whiplike extensions on cells that help them move
 - **Cytoplasm** (cytosol)- jelly like substance around cell nucleus and helps support organelles
- **Types of cells**
 - **Eukaryotic- (Eu is TRUE)** cells that have a true nucleus----animal cells/plant cells
 - **Prokaryotic- (Pro is before)** cells that DO NOT have a true nucleus---bacteria
- **Organization**
 - Cells→ tissues→ organs→ organ systems→ organism
- **Transport**
 - **Passive Transport**
 - Does not require energy
 - Molecules move from area of high concentration to area of low concentration (with the concentration gradient)
 - **3 types**
 - **diffusion-** substances move directly through cell membrane
 - **facilitated diffusion-** diffusion with the help of a carrier protein to help things move through the cell membrane

- **osmosis**- movement of water from high concentration to low concentration through a semi-permeable membrane
 - **Active Transport**
 - Requires energy
 - Movement of molecules from low to high concentration (against the concentration gradient)
 - **Types**
 - **Exocytosis- (exit)** movement of molecules OUT of a cell
 - **Endocytosis- (enter)** movement of molecules INTO the cell
- **Solution concentrations**
 - **Hypotonic**
 - Hypo=lower concentration of solute (like salt) than solvent (water)
 - A cell in a hypotonic solution would swell as water moved into the cell from high concentration to low concentration
 - **Hypertonic**
 - Hyper=high concentration of solute (like salt) than solvent (water)
 - A cell in a hypertonic solution would shrink as water moved out of the cell from high concentration to low concentration
 - **Isotonic**
 - Equal amounts of solute and solvent on both sides of the membrane and there is no net movement of water. Cell remains the same size.
- **Chemistry of life**
 - 6 elements found in living things **SPONCH** (make up 99% of living tissue)
 - Sulfur
 - Phosphorus
 - Oxygen
 - Nitrogen
 - Carbon
 - Hydrogen
 - **Organic Molecules (contain carbon)**
 - **4 organic compounds**
 - **Carbohydrates (sugars & starches)**
 - Quick energy source
 - Usually end in -ose
 - Monosaccharides (simple sugars)
 - Glucose, fructose, galactose
 - Disaccharides (double sugar---two monosaccharides bonded together)
 - **Lipids (fats, waxes, oils)**
 - Saturated- contains as many hydrogen bonds as it can contain
 - Unsaturated- does not contain as many hydrogen bonds as it can contain
 - **Protein**
 - Made on the ribosome inside the cell
 - Made of amino acids held together by peptide bonds
 - 20 different kinds of amino acids
 - Builds muscle in animals (most organisms MUST have protein to survive)
 - **Nucleic Acids**
 - Found in the nucleus of a cell
 - DNA- Deoxyribonucleic Acid (direct cell activity)
 - RNA- Ribonucleic Acid (involved in protein synthesis)
 - Inorganic Molecules (DO NOT contain carbon)
- **Cellular Energy**
 - Energy for chemical reactions and life processes comes in the form of a molecule called ATP (adenosine triphosphate) and Enzymes speed up the reactions. When chemical bonds form ENERGY is STORED. When chemical bonds break ENERGY is RELEASED
 - **ATP**- when broken apart and energy released, it is reduced to ADP
 - **Catalyst**- enzymes that speed up reactions and REDUCE activation energy needed to start a reaction

- **Ionic Bonds-**
 - Transfer of electrons
- **Covalent Bonds**
 - Sharing of electrons
- **Nonpolar**
 - Occurs between two atoms of the same element (Carbon-Carbon)
- **Polar**
 - Have slightly positive end and negative end (water)
- **Free Energy**
 - Energy available to do work; stored in chemical bonds of molecules
- **Cellular Respiration**
 - Process of breaking down glucose; takes place in mitochondria of cell
- **Cellular Energy:**
 - **Photosynthesis**
 - $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 \text{ (GLUCOSE)} + 6\text{O}_2$
 - Takes place in the chloroplast that is an organelle in a plant cell that has a double membrane with stacks of sac-like membranes called thylakoids which contain chlorophyll.
