Biology: Simple Studies Course Guide

From Simple Studies: https://simplestudies.edublogs.org & @simplestudiesinc on Instagram

Topic 1- Biochemistry

- **Vocab**
  - **Biomolecule-** Small molecules that make up living things
  - **Protein-** biomolecules that make body tissue, conduct body processes, help when you are sick
  - **Lipid-** provide long term energy, keep you warm, make cell membranes
  - **Carbohydrate-** provide fast energy
  - **Nucleic Acid-** make up your DNA (genetic code)
  - **Monomer-** a single unit of a biomolecule
  - **Polymer-** a long chain of monomers put together
  - **Dehydration Synthesis-** removing water to connect monomers and make a polymer
  - **Hydrolysis-** adding water (two hydrogens and oxygen) back to the molecules as they are broken apart
- **The 4 Biomolecules**
  - Comprised of some combination of Carbon (C), Hydrogen (H), O-Oxygen (O), Nitrogen (N), Phosphorous (P), Sulfur (S)
  - **Proteins**
    - Tissue building
    - Immunity
    - Enzymes
    - CHON(S)
    - **Monomer-** Amino Acid
    - **Polymer-** polypeptide chain
    - Ex: Meats, beans, dairy
  - **Lipids**
    - Long-term energy
    - Insulation
    - Involved in the cell membrane

        - CHO
        - **Monomer-** Glycerol & fatty acids
        - **Polymer-** Triglyceride
        - Ex: Oil, Butter, cholesterol
    - **Carbohydrates**
        - Fast energy
        - CHO
        - **Monomer-** monosaccharides
        - **Polymer-** polysaccharides
        - Ex: bread, sugars, pasta
    - **Nucleic Acids**
        - Coding of Traits
        - CHONP
        - **Monomer-** nucleotides
        - EX: DNA & RNA
- **Enzymes**
    - What are they?
        - A type of protein that helps with chemical reactions
    - Functions
        - Enzymes are **catalysts** which speed up reactions by reducing the **activation energy**
            - **Activation Energy**
                - The amount of energy needed to start a chemical reaction. Enzymes lower the amount of energy need to activate
        - They can put things together or break them apart
- **Macromolecules**
    - All living things make large molecules (macromolecules) from smaller molecules
    - What are macromolecules made from?
        - Can be made from a few repeating units
        - Can be composed of hundreds of thousands of smaller molecules
    - **Organic Compounds**

        - Organic compounds must contain carbon in their structure (i.e. macromolecules made by living organisms)
        - Organic compounds can form **carbon-to-carbon bonds**; inorganic compounds do not
        - Organic compounds have carbon to hydrogen bonds and can also form carbon to oxygen or carbon to nitrogen bonds
        - All organic compounds have a single basic building unit called a **monomer**. Monomers are put together to make variations and different forms of each organic compound.

Topic 2- Cells

- **Background Info**: Living organisms are made up of smaller units called cells. **Cells** may contain lots of smaller units called **organelles**. Some organisms are made of only one cell (making them **unicellular**). Some unicellular organisms have no organelles, whereas some unicellular organisms such as **protists** have several organelles. Other organisms, like plants and animals, are made up of millions of cells, making them **multicellular**. Cells of multicellular organisms contain many organelles. Some organelles are specific only to animal cells, some organelles are specific to plants, but most organelles are found in both plants and animals.
- **Organelles**
    - **Nucleus-** the storehouse for most of the genetic information (DNA) in your cells
    - **Endoplasmic Reticulum-** an interconnected network of thin, folded membranes
    - **Ribosomes-** tiny "organelles" that link amino acids together to form proteins
        - Not "true" organelles because they aren't membrane-bound
    - **Golgi Apparatus-** consists of closely layered stacks of membrane-enclosed spaces that process, sort, and deliver proteins
    - **Mitochondria-** supply energy to the cell
    - **Vacuole-** a fluid-filled sac used for the storage of materials needed by the cell
    - **Lysosomes-** membrane-bound organelles that contain enzymes
    - **Centrioles-** cylinder-shaped organelles made of short microtubules arranged in a circle

