Name _____ **Period** _____

Chapter 5: The Working Cell

Guided Reading Activities

Big idea: Membrane structure and function

Answer the following questions as you read modules 5.1–5.9:

1. Every cell has a(n) plasma membrane that allows it to maintain a cellular environment that is separate from the environment in which it is found.

2. Which of the following best describes the structure of a plasma membrane?

   a. Proteins sandwiched between two layers of phospholipids

   b. Proteins embedded in two layers of phospholipids

   c. A layer of protein on top of a layer of phospholipids

   d. Phospholipids sandwiched between two layers of protein

3. Biologists have described a cell's plasma membrane as being a fluid mosaic. Briefly explain why this is an accurate description. Use the figure on page 74 to help with this.
   This is an accurate description because a plasma membrane is made of multiple types of molecules with many different functions (the mosaic) and the molecules are in constant motion around each other (fluid).
4. True or false: The fact that all cells have a plasma membrane supports the evolutionary linkage of all life. If false, make it a correct statement.
   True
5. Match the following terms with their description: passive transport, diffusion, concentration gradient, and osmosis.

   a. Diffusion of water across a semi-permeable membrane: osmosis

   b. Movement across a cell membrane that requires no energy from a cell: passive transport

   c. Movement of a substance from high to low concentration: simple diffusion

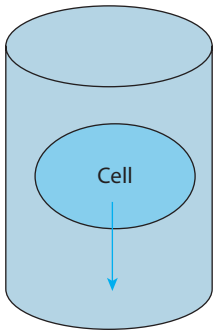
   d. When there exists a difference in the amount of a substance across a distance: concentration gradient

6. Complete the table that compares diffusion, osmosis, and facilitated diffusion.

	Diffusion	Osmosis	Facilitated diffusion
Is energy required from the cell?	No	No	No
Description	The movement of a substance from an area of high concentration to an area of low concentration	The diffusion of water across a semipermeable membrane	Diffusion of a substance down its concentration gradient through a transmembrane protein channel within the plasma membrane

7. What feature does diffusion, osmosis, and facilitated diffusion all share?
They are all types of passive transport.

8. A cell is placed into a beaker containing a 4% sucrose solution. The cell contains a 1% sucrose solution. Use an arrow to illustrate the direction in which water will diffuse in the figure below. Assume that the cell's membrane is not permeable to the sucrose.



9. Complete the table that compares terms associated with tonicity.

	Isotonic solution	Hypotonic solution	Hypertonic solution
Each term refers to . . .	Two solutions that have the same solute concentrations	A solution that has less solute than the solution it is being compared to	A solution that has more solute than the solution it is being compared to
Effect on a plant cell	Flaccid	Turgid	Shriveled
Effect on an animal cell	Normal	Lyse	Shrivel

10. Nonpolar is to diffusion as ____polar____ is to facilitated diffusion.

11. Which of the following statements regarding transport across a plasma membrane is false?

a. Passive transport requires an input of energy from the cell.

b. Osmosis is the diffusion of water across a selectively permeable membrane.

c. Substances always travel down their concentration gradient in passive transport.

d. Facilitated diffusion requires a specific transport protein found in the membrane.

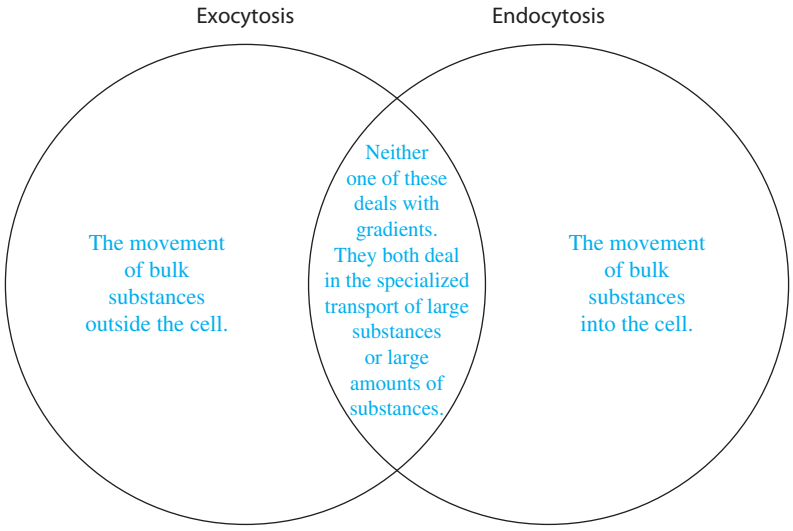
12. True or false: Aquaporins form the specific protein channel through which water diffuses. If false, make it a correct statement.
True

13. Dr. Agre's research into aquaporins hinged on two key observations. List both observations.
The antibody they made did not bind to any part of the Rh antigen and the antibody bound to red blood cells in large quantities.

14. In contrast to passive transport, active transport pumps a substance _____up_____ its gradient.

15. You are sailing on Lake Superior from Copper Harbor, Michigan, to Isle Royale National Park. A sudden storm causes your sailboat to spring a leak. You immediately grab a bucket and begin bailing water out of the boat. Briefly explain how your predicament could be used as an analogy to help explain both active and passive transport.
If you simply let the water flow into the boat, then water will travel down its concentration gradient (into your boat) until the gradient is abolished (your boat sinks). If you want your boat to stay afloat, then you simply bail water out of the boat. In effect, you are moving water against its concentration gradient in order to maintain that gradient (keeping your boat afloat).

