AP Biology Summer Assignment

You have signed up for a challenging and rewarding course for the 2019-2020 school year. In order to make sure that you are thinking about AP Biology once school is out, I want you to do a little preparation work over the summer.

Part I. Read Chapter 2- 7 and answer the following CONCEPT CHECK QUESTIONS that correspond to each chapter. You will be TESTED on the concept within the FIRST WEEK of school.

Chapter 2: The Chemical of Life

Concept Check 2.1

1. Review the discussion of emergent properties in Chapter 1 (p. 3). Explain how table salt has emergent properties.

2. Is a trace element an essential element? Explain.

3. In humans, iron is a trace element required for the proper functioning of hemoglobin, the molecule that carries oxygen in red blood cells. What might be the effects of an iron deficiency?

4. Review the discussion of natural selection in Chapter 1 (pp. 14–16) and explain how natural selection might have played a role in the evolution of species that are tolerant of serpentine soils.

Concept Check 2.2

1. A lithium atom has 3 protons and 4 neutrons. What is its atomic mass in Daltons?

2. A nitrogen atom has 7 protons, and the most common isotope of nitrogen has 7 neutrons. A radioactive isotope of nitrogen has 8 neutrons. Write the atomic number and mass number of this radioactive nitrogen as a chemical symbol with a subscript and superscript.

3. How many electrons does fluorine have? How many electron shells? Name the orbitals that are occupied. How many electrons are needed to fill the valence shell?

4. In Figure 2.9, if two or more elements are in the same row, what do they have in common? If two or more elements are in the same column, what do they have in common?

Concept Check 2.3

1. Why does the structure H¬C“C¬H fail to make sense chemically?

2. What holds the atoms together in a crystal of magnesium chloride (MgCl2)?

3. If you were a pharmaceutical researcher, why would you want to learn the three-dimensional shapes of naturally occurring signaling molecules?

Concept Check 2.4

1. Consider the reaction between hydrogen and oxygen that forms water, shown with ball-and-stick models on page 42. Study Figure 2.12 and draw the Lewis dot structures representing this reaction.

2. Which type of chemical reaction occurs faster at equilibrium, the formation of products from reactants or reactants from products?

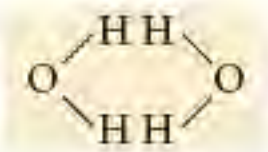
3. Write an equation that uses the products of photosynthesis as reactants and the reactants of photosynthesis as products. Add energy as another product. This new equation describes a process that occurs in your cells. Describe this equation in words. How does this equation relate to breathing?

Chapter 3: Water and Life

Concept Check 3.1

1. What is electronegativity, and how does it affect interactions between water molecules? Review p. 39 and Figure 2.13.

2. Why is it unlikely that two neighboring water molecules would be arranged like this?



3. What would be the effect on the properties of the water molecule if oxygen and hydrogen had equal electronegativity?

Concept Check 3.2

1. Describe how properties of water contribute to the upward movement of water in a tree.

2. Explain the saying “It’s not the heat; it’s the humidity.”

3. How can the freezing of water crack boulders?

4. The concentration of the appetite-regulating hormone ghrelin is about 1.3×10^{-10} *M* in a fasting person. How many molecules of ghrelin are in 1 L of blood?

5. A water strider (which can walk on water) has legs that are coated with a hydrophobic substance. What might be the benefit? What would happen if the substance were hydrophilic?

Concept Check 3.3

1. Compared with a basic solution at pH 9, the same volume of an acidic solution at pH 4 has ____ times as many hydrogen ions (H^+).

2. HCl is a strong acid that dissociates in water: HCl → H^++ CL^-. What is the pH of 0.01 *M* HCl?

3. Acetic acid (CH3COOH) can be a buffer, similar to carbonic acid. Write the dissociation reaction, identifying the acid, base, H_ acceptor, and H_ donor.

4. Given a liter of pure water and a liter solution of acetic acid, what would happen to the pH if you added 0.01 mol of a strong acid to each? Use the reaction equation from question 3 to explain the result.

Chapter 4: Carbon and the Molecular Diversity of Life

Concept Check 4.1

1. Why was Wöhler astonished to find he had made urea?

2. When Miller tried his experiment without the electrical discharge, no organic compounds were found. What might explain this result?

