AP Biology Summer Assignment 2024

Required textbook:

Campbell Biology in Focus, 3rd Edition, ISBN 9780135964422

Read Chapters 1-3, and either type or hand write your answers. Make sure you understand the **bolded terms.** If you are not familiar with the term, define it in your notes.

Your **printed** completed reading guides will be collected on the first day of class.

Chapter 1: Introduction: Evolution and the Foundations of Biology

We will start the year with an introduction to inquiry, the themes of this course, and evolutionarily, how living organisms all came to be as they are today.

Concept 1.1 The study of life reveals unifying themes

1. There are five organizing themes to AP Biology as a course. Without looking ahead, list a few words or ideas that are involved in each of:
    a. **Organization**
    b. **Information**
    c. **Energy and Matter**
    d. **Interactions**
    e. **Evolution**
2. What are **emergent properties?** Give two examples.
3. How does **systems biology** frame the study of life? What is part of *your* system? Consider biotic and abiotic factors, what substances you intake and put out in a single day.
4. List and describe five differences between **eukaryotic and prokaryotic** cells.
5. In no more than two sentences, summarize the takeaways of Figure 1.3.
6. Define:
    a. **Genes**
    b. **Gene expression**
    c. **Genome**
    d. **Genomics** and how it relates to and differs from….
    e. **Proteomics**
    f. **Bioinformatics**
7. On any given day, how do you take in, convert, and utilize energy?
8. On any given day, how do you interact with other organisms in your environment? (Not just humans, any and all other life forms!)

Concept 1.2 The Core Theme: Evolution accounts for the unity and diversity of life

9. What is your favorite organism? Do some research and find out how long it has been in its current state, and what other organisms it's related to on an evolutionary time span.

10. How do **bacteria, archaea, and eukarya** relate to each other? What are some key differences between each domain? Why do we (humans) care the most about the wonderful diversity of eukarya?
11. Think of any species or multiple species that you interact with - describe the unity/diversity combination of that specie(s). See Figure 1.15 for an example.
12. Darwin's idea of natural selection was born out of his observations of "descent with modification". In your own words, explain what **survival of the fittest** means. Consult Figure 1.16 for visual aids.

Concept 1.3 In studying nature, scientists form and test hypotheses

13. What is your current understanding of the scientific method? How do you think the idea of **inquiry** might change that understanding?
14. Explain the difference between **inductive and deductive reasoning**.
15. After digesting Figure 1.19, how does your understanding of the scientific method change, expand, or differ?
16. Define:
    a. **Controlled experiment**
    b. **Independent variable**
    c. **Dependent variable**
    d. **Theory**
17. Describe an experiment to test plant growth under red, green, and white lights. How would you set this (hypothetical!) experiment up? What environmental controls do you need? What are the independent and dependent variables?

Chapter 2: The Chemical Context of Life

In previous classes, you have learned about atoms, molecules, reactions and bonds. Now, we will look at those within a biological context.

Concept 2.1 Matter consists of chemical elements in pure forms and in combinations called compounds

1. Explain the difference between an **element** and a **compound**.
2. How do **essential elements** differ from **trace elements?**

Concept 2.2 An element's properties depend on the structure of its atoms

3. List the three subatomic particles we mostly focus on, and what charge each one carries. Within the atom, where can each one be found?

4. Write out an element symbol for an atom with six protons and eight neutrons. What element is this? What is the atomic number? What is the mass number?
5. What purposes do we use (radioactive) isotopes for in various fields?
6. In a typical atom of Al, how are the electrons arranged? Which/how many are **core electrons**, and which/how many are **valence electrons?** What distinguishes these groups? Use Figure 2.6 for assistance if needed.
7. Why do we care more/pay more attention to the **valence electrons** in both a chemistry and biology context?

Concept 2.3 The formation and function of molecules depend on chemical bonding between atoms

8. What are the strongest (two!) types of **chemical bonds?** Which electrons (core or valence) are making these bonds?
9. Describe what happens with the electrons in a **covalent bond**. How are a **single bond**, a **double bond**, and a **triple bond** different from each other?
10. Explain how a **nonpolar covalent bond** differs from a **polar covalent bond**, using electronegativity in your explanation.
11. How do **ionic bonds** differ from **covalent** ones?
12. Within a crystal of table salt (NaCl), which element forms **cations?** Which forms **anions?** How do **ions** differ from typical atoms of those elements?
13. What are the two weaker types of chemical interactions mentioned on pg. 30? How are they similar? How are they different?
14. How do **hydrogen bonds** actually work, re: what the electrons are doing?
15. In many biochemical molecules, **structure = function.** What is something else in your life that would change functionality if the structure was changed? (There are many answers, be creative!)

