

January 23rd

C, H, N, O make up
96% of living
matter

SI Session #2

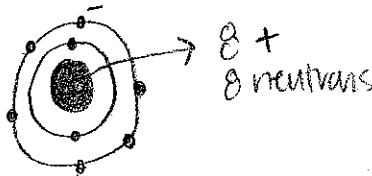
I. Review

II. Define the following terms:

- a. matter- anything that has mass & takes up space
- b. compound- 2 or more elements combined in a fixed ratio
- c. atomic number- # of protons, determines element
- d. isotope- varying form of the same element; differ in the # of neutrons
- e. trace element- elements required in very minute quantities; make up 1% of living matter
ex: Fe, I

III. Questions

1. Draw a diagram to show how the protons, electrons, and neutrons would be arranged in a molecule of oxygen. Depict the charges on each subatomic particle



oxygen = 8 e⁻
8 prot.
8 neut.

2. What determines the chemical behavior of an element?

electrons

3. What happens to electrons as they move between orbitals?

electrons absorb & emit energy

4. What is the octet rule? How many electrons can be housed in 3 electron shells?

elements want to have a full octet (8 valence e⁻), so they will lose, gain, & share electrons to fill their octet

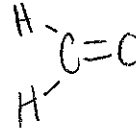
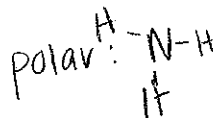
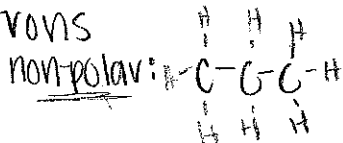
$$2n^2$$

n = # of shells

when n = 3

= 18 electrons

5. Define covalent bond. Draw an example of a non-polar and a polar covalent bond.
 a covalent bond is formed when 2 atoms share a pair of electrons



6. Define anion and cation. How many electrons would Mg^{2+} contain?

cation - positively charged - formed from the loss of an electron

anion - negatively charged - formed from the gain of an electron

$\text{Mg}^{2+} = 10 e^-$

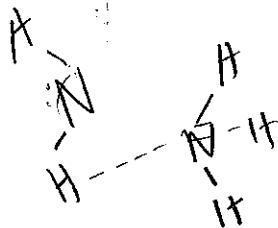
$\text{Cl}^- = 18 e^-$

7. Anions and cations are created in the formation of IONIC bonds.

8. True/False: Hydrogen bonds are created by the sharing of electrons. If false, how are hydrogen bonds created?

Hydrogen bonds are an attraction not a bond

9. Draw an example of a hydrogen bond



10. What is the difference between an ionic and covalent bond?

ionic bonds are the result of a transfer of electrons where covalent bonds result from the sharing of electrons

Ionic bonds

form salts

lattice shape

} NaCl, CaCl, MgO, KBr

*equilibrium: rates of forward & reverse rxns are equal

February 11th

SI Session #3

I. Review

II. Application

There are 4 emergent properties of water that contribute to Earth's suitability for Life:

A. Cohesion of Water Molecules

1. What is adhesion? Cohesion? Explain how adhesion and cohesion work together to transport water in plants.

adhesion - affinity for H₂O molecules to bind to walls

cohesion

H₂O molecules connect together by cohesion, travel up walls by adhesion

B. Moderation of Temperature by Water

1. What is kinetic energy? Potential energy? Give an example of each.

kinetic = energy of/in motion

potential = stored energy

3. Explain the difference between heat and temperature.

heat is the measure of total kinetic energy due to mol. motion

temp - measures intensity of heat

4. What is it about water's specific heat that makes it different from other common substances?

it is relatively high; allows H₂O to stay in "bodies of H₂O"

5. What would happen to the earth if water's heat of vaporization was lowered?

bodies of H₂O would evaporate

C. Floating of Ice on Liquid Water

6. How are water molecules arranged in ice?

lattice structure

D. The Solvent of Life

7. Describe the difference between hydrophobic and hydrophilic? Why is water such a good solvent?

hydrophobic = water fearing; non-polar

hydrophilic = water loving; polar

H₂O is a good solvent b/c it is polar; can surround charged molecules

*xylem

8. Sucrose has a molecular mass of 342 g/mol. How would you make a 2 molar aqueous solution of sucrose?

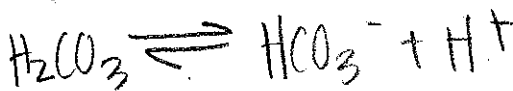
$$\frac{2 \text{ mol}}{\text{liter}} \cdot \frac{342 \text{ g}}{\text{mol}} = 684 \text{ g of sucrose}$$