- **Cell Wall-** a rigid layer that gives protection, support, and shape to the cell
- **Chloroplasts-** organelles that carry out photosynthesis
- **Cell Membrane-** forms a boundary between a cell & the outside environment; controls the passage of material in an out of a cell
- **Cytoplasm**- the jelly-like substance that contains dissolved molecular building blocks
- **Nucleolus-** a region where tiny organelles essential for making proteins (ex. ribosomes) are assembled
- **Cytoskeleton-** a flexible network of proteins that provide structural support for the cell
- Each of the organelles above carries out a **specific function**, allowing the cell to act as a small living unit

- What do all living things have in common? (These are the 8 **characteristics of life**)
  - Reproduce
  - Made of Cells
  - DNA & RNA (Universal genetic code)
  - Homeostasis
  - Stimuli
  - Grow/Develop over time
  - Require energy
  - Evolve/change
- **Cell Theory**
  - All living things are composed of one or more cells
  - A cell is the most basic unit of life
  - All new cells arise from existing cells
- **Major Scientists** that helped develop the cell theory
  - **Hooke**- was the first to identify cells and name them
  - **Leeuwenhoek**- observed live cells in greater detail
  - **Schleiden**- concluded that plants are made of cells
  - **Schwann**- concluded that animals and, in fact, all living things are made of cells
  - **Virchow**- proposed that all new cells come from preexisting cells

- **Prokaryote vs Eukaryote**
    - **Pro = NO nucleus, Eu = DO have a nucleus**
    - Organelles shared by both prokaryotes and eukaryotes
        - Cell membrane
        - Cytoplasm
        - Genetic material
        - Ribosomes
    - A unique organelle that prokaryotes have is the **flagella**. Unique organelles that both plant and animal eukaryotes have are mitochondria, endoplasmic reticulum, vacuoles, Golgi apparatus, and lysosomes.
- **Miller Urey**
    - An experiment that proved life could form from inorganic compounds in early Earth's atmosphere
    - First living organisms were prokaryotes. Prokaryotes are simpler, smaller, and older than eukaryotes.
- **Endosymbiosis**
    - The theory that eukaryotic cells were formed by engulfing prokaryotic cells (chloroplast and mitochondria) creating a symbiotic relationship.
        - Evidence for theory- Chloroplast and Mitochondria have their own DNA separate from the DNA of the cell in the nucleus.
- **Levels of Organization** (smallest to largest)
    - Biomolecules~Cells~Tissues~Organs~Organ Systems~Organism

Topic 3- Homeostasis

- **Homeostasis**- the ability of the body to maintain a stable internal environment despite changes in external conditions
- **The Cell Membrane-** the lipid barrier around a cell that allows only specific things in and out of the cell to maintain homeostasis. Because it's selective of what molecules can go across, it is **selectively permeable** or semi-permeable
    - **Structure**- The cell membrane is made up of layers of lipids. This layer is double-sided and called the **phospholipid bilayer**

    - Some **proteins** are stuck into the membrane to work as channels and pumps that help large molecules across.
    - Some **carbohydrates** stick off of the membrane to signal what type of cell it is
    - Each phospholipid is composed of a **hydrophilic head** (loves water) and a **hydrophobic tail** (hates water). The tails push away from the water forming the double layer.
    - **Types of Proteins**
        - Channel- doorways for molecules to cross the membranes
        - Receptor- receive chemical messages from outside of the cell that trigger the inside of the cell to do something (ex. Receive hormones)
        - Marker- glycoproteins that signal what type of cell it is
        - Pump- push molecules across the membrane (requires energy)
- **Membrane Transport**
    - **Passive Transport** (no energy needed)
        - **Osmosis-** the movement of water across the membrane. Water moves from a low to high solute concentration (tonicity)
        - **Diffusion-** the movement of small molecules across the membrane from high to low concentration (ex: gases)
        - **Facilitated Diffusion-** the movement of large molecules across the membrane through a protein channel (Ex: glucose)
    - **Active Transport** (energy needed: ATP)
        - **Endocytosis-** the cell membrane reaches out and grabs molecules engulfing them into the cell
        - **Exocytosis-** vesicles expel molecules out of the cell and rejoin the membrane
        - **Protein Pumps-** proteins that open and close, grabbing and forcing molecules across the membrane against the concentration gradient
- **Osmosis**
    - The movement of water across the cell membrane

        - Water moves from a **low concentration to a high concentration** across a membrane. The goal is to reach an equal concentration on each side, called **equilibrium**.
- **Concentration**
    - The amount of solute in a solvent
        - The **solute** is the molecules being dissolved
        - The **solvent** is the liquid dissolving the solvent
        - Example: In Koolaid, the sugar powder is the solute and water is the solvent. The higher percent of sugar you add, the higher the concentration of solute is.
- **Tonicity**
    - The term we use to describe the concentration of a solution in relation to a cell
        - **Hypertonic** solutions have a higher concentration compared to the cell, and therefore, water moves outward causing the cell to shrink
        - **Hypotonic** solutions have a lower concentration compared to the inside of the cell, and therefore, water moves into the cell causing it to swell or burst (lyse)
        - **Isotonic** solutions have the same concentration in and out of the cell, so there is minimal movement.

