

Biology EOC Study Guide – Study This!!!!!!

Name: _____

Access the new Biology wordpress for review activities that go with this study guide:

Types of Organic Molecules

- **Carbohydrates**- made of carbon, hydrogen and oxygen (2 hydrogen and 1 oxygen for every carbon)
 - Types of Carbohydrates
 - Monosaccharides – simple sugars – Benedict's Solution is used to test for
 - Example: Glucose – immediate sources of energy for organisms
 - Polysaccharides – complex sugars
 - **Examples**-
 - Glycogen- an energy storage molecule for mammals
 - Starch – an energy storage molecule for plants – Iodine tests for
 - Cellulose- used in the cell walls of plants
- **Lipids**- contain carbon, hydrogen and oxygen (many hydrogen carbon bonds and few oxygen carbon bonds)
 - Commonly called fats and oils.
 - Used for energy storage, insulation and protective coatings (esp. the cell membrane)
 - Subunits are glycerol and fatty acids.
 - A simple test for lipids is using a brown paper bag. (positive=translucent spot, negative=nothing)
- **Proteins**-contain carbon, hydrogen, oxygen and nitrogen
 - Examples:
 - Insulin -- regulates blood sugar
 - Enzymes- control rates of chemical reactions
 - Hemoglobin- transports oxygen within red blood cells
 - Basic building blocks are amino acids.
 - Proteins are also used for- building muscle tissue and providing immunity
 - Biuret's solution is used to test for proteins (positive=purple, negative=blue)
 - **Enzyme**- a type of protein that is used to speed up chemical reactions
 - Enzymes are specific to a reaction and they are reuseable.
 - Enzymes can be negatively affected by small changes in temperature and pH.
 - enzymes are long chains of amino acids that are folded into a particular shape
 - The shape determines the substrate the enzyme will act upon –Lock & Key
- **Nucleic Acids**- complex molecule that stores and transmits cellular information
 - Examples: DNA and RNA
 - Basic building blocks are nucleotides.
- Acids and Bases
 - Acids produce hydrogen ions and have a **pH below 7**
 - Bases produce hydroxide ions and have a pH above 7
 - Strong acids and bases can be harmful to living organisms.

Cells and Cell Parts

- **Cell**- basic unit of all living things.
 - Cell Organization – Cells → tissues → organs → organ systems
- **Prokaryotes**- cells without membrane bound structures, much smaller in size than eukaryotes and have circular DNA strand – they still have ribosomes to make proteins - Example: Bacteria Cells
- **Eukaryotes**- cells with membrane bound structures, Have linear DNA strands found in a membrane bound nucleus
- Example: Plant, animal, fungi cells
- **Organelles**- smaller parts of a eukaryotic cell that have specific function
 - **Plasma membrane** (cell membrane)- controls what enters and leaves a cell; Structure- a flexible, fluid like lipid bilayer, contains proteins that allow for the movement of certain molecules
 - **Cell Wall**- an inflexible barrier that protects and gives plant cells support; Structure- a porous, fibrous structure made of cellulose
 - **Nucleus**- control center of the cell- contains the directions to make proteins; Structure- contains chromatin (strands of DNA)
 - **Ribosomes**- sites of protein assembly; Structure- can be free floating or attached to the surface of a membrane called the ER, primary component is a RNA molecule

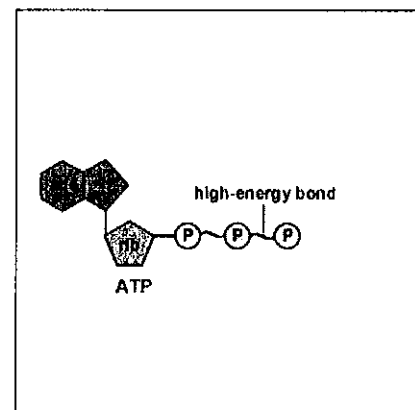
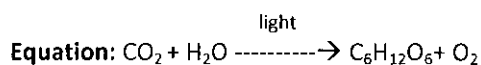
- **Vacuoles**- used for temporary storage of materials or water, much larger in plant cells
- **Mitochondria**- converts glucose into ATP (energy that can be used by the cell); Structure- rod shaped with an inner membrane that is folded
- **Plant cells vs. Animal cells**
 - Plant cells have chloroplasts, a cell wall and a large vacuole.
 - Animal cells lack chloroplasts and cell walls and come in many shapes and sizes.
 - The structure of an animal cell determines its function.
- Plant cells form a cell plate during the last stage of division(telophase)

