

STUDY GUIDE FOR BIO 156,
HUMAN BIOLOGY FOR ALLIED HEALTH

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INTRODUCTION

Welcome to BIO 156!!

This study guide is designed to help you study; it DOES NOT summarize lecture material, give you test questions ahead of time, etc. YOU must learn the material and adequately prepare yourself for exams. In the study guide, I am trying to tell you what you need to learn, and I am providing some tools to help you learn it. I do this by listing **objectives** for every unit; the objectives tell you what you should be able to do when you sit down to take a lecture test. The objectives are often followed with **additional questions**; these usually require you to apply what you have learned by accomplishing the objectives, and encourage you to think. A crossword puzzle (or puzzles) will be found at the end of each unit; these are often helpful to test your knowledge of important terms introduced and used in the unit.

The best way to succeed in this class is to devote consistent and considerable time to studying and thinking. (1) First, you should **read** the next lecture topic(s) BEFORE coming to class; at least acquaint yourself with what is coming. That way lectures will not seem foreign and beyond all understanding. (2) Next, you should listen carefully in **lecture and lab**, take thorough **notes**, and ask **questions** when you do not understand, or if you are just curious about something. (3) Third, you should **study** those notes and topics THE SAME DAY while the information is fresh in your minds. Make **flashcards** to review topics and memorize information. Take a flashcard out of the stack when you have learned the information on it; don't waste your time reviewing what you already know. (4) Fourth, you should answer the objectives and questions on the **study guide** immediately after **memorizing** and **understanding** topics. Ultimately, you should be able to answer all questions WITHOUT referencing your notes or book. (5) Fifth, you should **study with others**, testing each other and answering each other's questions. (6) Sixth, you should take the **online selftests** at http://gquiz.gc.maricopa.edu/qm_biology/perception.dll. Some lecture exam questions may be similar to these, others quite different. The bottom line is that if you can pass the online selftests and understand the material, you are preparing well for the lecture exams. Finally, when the time arrives to take a lecture exam, you should relax and feel satisfied that you have done everything that you can to prepare. Just do your best, and if you have followed my guidelines, you should pass, and hopefully you will get an "A" or "B".

Keeping to a schedule is one of the biggest challenges we ALL face! With this in mind, you SHOULD sit down and list all of your obligations this session. You should rank them in order of importance. You should write out a daily chart, Monday through Sunday, that outlines what you will be doing with your time every day. You should allot at least two hours of studying for each lecture hour spent in class. If you don't have time for everything, then you must give SOMETHING up; otherwise, you are making it much harder (if not impossible) for you to succeed.

I am your most important resource in this class. Why? Because I tell you what you need to learn, I give you assignments and exams and grade them, and finally, I assign you your final grade at the end of the term. Please understand that I am here because I am fascinated by biology, and I find teaching very rewarding and fulfilling. I want to help you!! This course may be challenging and demanding, but it needs to be to adequately prepare you for your future. Please remember that if you have questions or concerns about ANYTHING related to this class and your performance in it, I am here to help you.

Lastly, BIO 156 is a stepping stone to the next level in your Allied Health program of study. We all know that you are not Biology majors, but the general biology concepts and terms covered in this class, as well as the thinking skills that you develop, are critically important for succeeding at higher levels. Besides, awareness and understanding of general biology empowers you to better understand the world around you, and the world in you. There are many advances in technology and health that only can be understood if you have a grasp of general biology. So take advantage of this opportunity, like others before you have, and propel yourselves forward.

UNIT I STUDY GUIDE FOR BIO 156

CHAPTER 1: CHARACTERISTICS OF LIFE AND SCIENCE

Note: The “Objectives” section outlines the terms and concepts, covered in lecture and your textbook, that you need to learn and understand. The “Additional Questions” section requires you to apply your knowledge and understanding to specific questions.

Chapter 1 has two objectives. *First*, Biology is the study of life, and chapter 1 outlines the major characteristics of ALL living things (including human beings). Much of what you study in Biology, that prepares you for Allied Health majors, is based upon these common characteristics. *Second*, everything we understand about life has been accomplished through applying the methodology of science. Chapter 1 also outlines (in VERY brief form) what science is, and how hypotheses (answers to scientific questions) are tested, to see if they may be correct.