Topic 4-DNA and the Cell Cycle

- **DNA**
    - **Purpose**
        - **Deoxyribonucleic acid** is a molecule that contains the biological instructions or code that make each species unique
        - DNA is passed from an adult organism to their offspring during reproduction
        - DNA is the same in every cell in an organism's body. It is found in the nucleus
    - **Structure**

        - DNA is made of nucleotides held together by **hydrogen bonds** to form a twisted ladder shape (double helix)
        - A nucleotide (CHONP)
    - **Rules**
        - There are only 4 types of **nitrogenous bases** in DNA.
        - These bases can only pair following these rules
            - **Adenine-Thymine**
            - **Cytosine-Guanine**
        - All living things are made of the same 4 bases
        - What makes each individual and each species unique is the *order* that the bases are in
        - Every organism's code is unique.
- **The Cell Cycle and Its Phases**
    - **Interphase**
        - Interphase is divided into 3 parts
            - **G1-** The cell grows and performs normal functions
            - **S-** DNA replicates itself in preparation for mitosis
            - **G2-** Cell packages DNA and prepares organelles for mitosis
    - **S phase: DNA replication**
        - In order to make a copy of itself, the cell needs to first copy its DNA. This way both daughter cells have the same genetic code
            - 1. DNA unzips
            - 2. Each strand begins making new base pairs until 2 identical strands are formed.
        - **Final Product of S phase**
            - Chromosomes are made
                - The chromosome is a tightly compacted segment of DNA that codes for specific genes. There are 23 pairs (46 total) in humans.
                - The centromere- The middle region of a chromosome that will hold sister chromatids together after DNA replication.

Chromosomes are counted by the centromere, not by the chromatids (strands of a chromosome)

- **G2 Phase**
  - Chromosomes begin to tightly coil
  - The cell begins to make a new organelle called a **centriole**. Centrioles look like bundles of tubes. One forms on each pole (side) of the cell.
- **M Phase**
  - The second stage of the cell cycle (called cell division)
  - 2 sub-phases: Mitosis and Cytokinesis
    - **Mitosis- M phase**
      - Has 4 sub-phases (prophase, metaphase, anaphase, telophase)
      - **Prophase-** nuclear membrane begins to disappear and spindle fibers grow from centrioles
      - **Metaphase-** chromosomes line up in the middle of the cell. Then spindle fibers from the centrioles grow and attach to the centromeres
      - **Anaphase-** spindle fibers pull sister chromatids apart
      - **Telophase-** 2 new nuclear membranes begin to form around chromosomes at each pole. Spindle fibers then retract and disappear. **Cell Plate** (plants) or **cleavage furrow** (animals) begins to form down the middle
    - **Cytokinesis**
      - The final stages of the cell cycle where the cytoplasm divides and the cell membrane is split into 2, resulting in 2 identical daughter cells.

Topic 5- Reproduction and Development

- **Meiosis**
  - A process in which the number of chromosomes is cut in half
    - This is done so that specialized reproductive cells can be formed.

- Meiosis involves **2 cell divisions** and ends up with **4 cells** that aren't genetically identical to each other or the original parent cell. This is different from mitosis because mitosis only produces 2 cells that are identical to each other.
- The process of meiosis allows for the shuffling of chromosomes so that each new generation can have new combos of genetic traits. Mitosis occurs for organisms to grow and develop, and to replace damaged cells and tissues.
- **Gametes**
  - Sperm cells in men and egg cells in women
  - Hold half of an organism's chromosomes (**haploid**)
  - Have an assortment that makes up their haploid combination with a few from mom and a few from dad