Cell Communication

- Nerve cells can send messages to other nerve cells using neurotransmitters.
- Other cells communicate using hormones(proteins that circulate through blood) – these hormones target specific cells that have receptor proteins in their cell membrane. Hormones and receptors fit together specifically like lock and key(similar to enzyme function).
- **HOMEOSTASIS** – maintaining stable internal conditions (accomplished through transport)
 - Examples of homeostasis: Regulating water balance – achieved by transport, Regulation of blood glucose levels (insulin), Regulation of pH...
- **Cell membrane = Semipermeable membrane**- allows some things to cross but not others
 - Small molecules such as O₂ and CO₂ can diffuse across the membrane.
 - Large molecules such as starch cannot.
- **Diffusion**- movement of molecules from an area of higher concentration to an area of lower concentration
- **Osmosis**- the diffusion of water across the cell membrane
- **Types of solutions**
 - Distilled water (100% water) – cells placed in this type of water will **gain water** and **swell up** – animal cells will burst – plant cell walls prevent plants cells from bursting
 - Saltwater – cells placed in saltwater will **lose water** and will **shrink**
 - If the dissolved substances are equal inside and outside the cell then cells will remain the same size – Example – blood cells in blood plasma.
- **Passive transport**- diffusion and osmosis and other methods of transport that **do not require energy**- molecules move from high concentration to low concentration
- **Active transport**- transport from areas of lower concentration to areas of higher concentration- **requires energy**

Cells and Energy

- **ATP** – source of energy for cell activities
- ATP is converted into ADP and energy is released when the bonds between phosphate groups are broken.
- **Photosynthesis** - converting sunlight energy into chemical energy



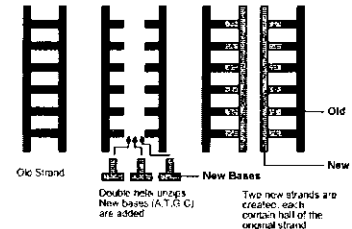
- **Factors that affect the rate of photosynthesis:** amount of light, color of light, amount of water, amount of CO₂ , temperature
- **Cellular Respiration**- converting of glucose into ATP
 - Equation: $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{ATP}$
 - **Aerobic respiration** requires oxygen- creates the most ATP
 - **Anerobic respiration** does not require oxygen- but creates only 2 ATP
 - Types of Anerobic respiration
 - **Alcoholic Fermentation** –performed by yeast and bacteria
 - **Lactic acid fermentation** – performed by muscle cells when not enough oxygen is available – causes muscle soreness

EOC STUDY GUIDE PART TWO – STUDY THIS!!!!

NAME: _____

Structure of DNA

- **DNA**- a very long molecule made of repeating subunits called nucleotides
 - **Nucleotides**- have 3 parts--- sugar, phosphate group, and a nitrogen base
- 4 nitrogen bases found in DNA-
 - Adenine –A
 - Guanine – G
 - Thymine –T
 - Cytosine- C
- The nitrogen bases in DNA bond together using hydrogen bonds and form a zipper like structure.
 - A only pairs with T
 - T only pairs with A
 - C only pairs with G
 - G only pairs with C
- **RNA**- single stranded, contains U's instead of T's, can leave the nucleus
- **Watson and Crick**- developed the double helix model of DNA
 - Double helix- a long zipper that is twisted
- **Mutation**- any change in the DNA code
- **Replication**- the copying of DNA for the process of cell division
 - Replication is semi-conservative meaning that every new strand of DNA formed is actually half old and half new.
 - Replication must occur before the cell can divide into new body cells or reproductive cells.



