

## ***BERG/STRYER VI STUDY GUIDE***

### **CHAPTER 1**

**COMPANION:** Always start with **Chapter Summary**. After reading chapter, go through **Learning Objectives** and **Self-Test**. Look at **Problems** and their answers

**TEXT:** The most powerful lesson of Biochemistry is the great similarity between all forms of life on Earth. There is basically one “operating system” and one kind of “software” – the genetic code – used by every organism on the planet. The only logical explanation for this similarity is **common ancestry**, which means all living things are related, far back in time. There are three domains of life, the **Eukarya** (eukaryotes), the **Bacteria** (prokaryotes), and the **Archaea**. See Figure 1.3. All multicellular organisms are Eukarya, and their cells have nuclei and other structures inside. Bacteria have no nucleus and no real subcellular compartments. Archaea are single celled organisms with no nucleus which tend to be found in extreme environments like hot, acidic, or salty places. Pay close attention to the time-line in Figure 1.2. We will look at banded iron and stromatolites in class. Stromatolites are photosynthesizing colonies which put oxygen into the air. Banded iron is made of iron which could only be dissolved in water under anaerobic conditions. These rocks provide evidence that the Earth used to be anaerobic, with no free oxygen. Know the structure of **DNA** as described on pages 4-5. Be able to draw the 4 bases and show where sugars attach. Be able to draw AT or GC **base pairs**. Be able to recognize and draw a right-handed helix.

Molecules are held together by **covalent** bonds, which are quite strong. A few weak **noncovalent** forces determine how proteins fold and how enzymes bind to their substrates. Understand **electrostatic interactions**, **hydrogen bonds**, and **van der Waals forces**. The omnipresence of water adds **hydrophobic interactions** as an apparent fourth weak force. Know that **entropy** is basically a measure of disorder, and that from the second law of thermodynamics we can derive an expression for **free energy** change,  $\Delta G = \Delta H_{\text{system}} - T\Delta S_{\text{system}}$ . In protein folding, the folding appears to make the entropy go down (the protein is getting organized) but in fact the entropy of the water interacting with the protein goes up as the hydrophobic groups are tucked away inside. And the “weak forces” contribute favorable **enthalpy** as well during folding.

Understand the discussion of acid-base chemistry (14-16) and know the **Henderson Hasselbalch equation** on page 17. See handout on *pH and Buffer Problems*. The handout is focused on amino acids but the chemistry is the same with nucleotides etc.

Your DNA contains all of the sequence information for arranging amino acids into protein chains. The fact that we now know the sequence of the human genome is highly significant for research and medicine. Genetic diseases can be easily understood if the variation in DNA sequence can be found.

Spend a little time looking at the appendix, and familiarize yourself with the significance of the different colors. Models and structures are an important part of Biochemistry.