AP Biology Exam Review Part I: Biochemistry, Cells and Transport

2A3: Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.

2B1: Cell Membranes are selectively permeable due to their structures.

2B2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.

2B3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.

4A1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.

4A3: The structure and function of subcellular components, and their interactions, provide essential cellular processes.

4C1: Variation in molecular units provides cells with a wider range of function.

1. **Chemistry of Life**
2. CHNOPS- most common elements in all living matter
3. Bonds- ionic (transfer electrons), covalent (sharing- polar/unequal sharing and non-polar/equal sharing), hydrogen (weak bonds between hydrogen and negatively charged items), hydrophobic interactions (how non-polar compounds congregate together- lipids)
4. pH
5. acid-base/ 0-14, # of H ions determines scale; logarithmic- pH 3 = 10-3 = 1/1000
6. blood- 7.4, stomach- 2, small intestine- 8; enzymes are specific to pH
7. buffers such as bicarbonate handle slight pH swing
8. Water properties- polarity, cohesion(attraction to other water molecules), adhesion (attraction to other charged compounds) low density when frozen, versatile solvent, high heat of fusion/vaporization; surface tension
9. Organic molecules (monomers are simplest form of all; monomers join together via dehydration synthesis- loss of water- to make polymers; polymers are broken down via hydrolysis- input of water.)
10. Carbohydrates- CHO 1:2:1 ratio, monomer= monosaccharides, 2=disaccharides, 3 or more= polysaccharides
11. Used for energy (cell respiration)
12. Examples
13. glucose- immediate energy to make ATP
14. starch- stored energy in plants
15. glycogen- stored energy in animals (stored in liver)
16. cellulose- plant cell wall
17. Lipids – C, H, O (not a 1:2:1 ratio) \*P only in phospholipids
18. fats, waxes, oils and sterols
19. Saturated fats have single bonds between carbons, unsaturated fats have at least one double bond between carbons (kinky); plants make polyunsaturated; animals make monounsaturated
20. Phospholipids make up cell membranes (double layer) and are amphipathic- hydrophilic and hydrophobic
21. uses- in all membranes, sex hormones, & corticoids; stored energy, protection, insulation, myelin sheath of nerves
22. Proteins- C, H, O, N (may have other elements in R group)
23. Monomer- amino acids (20 total types), 2=dipeptide, 3 or more= polypeptide
24. Parts of amino acid= carboxyl group (COOH) on one end, amino group on the other end (NH2), central carbon and variable R group (can be hydrophobic or hydrophilic) which determines chemical properties.
25. Protein Folding- shape determines function; primary= a.a. chain; secondary= beta pleated sheet or alpha helix( hydrogen bonds); tertiary=globular; folds in on itself (disulfide bridges, hydrogen bonds, hydrophobic interactions; ionic bonding); quartenary= more than one polypeptide.
26. Uses- protein carriers in cell membrane, antibodies, hemoglobin, enzymes, most hormones, muscle (actin and myosin)
27. Nucleic acids-
28. Monomer= nucleotide, 2 = dinucleotide, 2 or more polynucleotide
29. Nucleotide made up of sugar, phosphate and base
30. Used to store genetic information
31. DNA is double stranded, has deoxyribose, A, G, C, T
32. RNA is single stranded, has ribose, A, G, C, U
33. mRNA- copies genetic message; rRNA- attaches mRNA and makes up ribosomes (most common);tRNA- carries amino acids;DNA- carries genetic code

## Cells

1. Prokaryotic (Bacteria) Eukaryotic (all other living things)

 no membrane-bound organelles m.b.o, ex. Chloroplasts and nucleus

 no nucleus(single; circular DNA) multiple linear DNA

 free ribosomes and cell wall histones on DNA

2. Cell organelles

1. Nucleus- holds DNA and nucleolus(where ribosomal subunits are made)
2. Mitochondria- double membrane; outer is smooth and inside is folded with enzymes to make ATP (site of cellular respiration (glucose breakdown)
3. Ribosome- site of translation- protein synthesis; made of rRNA and protein
4. E.R.- connected to nucleus; allows for reactions, membranous; smooth= lipids; rough=proteins
5. Golgi complex- packaging in membrane and signals for export
6. Cytoskeleton: Microfilaments- contractile protein, gives shape, movement within cell; Microtubules- centrioles, cilia, flagella, spindle fibers
7. vacuoles/vesicles- water and solutes; large and central in plants
8. ANIMAL
* Lysosomes- contain enzymes; used for intracellular digestion and apoptosis
* Centrioles- used in cell division
* Peroxisomes- contain enzymes to break down H2O2
* Extra Cellular Matrix (ECM)- collection of proteins and glycoproteins on outside of cell membrane; MHC
1. PLANT
* Chloroplast- double membrane; site of photosynthesis (glucose synthesis)
* Cell wall- middle lamella- pectin; primary cell wall- cellulose; secondary cell wall- lignin
1. Cell junctions- plasmodesmata (between plant cells); gap junctions (between animal cells); tight junctions (stitched animal cells); anchoring junctions (riveted together animals cells)
2. Endosymbiont theory- all eukaryotic cells came from bacterial cells that lived together; proof= all chloroplasts and mitochondria have own DNA and are autonomous