Concept 2.4 Chemical reactions make and break chemical bonds

16. In photosynthesis, what are the **reactants** and what are the **products?**
17. Explain how something can be in **dynamic equilibrium.**

Concept 2.5 Hydrogen bonding gives water properties that help make life possible on Earth

18. Why is water being a **polar molecule** so important to its functionality in living things?
19. Define and give an example of each:
    a. **Cohesion**
    b. **Adhesion**
    c. **Surface tension**

20. How do **thermal energy** and **temperature** relate to each other?
21. What are the units we typically use for energy? Name all three and explain mathematically how they relate to each other.
22. If you took chemistry recently, you should know all about **specific heat capacity**. Why does water's specific heat capacity matter to us and other living things so much?
23. In a cup of hot coffee with sugar, what is the **solution?** What is the **solvent?** What is the **solute?**
24. What is an example of an **aqueous solution** that you could make in a kitchen?
25. What does it mean for something to be water soluble? What would it mean if a substance is fat soluble?
26. Define and give an example of each:
    a. **Hydrophilic substance**
    b. **Hydrophobic substance**
27. What is a **mole?** How do we calculate **molar mass** of a substance like water for example?
28. How does something become / become called **acidic?** What about **basic?** (use H+ and OH- in your explanations) How do each of these relate to **pH?**
29. Why is it important that human blood is a great **buffer?**
30. What is one key impact of **ocean acidification?**

Chapter 3: Carbon and the Molecular Diversity of Life

The basis for all life on Earth, carbon has the ability to bond with four separate atoms at once, and can make macromolecules integral to life.

1. What two elements do most **organic molecules** include?
2. How is a **macromolecule** different from a molecule?

Concept 3.1 Carbon atoms can form diverse molecules by bonding to four other atoms

3. Why do we call the number of bonds an atom can form its **valence?** Where else do we use that word in chemistry? Why do both meanings make some sense in relation to each other?
4. Take a look at Figure 3.4 and note the ways in which carbon skeletons can vary.
5. How do the three types of **isomers** differ from each other?
6. In Figure 3.6 there are several chemical groups listed. You do not need to memorize them, but look over the figure and take note of distinguishing characteristics of each group.
7. How do estradiol and testosterone differ with respect to their **functional groups?**

8. In many biological processes, ATP and ADP cycle back and forth. What is the difference between them?

Concept 3.2 Macromolecules are polymers, built from monomers

9. How do **monomers** and **polymers** relate to each other? What is an example of a monomer/polymer relationship in real life?
10. How do **dehydration synthesis** and **hydrolysis** relate to each other? What details make them the same or different?

Concept 3.3 Carbohydrates serve as fuel and building material

11. What is the suffix (ending) for the names of most sugars?
12. How do **monosaccharides** come together to become **polysaccharides?** What is the bond between them called?
13. How do plants and animals differ in how they store energy in carbohydrates?
14. What are the two structurally important polysaccharides? Where are they each found? How are they different from each other?

Concept 3.4 Lipids are a diverse group of hydrophobic molecules

15. How do **fats** and **fatty acids** relate to each other?
16. Chemically, what is the difference between **saturated** and **unsaturated fatty acids?** Where would you find each of them in the real world?
17. What distinguishes **steroids** from other lipids?

Concept 3.5 Proteins include a diversity of structures, resulting in a wide range of functions

18. What are some key roles that proteins fulfill? (Check Figure 3.17)
19. What are **catalysts'** specific role?
20. From your knowledge of chemistry, what are some properties of each of the core sections of an **amino acid** (not the R group side chain)**?** How do the three distinctions in figure 3.18 make a difference for how R groups interact with each other?
21. How do amino acids come together to form a **polypeptide?** What kind of chemical reaction/bonding occurs?
22. What are the four levels of **protein structure**? Name them and explain which chemical interactions are relevant/impactful for that specific level.
23. Figure 3.23 shows a common example of how **structure = function**. Explain how the phenotype (symptoms) of sickle cell anemia come from a change in the primary structure.
24. What is denaturation? Where can it be found in real life?

25. What is one common technique used to analyze protein structure in a lab? How does it work?

Concept 3.6 Nucleic acids store, transmit, and help express hereditary information

26. The process of DNA → RNA → protein is often called the **central dogma.** We'll use the framework throughout the year to understand cellular processes, genetics, and more. Why is it so central to all our traits?
27. What are the monomers and polymers of **nucleic acids?** What are the two sub-groups within the DNA bases and how do they differ?
28. Figure 3.27 shows components of nucleic acids. How do DNA and RNA differ? (3 differences, more info on page 68)
29. On a **sugar-phosphate backbone** of either DNA or RNA, what do **5'** and **3'** ends refer to?
30. What does it mean that the strands of DNA run **antiparallel** and are **complementary?**

Concept 3.7 Genomics and proteomics have transformed biological inquiry and applications

31. The field of bioinformatics has taken off in the past 70 years since DNA's structure was first accurately described in 1953. What practical benefits might come from knowing more about the entire genetic code of humans?
32. Genomics and proteomics differ slightly but are both huge advances in our knowledge of living organisms, according to Figure 3.30, what are some applications of each of these?

Congratulations! You have completed the AP Biology Summer Assignment.
Great work, and I look forward to having you in the classroom soon.