Midterm Review

- Type / for options
- ## Unit 1: Chem of Life
- ## Macromolecules
- ### Carbs
- C1:H2:O1
- Clucose, Fructose, Galactose
- Disacharrides = 2 monosacharides
- bond between 2 carbs is a glycosidic linkage
- ex: sucrose lactose maltose
- used for structure, cellulose in plants, and chitin in fungi cells
- also used for starch: starch for plants and glycogen in animals (glycogen is string of glucose)
- starch can be broken down, cellulose cant
- starch 1-3 alpha, all carbon on top
- cellulose 1-3 beta carbon switches top and bottom
- ### Lipids
- CHO (P in phospholipids)
- 1:2:few
- no monomer bc its not a repeating strucutre
- ALL LIPIDS ARE NONPOLAR
- Fats: glycerol backbone, 3 fatty acids
  - saturated fatty caids: every carbon has hydrogen all single bonds STRAIGHT
  - unsaturated fatty acids: at least one double bond, not all are saturated by hydrogen BENT
- Phospholipids: phosphate (hydrophillic head), glycerol, 2 fatty acids (hyrdrophobic tail)
- Steroids: four fused rings, mostly consumed as cholesterol, also hormones, important for cell communication

- ## Proteins

- CHON(S) Sulfur is sometimes
- Central carbon, amino group on left (H-N-H) very basic, carboxyl group (C-O-O-H) on right very acidic, R group
- R group varies based on amino acids
- Polypeptide is polymer
- these are held together by peptide bonds, oh of carboxyl and h of amino removed to form bond between
- always n to c left to right
- Structures of protein

1. primary, just string of amino acids, peptide bonds
2. secondary: alpha helix or beta pleated, coils up . these are held by hydrogen bond backbone
3. Tertiary: all bonds are applicable and happen between R groups. Structure is final 3D structure, this is last form of single polypeptide
4. Quaternary: All bonds, between R groups of DIFFERENT polypeptides, ex: 4 strucutures of hemoglobin interact

- R-groups determine polarity and folding: hydrophilic fold exterior (O and S), hydrophobic fold interior (C and H)

- ## Nucleic Acids

- CHONP, monomer is a nucleotide
- phosphate group, nitrogenous base, and a pentose sugar
- bond is a phosphodiester linkage, between phosphate and hydroxyl
- directionality is 5' ⇒ 3' anitparellel
- 5' is P, 3' is O
- Purine: Adenine and Guanine, have double ring
- Pyrimidine: Cytosine, thymine, uracil, single ring structure
- A/U pair with T (2 h bonds)
- C pair with G (3 h bonds)
- DNA has Thymine instead of Uracil (RNA)
- DNA deoxyribose, Ribose is RNA
- DNA double strnaded rna single stranded
- DNA misses 1 oxygen

- # Water Properties

- all off of water being polar
- Cohesion/Adhesion: cohesion attraction to itself, adhesion attraction to other POLAR substances. Ex: capillary action is result of both
- Universal Solvent
- Surface Tension: develops a surface because of hydrogen bonds
- Less dense when solid
- High specific: takes a large amount energy to change 1g of water by 1C. Important for temp control in coastal and homeostasis (body temp)
- pH: conc of H+ inc, pH dec (more acidic)

Unit 2: Cell Structure

Cell Organelles

- Nucleus:
  - double membrane (nuclear envelope) and has pores
  - it stores genetic info DNA , makes RNA and assembles ribosomes
- Rough ER:
  - membrane is studded with ribosomes and is attached to the nublear envolope
  - protein synthesis, cell compartmentalization, and helps intracellular transport
- Smooth ER:
  - folded cisternae also on nuclear envelope
  - mainly detoxing cell, stores calcium and makes lipids
- Golgi Complex:
  - membrane bound made of flattened sacs (cisternae)
  - folding and chemical modification of proteins
  - packages and sends them out MAILMAIN
- Ribosomes:
  - made of rRNA and proteins
  - have large & small subunits
  - can be bound like on ER or free like scatterred through cell
  - make proteins
- Mitochondria:
  - double membrane, outer is smooth, inner is highly folded and called cristae
  - inner membrane folded for higher surface area

    - out ribosomes and DNA
    - site of respiration, Oxidative phosphorylation and krebs cycle
- Chloroplasts:
    - double membrane as well
    - photosynthesis
    - thylakoid, stack of them is granum
- Lysosome:
    - little sack that has 'hydrolytic enzymes'
    - responsible for cell digestions like recycling organic materials and apoptosis (cell death)
- Vacuole:
    - membrane bound sac
    - storage and siposal of macromolecules
    - central: water retention
    - contractile is for osmoregulation (only in protists)

SA:V

- smaller cells usually have higher SA:V wolume ratio
- this means more efficient

Membrane Transport

- Plasma Membrane:
    - made of phospholipids, membrane proteins, glycolipids, and cholestrol
    - phospholipid tails face in, heads face out
    - membrane proteins are like channel proteins to help with like transport and comms
    - inhibit constriction like when it gets cold, cholestrol makes membrane not get solid and stay fluid
    - also keeps it together when really hot and glue together
- Simple Diffusion:
    - this is passive, and doesnt need energy
    - this is bc it js follows the conc gradient Hi-Lo
    - only small and nonpolar to fit through phospholipids (small to fit, nonpolar to not get repelled)
    - ex: O2 O2 N2 Steroids
    - very small water might leak through membrane
- Facilitated Diffusion:

