

Format:

Section I 26 multiple choice questions
Section II 1 essay question and 3 short free response questions

Reading: Hillis chapters 3 and 4

Concepts to Review:

- Biochemistry
 - Know the monomers, polymers, and functions of *carbohydrates, lipids, nucleic acids, and proteins*.
 - Be able to recognize diagrams of *monosaccharides, fatty acids, glycerol, nucleotides, and amino acids*.
 - Be able to describe the factors that influence the primary, secondary, tertiary, and quaternary levels of protein structure.
 - Be able to explain the way that an enzyme works, including the roles of *substrates, coenzymes, activators, inhibitors, kinases, and allosteric regulators*.
 - Be able to explain how environmental factors (temperature, pH, salinity, enzyme/substrate concentration) affect enzyme activity.
- Cells
 - Be able to calculate the surface area and volume of a cell (see formula sheet).
 - Be able to explain the significance of surface area and volume for a cell.
 - Be able to explain the major differences between prokaryotic and eukaryotic cells.
 - Know all the structure and function of all cell organelles in chapter 4, and which organisms they are found in.
 - Be able to recognize diagrams of the cell organelles in chapter 4.
 - Be able to predict some possible functions of a cell based on which organelles are found in large or small numbers in that cell.
- Labs
 - Understand the term *model*.
 - Be able to write a hypothesis and identify the *independent variable, dependent variable, control group, experimental group, and constants* (see Elements to Consider when Designing a Controlled Experiment handout).
 - Understand why large sample sizes, multiple trials, and statistical analyzes are used to verify results.
 - Be able to graph data appropriately and add 95% confidence intervals to a graph.
 - Be prepared to discuss the following labs: *Enzyme Catalysis* and *Toothpickase*.
 - Be able to explain how and why the rate of enzyme activity changes over time.
 - Be able to calculate the rate of a chemical reaction using the slope formula (dy/dx or dY/dt).

Overarching Questions to Consider:

****Suggestion: Answer all of these questions in writing, then compare answers with a classmate. I promise that taking the time to do so will be well worth it and much more useful than memorizing facts and definitions.****

1. Why do cells require enzymes? If an enzyme does not change a chemical reaction, how does it make the reaction go faster?
2. Why do different amino acids have different properties? Why does changing the primary structure of a protein result in changes to the secondary, tertiary, and quaternary levels too?
3. Why does altering the temperature or pH cause an enzyme to denature? Why is a denatured protein unable to function?
4. Why does the rate of an enzyme-mediated reaction increase at first, then level off as you add more substrate?
5. How are the time of a reaction, the amount of substrate used, the amount of product formed, and the reaction rate related?

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- How does DNA control cell activities and give you your unique characteristics?
- Why is it better for a cell to have a higher surface-area-to-volume ratio?
- How does the presence of membrane-bound organelles provide eukaryotes with an evolutionary advantage over prokaryotes?
- How do mitochondria and chloroplasts show evidence of endosymbiosis?
- How does the relative amount of various organelle types in a cell give us hints about the cell's function?

Practice Exam Questions:

Visit the course website and click on the "Multiple Choice Practice" link. Complete all practice questions for the relevant chapters and check your work against the answer key. Note: these items are password protected.

Essay Question Sneak Peak:

Read each question carefully and completely. Answers must be written out in paragraph form. Outlines, bulleted lists, or diagrams alone are not acceptable.

- An experiment was conducted to measure the reaction rate of the human salivary enzyme α -amylase. Ten mL of a concentrated starch solution and 1.0 mL of α -amylase solution were placed in a test tube. The test tube was inverted several times to mix the solution and then incubated at 25°C. The amount of product (maltose) present was measured every 10 minutes for an hour. The experiment was repeated five times and the resulting means and 2×SEM are provided in the table below.

Time (minutes)	Mean Maltose Concentration (μM)	2× Standard Error of Mean (SEM) Maltose Concentration (μM)
0	0.0	0.0
10	5.1	1.2
20	8.6	1.2
30	10.4	1.0
40	11.1	1.0
50	11.4	0.8
60	11.5	0.8

- On the axes provided, **construct** an appropriately labeled graph to illustrate the mean maltose concentration over time to within 95% confidence (i.e., mean \pm 2 SEM).
- Calculate** the rate of the reaction for the time period 0 to 30 minutes.
- Describe** how the reaction rate changed after 30 minutes and **provide reasoning** to connect this change to enzyme-substrate interactions.
- Propose** an appropriate control treatment for the experiment. **Describe** the results you expect to see in the control group and **explain** how these results would provide support for the claim that α -amylase catalyzes the hydrolysis of starch into maltose.
- Predict** how each of the following changes are likely to affect the reaction rate. **Provide support** for your predictions by connecting each factor to changes in the structure of the enzyme.
 - Adding a noncompetitive inhibitor to the mixture
 - Decreasing the pH from 7.0 to 4.0