 - Pigments absorb light energy
 - Light dependent reactions (in thylakoid)
 - Light independent reactions (in stroma)
 - **End products of photosynthesis**
 - **Light dependent reactions**----- \rightarrow ATP, Oxygen, NADPH (all of these are to be used in the light-independent reactions and the oxygen is released for us to breathe)
 - **Light independent reactions**----- \rightarrow use ATP and NADPH and carbon from carbon dioxide to make glucose.
 - **Cellular Respiration**
 - $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$
 - Process of breaking down food molecules to release energy.
 - **Two types:**
 - **Aerobic respiration-** occurs in presence of oxygen. Energy released is used to create ATP
 - **Glycolysis-** in cytoplasm; glucose is broken in half and used to make ATP
 - **Krebs Cycle-** (citric acid cycle) breaks down citric acid and produces more ATP
 - **Electron Transport-** occurs in mitochondria
 - **Anaerobic respiration (fermentation)**
 - Sugars break down in absence of oxygen and are converted into alcohol or lactic acid
- **pH**
 - **Acids-** pH less than 7
 - **Bases-** pH more than 7
 - **Neutral-** pH of 7
- **DNA**
 - Double helix (twisted ladder)
 - Made of nucleotides
 - Sugar- deoxyribose
 - Nitrogenous base
 - Adenine
 - Thymine
 - Cytosine
 - Guanine
 - Phosphate
 - Gene are pieces of DNA that code for specific proteins which are made in the cytoplasm on the ribosome
 - Found in the nucleus
 - Major function is to code for production of proteins

- **Replication** (when DNA copies itself)
 - Occurs in the S phase of Interphase during the cell cycle
 - Enzymes split the two strands of bases apart
 - New bases are paired up with the unzipped bases on the DNA strands
 - Phosphates and sugars are also added
 - The final product is two completely identical strands of DNA that came from one strand
- **RNA**
 - Single strand (small enough to leave nucleus with code to make proteins in cytoplasm)
 - Made of nucleotides
 - Sugar- ribose
 - Nitrogenous base
 - Adenine
 - Uracil
 - Cytosine
 - Guanine
 - Phosphate
 - **3-types**
 - **mRNA- (messenger)**. The message or recipe copied down from the DNA
 - **tRNA- (transfer)**. Carries the ingredients (amino acids) to the factory (ribosome) where they are assembled into proteins
 - **rRNA- (ribosomal)** makes ribosomes
 - **Protein Synthesis**
 - Enzymes are proteins that help carry out reactions in a cell
 - Hormones regulate body functions and are also made of proteins
 - Proteins provide structure and act as energy sources
 - Proteins transport molecules and help fight disease
 - Proteins are **ESSENTIAL** for survival
 - **Transcription** ("scribe" means to copy)
 - This is when DNA makes mRNA
 - DNA is the cook book
 - The recipes are codes for making proteins and mRNA copies the recipe down and leaves the nucleus and goes to the cytoplasm to the "factory" which is a ribosome (site of protein production, it is made of rRNA)
 - DNA is unzipped by enzymes
 - RNA bases are paired up with one side of the DNA to make mRNA
 - mRNA has a "start" codon (sequence of 3 bases on the strand)---AUG
 - mRNA has one of 3 "stop" codons---UAA, UAG, UGA
 - codons on mRNA pair up with anticodons on tRNA
 - mRNA leaves the nucleus
 - DNA zips back up
 - **Translation** ("translate" the code or recipe)
 - **mRNA** is on the ribosome with the recipe code
 - **tRNA** brings the ingredients (amino acids---there are 20 different kinds) to the ribosome and puts them together in the correct order
 - tRNA is like the transfer trucks bringing ingredients to the factory so it can make proteins
 - tRNA has an amino acid on one end and an anticodon sequence on the other end. The anticodon sequence pairs up with the codon sequence on the mRNA.