- **Karyotype and Chromosomal Abnormalities**
  - A **karyotype** is a picture of all the chromosomes in a cell arranged to homologous chromosomes paired by similar size, shape, and traits.
  - **Homologous Chromosome-** identical, or matching, chromosomes, one of each pair from each parent
  - The most common chromosomal abnormalities are caused when the chromosomes don't separate properly during meiosis (called **nondisjunction**)
    - **Monosomy-** when only one homologous chromosome is present in a homologous pair
    - **Trisomy-** when there are three chromosomes in the homologous pair
      - 3 of the more common nondisjunction chromosomal abnormalities
        - Nondisjunction at chromosome 21, the result could be trisomy 21(three #21 chromosomes). This is called **down's syndrome.**
        - Nondisjunction at chromosome 23, the result could be trisomy 23 (XXY). This is called **Klinefelter's syndrome**.
        - Nondisjunction at chromosome 23, the result could also be monosomy 23 (X). This is called **Turner's syndrome**

Topic 6- Genetics

- **Gregor Mendel**
    - Considered the father of genetics
    - Mendel's **pea experiments** established many of the rules of inheritance, now referred to as the **laws of inheritance**
    - Through his experiments, Mendel showed that when a yellow pea and a green pea were crossbred, their offspring always produced yellow seeds.
    - However, in the next generation, the green peas appeared in 1:3 ratio (green: yellow)
    - To explain this, Mendel created the terms **recessive** and **dominant** in reference to certain traits
    - His work demonstrated how **genes** determine the traits of an organism
- **Vocab**
    - **Genes-** sequences of DNA that code for physical traits
    - **Alleles-** variations of the same trait
        - Letters are used to represent alleles. A **capital** letter represents a dominant trait and **lowercase** for a recessive trait.
        - If 1 dominant allele is present, the dominant trait will be expressed
        - Both alleles must be recessive for a recessive trait to be expressed
    - **Mendelian Genetics-** one allele is dominant over the other (recessive)
    - **Punnett Squares-** charts used to predict the probability that certain traits will occur in offspring
    - **Monohybrid Cross-** used to predict the outcome of a single trait
    - **Dihybrid Cross-** used to predict the outcome of 2 traits
    - **Homozygous-** when alleles are the same
        - BB- **Homozygous dominant**
        - bb- **Homozygous recessive**
    - **Heterozygous-** when alleles are different
        - Bb- Heterozygous
    - **Genotype-** The 2 letters together
    - **Phenotype-** the genotype that will be expressed, a physical manifestation
- **Non-Mendelian Genetics**

- 1. **Codominance-** when both alleles show up in an offspring
    - Ex: spots
    - In codominant crosses, heterozygous offspring have both parents' alleles expressed
- 2. **Incomplete Dominance**- when the heterozygous offspring have a blend between the 2 alleles
    - Ex: A red rose and a white rose can produce pink roses
- 3. **Multiple Allele**- when there are more than 2 types of alleles for a trait
    - Ex: Eyes can be brown, blue, green, or hazel (codominance if green and brown)
- 4. **Polygenic Traits-** some traits are expressed as a result of many genes
    - Ex: Skin Color

- **Multiple Alleles (Blood Typing)**
    - Blood cells contain **antigen marker proteins** and carbohydrates in the cell membrane that signal that the blood belongs to the organism. There are two types of antigens, called A and B.
    - A person can have A antigens, B antigens, both A and B antigens, or no antigens
    - Based on these markers we say a person has the blood type: **A, B, AB, O**
    - People can also have a protein called an **Rh factor**. It is either present (positive) or not present (negative).
    - Your immune system sends antibodies through your circulatory system to check that there are no invading cells.
    - Antibodies will destroy any cell with the incorrect antigen. This is why a person can only receive a blood transfusion from a certain type of blood.
    - Blood type O is the **universal donor** and Blood type AB is the **universal recipient**.
- **Sex-Linked Traits**
    - Sex-linked traits are carried only on chromosome #23 on either the X or Y chromosome
    - Disorders on the Y chromosome will always be passed onto the offspring's sons
    - Sex-linked traits can be X - dominant, X - recessive, or Y - linked

- **X-linked Dominant**
    - In this type of disorder, only one affected X will cause the disorder in the offspring
- **X-linked recessive**
    - In this type of disorder, both X must be affected to express the trait in a female, but only one affected X will cause the disorder in the male offspring. This is why color blindness affects more men than women
    - In X recessive disorders a heterozygous parent is called a **carrier**. They do not have the disease but can pass it on to offspring

