**AP: FIRST SEMESTER REVIEW**

**UNIT 1. THE CHEMISTRY OF LIFE**

**Section 1: Chemistry**

**Bonds**

* ionic
* covalent: polar, non-polar
* hydrogen

**Section 2: Properties of Water**

* excellent solvent
* high heat capacity—moderating influence, evaporative cooling
* ice floats (most dense at 4oC
* strong cohesion & surface tension, adhesion

**Section 3: Macromolecules**

**Organic Molecules**

* carbon, monomers, polymers, functional groups
* dehydration synthesis vs. hydrolysis
* carbohydrates
	+ function: energy storage, structure
	+ groups:mono-, di-, and polysaccharides (starch, glycogen, cellulose, chitin)
* proteins
	+ function: structure, transport, defense, enzymes
	+ structure: amino acids, peptide bonds, 1°, 2°, 3°, 4° structure
* lipids
	+ function: energy storage (2X energy as carbs), cell membrane, hormones
	+ groups: triglycerides (fats, saturated, unsaturated), phospholipids, steroids
	+ (fats, oils, steroids-cholesterol, sex hormones)
* nucleic acids
	+ function: information storage
	+ structure: nucleotides, A,T,C,G,U—purines, pyrimidines
	+ groups: DNA, RNA

**Section 4: Enzymes**

**Structure**

* globular proteins, some kinds of RNA (Ribozymes)

**Function**

* catalysts = lowers activation energy
* catabolism (digestion, breakdown, hydrolysis, exergonic)
* anabolism (synthesis, dehydration synthesis, endergonic)
* induced fit model: substrate, active site, enzyme-substrate complex,
* product(s)
* “-ase”, substrate specific, unchanged during reaction

**Factors that affect function**

* pH, temperature, salts can denature
* coenzymes (organic), cofactors (inorganic)
* activators: allosteric, cooperativity
* inhibitors: competitive, noncompetitive, allosteric
* enzyme active site is “saturated” at Vmax
* negative feedback inhibition

**UNIT 2. THE CELL**

**Section 1: Cell & Membrane Structure & Function**

**Classification**

* plants: cell wall (cellulose), chloroplasts, central vacuole with tonoplast (membrane)
* animals: lysosomes, centrioles
* prokaryotes (bacteria): naked circular DNA, ribosomes, no nucleus or membrane-bound

organelles, sometimes cell wall (peptidoglycans)

* eukaryotes: nucleus & membrane-bound organelles

**Cell Membrane Structure**

* phospholipid bilayer: hydrophilic heads, hydrophobic tails; fluid mosaic model
* proteins
	+ integral & transmembrane: channel, transport, electron transfer
	+ peripheral: recognition, receptor, adhesion
	+ cholesterol maintains fluidity

**Organelles & Other Structures**

* nucleus, ribosomes, ER, Golgi, vesicles, mitochondria, chloroplasts, lysosomes,

centrioles, vacuoles

* motility: flagella, cilia (9 + 2 arrangement of microtubules, dynein side arms, use ATP)
* cytoskeleton: microtubules, intermediate filaments, microfilaments
* cell wall
* cell junctions: desmosomes, tight junctions, gap junctions, plasmodesmata

**Cell Membrane Function—Movement of Materials**

* selectively permeable membrane
* diffusion, osmosis, facilitated diffusion, active transport
* hypertonic, hypotonic, isotonic, plasmolysis
* bulk transport: exocytosis, endocytosis (phagocytosis, pinocytosis)

**Section 2: Cellular Respiration**

**Overview**

* C6H12O6 + 6 O2 → 6 CO2 + 6 H2O + energy
* glycolysis, all organisms, cytosol
* chemiosmosis (ATP production), all eukaryotes, mitochondria
* oxidize (lose e-), reduce (gain e-), reduced molecules have higher energy

**Glycolysis**

• glucose → pyruvate

• yield: net 2 ATP, 2 NADH, 2 pyruvate

• cytosol, anaerobic

**Kreb’s (Citric Acid) Cycle**

• pyruvate → acetyl CoA → Kreb’s cycle (2 turns of Krebs per glucose)

• yield per glucose: 2 ATP, 6 NADH, 2 FADH2, 4CO2 (exhale)

• function: reduces electron carriers (NADH and FADH2) for the ETC

• matrix of mitochondria

**Electron Transport Chain (ETC)**

* chemiosmosis, oxidative phoshorylation
* NADH & FADH2 donate electrons to ETC, cytochrome carrier proteins in membrane,
* pump H+ ions to intermembrane space, H+ flow down concentration gradient

through ATP synthase, phosphorylate ADP → ATP

* O2 is final electron acceptor
* yield: ~36 ATP per glucose plus heat
* inner membrane of mitochondria, cristae
* anaerobic respiration: no O2, lactic acid (animals), alcoholic fermentation (bacteria,

yeast, plants)

**Section 3: Photosynthesis**

**Overview**

* light + 6 H2O + 6 CO2 → C6H12O6 + 6 O2
* Autotrophs

**Light Reactions**

* chloroplast, thylakoid membrane
* noncyclic photophosphorylation
* photolysis (water provides electrons)🡪photosystem II (P680)🡪 electron transport chain,

