Study guide and possible essay questions on the next pages…..
Biochemistry Reading Guide (plus a little bit from earlier chapters)

These are questions to help you as you read/skim through the first five chapters of the old Campbell Biology textbook or the first three chapters of the new Biology in Focus textbook and/or watch the youtube videos. These will not be collected; however, this will be helpful for you as you study for our first unit exam (which will be on the third day of school).

Chapter 1 Questions (for both textbooks)

1. What are emergent properties? Give three examples to illustrate this.
2. What are the levels of biological organization? Give an example of each level.
3. What is bioinformatics? What is studied at this level?
4. What are the three basics of systems strategy in the study of genomics?
5. Compare and contrast negative and positive feedback. Give an example of each.
6. How many species of organisms have been identified so far? How does this contrast with the number of estimated species on the planet?
7. What are the two important qualities of a scientific hypothesis? Use examples to illustrate each.
8. Can a hypothesis be proven correct? Explain and give a specific example in your explanation.
9. What are the limits of science? Could science answer the question of intelligent design? Why or why not?
10. What is a scientific theory? How is a scientific theory different from a hypothesis? List and describe the three ways.
11. What is a scientific model? What are the important characteristics of a model? What forms can a model take?
12. A typical prokaryotic cell has about 3,000 genes in its DNA, while a human cell has about 20,500 genes. About 1,000 genes are present in both types of cells. Based on your understanding of evolution, explain how such different organisms could have the same subset of genes. What sorts of functions might these shared genes have?
13. The fruits of wild species of tomato are tiny compared to the gigantic beefsteak tomatoes available today. This difference in fruit size is almost entirely due to the larger number of cells in the domesticated fruits. Plant molecular biologists have recently discovered genes that are responsible for controlling cell division in tomatoes. Why would such a discovery be important to producers of other kinds of fruits and vegetables? To the study of human development and disease? To our basic understanding of biology?

Chapter 2 Questions (for both textbooks)

1. What is an isotope? A radioactive isotope? What are some useful applications of radioactive isotopes? Describe at leas three.
2. Explain what happens when light hits the atoms in chlorophyll during photosynthesis.
3. Why do atoms bond? What is a covalence bond? Ionic bond? For covalent bonds, define and give an example of single, double, and triple bonds. Make sure you could give the structural and Lewis dot diagrams of (a) H_2, (b) O_2, (c)H20, (D) CH4, (E) C2H4
4. What is a covalent bond? What is electronegativity. Compare and contrast nonpolar and polar bonds.
5. Describe why water has a localized positive and localized negative charge. Make sure you define and use electronegativity and polar.
6. What are ionic bonds? How are they formed? What is a cation? Anion? Use this to describe why salts form crystals.
7. Describe and give the importance of (a) van del Waals interactions, di-sulfide bridges,
8. Why is molecular shape crucial in Biology? Give two specific examples to support your answer.

Chapter 3 Questions (in Campbell Biology; part of chapter 2 in Focus in Biology)

1. What are hydrogen bonds? Why do they form between water molecules? Describe in detail the emergent properties water has because of hydrogen bonding between water molecules.
2. Describe how properties of water contribute to the upward movement of water in a tree.
3. Make sure you understand and can give examples of a solvent, solute, solution, hydrophilic and hydrophobic substances, colloids, moles, molarity, concentration.
4. Define and give an example of an acid and a base. At what pH are the solutions inside/around most living organisms?
5. What are buffers? What do they do? What buffer is found in our blood? Describe how it works.
6. What is acid precipitation? How is it caused? Why is it a problem?

Chapter 4 Questions (in Campbell Biology; part of chapter 3 in Focus in Biology)

1. Explain why the carbon atom is so versatile and why it is so important for life.
2. What are isomers? What is the different between structural, geometric and enantiomers? Give an example of each.
3. How are gasoline and fat similar?
4. What does the term amino acid signify about the structure of such a molecule?
5. What is ATP? Make a sketch of ATP. What chemical change occurs when ATP reacts with water and releases energy?