Topic 7- Evolution and Population Genetics

- **Evolution Vocab**
    - **Evolution**: how organisms change over time to better fit their environment
    - **Common ancestry**: the theory that all organisms came from one shared ancestor
    - **Adaptation**: a trait that allows an organism a better chance of survival
    - **Speciation**: when one type of organism becomes a different species over time and can no longer interbreed (have offspring)
    - **Biodiversity**: all of the variety of organisms on Earth
    - **Index fossils**: fossils found in large numbers in many areas around the world from the same timeline. They are used to help determine the age of other fossils
    - **Fossil record**: recorded timeline of all fossils found
    - **Gradualism**: when evolution takes place slowly over time. Horse legs grew longer and stronger as their habitat changed.
    - **Punctuated equilibrium**: an abrupt physical change in a species after a long period where the organism didn't change
    - **Stasis**: a long period of time where an organism doesn't change (part of punctuated equilibrium)
    - **Sudden appearance:** when a new tree shows up in a population that didn't have it before. Fish grew legs to help walk on land in low tide. (part of punctuated equilibrium)

- **Extinction**: when species can no longer survive and reproduce, they eventually die out.
- **Anatomical**: the physical features of an organism.
- **Homologous structure**: anatomical structures that are similar between organisms. Same structure, but different function
- **Analogous Structure**: when an anatomical feature is similar in function but not structure. Birds and butterflies can both fly, but birds have bones, and insects do not
- **Vestigial**: a physical trait that is disappearing in a population over time because it isn't needed.
- **Molecular Homologies**: similarities in DNA between organisms
- **Developmental Homologies**: similarities in the way offspring develop in different species
- **Embryology**: the study of embryos (developing babies)
- **Biogeography**: where organisms live on the planet
- **Charles Darwin**: one of the scientists given credit for proving natural selection
- **Natural Selection**: the best-adapted organisms in a population will survive and reproduce
- **Allele Frequency:** the percent of a trait showing up in a population
- **Hardy-Weinberg:** the expected ratio of alleles in a population if no evolutionary pressures were put on them
- **Population Curves**: graphs that show how population numbers change over time
- **Directional Selection**: a chart that shows how populations switch between allele frequency over time
- **Genetic Drift**: When frequency shifts between alleles based on a selective pressure
- **Gene Flow**: when a new allele is added to a population
- **Stabilizing Selection**: when a middle version, or a blend of the traits, is more beneficial than the 2 extremes
- **Disruptional Selection**: when 2 extreme traits are both beneficial, but an in=between version of the trait isn't

- **Carrying Capacity**: the largest a population can get based on the availability of resources
- **Fitness**: how successful an organism is at passing its genes to offspring
- **Allopatric Speciation:** speciation caused by a geographical separation of a species
- **Sympatric Speciation**: speciation that happens when organisms live in the same place
- **Hibernation**: when an organism enters a period of slowed life during the winter
- **Selective pressures**: a condition that affects a population's fitness
- **Reproductive Isolation**: organisms may not be able to mate due to different behaviors, gene differences or location
- **Estivation**: when an organism enters a period of slowed life during the summer

- **Evolution**
  - Occurs by
    - **natural selection**
    - **artificial selection**
    - **random mutation**
  - Evolution is also called
    - common ancestry
    - Phylogenetics
    - origin of life
      - The **origin of life** was established by Charles Darwin and Alfred Wallace by studying adaptations in similar species
  - **Definition of evolution**
    - how life has changed from one common organism to multiple species over time
  - Evolution is supported by
    - fossil records
    - Biogeography
    - Homologies
      - Anatomical

            - Developmental
            - Molecular
    - Evolution creates
        - **Biodiversity** (variation of living species)
            - which increases the health of all ecosystems
- **Fossils**
    - Fossils are studied by
        - **Paleontologists**: use index fossils (widely found fossils from a specific time that help identify the age of other fossils)
        - Fossils are the remains of ancient organisms (stored in the fossil record)
    - Fossils demonstrate
        - Evolution
            - punctuated equilibrium
                - Stasis (no change)
                - sudden appearance (rapid major change)
            - gradualism (slow change over time)
- **Homologies**
    - Homologies are similarities between organisms.
    - Homologies were seen in microevolution (evolution within the same species) and macroevolution (across different species)
    - **Types of Homologies:** anatomical (body structure), developmental (embryo development), and molecular (DNA)
- **Speciation**
    - definition: Creation of a new species by the process of evolution
    - Species that share a common ancestor become unable to meet based on different reproductive isolations
        - **Geographic Isolation**: Individuals live or mate in their preferred habit, and therefore don't meet individuals of similar species with different preferences
        - **Temporal Isolation**: Individuals of similar species do not mate because they are active at different times of the day or different seasons

