

Objectives for Unit Three: Chapter 6 and 33 (33.2 - 33.5):
Metabolism, ATP, Enzymes and Digestion

You should be able to:

1. Distinguish between anabolic and catabolic metabolic pathways.
2. Explain the relationship between kinetic energy, potential energy & thermodynamics.
3. Explain the relationships among enthalpy (energy), entropy (disorder), changes in free energy, spontaneous and non-spontaneous reactions, endergonic and exergonic reactions, downhill and uphill, negative and positive changes in free energy (ΔG), respiration and photosynthesis.
4. Discuss the meaning of the equation: $\Delta G = \Delta H - T\Delta S$.
5. List the three main ways cells do work.
6. Describe the structure of ATP. Explain why "high energy phosphate bonds" is misleading.
7. Explain the ATP cycle.
8. Explain how ATP supplies energy to an endergonic reaction (e.g. discuss phosphorylation).
9. Describe the effect enzymes have on chemical reactions.
10. Describe the relationship between enzyme, substrate and active site.
11. Sketch and label a graph illustrating the relationship between the free energy of reactants and products, activation energy with and without enzymes, and the ΔG of a reaction.
12. Describe four different mechanisms by which enzymes can lower activation energy.
13. Distinguish between "lock and key" and "induced fit" models of enzyme action.
14. Provide examples and describe the role of cofactors and coenzymes in enzymatic activity.
15. Describe the effect of enzyme inhibitors (competitive and non-competitive) on the rate of reactions catalyzed by an enzyme. Give examples of real inhibitors.
16. Relate the terms from the previous objective to hydrogen peroxide and liver.
17. Identify the characteristics of enzymes.
18. Given data, construct graphs and then calculate the rate of a reaction catalyzed by an enzyme.
19. Sketch a graph to illustrate the effect that changing temperature, enzyme concentration, substrate concentration, pH, salinity, and inhibitor concentration will have on the rate of a reaction catalyzed by an enzyme. Explain why each graph takes the shape it does.
20. Explain how feedback inhibition can regulate an enzyme and how its location in the cell or membrane and increase its efficiency. (We did not talk about this in class – pg. 159)
21. Distinguish between filter feeders, fluid feeders, and bulk feeders. Explain the problem a bulk feeder has that a fluid feeder does not.
22. Identify the organs of the alimentary canal and the accessory glands of the human digestive system. Label a diagram of the human digestive system, such as that in your binder.
23. Describe the mechanical and chemical digestion in each of the major organs of the alimentary canal.
24. Describe adaptations, both physical and chemical, of the human digestive system that enhances the functioning of the digestive enzymes.
25. Discuss the relationships among pepsin, pepsinogen, HCl, mucus, acid-tolerant bacteria, and gastrin.
26. Describe adaptations that prevent inappropriate digestion from happening.
27. Identify the substrate, original production location, and the end product of the following human digestive enzymes:
 - a. amylase
 - b. pepsin
 - c. lipase
 - d. Nucleases
28. Describe how the structure of the small intestine enhances absorption of the products of digestion.
29. Describe how the large intestine functions to retain the body's liquids.
30. Compare the size of a caecum in a carnivore with that of an herbivore.
31. Describe the digestive system of a ruminant such as a cow. How can a cow eat grass when it can't digest cellulose?
32. Describe how a hydra ingests its food.
33. Explain how termites can eat wood.
34. Regarding our LABS on enzymes:
 - a. Given a graph of a reaction catalyzed by an enzyme **calculate** the rate (initial velocity) of the reaction.
 - b. Design a controlled experiment to test the effect of an abiotic or biotic variable (pH, temperature, salinity, enzyme concentration, substrate concentration, inhibitor concentration, enzyme source) on the rate of a reaction catalyzed by an enzyme.
 - c. Explain why pressure could be measured to get at the rate of hydrogen peroxide breakdown by catalase. (Be familiar with this procedure)

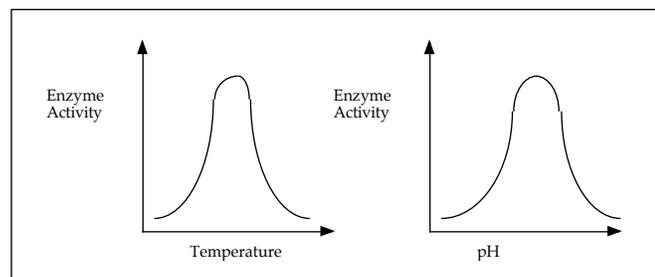
- d. Explain why a spectrophotometer could be used to get at the rate of hydrogen peroxide breakdown by peroxidase. (Be familiar with this procedure)
35. Each chapter has some multiple choice questions and a few other additional questions at its end. Give these a try. You might see them again!

Some Examples of Short Free Response Questions: (2-3 sentences): These might be the actual questions.

1. Relate ΔG to activation energy (E-A) to exergonic (exothermic) and endergonic (endothermic) reactions.
2. Relate the tertiary and/or quaternary structure of a protein enzyme to the specificity of an active site and the corresponding substrate..
3. How do competitive inhibitors work in relationship to the active site? What do non-competitive inhibitors, co-factors, and co-enzymes share in common?
4. Scientists try to design enzymes to work better in commercial applications (Tide detergent, biofuels). What do scientists need to consider in designing these enzymes?
5. **Identify** TWO environmental factors that can change the rate of an enzyme-mediated reaction. **Discuss** how each of those two factors would affect the reaction rate of an enzyme.
6. Given a graph of a trial for alpha-amylase, **draw** and **label** another line on the graph to predict the results if the concentration of alpha-amylase was doubled. **Explain** your predicted results.
7. **Given some data, graph** the data on the axes provided and **calculate** the rate of the reaction over a given time period.
8. **Describe** the structure of the ATP
9. **Discuss** how the structure of a protein affects the regulation of enzyme activity.
10. The relationship of structure to function is one of the major themes in biology. Describe the structure of an enzyme and explain how this structure is related to the function of catalysis.
11. Using pepsin as an example, explain several ways the digestive system protects itself of self-digestion.
12. Explain two ways the activity of enzymes are regulated in cells.
13. Describe the processes of fat digestion and product absorption in the small intestine. Include a discussion of the enzymatic reactions involved.
14. Describe the processes of protein digestion as it occur sin the human stomach. Include a discussion of the enzymatic reactions involved.
15. Describe two adaptations of two different organisms that enhance their ability to digest and absorb nutrients.

A possible essay to write outside of class is #145:

The effects of pH and temperature were studied for an enzyme-catalyzed reaction. The following results were obtained.



- a) How do (1) temperature and (2) pH affect the activity of this enzyme? In your answer, include a discussion of the relationship between the structure and the function of this enzyme, as well as a discussion of how structure and function of enzymes are affected by temperature and pH.
- (b) **Describe** a controlled experiment that could have produced data shown for either temperature or pH. Be sure to state the hypothesis that was tested here. (You may identify a specific enzyme and use it in your experiment.)