

## BERG/STRYER V STUDY GUIDE

### CHAPTER 1

1. *COMPANION:* Go through learning objectives and self-test. Look at Problems and their answers. 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. Know how **RNA** differs from DNA. Know that genes specify the **amino acid** sequences of the proteins in a cell. The folding of **proteins** allows the one-dimensional information held in gene sequences to enter the 3-dimensional world of the cell.
2. 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**. 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.
3. 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,  $G = H_{\text{system}} - T S_{\text{system}}$ . 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.
4. Please pay attention to section 1.4, which is a discussion of why Biochemistry is so interesting. Also understand the various models introduced in the appendix, and learn the color code, black is C, blue is N, red is O, and white is H. Yellow can be sulfur or phosphorus.

### CHAPTER 2

1. *COMPANION:* Learning objectives, self-test. Read over Problems, answers. Be able to describe **Stanley Miller's** experiment (Figure 2.1). This is no longer considered a good model for the origin of biomolecules because there was no **reducing atmosphere** over the early Earth. The same principles would apply to clouds in outer space or deep ocean chemistry.
2. Evolution requires **reproduction**, **variation**, and **selective pressure**. Any system with these properties will evolve. Spiegelman's experiments with RNA and Q replicase showed that molecules can evolve. We also know that RNA can act as a catalyst – ribozymes are enzymes made of RNA. This has led some people to visualize an RNA world, in which RNA acts as gene and enzyme and does most of the jobs in a cell. Today all protein is built by RNA. Others think there must have been an earlier way to form proteins, and that proteins predate RNA.
3. The rest of the chapter describes common features of life on Earth. ATP is used as energy currency, cells are surrounded by membranes. There are ion pumps to counter osmotic forces, and these pumps can be run backward to make ATP. Molecular oxygen, while dangerously toxic, can be harnessed for metabolism.
4. Pay close attention to the time-line in Figure 2.27. We will look at banded iron and stromatolites in class. Understand the implications of these! Where did our oxygen come from? And how did cells have to change to allow development of multicellular organisms?