        - **Behavioral Isolation:** Potential mates meet, but choose members of their own sub-species.
        - **Hybrid Sterility:** Hybrid is viable, but sterile
        - **Gamete Incompatibility**: Sperm transfer takes place, but the egg is not fertilized. Frequently, sperm from an incompatible won't even be attracted to the egg of another species
- **Taxonomy Vocab**
    - **Taxonomy**: the science of classifying organisms by their characteristics
    - **Taxa**: the levels used to group organisms by their shared characteristics
    - **Domain**: the 3 main groups of organisms on the planet: bacteria, archaea, and eukarya. Organisms that are bacteria and archaea are prokaryotic. The domain is the 1st and least specific level of taxa.
    - **Kingdom**: classification gets more specific inside each domain to form 6 kingdoms of similar organisms (the 2nd level of taxa)
    - **Phylum**: each kingdom is divided into a more specific group (the 3rd level of taxa)
    - **Class**: inside each phylum, organisms are divided into classes (the 4th level of taxa)
    - **Order**: the 5th level of taxa. Organisms begin looking more similar
    - **Family**: the 6th level of taxa. Families are even more similar in characteristics
    - **Genus**: the 7th level of taxa. Organisms in this taxa have the most similarities without being able to breed in the wild
    - **Species**: the 8th and most specific level of taxa. Organisms that can successfully breed are the same species.
    - **Carolus Linnaeus:** the scientist that decided it was important to give organisms scientific names using binomial nomenclature
        - **Binomial Nomenclature**: the scientific name of an organism using its genus and species like a first and last name
    - **Eubacteria**: under the bacteria domain, eubacteria is one of the 6 kingdoms. Organisms are prokaryotic bacteria with no nucleus. They are found everywhere and can be good or bad.

- **Archaebacteria**: under the bacteria domain, archaebacteria are one of the 6 kingdoms. Organisms are prokaryotic with no nucleus. They can survive in extreme environments (extremophiles)
- **Protista**: a kingdom of eukaryotic organisms that are mostly unicellular. Unlike prokaryotic organisms, they have a nucleus
- **Plantae**: a kingdom of eukaryotic multicellular organisms that can perform photosynthesis (autotrophs). Their cells have cell walls made of cellulose.
- **Animalia**: a kingdom of organisms that must obtain energy from eating other organisms (heterotrophs). Animals do not have cell walls around their cell membranes.
- **Fungi**: a kingdom of organisms that are multicellular and obtain energy from chemically absorbing it (chemotroph). Their cell walls are made of chitin.
- **Cladogram**: a chart used to demonstrate evolutionary relationships based on traits.
- **Levels of Organization**: An organism can be unicellular or multicellular. Multicellular organisms can be made of tissues, organs, and organ systems
  - **Multicellular**: made of many cells working together to form an organism
  - **Unicellular**: an organism is made of only one cell

Topic 8- Immune System

- **Pathogens** make you sick. They can be bacteria, viruses, protists, or fungi.
- Difference between an infection and a disease
  - An **infection** is a sickness caused by a pathogen that might lead to disease if it's left untreated. A **disease** is a change that disrupts the normal functions of the body (causes conditions you have to live with)
- **Pathogens** can be transmitted by contact with infected cells, contaminated water or food, or infected animals (vectors)
- The **function** of the immune system is to **fight infection** through the production of cells that inactivate foreign substances or cells.
- **The 1st line of defense**
  - Goal: to keep out pathogens