9. Complete the following table:

$[H^+]$	$[OH^-]$	pH	Acid, Basic, or Neutral
10^{-3}	$[10^{-11}]$	3	acid
10^{-8}	10^{-6}	8	base
10^{-7}	$[10^{-7}]$	7	neutral
10^{-1}	10^{-13}	1	acid

10. What is an acid? A base? Where are they located on the pH scale?

Acid = H^+ donor
base = H^+ acceptor



11. What does a buffer do? Write out the Carbonic Acid- Bicarbonate Buffer chemical equation. Which direction does the reaction proceed when the pH begins to fall? When the pH rises?

buffer = combo of weak acid & base

when pH falls: left
when pH rises: right

→ = move acidic

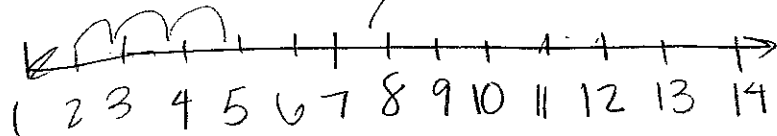
← = move basic

12. A pH of 2 is 1000 times stronger than a pH of 5.

$$10 \times 10 \times 10 = 1,000$$

pH of 14 is 10,000 more basic than pH 10

$$10 \times 10 \times 10 \times 10$$



Acid

SI Session #4

I. Review

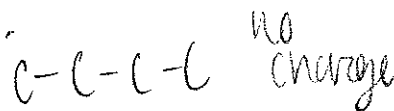
II. Questions

1. Explain the Stanley Miller experiment.

showed that organic molecules could form under conditions like those on earth. disproved "vitalism"

2. Are hydrocarbons hydrophobic or hydrophilic? Why?

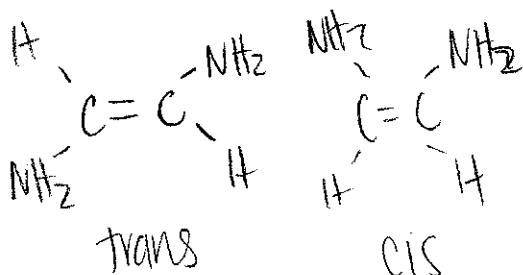
hydrophobic b/c they are non-polar.



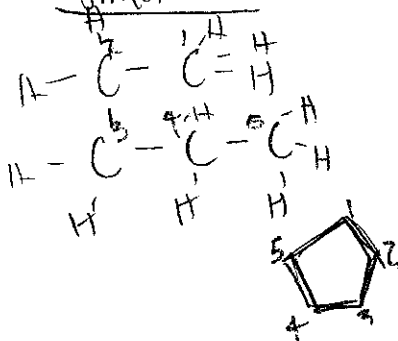
3. What is an isomer? Draw an example of cis-trans isomer, enantiomer, and structural isomer.