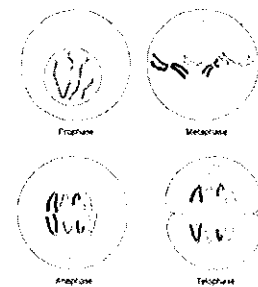
Protein Synthesis

- **Transcription**- copying of DNA into mRNA (messenger RNA)
 - DNA unzips at a particular location and the RNA nucleotides attach to DNA nucleotides
 - A mRNA (messenger RNA) strand is formed and it leaves the nucleus to travel to the ribosome.
- **Translation**- the mRNA code is converted into a sequence of amino acids by a tRNA (transfer RNA) , each 3 base pairs codes for a particular amino acid
 - tRNA brings the correct amino acids to the ribosome
 - A peptide bond forms between each amino acids.
 - A long peptide chain is formed and is eventually folded into a protein.
- **Gene Regulation**
 - Different cells in the body produce different proteins for specific purposes.
 - Cells also respond to their environment by producing different proteins.
 - **Cancer** results when genes are not regulated and cells divide uncontrollably.

Cell Cycle

- **Mitosis**- the process in which 2 identical cells are made from 1 for the purpose of growth and replacement
 - **STEPS OF MITOSIS**

- DNA replicates (copies) – chromosome copies pair up
- DNA condenses and becomes more visible forming chromatids (Prophase); nuclear membrane disappears (Prophase)
- Chromosomes line up in middle (Metaphase)
- Chromatids (Copied chromosomes) spilt (Anaphase)
- Cell membrane pinches inward in animal cells (Telophase)
- Cell plate forms in plant cells that will eventually for cell wall



Reproduction

- **Asexual Reproduction**- single celled organisms such as bacteria reproduce this way—reproduction is rapid generating many organisms –but does not provide for genetic recombination - uses mitosis
- **Sexual Reproduction**- two individuals required—reproduction not as quick but provides for genetic recombination -- requires gametes (sex cells) – needs meiosis
- **Meiosis**- the process of making sex cells also called gametes (either sperm or egg), the chromosome number is halved so that when sex cells join during fertilization the original number of chromosomes is conserved

Mitosis vs. Meiosis

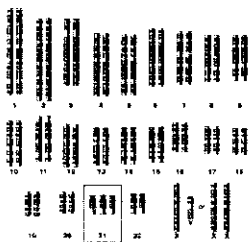
Mitosis	Both	Meiosis
Produces 2 cells	Chromosome replication occurs prior to	Produces 4 cells
Diploid cells for diploid cells		Diploid cells produce haploid cells
Chromosome number remains the same		Chromosome number is halved
Cells divide once		Cells divide twice

Sources of variation

- **Crossing over**- during meiosis homologous chromosomes line up and sometimes swap sections of their DNA, this ensures that the genetic code is mixed up—differences in genetic code can make for more fit individuals
- **Law of Independent Assortment/ Random assortment of chromosomes** - during meiosis there is no set way in which chromosomes are divided - Humans have 23 pairs of chromosomes --- 1 chromosome of each pair must end up in a sex cell— but it does not matter which chromosome in the pair
 - Leads to the differences seen among siblings
- **Fertilization**- joining of gametes from two sources
- **Mutations**- change the DNA sequence (blue eye color)
- **Nondisjunction** – occurs when chromosomes don't separate properly during meiosis
 - Creates disorders such as Trisomy-21 also known as Down's Syndrome

Genetics

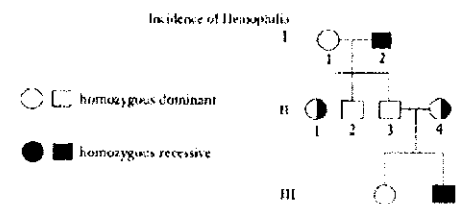
- **Father of Genetics** – Mendel—studied pea plants
- **Gene**- a segment of DNA that encodes for a trait
- **Allele**- different form of the same gene
- **Dominant allele**- masks any other form present
- **Recessive allele**- the form of a gene that is masked
- **Homozygous** –an individual that has two of the same alleles for a gene
- **Heterozygous**- an individual that has two different alleles for a gene
- **Test cross**- crossing an unknown individual with a recessive individual to determine whether the unknown individual is heterozygous or homozygous
 - $TT \times tt \rightarrow 1:0$ ratio of tall to short (all tall)
 - $Tt \times tt \rightarrow 1:1$ ratio of Tall to short (half tall, half short)
- **Incomplete dominance**- neither allele masks the other but instead you see an intermediate in the heterozygous
 - Red flower \times White flower \rightarrow Pink flowers
- **Codominant alleles**- when neither allele masks the other but instead you see both alleles appear
 - Example: Roan coat color in cows – mixture of red and white hairs
 - AB blood type in humans
- **Multiple Alleles**- more than two alleles influence the same gene
 - Example: A,B,AB,O blood types—also an example of codominance since AB blood type can occur
- **Polygenic traits** – traits such as hair color that are controlled by **more than one gene**
- **Karyotypes**- diagrams that arrange chromosomes from largest to smallest in order to detect diseases caused by nondisjunction or other abnormalities