Chapter 5 Questions (in Campbell Biology; part of chapter 3 in Focus in Biology)

1. Outline the differences between dehydration and hydrolysis reactions. How are both reactions important to many biological molecules?
2. To what do the terms monosaccharide, disaccharide, and polysaccharide refer? What do all three have in common?
3. State the general molecular formula for a monosaccharide. Write the straight chain and ring structural formulas for alpha glucose and number the carbon atoms.
4. List and describe the differences between amylose, amylopectin, and glycogen. Where would each be found?
5. Compare the primary structure of amylose with that of cellulose. How do they differ in their secondary structure (glycosidic linkages)? What are the dietary implications of the difference? What is it that makes cellulose so strong?
6. Name the components of a triglyceride. What reaction is used to join the components? What feature of the composition of a triglyceride makes it hydrophobic?
7. Distinguish between an oil and a fat and between a saturated and unsaturated fat. Where are saturated fats more common? Unsaturated fats?
8. Describe the general structure of phospholipids. Why are they amphipathic?
9. List the special uses of steroids. How do steroids differ structurally from other lipids?
10. Define the term protein. How does a protein differ from a polypeptide? What are six significant uses for proteins? State two specific examples for each.
11. What do all amino acids have in common? What are the three groups of amino acids? What process links two amino acids together? Describe the reaction and the name of the bond formed.
12. Describe the four levels of organization possible in a protein and explain what forces are involved at each level. What must a protein have in order to have a quaternary structure? Why is the three dimensional shape of a protein so important?
13. What is denaturation? How or when may it occur? What does a protein do when it becomes denatured?
14. Draw and identify the three monomers founding a nucleotide.
15. What is the difference between a purine and a pyrimidine? How are purines and pyrimidines linked in a double helix? Which ones attach to which?

Possible long and short essay questions

1. Acetic acid (CH_3COOH) can be a buffer, similar to carbonic acid. Write the dissociation reaction, identifying the acid, base, H^+ acceptor and H^+ donor.
2. Design a controlled experiment to test the hypothesis that acid precipitation inhibits the growth of *Elodea*, a common freshwater plant.
3. In agricultural areas, farmers pay close attention to the weather forecast. Right before a predicted overnight freeze, farmers spray water on their crops to protect the plants. Use the properties of water to explain how this method works. (Be sure your explanation includes the role of hydrogen bonds).
4. What if you had an organic molecule such as glycine, and you chemically removed the $-NH_2$ group and replaced it with –COOH. Draw the structural formula for this new molecule and speculate about its chemical properties.
5. In 1918, an epidemic of sleeping sickness cause an unusual rigid paralysis in some survivors, similar to symptoms of advanced Parkinson's disease. Years later, L-dopa was given to some of these patients, as dramatized in the movie *Awakenings*. L-dopa was remarkably effective at eliminating paralysis, at least temporarily. However, its enantiomer D-dopa was subsequently shown to have not effect at all, as is the case for Parkinson's disease. Suggest a hypothesis to explain why, for both diseases, one enantiomer is effective and the other is not.
6. The unique properties of water make life possible on Earth. Select three properties of water and
   a. for each property identify and define the property and explain it in terms of the physical/chemical nature of water.
   b. for each property describe one example of how the property affects the functioning of living organisms.

7. The physical nature of a protein often reflects and affects its function.
   a. Describe three type of chemical bonds/interactions found in proteins. For each type, describe its role in determining protein structure.
   b. Discuss how the structure of a protein affects the functions of two of the following.
      - muscle contraction
      - regulation of enzyme activity
      - cell signaling
8. Water is essential to all living things.
   a. Discuss three properties of water.
   b. Explain each of the following in terms of the properties of water. You are not limited to the three properties discussed in part (a).
      - the role of water as a medium for the metabolic processes of cells
      - the ability of water to moderate temperature within living organisms and in organisms' environments
      - the movement of water from the roots to the leaves of plants
9. Water is important for all living organisms. The functions of water are directly related to its physical properties. Describe how the properties of water contribute to
   - transpiration
   - thermoregulation of endotherms
   - plasma membrane structure