isomer - compound w/ same molecular formula but different structural formulas

cis-trans

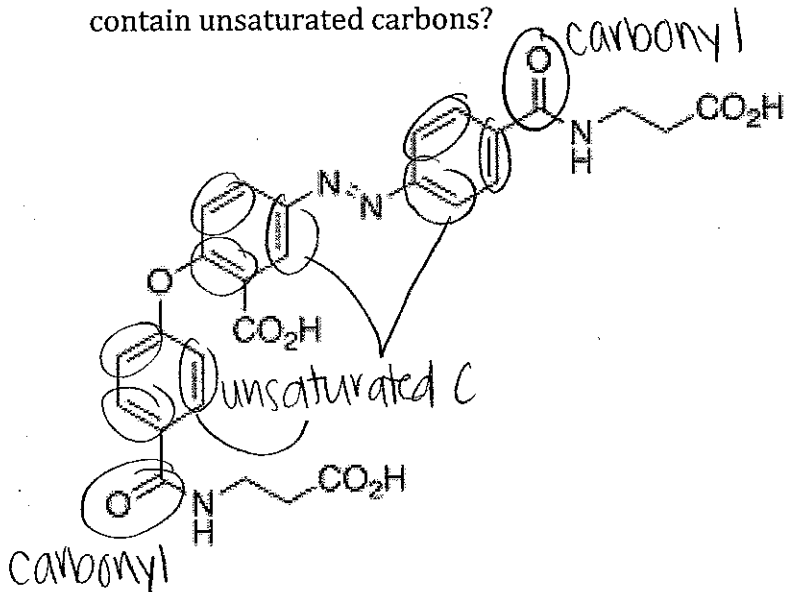


structural

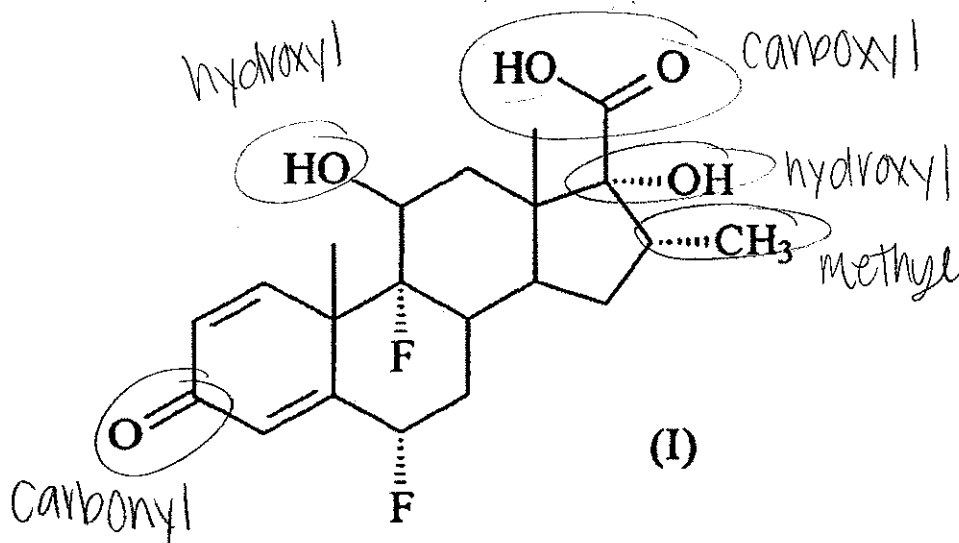


enantiomer

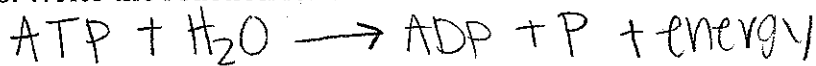
4. What functional group(s) is(are) present in this molecule? Does this molecule contain unsaturated carbons?



5. Label the functional groups in the following molecule



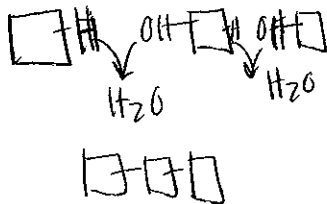
6. Write the reaction for the breakdown of ATP. How is the ATP broken down?



- hydrolysis: add H₂O to pop a phosphate off * exergonic rxn

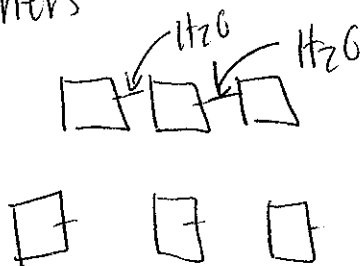
7. How does dehydration synthesis work?

- take out H₂O to join monomers together



8. How does hydrolysis work?

- add H₂O to break a polymer into its original monomers



opposite

9. You can recognize a monosaccharide by its multiple hydroxyl groups and its one carbonyl group, whose location determines whether the sugar is an aldose or ketose. In aqueous solutions, most five and six carbon sugars form rings.
(aldehyde) (ketone)