16. Use the Venn diagram to compare exocytosis with endocytosis.



Big idea: Energy and the cell

Answer the following questions as you read modules 5.10–5.12:

1. Complete the table that compares kinetic to potential energy.

	Kinetic energy	Potential energy
Description	The energy of motion	Energy associated with a substance that can be converted to kinetic energy
Example	Solar energy	A candy bar

2. The food we eat has chemical energy. Is it possible for a candy bar to have potential energy for two different reasons at the same time? Briefly explain your answer.
Yes, it is. The candy bar has potential energy due to the bonds within the molecule, but it could also have potential energy if you placed it near the edge of a table.
3. Energy is never created or destroyed. What happened to the energy that was stored in your gas tank after your lawnmower comes to a stop as a result of running out of gas?

   a. The energy was lost.

   b. Entropy decreased in the universe.

   c. It was converted to heat.

   d. The lawnmower gained energy.

4. Match the following terms with their correct description: exergonic reaction, endergonic reaction, metabolism, metabolic pathway.

   a. The sum of all chemical reactions in an organism: metabolism

   b. A series of reactions that either build or break down a molecule: metabolic pathway

   c. A reaction that gives off energy: exergonic reaction

   d. A reaction that requires an input of energy: endergonic reaction

5. A chemical reaction is determined to be endergonic. If you were trying to get that reaction to occur using a separate reaction, what would you do?
You would couple it to an exergonic reaction.

6. The phosphorylation of ADP creates ATP.

7. A cell pumps certain ions against their concentration gradient in order to maintain those gradients. What type of cellular work is this?
This would be considered transport work.

8. Anything that inhibits ATP synthesis in a cell most likely

   a. forces the cell to use ADP as an energy source.

   b. results in the death of the cell.

   c. makes the cell start using lipids as energy.

   d. causes the cell to stop doing mechanical work but not transport work.

Big idea: How enzymes function

Answer the following questions as you read modules 5.13–5.16:

1. The energy needed to initiate a chemical reaction is the _____.

   a. activation energy

   b. substrate energy

   c. active site

   d. inhibition site

2. In pole vaulting, the higher the bar is placed, the more difficult it is to clear it. Explain why this is a good analogy to help students understand enzymes and activation energy.
   In this analogy, the bar represents the activation energy necessary for the reaction to occur. The higher the bar, the harder it is to jump. The more activation energy that is required, the harder it will be for the reaction to occur.
3. The graph on page 83 in your textbook illustrates the difference between a chemical reaction with and without an enzyme. Can the reaction represented by the black line still occur without the enzyme? Briefly explain your answer.
   Yes, it would just take more energy to get the reaction started.

4. The relationship between an enzyme's active site and its substrate is most like which of the following?

   a. A comb and hair

   b. A car and a driver

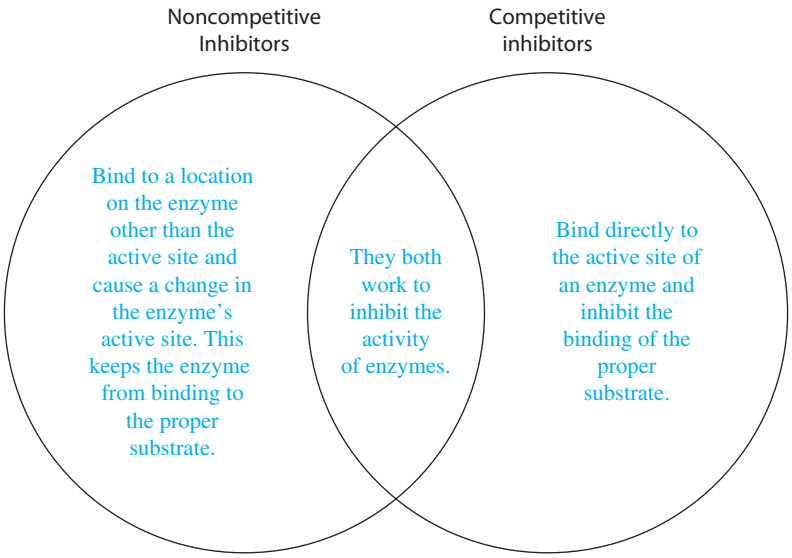
   c. A scarf and a hand

   d. A key and a lock

5. In the following reaction, circle the enzyme.

   (Lactose) → Glucose + Galactose

6. Sucrase is the enzyme that breaks down sucrose into glucose and fructose. Will sucrose also catalyze the breakdown of the disaccharide maltose? Briefly explain your answer.
   No, because maltose will have a different structure than sucrose and so it will not fit into the active site of sucrase
7. Complete the Venn diagram comparing inhibitors.



8. Use Figure 5.15B on page 85 of your textbook to answer this question. Assume that a toxin is introduced to the cell that binds to and removes substance C from the pool of molecules participating in the reaction. Briefly explain what would happen to the amount of substance B.
   The amount of substance B would increase because there would no longer be any feedback inhibition.
9. Penicillin is a drug that affects bacterial cells and not human cells. How is this possible?
   This is possible because the drug is targeting a structure not found in eukaryotic cells.

CONNECTING THE BIG IDEAS

Use your knowledge of the information contained within this chapter's "Big Ideas" to answer this question.

Aquaporins are membrane proteins that span the entire membrane. An aquaporin protein must be able to interact with polar regions that are both extracellular and intracellular as well as polar water molecules moving through it's core. Additionally, it must be able to interact with the nonpolar phospholipid tails. How is it possible that this protein (a collection of amino acids) can meet all of these requirements?