 - **CODON-----mRNA-----AUG----CCU----GGG-----UUU-----CGA----UGA**
 - **ANTICODON—tRNA-----UAC---GGA---CCC-----AAA-----GCU----ACU**
 - **AMINO ACID ON tRNA (use CODON sequence to determine which amino acid is attached to the tRNA trucks because the codon is the recipe)**
 - Order of amino acids for codon sequence above
 - Methionine START
 - Proline
 - Glycine
 - Phenylalanine

- Arginine
 - STOP
 - **The Cell Cycle**
 - The time from one cell division to another
 - **Interphase**
 - Longest phase
 - 3 parts
 - **G1**—cell grows in size
 - **S**—DNA replication occurs
 - **G2**—cell prepares to divide
 - **Mitosis** (nuclear division)
 - **Prophase**—chromatin coils up into chromosomes; centriole divides and moves to each end of cell; spindle fibers form between centrioles; nuclear membrane and nucleolus begin to disappear
 - **Metaphase**—chromosomes line up at equator of the cell “Meet me in the middle during metaphase”.
 - **Anaphase**— spindle fibers reach down and pull chromosomes apart and take them to each end of the cell
 - **Telophase**—chromosomes uncoil into chromatin; nuclear membrane and nucleolus reappear
 - **Cytokinesis** (cytoplasmic division)
 - Division of the cytoplasm that separates the two cells
 - **Meiosis** (production of gametes...sperm and egg)
 - Only occurs in cells of testes and ovaries
 - 1 diploid (2n) cell produces 4 haploid (n) cells
 - **Phases**
 - **Meiosis-1**
 - **Prophase-1:** nuclear membrane and nucleolus disappear; chromatin coils into chromosomes and homologous chromosomes find each other and pair up
 - **Metaphase-1:** Homologous pairs line up at the equator; they exchange genetic information and “shuffle the cards”—this is “crossing-over”
 - **Anaphase-1:** Spindle fibers reach down and separate homologous chromosomes
 - **Telophase-1:** Chromosomes uncoil and form chromatin
 - **DNA REPLICATION DOES NOT OCCUR—THAT PART IS SKIPPED**
 - **Meiosis-2**
 - **Prophase-2:** chromatin coils into chromosomes
 - **Metaphase-2:** Spindle fibers form and chromosomes line up at the equator
 - **Anaphase-2:** Chromosomes separate and move to opposite ends of the cell
 - **Telophase-2:** nuclear membrane reappears and forms in 4 daughter cells (gametes) that contain a haploid (n) number of chromosomes
 - Females produce 1 egg and 3 polar bodies that disintegrate and do not become “eggs” . Each of them have 23 chromosomes
 - Males produce 4 sperm each with 23 chromosomes
- **Asexual**- without sex. Reproduction where there is not an exchange of genetic material. All offspring are genetically identical to parent
- **Sexual**- reproduction where there is an exchange of genetic material. All offspring are genetically different from parent
 - **Fertilization**- when gametes unite to form a new diploid cell
 - **Zygote**- fertilized egg
 - **Embryo**- first stage of growth
 - **Embryonic stem cells**- the group of cells in early embryo growth that are similar to the original zygote. They have to capability to become any type of cell

- **Cell differentiation**- when the embryo reaches 20-150 cells in size, the cells become specialized to produce different parts of the body and produces proteins for specific bodily functions
- **Mutations**
 - Mistakes in the duplication of chromosomes.
 - Usually occur in the nucleus of the cell during replication
 - Some harmful
 - Some beneficial
 - **Types:**
 - **Gene mutations**- mistakes that affect individual genes on a chromosome. (ex: when one base on DNA strand substitutes for another base)
 - **Substitutions**- one base substituted for another
 - **Frameshift mutation**- a shift in the sequence of bases because a base is deleted or inserted.
 - **Chromosomal mutations**- mistakes that affect the whole chromosome
 - **Duplication mutations**- when chromosome segment attaches to homologous chromosome that has not lost the complimentary segment
 - **Deletion mutations**- when chromosome segment breaks off and doesn't reattach
 - **Inversion mutations**- when segment of chromosome breaks off and reattaches backwards
 - **Translocation mutations**- when chromosome segment attaches to nonhomologous chromosome
- **Genetics**
 - **Genes**- specific portions of DNA that determine hereditary characteristics
 - **Alleles**- different forms of a gene. Each parent passes one allele for each trait to their children. Each child has two alleles for the same trait (one from each parent). This is their genotype. How the gene expression looks is its phenotype.