10. What is the monomer of a carbohydrate? What type of bond forms between these monomers?

monosaccharide, linked by glycosidic linkages

- cellulose in plant walls
- chitin in exoskeletons of arthropods

11. What is the difference between alpha and beta glucose?

α = OH group on C_1 is down

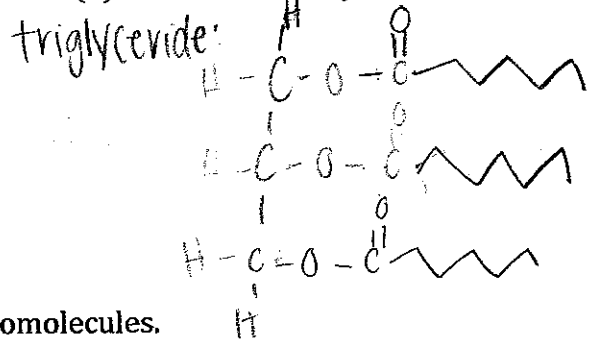
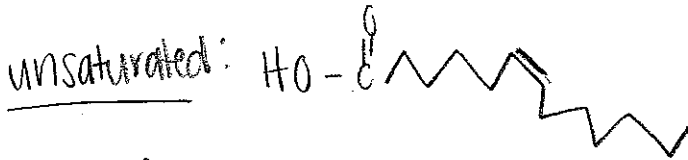
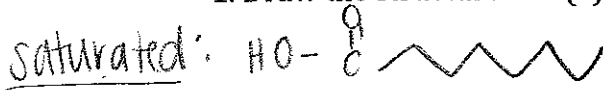
β = OH group on C_1 is up

SI Session #5

I. Review

II. Questions

1. Draw the structure of a (a) saturated fatty acid and (b) unsaturated fatty acid.



They have
no repeating
subunits

2. True or false: Lipids are not classified as macromolecules.

3. What are the C-C bond angles in a saturated fatty acid? Why is this important?

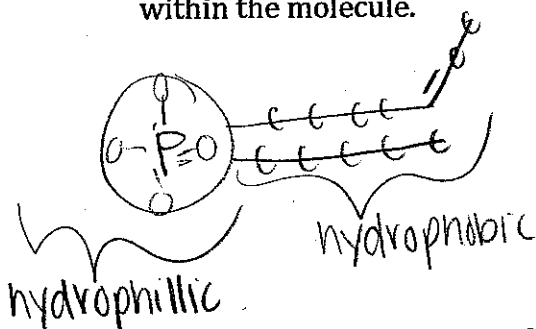
180° → allows fatty acids to pack together b/c the molecules are linear.

double bonds restrict movement & packing

4. What is hydrogenation?

converting unsaturated fatty acids to saturated fatty acids by adding hydrogens (converts liquid fat → solid fat)

5. Draw the general structure of a phospholipid. Describe the polarity differences within the molecule.



• the phosphate head carries a negative charge b/c of the oxygen so it is polar

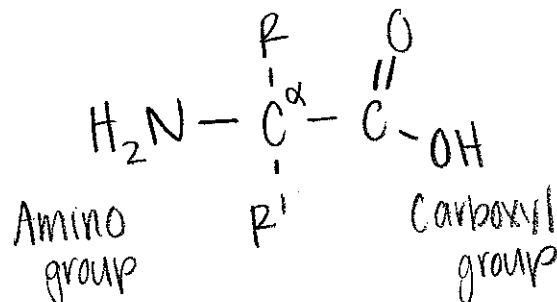
• the tails are long non-polar hydrocarbons so they are hydrophobic

6. Steroids can be recognized by four fused rings.

7. What is the importance of the steroid cholesterol.

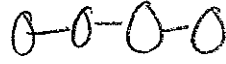
- helps to maintain fluidity of the plasma membrane
- it is a precursor to the synthesis of steroid hormones

8. Draw the general structure for an amino acid. Label the side groups and the alpha carbon.



9. What is the primary structure of a protein?

single strand of amino acids

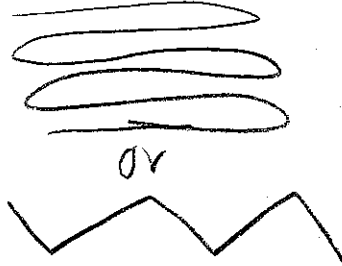


10. Draw (in 2-D) the secondary structures of a protein. What type of interaction(s) allows these shapes form?

α -helix



β pleated sheet



Secondary structures are formed due to H-bondings
NOT R-group interaction

11. What type of interaction(s) allows the tertiary structure of a protein to form?

H-bonding, disulfide bridges, ionic bonding, hydrophobic interactions, van der Waals forces