🡪photosystem I (P700)🡪NADP→NADPH

* proton gradient in thylakoid space, ADP🡪ATP (phosphorylation), chemiosmosis
* cyclic photophosphorylation

**Calvin Cycle (Light Independent-Reactions or “Dark” Reactions)**

* chloroplast, stroma
* carbon fixation, Rubisco (enzyme), CO2 + RuBP 🡪PGA (3C) 🡪glucose (6C)
* C3 plants
* 6 turns of Calvin cycle to make one glucose

**C4 & CAM photosynthesis**

* photorespiration, inefficiency of Rubisco in high [O2]
* C4: separate carbon fixation and Calvin cycle—2 locations
	+ PEP carboxylase for carbon fixation—doesn’t bind to O2, found in spongy mesophyll
	+ Calvin cycle occurs in bundle sheath cells away from high O2
	+ grasses, corn, rice, sugar cane
* CAM separate 2 steps of carbon fixation temporally = 2 different times
	+ fix carbon at night (when stomates open), put it in “storage” compounds (organic
	+ acids: malic acid, isocitric acid),
	+ then in day (when stomates closed), release CO2 from “storage” compounds to Calvin cycle
	+ cacti, succulents, pineapple

**Section 4: Cell Cycle/Mitosis**

**Mitosis**

* clones, asexual reproduction, growth, repair
* chromosomes, chromatids, centromere, kinetochore (where spindles attach)
* interphase, G1, S, G2, G0
* prophase, metaphase, anaphase, telophase
* cytokinesis: cleavage furrow (animals, microfilamants), cell plate (plants)
* cell division triggered by growth (surface to volume ratio), density dependent inhibition

**UNIT 3. GENETICS**

**Section 1: Meiosis**

**Gamete Production**

* 1st division of meiosis separates homologous pairs
	+ reduction division, diploid 🡪 haploid, 2n 🡪 1n
	+ interphase 1, prophase 1 (crossing over), metaphase 1, anaphase 1, telophase 1
	+ crossing over: tetrad, synapsis
	+ independent assortment
* 2nd division of meiosis separates sister chromatids
	+ haploid 🡪 haploid, remains 1N
	+ prophase 2, metaphase 2, anaphase 2, telophase 2
	+ Function
	+ haploid gamete (sex cell) production
* genetic variation: crossing over, independent assortment at meta I, and random fert.

**Section 2: Heredity**

**Mendelian Inheritance**

* locus, gene, allele, homologous pairs, dominant, recessive, phenotype, genotype,
* homozygous, heterozygous, monohybrid cross, dihybrid cross; P, F1, F2 generations,
* test cross, Punnett squares
* Law of Segregation: random segregation of alleles to separate gametes
* Law of Independent Assortment: chromosomes segregate separately from other nonhomologous chromosomes

**Non-Mendelian Inheritance**

* incomplete dominance, codominance, multiple alleles, epistasis, pleiotropy, polygenic

inheritance, linkage, sex-linked, X inactivation, non-disjunction, deletion, duplication,

translocation, inversion

**Section 3: Molecular Genetics**

**DNA Replication**

* semi-conservative replication, template strand, DNA polymerase, leading strand, lagging

strand, helicase, replication fork, single stranded binding proteins, DNA ligase, Okazaki

fragments, RNA primase, RNA primer, 3’ vs. 5’ end

* mutations: deletion, substitution, insertion, frame shift

**Protein Synthesis**

* one-gene-one-enzyme hypothesis
* transcription
	+ mRNA, RNA polymerase
	+ RNA processing: introns, exons, 5’ cap, poly-A tail
* translation
	+ mRNA, codon, tRNA, anticodon, rRNA, ribosome, small RNA subunit, large RNA
	+ subunit, P site, A site, wobble, stop codon, start codon (Met)
	+ initiation, elongation, termination

**DNA Organization**

* chromatin, histone proteins, nucleosomes, euchromatin, heterochromatin,
* transposable elements (jumping genes)

**Viruses**

* bacteriophages, capsid, envelope, retroviruses, reverse transcriptase,

**Bacteria**

* plasmids, conjugation, transduction, transformation
* regulation of gene expression: operons
	+ regulatory gene, repressor protein, promoter, operator, structural genes
	+ inducible enzyme: lac operon, when lactose present it binds to repressor and inactivates it so transcription can begin
	+ repressible enzyme: trp operon, when tryptophan (corepressor) is presen it binds to

repressor & activates it so that transcription/translation is blocked.

**Section 4: Biotechnology**

**Recombinant DNA**

* restriction enzymes, sticky ends, ligase, plasmids (vector), transformation

**Other Technologies**

* gel electrophoresis, RFLPs (restriction fragment length polymorphisms), PCR

(polymerase chain reaction), reverse transcriptase, probes, Southern blot

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**Nutrient cycles**

* carbon cycle, nitrogen cycle (nitrogen fixation, denitrification)