 - **Dominant gene**- trait that will express itself
 - **Recessive gene**- trait that is not expressed unless it is with another recessive gene
 - **Homozygous**- two of the same alleles (TT, RR, tt, rr)
 - **Heterozygous**- two different alleles (Tt, Rr)
 - **Punnett Square**- a square that shows possible combinations of a trait an offspring may inherit from its parents
 - **Monohybrid cross**- cross involving one trait
 - **Dihybrid cross**- cross involving two traits
 - **Gregor Mendel**- father of genetics; worked with pea plants
 - **Cross pollinate**- have two different parents
 - **Self-pollinate**- have only one parent
 - **True-breeders**- have known genetic history and will self pollinate to produce offspring identical to themselves
 - **Parental generation- (P)** the crossing of true breeders; the offspring they produce are the first filial generation (F1); the offspring of the F1 generation are called the second filial or F2 generation
 - **Principle of segregation**: when forming sex cells, the paired alleles separate so that each egg or sperm only carries one form of the allele and the two forms will come together again during fertilization
 - **Principle of independent assortment**: each pair of alleles segregates independently during the formation of the egg or sperm.
 - **Sex chromosomes**: chromosomes responsible for determining the sex of an organism
 - Males have XY and determine the sex of a child
 - Females have XX
 - **Incomplete Dominance**- when one trait is not completely dominant over the other and the traits "blend" (red and white flowers cross to produce pink offspring)
 - **Co-Dominance**- when both traits appear in the F1 generation and contribute to phenotype of offspring (red horse crosses with white horse to produce offspring with red and white hair)
 - **Multiple Alleles and Traits**- blood type, hair color, eye color are determined by two genes for every trait, one from each parent

- **Biotechnology**- commercial application of biological products. Refers to the processes that manipulate DNA (recombinant DNA technology, genetic engineering of agricultural crops, gene therapy, cloning, and DNA fingerprinting)
 - **Stem Cell**- could help people with nerve damage, Alzheimer's, Parkinson's or arthritis; can be harvested from adult bone marrow, umbilical cord blood after delivery, or from human embryos which results in the death of the embryo
 - **Cloning**- creation of genetically identical organisms
 - **DNA Fingerprinting**- Every person's DNA is different (except for identical twins); DNA fingerprinting is the identification of a person using his or her DNA; used to determine if suspects are guilty of crimes, identify parents of children. Gel electrophoresis is used to make the fingerprint.
 - **Human Genome Project**-
 - **Genome**- organism's complete set of DNA
 - Humans have 46 chromosomes that contain 30,000 genes made up of about 3 billion base pairs
 - Human genome project started in 1990 wanted to identify all human genes and determine all base pair sequences in all human chromosomes. It was completed in 2003 thanks to biologists all over the world.
- **Taxonomy**
 - **Biological Classification**
 - **Taxonomy**- the classification of an organism based on several features like structure, behavior, development, DNA, nutritional needs...
 - Divides organisms into several categories: "King Phillip Came Over From Greece Sneezing"
 - **Kingdom (6 kingdoms)**
 - **1. Archaeobacteria**- ancient forms of bacteria; prokaryotic; anaerobic; found in EXTREME habitats
 - **2. Eubacteria**- true bacteria; eukaryotic; heterotrophic, autotrophic, and chemotrophic
 - **Heterotroph**- eat to obtain energy (animals)
 - **Autotroph**- make their own food (plants)
 - **Chemotroph**- get energy from breaking down inorganic, nonliving substances
 - Archaeobacteria and Eubacteria were once in a kingdom called Monera. Bacteria reproduce through Binary Fission (where the cell divides in half, similar to mitosis). They can also reproduce by conjugation (where genetic material is exchanged between two cells). Bacteria are found everywhere. Most are harmless. They are important decomposers feeding on dead matter. Some bacteria cause disease by reproducing and damaging tissue or releasing toxins that interfere with cellular functions. (Antibiotics and drugs are used to fight them)
 - **3. Protista**- protists;
 - Plantlike, animal like or fungus like organisms (euglena, algae, diatoms, amoeba, paramecium)
 - **4. Fungi**- fungus;
 - Mushrooms, athlete's foot, ringworm, lichen (type of fungus that grows together with algae in a symbiotic relationship); fungi reproduce by budding (when a piece of the organism becomes detached and lives and grows on its own as a complete structure)
 - **5. Plantae**- plants
 - **Vascular**: have xylem and phloem (tubes that carry water nutrients through the plant)
 - Spore bearing (ferns)
 - Seed bearing
 - **Gymnosperm** (conifers.....evergreens.....pine trees)
 - **Angiosperm** (flowering trees like magnolia...many are deciduous and lose their leaves during the fall)
 - **Herbaceous**- soft stems
 - **Woody**- hard stems
 - **Monocots**- have one seed leaf (cotyledon)....CORN
 - **Dicot**- has two seed leaves (cotyledons)....PEANUT
 - **Leaves**- factories of the plant. Take in energy and make sugar. They contain chlorophyll and undergo photosynthesis.