Objectives:

1. List and describe properties that are common to ALL organisms, and life in general (sections 1.1-1.6). Give specific examples within each property (see “Additional Questions, #6” below).
 - a) List and describe the **levels of hierarchical organization** of living things (Section 1.1). Give specific examples of each level (see “Additional Questions, #2” below).
 - b) Describe ways in which living organisms are interconnected to their environments. Give examples.
 - c) Describe key characteristics of **cells**. Define **systems** and **emergent properties**, and explain what is meant by the phrase “the whole is greater than the sum of its parts”. Differentiate between **prokaryotic** and **eukaryotic** cells (also, how are these names translated?), and list the major types of organisms having each cell type. Explain how a cell may be regarded as a “system”, or an organism (e.g., human) as a “system”.
 - d) Describe the structure and function of **DNA**, and explain why it is the ‘thread’ that ties all of life on Earth together.
 - e) “Organisms exhibit the property of **regulation**.” Explain what this means, and give several examples.
 - f) Explain the difference between **growth** and **development**, and give examples of each.
 - g) Explain why organisms must take in and have access to **energy**.
 - h) Explain what is meant by “**organisms respond to their environment**”, and give several examples.
 - i) Define evolution, and explain why evolution is one of the most important unifying themes of biology. Explain the difference between the **fact** and **theory** of evolution. Also, (a) Explain how the **Theory of Common Ancestry** accounts for the unity (similarities) of living things, and how this theory is important to the health sciences. (b) Explain how the **Theory of Natural Selection** accounts for the diversity (different varieties) of living things, and how this theory is important to the health sciences. As part of your answer, describe the conditions that must exist for natural selection to occur. (c) Define **adaptation**, explain how adaptations originate, and give at least one example (Section 1.6).

2. List the 3 **domains** of life, and describe the types of organisms found in each domain (Section 1.5). Within the domain Eukarya, list and describe the 3 **kingdoms** of *multicellular* eukaryotes, and describe the *unicellular* eukaryotes.
3. Compare and contrast **Discovery Science** and **Hypothesis-Driven Science** (Section 1.7). Provide an example of each. In regards to hypothetico-deductive reasoning:
 - a) Define **hypothesis**, and give at least one example.
 - b) Explain how **deductive reasoning** works, and compare it to **inductive reasoning**.
6. Explain how hypotheses may be tested (Section 1.8). Describe the hypothetico-deductive method of testing hypotheses; outline the steps used in this way of reasoning.
7. Contrast **independent, dependent, and controlled variables**. Explain the importance of having only one independent variable in an experiment.
8. Contrast **experimental and control groups**, and explain the importance of a control group to an experiment (Section 1.8). Provide an example (perhaps the same example from objective #6, above). Also, identify these variables and groups when given different experimental scenarios (see problems below in this study guide).
9. Explain (a) why hypotheses and theories cannot be proven, but only falsified or supported, and (b) why supernatural phenomena do not have a place in science.
10. Define **technology**, and list several examples of how biology influences the development and implementation of technology (Section 1.9). Also, explain how and why biology may be applied to help solve many of the problems we face today, including with our natural environment.

Additional Questions:

1. Place the following in the correct hierarchical order, from smallest to largest: organs, molecules, community, tissues, cells, organism, ecosystem, population. Describe the characteristics of each level.
2. Referring to Life's Hierarchy of Organization, what level of organization would you place:
 - A) The stomach
 - B) A human
 - C) The Sonoran Desert
 - D) A collection of nerve cells
 - E) The esophagus, stomach, small intestine, large intestine, liver, etc.
 - F) DNA

G) A bacterium or amoeba.

3. (A) Joanne did a study on natural pest control. She had seven garden plots, all infested with aphids (an insect that eats plants). To one of the gardens she did nothing. To the other six plots, she let loose increasing numbers of ladybugs (beetles known to eat aphids). All the gardens received equal amounts of water and fertilizer. At the end of a month, Joanne sampled the number of aphids in each plot.

What was the independent variable in this experiment?

What was the dependent variable in this experiment?

What were the controlled variable(s) in this experiment?

What is / are the control group(s) in this experiment?

What is / are the experimental group(s) in this experiment?

