**CONCEPT 1 - BIOCHEMISTRY**

1. CHNOPS- most common elements in all living matter
2. 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)
3. pH
4. acid-base/ 0-14, # of H ions determines scale; logarithmic- pH 3 = 10-3 = 1/1000
5. blood- 7.4, stomach- 2, small intestine- 8; enzymes are specific to pH
6. 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
7. 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)
8. Carbohydrates- CHO 1:2:1 ratio, monomer= monosaccharides, 2=disaccharides, 3 or more= polysaccharides

* Used for energy (cell respiration)
* Examples

1. glucose- immediate energy to make ATP
2. starch- stored energy in plants
3. glycogen- stored energy in animals (stored in liver)
4. cellulose- plant cell wall
5. Lipids – C, H, O (not a 1:2:1 ratio) \*P only in phospholipids
6. fats, waxes, oils and sterols
7. Saturated fats have single bonds between carbons, unsaturated fats have at least one double bond between carbons (kinky); plants make polyunsaturated; animals make monounsaturated
8. Phospholipids make up cell membranes (double layer) and are amphipathic- hydrophilic and hydrophobic
9. Uses- in all membranes; stored energy, protection, insulation, myelin sheath of nerves
10. Proteins- C, H, O, N (may have other elements in R group)
11. Monomer- amino acids (20 total types), 2=dipeptide, 3 or more= polypeptide
12. 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.
13. 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.
14. Uses- protein carriers in cell membrane, antibodies, hemoglobin, enzymes, most hormones
15. Nucleic acids – C, H, O, N
16. Monomer= nucleotide, 2 = dinucleotide, 2 or more polynucleotide
17. Nucleotide made up of sugar, phosphate and base
18. Used to store genetic information
19. DNA is double stranded, has deoxyribose, A, G, C, T
20. RNA is single stranded, has ribose, A, G, C, U
21. mRNA- copies genetic message; rRNA- attaches mRNA and makes up ribosomes (most common);tRNA- carries amino acids; DNA- carries genetic code
22. Enzymes
23. Biological catalysts (made of protein) that speed up rate of chemical reactions by lowering activation energy required for reaction to occur
24. Enzyme has active site (exposed R groups) where reaction occurs
25. Enzymes can break down substance (catabolic reaction) or build up substances (anabolic)
26. Enzyme/substrate complex is formed
27. Substrate is what enzyme acts on
28. Rate is determined by collisions between substrate and enzyme
29. Ends in –ase, named after substrate often
30. Enzyme is specific to substrate; the substrate must be complementary to the surface properties (shape and charge) of the active site (which is made up of R groups with specific chemistry, i.e. hydrophobic).
31. Enzyme rate is affected by:

* **pH** (optimal for each enzyme),
* **temperature** (optimal for each enzyme but in general increased temp means increased collisions so rate goes up initially; too much heat can denature enzyme), enzyme concentration (more enzyme faster rate or vice versa)
* **substrate concentration** (more substrate faster rate; vmax is fastest enzyme can work when saturated)

1. Inhibition-competitive inhibition (something competes for active site; can be overcome with more substrate)
2. Non-competitive inhibition- attaches at allosteric site and changes shape of enzyme so it is not functional; can not be overcome with more substrate
3. Coenzymes (organic; NAD and vitamin B etc.) and cofactors (inorganic; zinc, magnesium etc.) interact with enzymes to put them into the right structure to do work.