The **karyotype** to the left shows a person with Down's syndrome (3 chromosome 21's).

Pedigrees- a chart, similar to a family tree that traces a particular trait or disease

- Hemophilia and colorblindness are sex linked traits that can be traced using a pedigree.
- Circles represent females/ Squares males.
- Fully shaded individuals have the trait. Those that are half shaded carry the trait.



DNA technology

- **Human Genome Project**- sequence the entire human DNA (all the ATCG's)
 - allows us to determine if an individual carries a disease
 - allows us to create gene therapies
- **Gene Therapy**- replacing defective genes with normal copies
- **Recombinant DNA**- DNA from humans can be taken and placed in bacteria cells so that proteins like insulin can be made more efficiently.
- **DNA fingerprinting**- Every person has unique DNA, that can be placed in a gel electrophoresis to form a unique "fingerprint". – Used for solving crimes, identify people
 - Gel electrophoresis – a technique that is used to separate DNA based on size
- **Transgenic Organisms**- organisms that have DNA from other organisms placed in them
 - Human gene for insulin is placed into bacterial cells – bacterial cells then make insulin

Genetic Disease

- **Sickle Cell Anemia**- red blood cells are shaped like a sickle (half moon) due to a mutation in the hemoglobin protein attached to the red blood cell—people with this disorder cannot carry oxygen as well—but it does provide an immunity to malaria, common only in African Americans
- **Cystic Fibrosis** – a disorder in which an enzyme that breaks down mucus is not present so mucus in the lungs and respiratory track become blocked—the average life span for someone with cystic fibrosis is 20 years
- **Down syndrome**- a condition in which an individual receives an extra copy of chromosome 21 due to mistakes in meiosis—the resulting individual could have severe to mild mental retardation
- **Huntington's Disease**- a disease which can be detected by a genetic test but its effects cannot be seen until the individual is in his 40's – sex linked dominant trait
- **Environmental Risk Factors**- radiation, tobacco smoke and exposure to certain chemical can mutate your DNA—this can lead to cancer or birth defects depending on which cells are exposed or effected
- **PKU**- a disorder caused by defects in the genetic code that lead to one or more enzymes not be created correctly
- **HIV** – virus that is transmitted through bodily fluids either sexually or through needles
 - Can live in your body for a long period of time without symptoms
 - Destroys a persons immune system – causes the disease AIDS
- **Influenza** – flu – caused by a virus that mutates rapidly requiring us to create annual vaccines
- **Smallpox** – bacterial disease that has been eliminated from human population due to vaccination programs
- **Streptococcus** – strep throat – bacterial disease that can be treated with antibiotics

Immune Response

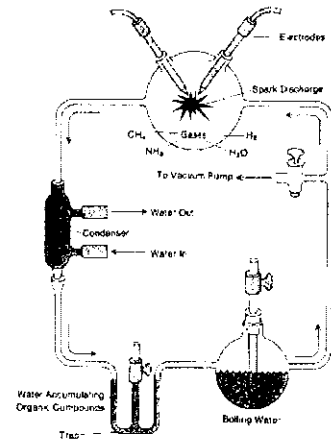
- White blood cells
- **T cells** – “killer cells” that destroy viruses and bacteria/ also help B cells make antibodies
- **B cells** – make antibodies that attach to antigens found on viruses and bacteria
- **Immunity** – remembering something that has attacked you so its easier to fight the next time you are exposed
- **Passive Immunity** – a person gets from another person (mother's milk) and is short lived
- **Active Immunity** – is acquired by being exposed to diseases or by vaccines
- **Vaccines** – a weakened or killed bacteria or virus is injected into a person so that it stimulates the immune system recognize the bacteria or virus in the future and remember to attack and destroy it.

