

## **Biology HN All Course Review**

### **Unit 1 Nature of Science + Water**

#### Characteristics of Life

1. All living things are made of cells
2. All living things are organized in specific ways
3. All living things can reproduce
4. All living things have a genetic code
5. All living things grow and develop
6. All living things need energy
7. All living things respond to stimuli
8. Homeostasis (All living things maintain a stable internal environment)
9. All living things evolve

#### Properties of Water

1. Cohesion
2. Adhesion
3. Universal Solvent
4. Surface Tension
5. High Boiling Point
6. Capillary Action
7. High Specific Heat
8. Ice Is Less Dense Than Water

### **Unit 2 Biochemistry**

**pH:** Potential Hydrogen, measure of how acidic or basic a substance is. Hydrogen ion ( $H^+$ ) means it's more acidic and less than 7 and hydroxide ion ( $OH^-$ ) means it's more basic and higher than 7.

**Buffers:** Solutions in a cell that stop big changes in pH to maintain homeostasis

**Catalysts:** Anything that speeds up a chemical reaction

**Induced Fit:** An enzyme is molded perfectly to fit the substrate, this perfect fit is called induced fit.

**Activation Energy:** Enzymes lower the activation energy needed to start the reaction.

**Enzymes:** Functional proteins that help do a job, enzymes act as catalysts, fitting into a substrate to speed up a reaction.

### Characteristics of Enzymes:

- They are catalysts
- They have a specific shape whose active site binds to a specific substrate
- The same enzyme works for both backwards and forwards reactions
- Enzymes can be reused, ergo they are never “used up”
- Temperature, pH, and vitamins & minerals called coenzymes/cofactors affect enzymes.  
When an enzyme gets too hot it will melt and change its shape and the substrate won't be able to fix, this is called being denatured.

### Macromolecules

Organic molecule (polymer)	Atoms present	function	examples	shape	Name of monomers	Structural formula
carbohydrate	CHO 1:2:1	Quick energy, main source of energy	Rice, bread, potatoes (starch)	hexagon	Monosaccharides (simple sugar)	
lipid	CHO	Long term energy ←-because it has more bonds, insulation, protection, buoyancy	Oil, butter, wax, cholesterol	“E” shape	Fatty acids, Glycerol	
protein	CHON	Muscle development, protecting immune system, enzymes, hormones	Meats, beans, fish	circle	Amino acids	
Nucleic acid	CHONP Carbon Hydrogen Oxygen Nitrogen Phosphorus	Genetic information	Anything that was living and has cells (DNA)	Circle pentagon rectangle  Phosphate sugar base	nucleotides	

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### Unit 3 Cells

#### Cell Basics:

Virchow - cells come from other cells

Schelliden - plants

Schwann - animals

Hooke - named "cells"

Leeuwenhoek - first microscope

Cell theory: all organisms are made up of cells, cells are the basic unit of life, cells come from preexisting cells

PRO → no nucleus EU → more complex & nucleus

#### Cell Cycle:

Interphase - longest part of the cell cycle, 3 phases: G1 growth, S-DNA replication, G2 preparation for cell

#### Mitosis

1. Prophase - centrioles go to opposite poles and start producing spindle fibers, nuclear envelope disintegrates
2. Metaphase - chromosomes line up in the middle of the cell
3. Anaphase - sister chromatids pulled apart to opposite sides
4. Telophase - nuclear envelope reforms

Cytokinesis - cytoplasm divides into separate daughter cells

Diagram and chromosome and mitosis diagram

#### Cell Parts:

Nucleus - protects DNA

Ribosomes - makes proteins

Mitochondria - makes ATP energy

Chloroplasts - used for photosynthesis

Endoplasmic reticulum - transports materials around the cell

Golgi apparatus - sorts and packages proteins

Lysosomes - digestive enzymes, cleans cell

Cell membrane - controls what leaves and enters

Cell wall - provides support and protection

Vacuole - storage

Cytoplasm - supports organelles

Centrioles - produces spindle fibers for reproduction

Cytoskeleton - provides shape and support

Cell Membrane:

Cell membrane functions: acts as a barrier, regulates substance exchange in & out of cell, communicates with outside, identifies cell as part of the organism

Hydrophilic heads and hydrophobic tails make up the Phospholipid bilayer

Protein channels help stuff get through

Cholesterol makes cell membrane stronger

Channel proteins, passage of materials in and out

Receptor proteins, detect molecules

Recognition proteins, identify cell as “self”