 - Cuticle- waxy coating on leaves to prevent water loss
 - Stomata- opening on underside of leaf for gas exchange
 - **Flowers**- reproductive structure of angiosperm
 - **Stamen**- male structure

- **Anther**- top of stamen that produces pollen (pollen lands on stigma and grows pollen tube into ovary to fertilizes eggs)
 - **Pistil**- female organ
 - **Stigma**- top of pistil that is sticky so pollen can stick to it
 - **Style**- the long slender portion of the pistil that leads to ovary
 - **Ovary**- at bottom of pistil where the eggs are; Fruit like apples are the ripened ovary of the apple flower.
 - **Germination**: when seed coat splits and a young plant begins to grow
 - **Nonvascular**: don't have xylem and phloem (mosses)
 - **6. Animalia**- animals
 - **Heterotrophs**- eat to get energy (animals)
 - **Autotrophs**- make their own food (plants)
 - **Invertebrates**: don't have a backbone; most abundant group; they are multicellular. (sponges, jellyfish, worms, clams, oysters, starfish, insects, spiders, crab...) Some have exoskeleton---skeleton on outside of body
 - **Complete metamorphosis**- series of stages of insect development; egg, larva, pupa, and adult stages
 - **Incomplete metamorphosis**- egg, nymph, and adult stages
 - **Vertebrates**: Have a backbone. Have a notochord, gill slits and endoskeleton---internal skeleton. (fish, amphibians, reptiles, birds, mammals)
 - **Dichotomous Key**: tools used to identify organisms. It is a set of questions, each with yes or no answers. You compare the organism's characteristics with the dichotomous key.
 - **Phylum**
 - **Class**
 - **Order**
 - **Family**
 - **Genus**
 - **Species**
 - **Carl Linnaeus**- botanist who devised current system of classification. He used **binomial Nomenclature** which names organisms using two-part name written in Latin. It is the genus and species name of the organism. They are written in italics and the Genus name is capitalized and the species name is lower case. (*Homo sapiens*---scientific name for humans)
- **BIOMES**
 - **Terrestrial Biomes**
 - 1. Tundra
 - 2. Coniferous Forest
 - 3. Deciduous Forest
 - 4. Grasslands
 - 5. Tropical Rain Forest
 - 6. Desert
 - **Aquatic Biomes** (based on salinity...the amount of salt in the water)
 - 1. Marine---ocean
 - 2. Freshwater---ponds and lakes
 - 3. Estuaries---mixture of salt and fresh, brackish water
- **Ecosystems**
 - **Ecosystem**- physical environment where plants and animals live
 - **Biosphere**- zone around the earth that contains self-sustaining ecosystems made of biotic and abiotic factors
 - **Biotic**- living factors---plants & animals
 - **Abiotic**- nonliving factors---water, oxygen, carbon
 - **Community**- smaller area within the ecosystem where certain types of plants or animals live in close proximity to each other (a wooded area, clearing in forest). Each member of a community has its own **habitat** (where organism seeks food and shelter). The habitat provides food and shelter for the members of the community. In turn, each species of the community has its own **niche**. A niche is the role that an organism plays in its community, like what it eats and where it nests.