    - still passive and no energy
    - still follow conc gradient
    - requires transport protein tho bc it might not be nonpolar
    - Ex: water, Na+, K+, Ca+
    - specific channels so if sodium only sodium can pass through
- Active transport:
    - requires energy
    - against the conc gradient
    - it still needs transport protein
    - Ex: Sodium potassium pump or proton pump
- Bulk transport:
    - type of active transport
    - Endocytosis: import into cell
        - Phagocytosis: cellular eating, big molecules
        - Pinocytosis: Cellular Drinking, extracellular fluid
    - Exocytosis: export out of cell
        - ex of this rough er to golgi to pushing out of cell
- Osmosis:
    - always move from hi water to low water
    - can also think of low solute to hi solute
    - still passive
    - high to low water potential as well
    - Hypertonic:
        - high solute and low water INSIDE cell
        - this will GAIN water from OUTSIDE hypotonic solution
        - will burst if too much
    - Isotonic:
        - equal solute and water concetration
        - water still moves but net zero
    - Hypotonic:
        - low solute conc and high free water INSIDE cell
        - water will leave to OUTSIDE hypertonic solution
        - will shrivel if too much

Unit 3: Cellular Energetics

- Endergonic: absorb energy, ex: ADP + Pi ⇒ ATP
- Exergonic: release energy, ex: ATP ⇒ ADP + Pi

Enzymes

- biological catalyst, so speed up reactions by reducing activation energy
- activation energy is the amount needed for a reaction to take place
- these are proteins
- substrate binds to active site
- when they bind confirmational change/induced fit
- now they attach and form an enzyme/substrate complex
- it gets converted into products
- the products leave and enzyme is ready for reuse
- inhibitors bind to an active site and affect reaction
  - Competitive: bind to active site and serve as direct competition
  - Noncompetitive: binds to allosteric (different site on enzyme) site and changes enzyme shape. this stops the substrate for binding with the enzyme
- Denaturation: basically protein stops working and this happens to extreme temp, unoptimal pH, salinity

Cellular Respiration

- Glycolysis:
  - located in cytoplasm
  - any organism can go thru this
  - believed first process to happen evolutionarily
  - Glucose turns into 2 Pyruvate, 2 NADH (electron carrier has electron right now), 2 ATP
  - split glucose into 2 pyruvate
  - 2 ATP turned into 2 ADP
  - 2 NAD reduced to NADH
  - technically 2 ATP invested and 4 ATP output but net 2 ATP
  - AFTER this there is Link Reaction:
    - 2 pyruvate goes through process where 2 CO_2 and 2 NADH is released
    - results in 2 Acetyl CoA
- Krebs Cycle:

- happens in mitochondria matrix
- acetyl CoA turned into coenzyme A
- 6 Carbon molecule releases 1 CO_2 (NAD is also reduced)
- 5 Carbon molecule releases CO_2 (another NAD is reduced)
- ADP turned into ATP
- FAD is reduced
- another NAD is reduced
- 4 Carbon molecule output
- REACTANTS: Acetyl CoA
- PRODUCTS: 2 CO_2, 3 NADH, 1 $FADH_2$, 1 ATP

- Oxidative Phosphorylation:
  - happens in mitochondria cristae
  - REACTANTS: NADH/$FADH_2$ (for electrons)
  - PRODUCT: ATP (34ish)
  - ETC:
    - electron gets removed and passed down chain
    - this energy from electron is used to pump protons across membrane (forms potential energy)
    - doesn't make ATP
    - only makes H+ gradient
    - oxygen accepts these electrons at end
    - lack of oxygen backs up all of this and results in fermentation
  - Chemiosis:
    - the earlier proton gradient is used by ATP Synthase
    - ATP Synthase makes ATP by adding phosphate grp to ADP
    - This is where most of the ATP is made
- **NADH IS CELL RESPIRATION**
- **NADPH IS PHOTSYNTHESIS**
- ## Photosynthesis
- Light Reactions:
  - happens in thylakoid membrane
  - starts with water getting split and giving H+ ions
  - also uses Photons

- REACTANTS: WATER, PHOTONS
- PRODUCTS: ATP, NADPH
- first step is electron transport chain
- PSII (P680) catches light and excites electron before releasing
- this electron makes way down chain
- energy from this is used to pump protons
- reaches PSI (P700) where it replaces the electron it just lost in the same way
- electron from PSI combines with NADP+ to make NADPH (electron carrier)
- H+ gradient is used for ATP Synthase again
- results in synthesis of ATP via adding phosphate to ADP

- Calvin Cycle (Light Independent):
  - CO2 comes in, binds to RuBP via enzyme RUBISCO
  - formation of 6 carbon molecule
  - split into 2 3 carbon molecules
  - NADPH oxidized (turned into NADP+) and ATP used (turned into ADP)
  - this makes carbon molecules organic, G3P
  - 1 of them gets turned into glucose
  - other follows path and uses ATP before being turned into RuBP
  - REACTANTS: 3 CO2, 9 ATP, 6 NADPH
  - PRODUCTS: G3P