Parasites

- Malarial parasites are carried from person to person by mosquitoes (vector) – inside of a human they reproduce in liver cells. A person with malaria will experience high fevers, headache and it can result in death.

Origins of Life

- **Pasteur**- disproved the idea of abiogenesis (life can come from nonliving matter) he set up curved shaped flasks with broth that had been boiled—for a year the broth remained clear despite its exposure to air-- until he allowed the broth to come in contact with the particles contained in the air
- **Early atmosphere experiments** have proved that gases present at the time the earth was first made could have created organic molecules that eventually led to the formation of life on earth.
- **Sequence of organism evolution on Earth**
 - Anaerobic prokaryotic heterotrophs
 - Prokaryotic autotrophs (photosynthesis)
 - O₂ produced by photosynthesis
 - Aerobic prokaryotes
 - Eukaryotes (have a nucleus)
 - Multicellular organisms
- **Charles Darwin**- based on his observations of organisms he concluded that organisms best suited to an environment were best able to reproduce and therefore that type of organism began to make up most of the population –his idea was called **Natural Selection**
 - **Variation** – difference among individuals is necessary for nature to select the best suited traits. Those variations must be heritable, and variations that lead to increased fitness will appear more often in future generations.
- **Evidence for Evolution**-
 - **Fossils** – patterns show that organisms that once lived on earth are no longer living and more advanced organisms appeared over time
 - Relative dating – dating fossils by their position in rock
 - Absolute dating – uses radioactive materials to place a more exact date on a fossil
 - **Biochemical similarities**- DNA very similar in organisms that are more related
 - **Embryological similarities**- embryos of many different types of organisms appear to be very similar



- **Shared anatomical structures** – bat wing and human arm have bones in the same position just arranged differently for their different functions
- **Geographic Isolation**- animals such as birds who fly to islands or other places and adapt to the new environment - results in new species (speciation)
- **Current Evolution Theory**
 - The use of antibiotics and pesticides selects for antibiotic resistant (strong) bacteria and for pesticide resistant (strong) insects. Therefore new antibiotics and new pesticides must be created. Resistance prevented by taking medications as directed and entirely.

Unity and Diversity of Life

- **Carolus Linnaeus**- developed a system to classify (place in groups) organisms that is still used today – he originally placed all organisms in 2 kingdoms – plants and animals
 - As our knowledge of organisms increased so did the number of Kingdoms
- Scientists group organisms based on relatedness that is determined by DNA.
- There are levels of classification that every organism is placed in:
 - **Kingdom, Phylum, Class, Order, Family, Genus and Species**
 - The more levels of classification two organisms have in common the more related they are.

Example:

	Human	Chimpanzee	Domestic Cat
Kingdom	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Chordata
Class	Mammalia	Mammalia	Mammalia
Order	Primates	Primates	Carnivora
Family	Hominidae	Hominidae	Felidae

A human is more similar to a Chimpanzee than a Domestic Cat.

- **Kingdoms**
 - **Bacteria** → **Eubacteria and Archaeobacteria**
 - -Prokaryotic - unicellular, autotrophic and heterotrophic, asexual reproduction
 - **Protista**
 - -Eukaryotic, single or multicellular, autotrophic and heterotrophic, asexual and sexual reproduction
 - **Fungi**
 - Eukaryotic, single or multicellular, heterotrophic, eukaryotes, asexual and sexual reproduction
 - **Plants**
 - Eukaryotic, multicellular, autotrophic, with tissues, asexual and sexual reproduction
 - **Animals**
 - -Eukaryotic, multicellular, heterotrophic, with tissues & organs, sexual reproduction
 - Heterotrophic – obtains food by getting it from other organisms
 - Autotrophic – perform photosynthesis – make their own food

Important Phyla of Animalia

- Phylum Annelida- earthworms, leeches (segmented body)
- Phylum Arthropoda- Insects, Spiders, Crabs (jointed exoskeleton)
- Phylum Chordata- Class Mammalia