    - Components: skin, cilia, mucus, lysozymes
- **2nd line of defense**
    - When pathogens enter the body from the site of an injury, the blood vessels near the site of the injury expand. Then **white blood cells** enter the infected tissue where they engulf and destroy the pathogens.
    - **Phagocytes-** engulf and destroy pathogens, **Fever-** slow down pathogens, **Interferon-** help other cells resist infection
- **3rd line of defense**
    - **Antigens-** triggers the response, **T-Cells-** identify the threat and organize a response, **B-Cells-** make antibodies that will bind to an antigen, **Macrophages-** engulf the pathogen to destroy it
- Why is the secondary response faster than the primary response?
    - **Memory Cells** already know how to fight that specific pathogen.
- **Immune System Disorders**
    - **Autoimmune Disease**- happens when the immune system targets and destroys its own tissues (Ex: Multiple Sclerosis, Lupus)
    - **Immune Deficiency**- decreases the body's ability to fight invaders, making it vulnerable to infections (Ex: AIDS)
- **HIV**
    - What is it?
        - A **virus** that invades the helper cells in the body of the host. It is preventable and manageable but not curable.
    - What makes HIV different from other viruses?
        - It uses **reverse transcription** to turn its RNA into DNA.
    - Once T-cell count becomes too low, individuals with HIV may acquire
        - **Opportunistic infections**: take advantage of a weaker immune system
        - 3 examples of opportunistic infections are tuberculosis, pneumonia, and toxoplasmosis.
    - At what point does HIV become **AIDS**?
        - Once t-cell count drops below 200 cell/mm^3
    - What does a person with HIV usually die from?

        - Other infections
    - How is HIV transmitted?
        - Blood/body fluids, sharing IV needles, mother to child, unprotected sexual contact.

Topic 9- Plants

- There are nonvascular plants and vascular plants. **Bryophytes** are nonvascular plants (Ex: moss). Vascular plants can either reproduce with spores or seeds. **Pteridophytes** are a type of vascular plant that reproduces with spores (Ex: ferns). There are 2 types of vascular plants that reproduce with seeds. **Gymnosperms** are a type of vascular plant that reproduces with naked seeds (Ex: pinecones). **Angiosperms** are a type of vascular plant that reproduces with enclosed seeds (Flowers/Fruit).
- **Vocabulary**
    - **Spores**: Environmentally resistant cells that are capable of developing into adults without fusing with another cell and develop only when conditions are favorable
    - **Gymnosperm**: Seed plants whose seeds are exposed and not protected by fruit
    - **Angiosperms**: Seed plants that have flowers and whose seeds are not exposed and protected by fruit
        - **Monocots**: Angiosperms that have one cotyledon in the seed
        - **Dicots**: angiosperms that have two cotyledons in the seed
    - **Cotyledon**: The leaf of the embryo of an angiosperm
- **Characteristics of Seedless Plants**
    - No seeds and produce spores, Bryophytes(nonvascular) and Pteridophytes (vascular) are seedless plants.
- **Monocots and Dicots**
    - Angiosperms are further divided into 2 groups: monocots and dicots
    - **Monocots**:
        - 1 cotyledon, flower parts in multiples of three, parallel veins, herbaceous stems, vascular bundles in stems are scattered
    - **Dicots**

        - 2 cotyledons, flower parts in multiples of 4 or 5, netted veins, herbaceous or woody stems, ring-like vascular bundles
- **Seed Plants**
    - Vocab:
        - **Chlorophyll-** the green pigment found in chloroplasts that absorbs light energy; required for photosynthesis
        - **Chloroplast-** a specialized organelle in photosynthetic organisms that captures the energy from sunlight and converts it into chemical energy
        - **Pollen-** the tiny grains that come from the anther and later become sperm cells
        - **Seed-** a structure that contains a plant embryo and its nutrients within a protective coating
    - **Gymnosperms and Angiosperms**
        - **Vascular Tissues**
            - **Xylem-** carries water and nutrients from roots
            - **Phloem-** carries food from leaves
        - **Reproduction**
            - **Pollen-** Tiny germs that develop into sperm cells
            - **Seeds-** Contains a plant embryo and its nutrients within a protective coating
        - **Leaves**
            - Function: make food through photosynthesis
            - Structures: chloroplasts, chlorophyll, stomata
        - **Stems**
            - Function: Grow above ground, provides structure and support, hold the leaves up to the sun, carry substances throughout the plant
            - Types: Herbaceous and Woody
        - **Roots**
            - Function: anchor the plant to the ground, absorb water and minerals, grow downward due to gravitropism, store food
            - Types: fibrous, taproot