Cell membrane is selectively permeable

Diagram of cell membrane

Cellular Transport

passive transport (no energy required)

Simple diffusion - molecules move down the concentration gradient until there is equilibrium

Osmosis - diffusion of water molecules from more water to less water across the plasma membrane

Facilitated diffusion - molecules move down the concentration gradient through a protein channel

active transport (energy required)

active transport - molecules move against the concentration gradient (less to more) through a protein channel, uses ATP energy

Bulk transport - endocytosis, entering the cell via membrane enclosed vesicles & exocytosis, leaving the cell via membrane enclosed vesicles

Tonicity & Osmosis

Isotonic - equal amounts of water and solutes inside and out of the cell, nothing happens

Hypotonic - more water than solutes outside the cell, water goes into cell, cell bursts

Hypertonic - less water than solutes outside the cell, water goes out, cell shrivels up

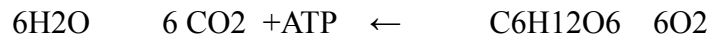
## Unit 4 Energy

Leaf diagram and parts

Photosynthesis equation

Water + carbon dioxide + sunlight → glucose + oxygen

Cellular respiration chemical equation



Aerobic respiration, uses oxygen and mitochondria, makes 36 ATP. Steps are Glycolysis, Krebs Cycle, and Electron Transport Chain

Anaerobic respiration, does not use oxygen and mitochondria, makes 2 ATP. Two processes, Alcoholic Fermentation and Lactic Acid Fermentation

ATP

ATP - nucleotide consisting of nitrogen base-adenine, 5-carbon sugar-ribose, 3 phosphate groups

Diagram of ATP & ADP

When ATP loses a phosphate group energy is released for cells and a molecule of ADP forms.

Photosynthesis

1. Capturing Light Energy, chloroplasts absorb light energy
2. Light Dependent Reaction (converting light energy into chemical energy), happens in thylakoid membrane
3. Light Independent Reaction or Calvin Cycle or Dark Reactions (it doesn't need sun, converting chemical energy to glucose, occurs in the stroma)

Abiotic factors including light intensity, light color, available CO<sub>2</sub> and temperature affect the rate of photosynthesis.

## Unit 5 DNA

DNA Structure Replication History

1. Chargaff - base pair rule
2. Franklin - 1st image of DNA
3. Watson & Crick - double helix model

Adenine bonds to Thymine

Cytosine bonds to Guanine

Phosphate - sugar - nitrogenous base

Pyrimidines - one nitrogen ring, thymine & cytosine

Purines - 2 nitrogen rings, adenine & guanine

Model of DNA

Dna - rna

Thymine - uracil

Adenine - a

Guanine - g

Cytosine - c

Nucleotide diagram

Dna helicase unwinds and unzips the DNA

Dna polymerase makes the complementary strand

Dna ligase links the new nucleotides together

The new strand of DNA is synthesized 5 prime to 3 prime

transcription dna is transcribed into messenger RNA

Translation: mRNA is translated into amino acids to make a protein chain

3 nucleotides : 1 codon : 1 amino acid

Mutations:

1. Substitutions
  - No changes, silent
  - Changes amino acid to another, missense
  - Changes amino acid to 'stop', nonsense
2. frameshift
  - Insertions
  - deletions

## **Unit 6 Genetics + Meiosis**

Mendel's laws:

1. Recessive traits hide behind dominant traits
2. Law of segregation: allele pairs separate from each other to be passed onto offspring
3. Law of independent assortment: separation of genes during gamete formation regardless of other genes (you have an equal chance of getting dominant, recessive, mixture)

## Dominance

1. Complete dominance - one allele shows full dominance over the other ( red flower VS white flower)
2. Incomplete dominance - neither allele is fully dominant over the other (red flower VS pink flower VS white flower)
3. Codominance - two phenotypes “fight” for dominance (red flower VS red and white flower VS white flower)

## Meiosis:

Sex cells (gametes) have half the chromosomes compared to body cells (somatic)

Meiosis I: homologous chromosomes separate

1. Prophase I - envelope disintegrates, centrioles migrate, homologous chromosomes pair up, synapsis (crossing over) happens
2. Metaphase I - homologous pairs of chromosomes line up in middle
3. Anaphase I - homologous pairs pulled apart
4. Telophase I & Cytokinesis - cytoplasm divides

Meiosis II: sister chromatids separate

1. Prophase II - centrioles migrate and produce spindle fibers that connect to chromosome centromeres
2. Metaphase II - chromosomes line up in middle of cell
3. Anaphase II - sister chromatids pulled apart to opposite poles
4. Telophase II & Cytokinesis - nuclear envelope reforms, cytoplasm splits, 4 daughter cells with different genetic information

## Unit 6.5 Biotechnology & Microorganisms

### Biotechnology

Put in picture of the infographic

Germs: Bacteria & Viruses

Disease - disorder of structure or function within an organism not due to external injury (something foreign needs to get in for it to be a virus)

Germ Theory states that many diseases are caused by microorganisms

Microbes that cause disease are pathogens.