Life functions of Animals

- Transport – how organisms get what they need to their cells
- Excretion – how organisms get rid of waste and balance their fluids (water)
- Regulation – how organisms control body processes – hormones & nervous system
- Respiration – exchange gases
- Nutrition – how organisms break down and absorb foods
- Reproduction – Internal fertilization – occurs inside the body – on land
 - External fertilization – occurs outside the body – usually in water

Important Phyla of Plantae

- Mosses- nonvascular (no water conducting tissue)- reproduce by spores
- Ferns- vascular –reproduce by spores have swimming sperm
- Gymnosperms- vascular – reproduce by naked seeds contained on cones
- Angiosperms- vascular- reproduce by covered seeds formed in flowers- ovaries of flowers ripen into fruits – fruits aid in seed dispersal

Plant tissues and structures

- **Vascular tissue**- transports water from roots to stems
 - **Xylem** – transports water
 - **Phloem** – transports sugars
- **Stomata**- small structures on leaves that open and close to allow gases to exchange but prevent water loss
- **Seeds** – contain a protective covering and food for the plant embryo

Ecology

- **Abiotic factors**- nonliving factors of an environment such as temperature, wind, water that affect the living factors
- **Biotic factors**- living factors of an environment (predators limit populations of prey)
- **Symbiotic relationships**-
 - Predator/Prey relationship – an eagle preys on rabbits
 - Commensalism- one organism benefits and the other doesn't but is not harmed
 - Mutualism- both organisms benefit
 - Parasitism- one organism benefits and the other one is harmed
 - Competition – overpopulation of organisms creates a demand for resources
- **Carbon Cycle**- plants take in CO₂ and turn it into sugar in the process of photosynthesis
 - Animals and plants give off CO₂ when breaking down sugars in the process of respiration

Energy Transfer

- The ultimate form of energy is the sun.
- Plants (autotrophs) convert sun energy into chemical energy.
- Animals (heterotrophs) eat plants and use the chemical energy.
- **Trophic Levels**
 - Producers → Primary Consumers → Secondary Consumers → Tertiary Consumers
 - Plants → Herbivores → Omnivores → Carnivores
- Energy is lost in the form of heat as it is transferred from one level to another.
- **Food chains**- show the transfer of energy from one organism to another
- **Food webs**- show all the transfers in an ecosystem

Human Impacts

- **Climate Change** – humans burn fossil fuels which add extra CO₂ to the atmosphere & natural processes such as volcanoes can produce excess CO₂ which can also lead to climate change.
- **Habitat destruction** – caused by deforestation or acid rain can lead to the endangerment of species

Plant tropisms

- **Phototropism**- cells on the side of the plant opposing sun elongate so that the leaves turn toward the sun
- **Geotropism (Gravitropism)**- when seeds germinate the roots always grow down and the stem up regardless of how the seed is oriented
- **Thigmotropism**- plants exposed to lots of wind grow shorter and stouter than those that are not, also some plants curl up when touched or at dark

Animal behaviors

- **Innate Behaviors**
 - **Chemotaxis**- animals avoid chemicals that might be dangerous
 - **Phototaxis**- animals avoid light so that they can be hidden
 - **Instincts**- baby animals know where to suckle on their moms
 - Migration – animals move to and from places with food and water
 - Estivation – animals that live in climates that get too hot will burrow in the mud to avoid the heat – metabolism slows so they can go without food
 - Hibernation – response to cold – metabolism slows so they can go without food
- **Learned behaviors**
 - **Habituation** – organism stops responding to repeated stimuli that does not harm or help them
 - **Imprinting** – learned behavior that occurs in a short but critical period of time Ex. goslings follow the first moving thing they see when they are born
 - **Classical Conditioning** – stimulus association – Pavlov's dog salivated when a bell was rung – because they associated the bell with food
 - **Trial and Error** – learned by being rewarded by the correct behavior
- **Social Behavior**
 - **Communication** – bees and ants use pheromones
 - **Courtship dances** – are used to attract the best mates for reproduction
 - **Territorial defense** – organisms fight over food, space or mates