- (B) Regis was interested in testing the claims made by a local health food store about the effectiveness of an “organic” flea powder for dogs made with herbs. He got a hundred dogs and sampled the number of fleas on each. Then he divided them into several groups; the “herb powder” was sprinkled on the dogs daily as instructed by the package. One group of dogs was not treated, while the dogs in the other five groups were treated with increasing amounts of the powder. None of the dogs were bathed during the two week experiment; all were exercised in the same area. At the end of two weeks, the flea numbers were determined again and compared to the original population on each dog.

What was the independent variable in this experiment?

What was the dependent variable in this experiment?

What were the independent variable(s) in this experiment?

What is / are the control group(s) in this experiment?

What is / are the experimental group(s) in this experiment?

5. Observation: Imagine you see an advertisement for a weight-loss pill that states “Eat the same as you always do, and lose 5 pounds a week at the same time!”

Describe an experiment that would test this claim. In your description, be sure to:

- (A) State the question to be answered.
- (B) List alternative hypotheses
- (C) Write a deductive statement that includes your preferred hypothesis and a logical deduction (prediction) that follows from your hypothesis.

(D) Describe how you would design and carry out the experiment. Identify your independent, dependent, and controlled variables (identify AT LEAST two different ones), and explain why they qualify as these types of variables.

(E) Identify whether you would need a control group and why. If you do, describe how the control and experimental groups would differ.

(F) Explain how the results of your experiment could be used to evaluate your original hypothesis.

(G) Include any other statements, descriptions, etc. you might think are important or pertinent to designing and carrying out this experiment.

4. A) You identify a cell as having a nucleus and many different organelles. What Domain of life would this organism belong to?

B) Upon further inspection you note that cell comes from a multicellular organism, and the cell contains chloroplasts. What Kingdom of life might this organism belong to?
5. What molecule carries the code for making the appearance of each flower species different and similar?
6. As you should already know, living things share several common properties. Which property is exemplified by:
 - A) Food is eaten so that you can run in a marathon.
 - B) You (and most mammals) keep your body temperature constant (@ 98.6 for *Homo sapiens*).
 - C) Your cat has kittens.
 - D) A new-born looks dramatically different from when sexual maturity is reached.
 - E) The hair on the back of your neck “stands up” when an aggressive male approaches you.
 - F) A population of humans living in the Amazon basin has changed slightly over the past 5,000 years due to natural selection.
7. (A) Corn, Morel Mushrooms, Insects, and Humans all share many of the same proteins, DNA sequences, cellular structures, etc. Explain why (i.e., which theory explains these observations?).

(B) Corn, Morel Mushrooms, Insects, and Humans all have different and unique characteristics that suit them to different ways of life. Explain why.
8. (A) You wish to study the health effects eating various quantities of sugar as part of a daily diet. Is this science or technology? Why?

(B) A pill exists that prevents one’s body from using 50% of the sugar ingested on a daily basis as an obesity control mechanism. Does the pill represent science or technology? Explain.

OTHER STUDY RESOURCES:

- “Testing Your Knowledge”, pp. 13-14, “Describing, Comparing, and Explaining”, p. 14, and “Applying the Concepts”, p. 14.
- Quizzes and Activities on the **Interactive Study Partner** (CD that is included with your textbook).
- Take “Self-test” at http://gquiz.gc.maricopa.edu/qm_biology/perception.dll
Take this quiz several times, and for each incorrect answer, make sure you understand why you missed the question before moving on. See me if you have problems logging on to the “Self tests”.
- Each other!! Study in groups, test each other, and ask each other questions!

CHAPTER 2: THE CHEMICAL BASIS OF LIFE

Note: The “Objectives” section outlines the terms and concepts, covered in lecture and your textbook, that you need to learn and understand. The “Additional Questions” section requires you to apply your knowledge and understanding to specific questions.

Chapter 2 overviews some fundamental concepts of Chemistry that are important to understanding the chemistry of living things, including the ideas of elements, atoms, types of chemical bonds, the properties of water, and the pH scale. Understanding this basic chemistry is critical to understanding how human physiology works.

