**Study Guide for General Biology I**

**Chapter 2**

***Make Flash Cards:***  It is highly recommended to make flash cards of all vocabulary terms in the chapter and in the lecture notes (PowerPoints).

***Use the following expected student learning outcomes as a guide for studying this chapter…***

**CHAPTER 2: THE NATURE OF MOLECULES AND THE PROPERTIES OF WATER**

2.1 The Nature of Atoms

* Define matter, atom, and element.
* Recall where atoms fit into the hierarchical organization of living systems.
* Recite Bohr’s view of atomic theory, using the terms electron, proton, neutron, and *atomic* nucleus.
* Define electron, proton, and neutron.
* Define “atomic number” and explain how it relates to the concept of an “element”.
* Distinguish between mass and weight.
* Define atomic mass.
* Define Dalton (also known as “atomic mass unit” or “amu”).
* Interpret simple diagrams of atoms (see Figures 2.3 and 2.4).
* Define anion, cation, and neutral atom.
* Recall that atoms and their electron orbitals are three dimensional (see Figure 2.5).
* Define isotope and radioactive isotope.
* Use electron “shell” diagrams to describe the structure of an atom (see Figure 2.9).
* Recall that electrons determine the chemical behavior of atoms.

2.2 Elements Found in Living Systems

* Define “valence electron” and briefly state why they are important in chemistry.
* Explain the significance of the number “8” in reference to electrons (the so-called “octet rule”).
* Recognize the periodic table of elements and interpret the information in an entry for a given element.
* Define “organic compound”.
* List the four most common elements in living systems.

2.3 The Nature of Chemical Bonds

* Know that “chemical bonds” are what allow atoms to combine to form molecules.
* Define molecule and chemical bond.
* Distinguish between “element” and “compound”.
* Define ionic bond.
* Using sodium chloride as an example, describe how ionic bonds form crystals.
* Define “ionic compound”.
* Define covalent bond.
* Explain how two hydrogen atoms can form a molecule of hydrogen.
* List three reasons for the stability of a hydrogen molecule.
* Recall that there are single, double, and triple covalent bonds.
* Interpret structural formulas and molecular formulas.
* Recall that molecules can contain many more than two atoms, and many chemical bonds.
* Distinguish between a diatomic molecule and a compound.
* Explain how the structure of a carbon atom allows it to be part of many different types of molecules.
* Be able to reproduce Table 2.1.
* Define electronegativity, polar, and nonpolar.
* Define “polar covalent bond”.
* Recall that oxygen has high electronegativity.
* Explain why polar or nonpolar is a characteristic of molecules, but not a characteristic of a single atom.
* Define chemical reaction, reactant, and product.
* Interpret a simple chemical equation (see page 25).
* List three things that influence the extent to which chemical reactions occur.
* Define catalyst.
* Recall that many reactions are reversible.
* Distinguish between a polar covalent bond and an ionic bond.

2.4 Water: A Vital Compound

* Recall that water is essential for life on Earth.
* Draw the structure of a water molecule, including the atoms, electrons, and partial charges.
* Explain how the structure of a water molecule makes it polar, including the word “electronegativity” in your explanation.
* Draw two water molecules engaging in a hydrogen bond (see Figure 2.12).
* Explain why hydrogen bonds form with molecules, but not between two single atoms.
* Explain how polar covalent bonds are related to hydrogen bonding.
* Know that molecules are three dimensional structures (not flat, like they appear in some diagrams).
* Know that the polar nature of water underlies its importance in the chemistry of life.
* Define the properties of water known as cohesion and adhesion, and give examples of them in living systems.

2.5 Properties of Water

* Know that water heats up more slowly than almost any compound and holds its temperature longer.
* Explain the significance, for living systems, of water’s high specific heat.
* Know that solid water floats in liquid water, and that this is an unusual property for a compound.
* Know that water facilitates cooling due to its heat of vaporization.
* Know that water functions well as a solvent for ions and other polar molecules.
* Define solvent, solute, and soluble.
* Define hydrophobic and hydrophilic.
* Explain how water can ionize to release hydrogen ions (protons).
* Looking at a diagram of a hydrogen atom, describe how “hydrogen ion” and “proton” can mean the same thing.
* Define mole and molar concentration.
* Know how the important properties of water noted in section 2.5 are due to water’s hydrogen bonding behavior.

2.6 Acids and Bases

* Define acidity and basicity (or acid and base).
* Define pH.
* Know what the position of a solution on the pH scale means about its hydrogen ion concentration.
* Know what is meant by “neutral” on the pH scale.
* Use pH values to determine the relative acidity or basicity of materials.
* Define buffer.
* Explain why buffers are important in living systems.

**In addition to the above objectives, also do the following:**

* Accomplish the “Learning Outcomes” in this chapter and be able to do the “Learning Outcomes Review” items.
* Read and look at the information in any “Scientific Thinking” figures for this chapter and be able to use the information to illustrate the classic steps and process of a scientific investigation.
* Know the material in the Chapter Review.
* Do the “Understand” and “Apply” questions in the chapter Review Questions and know *why* the correct answer is the right choice (and *why* the incorrect answers are the wrong choices). Be able to answer similar questions based on any of the above specific learning objectives.