Biotic: bacteria, fungi, protists

Abiotic: viruses

Louis Pasteur proved that bacteria is in the air. Koch found that pathogens caused diseases, not poisonous clouds.

Bacteria: living small, prokaryotic

They reproduce asexually through binary fission but they can also do it through budding and conjugation (sexual)

Viruses: not living, they are nucleic acids surrounded by a protein capsid, they depend on a host cell for everything

Lytic Cycle:

Lysogenic Cycle:

Put in pictures diagram

## Unit 7 Classification

Classification Chart

Kingdom Name	domain	Number of cells	Type of cell	Nutrition type	Type of reproduction	Cell wall composition	Big clues	examples
archaea	archaea	uni	pro	both	asexual	variety	Pro, extreme environment	
eubacteria	bacteria	uni	pro	both	asexual	peptidoglycan	Pro, peptidoglycan, cell wall	
protista	eukarya	both	eu	both	both	Some have, cellulose	Catch all kingdom	
fungi	eukarya	both	eu	hetero	both	chitin	Chitin cell wall	
plantae	eukarya	multi	eu	auto	both	cellulose	Cellulose cell wall, photosynthesis	



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animalia	eukarya	multi	eu	hetero	sexual	no	Multi, sexual reproduction	

Species Classification:

Domains: Bacteria, Archaea, Eukarya

Kingdoms: Eubacteria, Archaeobacteria, Protista, Fungi, Plantae, Animalia

Phylum

Class

Order

Family

Genus

Species

## Unit 8 Evolution

Evolution Theory:

1. Biochemical comparison - similarities in DNA or amino acid sequences
2. Embryological comparisons - similarities in embryo stages of development across species
3. Comparative anatomy - similarities in body anatomy between species
4. Fossil record - evidence of life's history and origin found inside the earth

Theory of Gradualism - evolution occurs at a slow steady continuous rate VS Theory of

Punctuated Equilibrium - species have long periods of stability interrupted by brief period of rapid change

Natural selection, survival of the fittest is when good traits increase in a population and bad traits decrease

1. Stabilizing selection - intermediate traits are shown the most
2. Directional selection - frequencies shift to 1 extreme
3. Disruptive selection - both extremes are shown while intermediate is not

Diagram of these selections

Species change due to isolation, random mutation, and natural selection

Isolation:

1. Ecological isolation - habitat or geography
2. Behavioral isolation - different mating behaviors (mating dances/calls)
3. Temporal isolation - different mating periods or seasons

4. Mechanical isolation - different anatomies that don't fit
5. Gametic isolation - non-matching gametes (egg rejects the sperm)

Divergent Evolution: speciation/species separating that came from a common ancestor

Convergent Evolution: unrelated species developing similar adaptations because of similar environments

## **Unit 9 Ecology**

Ecology - study of how organisms interact with each other and their environment

Populations consist of biotic and abiotic factors

- Organism
- Population
- Community
- Ecosystem
- Biome
- biosphere

Organisms have specific niches

4 things that affect population

1. Natality
2. Immigration
3. Mortality
4. emigration

Logistic growth, s shaped curve

Exponential growth, j shaped curve

Primary succession occurs on barren rock with no soil. First to inhabit

Secondary succession, occurs where soil already exists, happens after wildfires, deforestation, ect.

Herbivore - plants

Omnivore - plants and animals

Carnivore - eats animals

Detritivore - eats dead organisms

Food web - producers → consumers (1st 2nd 3rd 4rd) → decomposers

Energy pyramid - amount of energy available

Biomass pyramid - total mass of organisms at each trophic level

Numbers pyramid - number of organisms at each trophic level

1. Competition - organisms compete for same resources
2. Predation - predator & prey relationships
3. Mutualism - both species benefit
4. Commensalism - one benefits, the other is not affected
5. Parasitism - one gains, the other suffers

Diagrams of water, carbon, and nitrogen cycle