Objectives:

1. Define matter and element, and identify how many of the known elements are naturally occurring (Section 2.1).
2. List the top 11 **elements** found in living things (Table 2.1), and identify them by their chemical symbol. Identify which of these are primarily found in organic molecules (Chapter 3).
3. Define trace element, and explain their importance.
4. Define compound and list several examples (Section 2.3)
5. Describe the structure of an atom (Section 2.4); determine the number of **protons**, **neutrons**, and **electrons** from atomic number and mass.
6. Diagram the distribution of electrons in **electron shells** (when given an atomic number, or the number of e⁻ surrounding a nucleus), and determine which shells are full (Section 2.6).
7. Distinguish between **inert** and **active atoms** (Section 2.6); distinguish between **neutral atoms** and **ions** (Section 2.7).

8. Compare and contrast **ionic** and **covalent bonds** (Sections 2.7 – 2.8). Describe the circumstances under which they each form and give examples of molecules containing each type of bond. Describe how each is related to the **Rule of the Octet**. Also, define **electronegativity**, and explain how this property affects whether an atom becomes an ion or
9. Distinguish between **polar** and **nonpolar covalent bonds** (Section 2.9). Describe the circumstances under which they each form.
10. Define **hydrogen bond** (Section 2.10). Describe the kinds of molecules between which hydrogen bonds tend to form.
11. List and discuss the properties of water (Sections 2.11 – 2.14): Describe how these properties are related to water's polar nature, and describe the biological significance of each property.
12. Define **hydrophilic** and **hydrophobic**. Discuss how molecules containing nonpolar and polar functional groups will behave in water.
13. For **pH**:
 - A) Contrast **acidic**, **basic**, and **neutral solutions**. Define **acid** and **base**.
 - B) Describe the pH of each (i.e., equal to 7, less than 7, more than 7), and relative concentrations of H^+ and OH^- (e.g., is $[H^+]$ greater in acidic, basic, or neutral solutions?).
 - C) What magnitude of change in $[H^+]$ is represented by a change of 1 pH unit?
 - D) Explain why proper pH is critical to living things.
 - E) Explain what a chemical **buffer** is, and why they are important in living things.

Additional Questions and Problems:

1. Using your Periodic Table handout, determine the atomic number and atomic mass of this atom: ^{39}K . How many protons does an atom of this element (potassium) have? How many neutrons? How many electrons?
2. The ion, Cl^- , K^+ , and Ca^{++} all have the same number of electrons as a *neutral* atom of what element? Use your periodic table to answer this.
3. Draw the covalent bonds between 1-C and 4-H's, between 2-O's and 1-C, and between 1-N and 3-H's. Write the empirical formula of each molecule.
4. You have a beaker of water and the following substances: an ionic compound, a polar molecule, and a nonpolar molecule. If you stirred them into the water, how would they interact with each other (e.g., would there be chemical attractions, and if so, explain)?
5. A liter of oil heats (i.e., raises its temperature) faster than a liter of water, when each is exposed to identical environments. Explain why. [Hint: oil molecules are nonpolar, and water molecules are polar].

6. How does perspiration cool a mammal? Explain. What properties of water are involved with the cooling process?
7. A paper towel absorbs water, whereas wax paper does not. Why? Explain by referring to the chemical properties of each type of “paper
8. The pH of vinegar is 3, the pH of shaving cream is 5, and the pH of urine is 8. Which is the most acidic? Most basic? Which has the lowest concentration of H^+ ? Which has the highest concentration of OH^- ? Is concentration of H^+ or OH^- greater in shaving cream?
9. Fill in the blanks with $<$ (*less than*), $>$ (*greater than*), $=$ (*equal to*) and the second blanks with *acidic*, *basic*, or *neutral*.
 - A) At $pH < 7$, the $[H^+]$ is _____ $[OH^-]$. A solution with this pH would be _____.
 - B) At $pH > 7$, the $[H^+]$ is _____ $[OH^-]$. A solution with this pH would be _____.
 - C) At $pH = 7$, the $[H^+]$ is _____ $[OH^-]$. A solution with this pH would be _____.
10. Solution A has a pH of 4, and Solution B a pH of 6. How does the $[H^+]$ of A compare to that of B?

Other study resources for this chapter:

- **Connecting the Concepts**, p. 30
- **Testing Your Knowledge**, pp. 30-31.
- **Applying the Concepts** (page 31).
- Quizzes and Activities on the **Interactive Study Partner** (CD that is included with your textbook).
- **Online BIO 156 Self-tests** (“Inorganic Chemistry” for this exam) at:
http://gquiz.gc.maricopa.edu/qm_biology/perception.dll.
- Study in groups!!