3. Cell membrane (separates the internal environment of cell from external environment).

1. Phospholipid bilayer (selectively permeable; amphipathic)
2. Fluid mosaic model (in motion; proteins, cholesterol, glycoproteins and glycolipids among phospholipids). Membrane is hydrophilic on inside and outside, hydrophobic within membrane
3. Simple diffusion- from high to low concentration- small and uncharged move freely through phospholipids ex. CO2, O2 (passive; no energy;no protein carrier)
4. Facilitated diffusion- large or charged from high to low, passive; with protein carrier: ex. glucose, K+,
5. Active transport- from low to high concentration; uses ATP; uses a protein
6. Endocytosis- phagocytosis (solid) and pinocytosis (liquid); membrane surrounds and forms vesicles; receptor mediated endocytosis has receptors on surface
7. Exocytosis- release of material using vesicles fusing with membrane
8. Osmosis- diffusion of water using a selectively permeable membrane; passive; no proteins
9. Water potential= pressure potential plus pressure potential; water moves from high water potential to low water potential; solutes always lower water potential; pressure can increase or decrease depending on if it is negative or positive.
10. Plant cells have pressure related to cell wall and vacuole; turgor pressure
11. Hypertonic (high solute), hypotonic (low solute), and isotonic solutions(equal concentration)
12. Plasmolysis (plant cells; membrane pull away from cell wall); crenation (animal cell shrivels)

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**AP Investigation 4: Diffusion and Osmosis**

Part I- Diffusion in Agar Cubes

Overview: Various size cubes of phenolphthalein agar were placed in NaOH and then diffusion rates were calculated.

IV- Size of cube

DV- percent diffusion

Equations: Volume = L x W x H, volume diffused = total volume – volume not pink, % diffusion = Volume diffused /total volume x 100, surface area of a cube = L x W x # of sides, surface area/volume ratio.

Part II- Osmosis in Living Cells (Potatoes)

Overview: Potato cylinders placed in sucrose (sugar) solutions and massed before and after to get percent change in mass.

Determined by graphing percent changes in mass versus molarity of solution

IV- Sucrose solutions (varying molarities)

DV- percent change in mass

Equations: ,

Part III- Design Your Own Experiment (Dialysis Bags)

Overview: Students were provided with dialysis bags, colored sucrose solutions of unknown molarities, and basic lab equipment to use to design an experiment on how to determine the molarities of the colored solutions.

IV- unknown molarities

DV- for most groups it was percent change in mass

Equations: (final mass-initial mass)/ initial mass

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**Biochemistry:**

amino acid

amphipathic

carbohydrate

carbon

denaturation

disaccharide

ester bond

fibrous protein

globular protein

glycosydic bond

hydrogen bond

ion

lipid

macromolecule

monomer

monosaccharide

nitrogen

non-polar molecule

nucleic acid

nucleotide

organic molecule

peptide bond

phospholipid

polar molecule

polymer

protein

water

**Cells:**

active transport

amphipathic

apoptosis

aquaporin

carrier protein

cell wall

centrioles

channel protein

chloroplast

concentration gradient

cytoplasm

cytoskeleton

diffusion

electron microscope

endocytosis

endoplasmic reticulum

glycolipid

glycoprotein

Golgi apparatus

hypertonic

hypotonic

ion pump

isotonic

ligand

light microscope

lysosome

magnification

membrane

mitochondrion

nuclear envelope

nuclear pore

phospholipid

pinocytosis

plasma membrane

plasmolysis

prokaryotic cell

resolution

ribosome

rough ER

selectively permeable

smooth ER

exocytosis

eukaryotic cell

facilitated diffusion

flagella

fluid mosaic model

nucleus

organelles

osmosis

passive transport

phagocytosis

surface area:volume ratio

transmembrane protein

turgor

vacuole

--------------------------------------------------------------------------------------------------------------------------------------------------Questions and Practice

1. How do the unique chemical and physical properties of water make life on earth possible?
2. What is the role of carbon in the diversity of life?
3. How do cells synthesize and breakdown macromolecules?
4. How do structures of biological molecules account for their function (carbs, proteins, lipids, DNA)?
5. What are the similarities and differences between prokaryotic and eukaryotic cells?
6. What the evolutionary relationships between prokaryotic and eukaryotic cells?
7. How does compartmentalization organize a cell’s functions?
8. How are the structures of the various subcellular organelles related to their functions?
9. How do organelles function together in cellular processes?
10. What is the current model of molecular architecture of membranes?
11. How do variations in this structure account for functional differences among membranes?
12. How does the structure of membranes provide for transport and recognition?
13. What are various mechanisms by which substances can cross the membrane?
14. In osmosis and diffusion lab, how was osmosis measured in both living and artificial?
15. What was the IV in the dialysis bag part of the lab? DV? Control? Controlled variables?
16. What was the IV in the potato part of the lab? DV? Control? Controlled variables?
17. Draw concept map showing the connections between the following terms: Atom, Compound, Carbohydrate, Lipid, Protein, Nucleic Acid, Organelles, Nucleus, Mitochondria, Cell membrane, Golgi Apparatus, ER, prokaryotic cell, eukaryotic cell