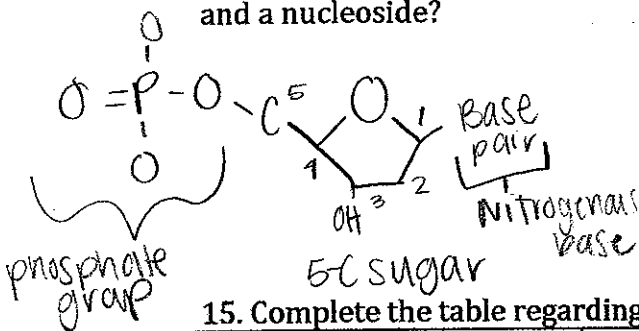
12. What is the quaternary structure of protein?

2 or more polypeptide chains that aggregate together

13. In regards to proteins, why is it important for the body to maintain an optimal pH, temperature, and ion concentration?

proteins are sensitive; if equilibrium is lost, proteins can denature

14. What is a nucleotide composed of? What is the difference between a nucleotide and a nucleoside?



- nucleotide = sugar, base, phosphate group
nucleoside = 5-C sugar & base pair

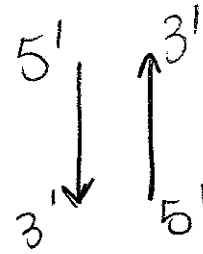
15. Complete the table regarding the DNA base pairs:

	# of rings	Example
Purine	two	Adenine, Guanine
Pyrimidine	one	Thymine, Cytosine, Uracil

16. DNA is anti-parallel, what does this mean?

strands are arranged in opposite directions

Adna is read in 5' → 3' direction



17. Complete the following table:

	Monomer	Type of bond present	Function
Carbohydrate	monosaccharide	glycosidic linkage	Fuel, structural support, storage
Protein	Amino Acid	Peptide bond	• catalysts (enzymes), structure support, transport, immunity, signaling
Lipid (fatty acid)	X no monomer	ester linkage	• phospholipid bilayer • energy source
Nucleic Acid	nucleotide	phosphodiester linkage	stores hereditary info, replication info, mRNA synthesis, protein synthesis

18. What is the difference between light and electron microscopy?

EM uses a beam of e⁻ instead of a light source

19. What type of electron microscope would you use if you wanted to see the inside of a muscle cell?

- transmission electron microscope (TEM)
- SEM only shows external surface/structure

*** Figure 6.2***

(don't forget about it!)

SI Session #6

I. Review

II. Questions

1. Describe the difference(s) between a ^{plant} prokaryotic and ^{animal} eukaryotic cell.

animal cells have lysosomes, centrioles, flagella

plant cells have: chloroplasts, central vacuole, cell wall, plasmodesmata

2. Why is it important for cells to have a large surface area to volume ratio?

want to maximize diffusion across the cell membrane

3. Describe the structure of the nucleus. What is stored inside the nucleus?

has a double membrane (envelope) w/pores

houses genetic material dna

4. What are the two types of ribosomes? How do they differ?

Free

-suspended in the cytosol; makes proteins that are going to stay in cell

Bound

-attached to the rough or smooth ER; make proteins destined for membranes or secretion

5. What is the difference between the rough and smooth endoplasmic reticulum.

-rough ER contains ribosomes; protein synthesis, adds carbs to proteins

-smooth ER has no ribosomes; synthesis of lipids, carb metabolism, Ca^{2+} storage, drug detx