Concept Check 4.2

1. Draw a structural formula for C_2H_4.

2. Which molecules in Figure 4.5 are isomers? For each pair, identify the type of isomer.

3. How are gasoline and fat chemically similar?

4. Can propane (C_3H_8) form isomers?

Concept Check 4.3

1. What does the term *amino acid* signify about the structure of such a molecule?

2. What chemical change occurs to ATP when it reacts with water and releases energy?

3. Suppose you had an organic molecule such as cysteine (see Figure 4.9, sulfhydryl group example), and you chemically removed the —NH_2 group and replaced it with —COOH. Draw the structural formula for this molecule and speculate about its chemical properties. Is the central carbon asymmetric before the change? After?

Chapter 5: The Structure and Function of Large Biological Molecules

Concept Check 5.1

1. What are the four main classes of large biological molecules? Which class does not consist of polymers?

2. How many molecules of water are needed to completely hydrolyze a polymer that is ten monomers long?

3. Suppose you eat a serving of fish. What reactions must occur for the amino acid monomers in the protein of the fish to be converted to new proteins in your body?

Concept Check 5.2

1. Write the formula for a monosaccharide that has three carbons.

2. A dehydration reaction joins two glucose molecules to form maltose. The formula for glucose is $C_6H_{12}O_6$. What is the formula for maltose?

3. After a cow is given antibiotics to treat an infection, a vet gives the animal a drink of "gut culture" containing various prokaryotes. Why is this necessary?

Concept Check 5.3

1. Compare the structure of a fat (triglyceride) with that of a phospholipid.

2. Why are human sex hormones considered lipids?

3. Suppose a membrane surrounded an oil droplet, as it does in the cells of plant seeds. Describe and explain the form it might take.

Concept Check 5.4

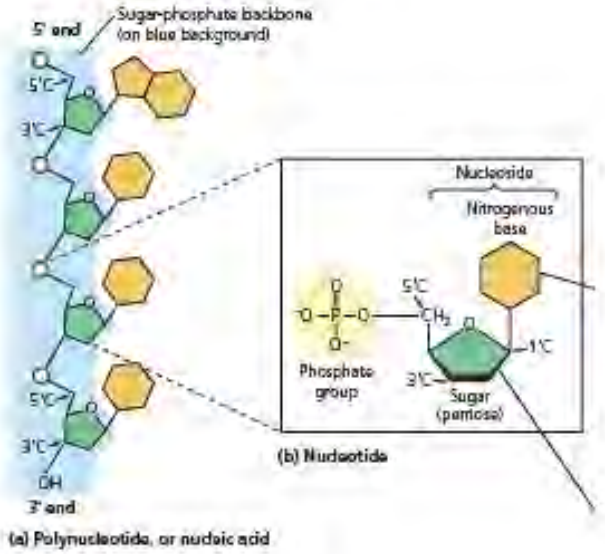
1. Why does a denatured protein no longer function normally?

2. What parts of a polypeptide participate in the bonds that hold together secondary structure? Tertiary structure?

3. When would you expect an polypeptide region that is rich in the amino acids valine, leucine, and isoleucine to be located in the folded polypeptide? Explain?

Concept Check 5.5

1. Go to figure 5.26a below and, for the top three nucleotides, number all the carbons in the sugars, circle the nitrogenous bases and star the phosphates.



2. In a DNA double helix, a region along one DNA strand has this sequence of nitrogenous bases: 5'-TAGGCCT-3'. Copy this sequence, and write down its complementary strand, clearly indicating the 5' and 3' ends of the complementary strand.

3. (a) Suppose a substitution occurred in one DNA strand of the double helix in question 2, resulting in
5'-TAAGCCT-3'
3'-ATTCGGA-5'
Copy these two strands, and circle and label the mismatched bases.

(b) If the modified top strand is used by the cell to construct a complementary strand, what would that matching strand be?

Chapter 6: A Tour of A Cell

Concept Check 6.1

1. How do stains used for light microscopy compare with those used for electron microscopy?

2. Which type of microscope would you use to study (a) the changes in shape of a living white blood cell and (b) the details of surface texture of a hair?

Concept Check 6.2

1. After carefully reviewing Figure 6.8, briefly describe the structure and function of the nucleus, the mitochondrion, the chloroplast, and the endoplasmic reticulum.