***Vocabulary***

active site

allosteric site

amino acid

amphipathic

anabolic

carbohydrate

carbon

catabolic

catalyst

coenzyme

denaturation

disaccharide

hydrogen bond

hydrophilic

hydrophobic

ion

lipid

macromolecule

monomer

monosaccharide

non-polar molecule

nucleic acid

nucleotide

organic molecule

peptide bond

polar molecule

polymer

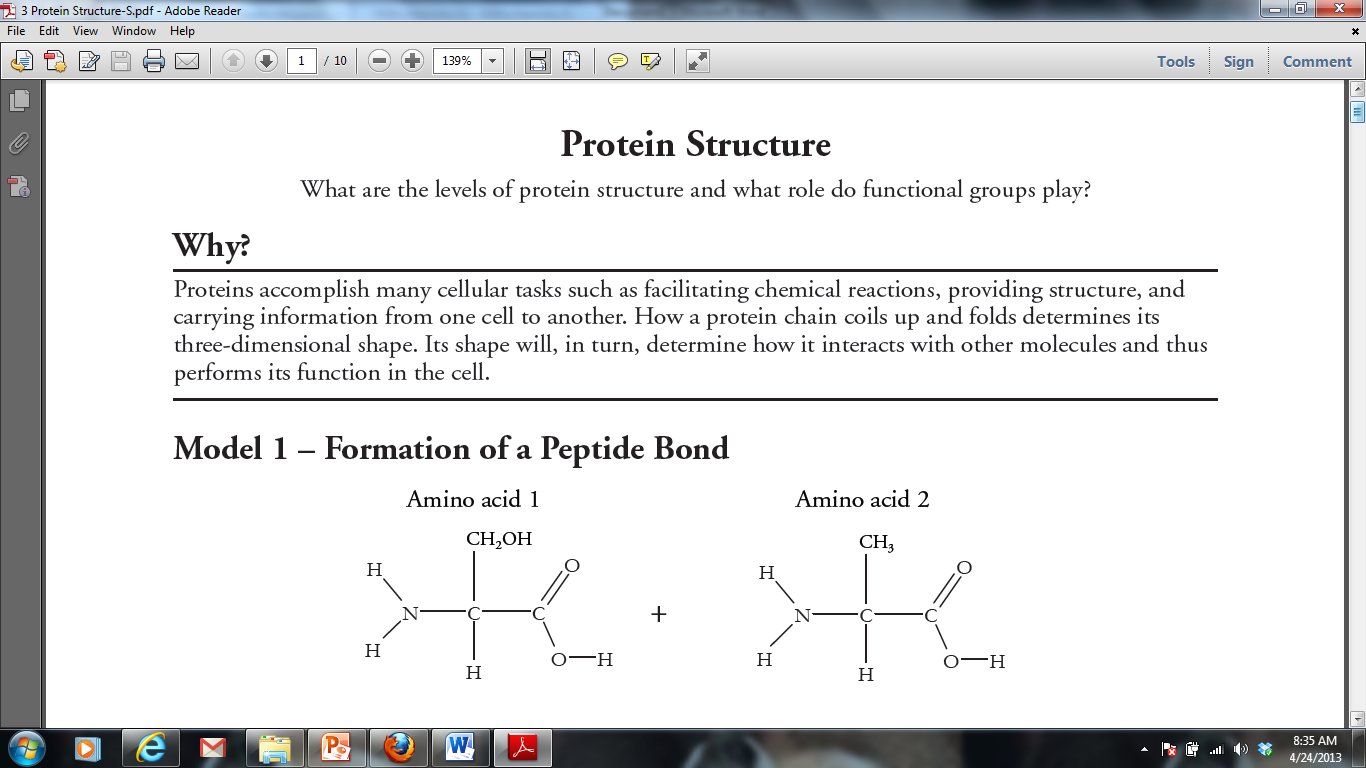
protein

substrate

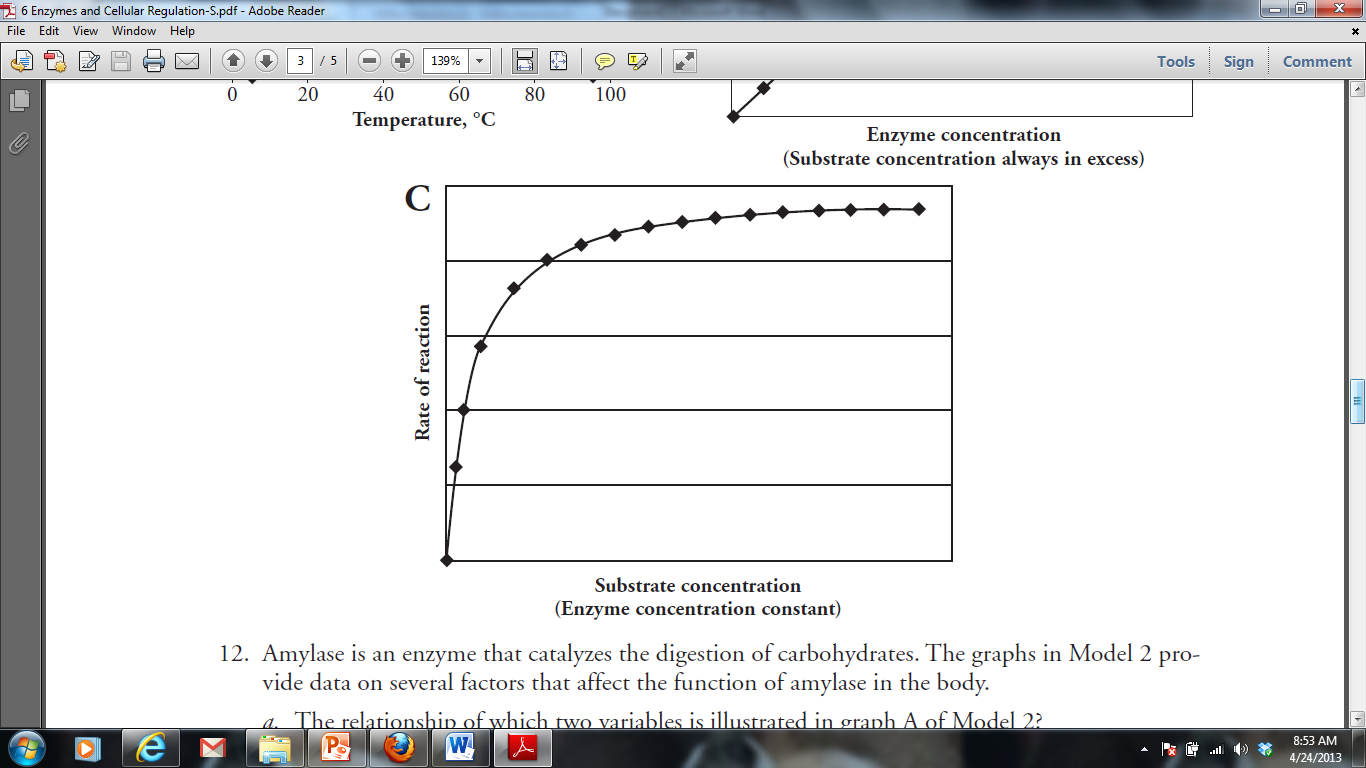
water

***Thinking Practice***

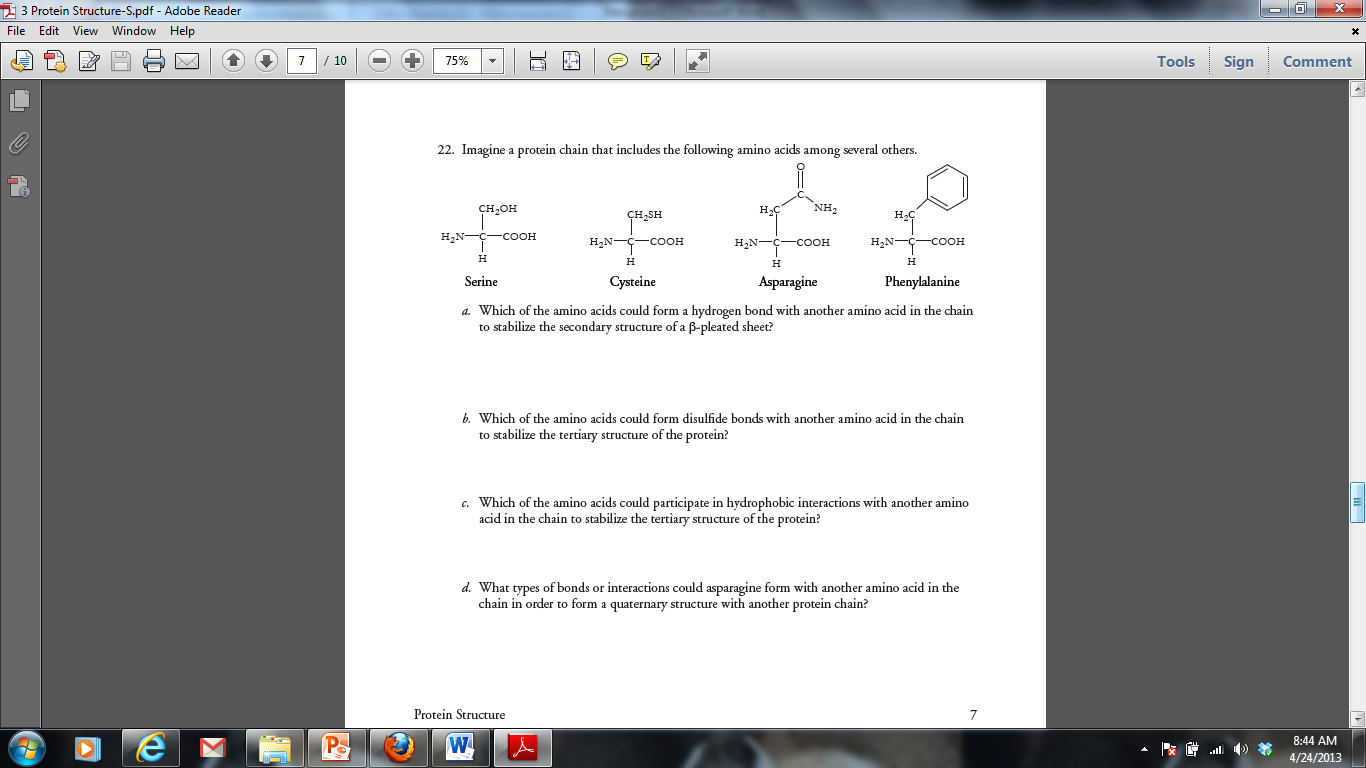
1. If the following molecules were to undergo a dehydration synthesis reaction, what molecules would result? **Circle** the parts of each amino acid that will interact and **draw** the resulting molecule.



1. Construct a bar graph that displays the relative amounts of hydrogen, carbon, oxygen, and nitrogen in each of the four types of macromolecules (carbohydrates, lipids, proteins, nucleic acids).
2. Describe the relationship between substrate concentration and reaction rate shown in the graph below and propose an explanation for it.



1. DNA polymerase from *T. aquaticus (Taq)* is used in PCR (polymerase chain reaction). PCR is a technique where millions of copies of DNA can be made from one original copy. In this method, the target DNA molecule is subjected to temperatures over 95 °C to make the double-stranded DNA separate. The temperature is then lowered slightly to allow primers to anneal before the *Taq* polymerase catalyzes the reactions to incorporate new nucleotides into the complementary strands. The cycle is then repeated over and over until there are millions of copies of the target DNA.
2. Predict why this bacterial polymerase is used instead of a human polymerase.
3. What would happen if you used a human polymerase in a series of PCR reactions?



5.

**Biochemistry – Short Free Response (4 points)**

Water is importan t for all living organisms. The functions of water are directly related to its physical properties. Describe how the properties of water contribute to TWO of the following:

* Transpiration
* thermoregulation in endotherms
* plasma membrane structure