AP Biology **Name:** **P:**

Chapter 6 Reading Guide: An Introduction to Metabolism

How to use this reading guide: Look over the entire reading guide—read each question to prepare yourself for reading the chapter. Read the chapter carefully and thoroughly. Make sure to look at all of the figures and pictures and read their captions. Then…answer the questions posed below.

The Energy of Life

1. The analogy is made that a cell is a chemical factory. Explain why this might be an appropriate analogy.

An organism's metabolism transforms matter and energy, subject to the laws of thermodynamics

2. What is **metabolism**?

3. Metabolism involves pathways. Describe what is meant by a metabolic pathway.
    a. Contrast **catabolic** pathways with **anabolic** pathways. Give examples of each type.
        i. Explain whether each type releases energy or stores energy.

4. How can catabolic and anabolic pathways work together?

5. Energy is the ability to cause change. Give an example that helps explain what this might mean to life.

6. Contrast **kinetic** with **potential** energy.
    a. What is a biological example of kinetic?

    b. What is a biological example of potential?

7. There are laws that govern energy and its transformations in matter. The study of these laws is known as **thermodynamics**.
    a. State the first law of thermodynamics and give a biological example.

    b. State the second law of thermodynamics. Why does this explain that energy can't be recycled?

8. Of what is **entropy** a measure? Use some examples to help explain.
    a. How is spontaneity of a reaction related to entropy?

9. Living organisms are an example of both low entropy (meaning high order) and high entropy (meaning low order). Explain how both can be occurring in a living organism simultaneously.

10. Since the world in getting more and more random, how can organisms be getting more and more ordered?

11. How does the second law of thermodynamics explain the diffusion of a substance across a membrane?

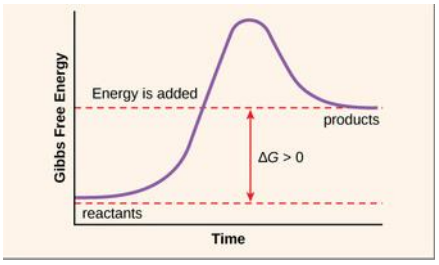
12. Describe the forms of energy found in an apple as it grows on a tree; then falls and is digested by someone who eats it.

The free-energy change of a reaction tells us whether the reaction occurs spontaneously

13. What is free energy?
    a. How is it calculated?

14. What does the value of ΔG help you predict?
    a. If ΔG is negative =
    b. If ΔG is positive =
    c. Why do biologist care about ΔG?

15. What type of reaction is shown in the diagram at right – exergonic or endergonic? Explain how you know.
    a. Would this be a spontaneous or not?
    b. In the body what type of reaction might this represent?



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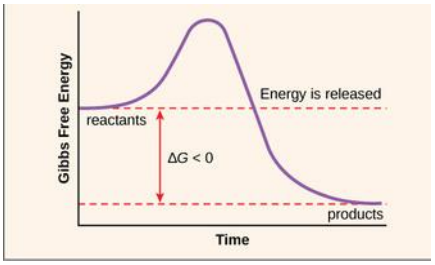


17. How are free energy related to equilibrium?

ATP powers cellular work by coupling exergonic reactions to endergonic reactions

18. What types of work does a cell do? Give an example of each.

    a. How does energy coupling help explain how a cell does its work?

19. ATP is the immediate source of the energy used to do work. Diagram a molecule of ATP and explain where the energy is located in the molecule.

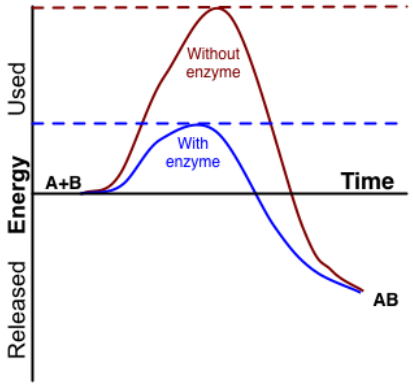
20. How does ATP perform work? Give an example of the types of reactions that are powered by the hydrolysis of ATP.

21. ATP is like a rechargeable battery. How does ATP get regenerated?

Enzymes speed up metabolic reactions by lowering energy barriers

22. *Just because a reaction is spontaneous doesn't mean that it will happen any time soon!* Why not?
    a. How is this related to activation energy?

23. The diagram at right shows a chemical reaction as it takes place without an enzyme and the same reaction with an enzyme.
    a. label the Ea of the uncatalyzed reaction
    b. label the Ea of the catalyzed reaction
    c. label ΔG (the free energy).
    d. Comparing the catalyzed to the uncatalyzed reaction explain how the following change (and/or don't change): Ea and ΔG.



24. What type of macromolecule is an enzyme?

25. How do enzymes recognize their substrate? How does this relate to "specificity"?
    a. How are substrates held in active sites?

26. Explain how an enzyme catalyzes a reaction. (study figure 6.15)

27. What is meant by “optimal temperature”? What happens to the rate of the reaction as the temperature increases WITHIN the optimal range? What happens if the temperature is outside (either too high or too low) the optimal range?

28. What is meant by “optimal pH”? Is the optimal pH the same for all enzymes? Explain your answer with examples.

29. Distinguish between cofactors and coenzymes. How are they different? How are they similar?

30. Contrast competitive with non-competitive inhibitors. Where does each bind? Do they turn the enzymes “on” or “off”? Is it reversible or irreversible?
    a. How does this relate to toxins and poisons?

31. Some enzymes have allosteric sites. What is an allosteric site?
    a. Draw an enzyme and label the active site and allosteric site.

32. Contrast allosteric inhibition with allosteric cooperativity.

33. What is feedback inhibition? Why is it so useful for a cell?