2. Imagine an elongated cell (such as a nerve cell) that measures 125 _ 1 _ 1 arbitrary units. Predict how its surface-to-volume ratio would compare with those in Figure 6.7. Then calculate the ratio and check your prediction.

Concept Check 6.3

1. What role do ribosomes play in carrying out genetic instructions?

2. Describe the molecular composition of nucleoli and explain their function.

3. As a cell begins the process of dividing, its chromatin becomes more and more condensed. Does the number of chromosomes change during this process? Explain.

Concept Check 6.4

1. Describe the structural and functional distinctions between rough and smooth ER.

2. Describe how transport vesicles integrate the endomembrane system.

3. Imagine a protein that functions in the ER but requires modification in the Golgi apparatus before it can achieve that function. Describe the protein's path through the cell, starting with the mRNA molecule that specifies the protein.

Concept Check 6.5

1. Describe two common characteristics of chloroplasts and mitochondria. Consider both function and membrane structure.

2. Do plant cells have mitochondria? Explain.

3. A classmate proposes that mitochondria and chloroplasts should be classified in the endomembrane system. Argue against the proposal.

Concept Check 6.6

1. Describe shared features of microtubule-based motion of flagella and microfilament-based muscle contraction.

2. How do cilia and flagella bend?

3. Males afflicted with Kartagener's syndrome are sterile because of immotile sperm, and they tend to suffer from lung infections. This disorder has a genetic basis. Suggest what the underlying defect might be.

Concept Check 6.7

1. In what way are the cells of plants and animals structurally different from single-celled eukaryotes?

2. If the plant cell wall or the animal extracellular matrix were impermeable, what effect would this have on cell function?

3. The polypeptide chain that makes up a tight junction weaves back and forththrough the membrane four times, with two extracellular loops, and one loop plus short C-terminal and Nterminal tails in the cytoplasm. Looking at Figure 5.16 (p. 79), what would you predict about the amino acid sequence of the tight-junction protein?

Chapter 7: Membrane Structure and Function

Concept Check 7.1

1. The carbohydrates attached to some proteins and lipids of the plasma membrane are added as the membrane is made and refined in the ER and Golgi apparatus. The new membrane then forms transport vesicles that travel to the cell surface. On which side of the vesicle membrane are the carbohydrates?

2. The soil immediately around hot springs is much warmer than that in neighboring regions. Two closely related species of native grasses are found, one in the warmer region and one in the cooler region. If you analyzed their membrane lipid compositions, what would you expect to find? Explain.

Concept Check 7.2

1. Two molecules that can cross a lipid bilayer without help from membrane proteins are O_2 and CO_2. What property allows this to occur?

2. Why is a transport protein needed to move water molecules rapidly and in large quantities across a membrane?

3. Aquaporins exclude passage of hydronium ions (H3O_; see pp. 52–53). Recent research on fat metabolism has shown that some aquaporins allow passage of glycerol, a three-carbon alcohol (see Figure 5.10, p. 75), as well as H2O. Since H3O_ is much closer in size to water than is glycerol, what do you suppose is the basis of this selectivity?

Concept Check 7.3

1. How do you thi nk a cell performing cellular respiration rids itself of the resulting CO2?

2. In the supermarket, produce is often sprayed with water. Explain why this makes vegetables look crisp.

3. If a *Paramecium caudatum* swims from a hypotonic to an isotonic environment, will its contractile vacuole become more active or less? Why?

Concept Check 7.4

1. Sodium-potassium pumps help nerve cells establish a voltage across their plasma membranes. Do these pumps use ATP or produce ATP? Explain.

2. Explain why the sodium-potassium pump in Figure 7.18 would not be considered a cotransporter.

3. Review the characteristics of the lysosome in Concept 6.4 (pp. 106–107). Given the internal environment of a lysosome, what transport protein might you expect to see in its membrane?

Concept Check 7.5

1. As a cell grows, its plasma membrane expands. Does this involve endocytosis or exocytosis? Explain.

2. Return to Figure 7.12, and circle a patch of plasma membrane that is coming from a vesicle involved in exocytosis.

3. In Concept 6.7 (pp. 119–120), you learned that animal cells make an extracellular matrix (ECM). Describe the cellular pathway of synthesis and deposition of an ECM glycoprotein.