        - **Steps of Seed Growth:**
            - Seed absorbs water, embryo uses stored food, Roots grow downward, Stems and leaves grow upward, leaves open
- **Nonvascular Plants vs Vascular Plants**
    - **Nonvascular plants**
        - Have no vascular tissue, live in moist environments, small when fully grown
    - **Vascular plants**
        - Have vascular tissue, larger when fully grown, live further away from a water source, may have seeds
- **Plant Responses:**
    - **Vocabulary**
        - **Gravitropism**: the growth of a plant downward in response to gravity
        - **Hydrotropism**: the growth of a plant in response to water
        - **Phototropism**: the growth of a plant in response to light
        - **Stimulus**: anything that can cause an organism to respond or react
        - **Thigmotropism**: the growth of a plant in response to touch
        - **Tropism**: the growth of a plant in response to a stimulus
        - **Lateral**: coming from the side
        - **Auxin**: a plant hormone that speeds up the growth of plant cells
        - **Dormancy**: a period of time in which an organism is not active and does not grow
        - **Hormone**: a substance produced by a plant that affects how it grows and develops
        - **Photoperiodism**: a plant's response to seasonal changes in the length of the day
- **Photosynthesis and Cellular Respiration:**
    - **Both** photosynthesis and cellular respiration
        - Deal in energy conversion
        - Occur in specialized organelles
        - Use a cycle of chemical reactions

        - Use and produce ATP
        - Use electron transport chains
    - Photosynthesis and cellular respiration
        - have different reactants and products
        - deal with storing and releasing energy differently
        - are carried out by different organisms
        - are complementary reactions

Topic 10- Ecology

- **Cycles of matter**
    - **The Water Cycle**
        - Water evaporates from bodies of water to form the water vapor in the atmosphere
        - Water vapor in the air condenses to form clouds
        - Water precipitation may infiltrate the ground or become runoff
    - **The Carbon Cycle**
        - CO_2 is removed from the atmosphere during photosynthesis
        - Organisms release CO_2 as waste during cellular respiration
        - Carbon compounds and CO_2 are returned to the soil and atmosphere during decomposition
    - **The Nitrogen Cycle**
        - Free nitrogen is changed to a usable form
        - Plants absorb nitrogen compounds through roots
        - Consumers get nitrogen by eating organisms
        - Decomposers return nitrogen to the soil
        - Free nitrogen is returned to the atmosphere
- **Food chains**
    - All food chains contain producers, consumers, and decomposers.
    - **Producers** convert the sun's energy into food, creating usable food energy for other organisms and themselves

- **Consumers** balance the number of producers and other consumers in an ecosystem
- **Decomposers** ensure that nutrients are recycled in the ecosystem
- Organisms in the food chain depend on each other for survival
- A **food chain** is a tool used to show energy flow in an ecosystem from one organism to another
  - Each step in a food chain is called a **trophic level**.
  - Only about **10%** of the energy at one trophic level is passed on to organisms at the next trophic level.

- **Food Webs**
  - Food webs show the *interconnected* food chains in an ecosystem.
- **Interactions among Organisms**
  - **Five** main types of interaction: **mutualism, commensalism, parasitism, predation, and competition.**
  - **Symbiosis**- a long-term relationship between two different species
  - Mutualism, commensalism, and parasitism are **symbiotic interactions**
- **Interdependence**
  - All five types of interactions result in interdependence
    - Interdependence can lead to changes in a population size
    - Interdependence can lead to coevolution
- **Invasive species**
  - **Introduced species** - brought into a new ecosystem
  - **Invasive species** – become established in the new ecosystem
  - Can cause environmental harm, economic harm, or harm to human health
- **Disturbances in an ecosystem**
  - Volcano
  - Glacial movement or melting
  - Wildfires
  - Clearcutting
  - Climate change
  - Introduced species

- **Ecological succession**
  - Ecosystem's response to a disturbance with a predictable, gradual pattern of change
    - **Primary succession** occurs on surfaces where there is no soil after the disturbance
    - **Secondary succession** occurs on surfaces where the soil remains after a disturbance
- **The Importance of Biodiversity**
  - **Loss of species diversity**
    - species rely on each other for several things
    - the loss of species could affect many others
  - **Loss of genetic diversity**
    - reduced options for males lead to interbreeding
    - species become more susceptible to disease

Works Cited:

"Online Curriculum & Coursework for K–12 Education: Edgenuity Inc." *Edgenuity Inc.*, www.edgenuity.com/