6. What is the function of the golgi apparatus?

proteins are modified, packaged, and stored

abundant in cells that are specialized for secretion

7. What structure houses hydrolytic enzymes? What do these enzymes do?

lysosome. the enzymes digest macromolecules

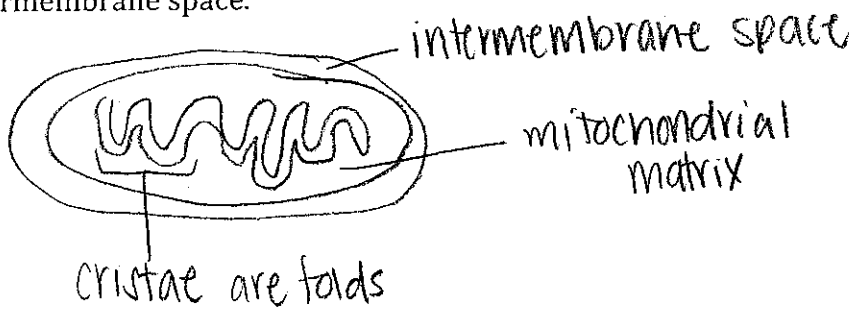
• organic material is recycled

#cytosol is neutral

8. What purpose do vacuoles serve in the cell?

digestion, waste disposal, storage, cell-growth

9. Draw a mitochondria and label the cristae, mitochondrial matrix, and the intermembrane space.



10. Explain how chloroplasts are arranged. Why are they green?

- thylakoids $\xrightarrow{\text{stacked into}}$ granum
 - stroma surrounds thylakoids

green because of plastids
 ↓
 amyloplast chromoplast

11. What is a peroxisome?

produces hydrogen peroxide (oxidation)
 - breaks down fatty acids & alcohol
 - detoxification

Cytoskeleton Component	Structure & Monomers	Functions
Microtubules	hollow tube formed from tubulin dimers	cell shape & support, chromosome movement, beating of flagella
Microfilaments	two twisted chains of actin	muscle contraction; maintain & change cell shape, cytoplasmic streaming
Intermediate filaments	supercoiled fibrous proteins of the keratin family	reinforce cell shape; anchor nucleus & form nuclear lamina

tracks for moving organelles

2/11/13

SI Session 7

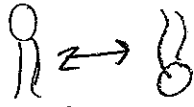
1. What is the accepted model of the cellular membrane, and what does it say about the structure of the membrane?


Fluid-mosaic: phospholipid bilayer studded with proteins

2. What is the function of cholesterol in membrane function? What is one other function of cholesterol?

- cholesterol helps maintain the fluidity of the membrane
- precursor to the synthesis of steroid hormones

3. Describe the difference between lateral movement and flip-flopping. Which is more common and why?

flip-flop: 

lateral: 

*lateral is more common b/c the hydrophilic head doesn't have to cross the hydrophobic interior

4. What is different about the cellular phospholipids in the cell of an animal that generally lives in cold environments? What about an animal that lives in warm environments?

cold: unsaturated hydrocarbons present
hot: saturated hydrocarbons present

5. What is the difference between peripheral proteins and integral proteins in the cellular membrane?

- integral extend through interior of membrane
- peripheral attach to surface of membrane

6. What is the function of carbohydrates in the cell membrane?

cell-cell recognition
(glycolipids & glycoproteins
ex: RBCs)

7. What three factors affect the permeability of molecules through the cell membrane?

a. size

b. charge

c. permeability of the membrane

8. Name the three types of passive transport. What does passive transport mean?

Simple diffusion

osmosis

facilitated diffusion

9. Explain the process of simple diffusion

no help of protein or energy, travels down concentration gradient

10. Explain the process of facilitated diffusion

no energy, substance travels through a protein

11. Explain the process of osmosis

movement of water down concentration gradient

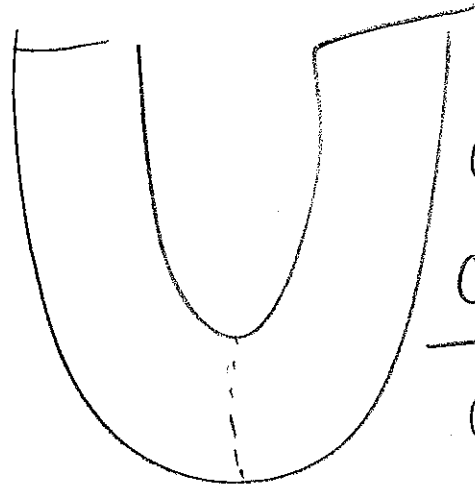
12. Explain what happens in each situation:

Solution Type	Animal Cell	Plant Cell
Isotonic equal concentration	nothing	Flaccid
Hypotonic	lyses	Turgid (normal)
Hypertonic	shriveled	plasmolyzed

≠ sucrose

0.2 glucose
0.1 sucrose
0.1 fructose

0.4 []



0.5 glucose
0.4 sucrose
0.3 fructose

0.12 []

← glucose
← fructose
→ H₂O