 - **Population**- A community is composed of populations that are made up of the individual species in a community. (populations of plant and animal species like deer, squirrels...)

- **Species-** a group of similar organisms that can breed with one another to produce fertile offspring.
 - **Relationships among organisms**
 - **Symbiosis-** relationship where two organisms live together and one or both benefit
 - **Commensalism-** one benefits, one unaffected
 - **Mutualism-** both benefit
 - **Parasitism** – one benefits, one harmed
 - **Competition-** fighting over resources (food, water, shelter, space)
 - **Predation-** predator/prey relationship. Predator hunts the prey.
 - **Population Dynamics**
 - The study of characteristics of a population, like growth rate, density, distribution
 - **Growth**
 - **Growth rate-** the change in population size over time
 - **Immigration-** organisms moving in to an area
 - **Emigration-** organisms leaving an area
 - **Exponential growth-** when a population starts out slowly and then increases rapidly as the number of reproducing individuals increase
 - **J-shaped curve**
 - **Density & Distribution**
 - **Density-** the number of organisms per unit area
 - **Distribution-** the pattern of where the organisms live
 - **Carrying Capacity**
 - The number of individuals an environment can support in a given area. Growth will increase and then level out when carrying capacity has been reached.
 - **Regulation of Population Size**
 - **Limiting Factor-** anything in a population that restricts the population size
 - **Density-dependent factors-** usually affect large, dense populations; things like competition, disease, predation
 - **Density-independent factors-** size of population doesn't matter; things like natural disasters, seasonal cycles
 - **Succession-** when one community replaces another
 - **Primary Succession-** occurs in areas that are barren of life because of lack of soil. (volcanic island) lichens→soil→seeds→trees→shrubs
 - **Secondary Succession-** seeds and soil are all that remain. The community was partially or completely destroyed. (Planting a garden. Once finished with garden, native species move back in)
- **Energy Flow through the Ecosystem**
 - **Food Chains-** producers, consumers and decomposers of each ecosystem. Energy flows through an ecosystem in food chains, passing energy from one organism to the next.
 - **Producers-** plants; produce their own food
 - **Consumers-** depend on other organisms for food
 - **Herbivores-** eat plants
 - **Carnivores-** eat meat
 - **Omnivores-** eat plants and meat
 - **Decomposers-** live on dead or decaying organisms and break them down to return to the soil; bacteria and fungi
 - **Food Webs-** interaction of many food chains
 - **Energy Pyramid-** shows the different trophic levels and percentage of biomass in each level.
 - **1st trophic level (bottom)-** producers
 - **2nd trophic level-** Primary consumers---eat plants (producers)
 - **3rd trophic level-** Secondary consumers---eat primary consumers
 - **4th trophic level-** Tertiary consumers---eat secondary consumers; top of the food chain; usually omnivores, or carnivores

- **Nutrient Cycles**
 - **Carbon cycle**
 - Cycling of carbon between carbon dioxide and organic molecules. Plants use carbon dioxide and energy from the sun to perform photosynthesis. When animals eat plants, the carbon passes into their tissues. Through food chains, carbon passes from one organism to another. It returns to earth through respiration, excretion, or decomposition after death. Animals that are buried and compressed over long periods of time become fossils fuels like coal, oil, and gas. When these are burned, the carbon dioxide returns to the atmosphere.
 - **Nitrogen cycle**
 - The most abundant atmospheric gas (78%) but it's not in a form that is usable to most organisms. The nitrogen cycle transforms nitrogen into ammonia, nitrite and nitrate so that plants and animals can use it. This is **Nitrogen Fixation** and it is done by several types of bacteria. **Legumes** like peas and beans have bacteria that live on their roots that fix the nitrogen and return it to the soil.
 - **Water cycle**
 - Circulates fresh water between the atmosphere and the earth. Water covers most of earth, 95% is salt water. Most fresh water is in glaciers.
 - **Precipitation**- rain, ice, snow, hail, dew
 - **Runoff**- when water runs off the surface and collects in low lying areas like rivers, streams, oceans
 - **Evaporation**- sun provides energy in form of heat that sends water vapor into the atmosphere from bodies of water.