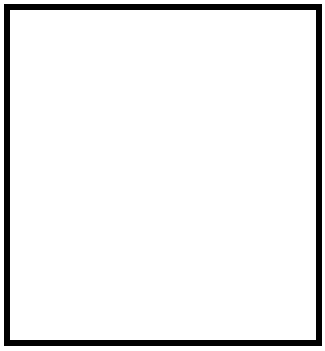
AP Chapter 7 Study Guide: The Cell Membrane and Transport Mechanisms

(Rob Hamilton)

Teacher's Note: *Chapter 7 is bread and butter biology and the concepts discussed in this chapter consistently occupy a large question set on the objective portion of the AP exam. Free response questions occurred most recently in'02,'98 and '92. You must develop your knowledge concerning the structure and function of the cell membrane because to remain alive, cells must constantly take in nutrients and rid themselves of waste. We will begin by examining cell membrane structure. Read pgs 124-127 and answer the following questions:*

1. In the space provided, make a simple drawing of a phospholipid molecule. Label its polar/hydrophilic portion and its nonpolar/hydrophobic portion.



2. Now scale down the size of your phospholipids and draw a section of the cell membrane in the space below. Use brackets to identify the hydrophobic and hydrophilic portions of the membrane.

3. What laboratory evidence suggests this hypothetical arrangement of phospholipids may in fact be correct?

_____

_____

_____

4. What is the name of the currently accepted model for the arrangement of molecules within the cell membrane? _____ _____ _____

5. What is the primary function of this bilayer of molecules? _____

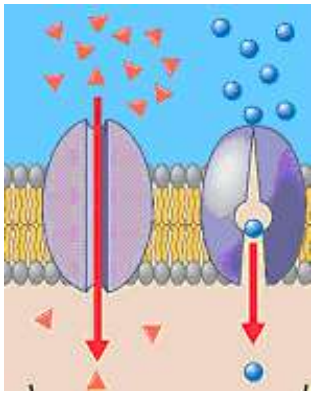
_____

6. Cholesterol which is also a lipid may be found in the bilayer. Use a colored pen to add some cholesterol molecules to your bilayer drawing in the box for #2.

7. Describe the function of cholesterol within the membrane _____

_____

8. *The phospholipids bilayer serves as a medium for embedding protein which have many diverse functions. Read pgs 127-129 then look at the pictures and describe the function of the proteins.*



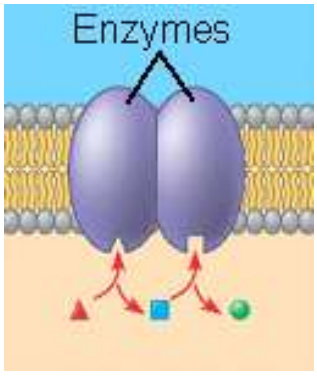
_____

_____

_____

_____

_____



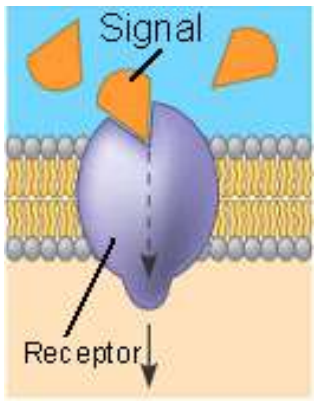
_____

_____

_____

_____

_____



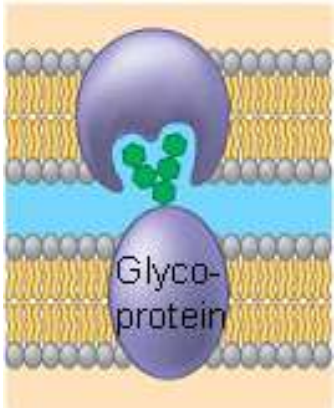
_____

_____

_____

_____

_____



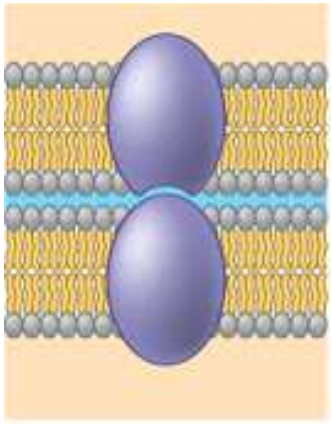
_____

_____

_____

_____

_____



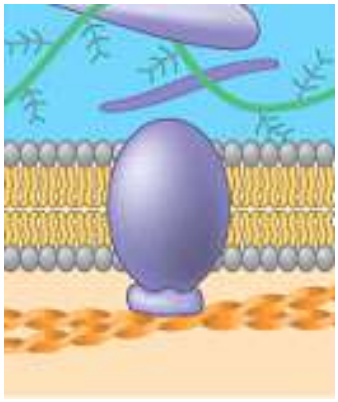
_____

_____

_____

_____

_____



_____

_____

_____

_____

_____

9. What is the laboratory evidence that indicates that proteins are found in the bilayer? _____

_____

_____

Has it dawned on you that since DNA codes for protein, it is your genetic material that controls all of these membrane functions related to protein. ***Wow!!!!!!*** *Many small, non-polar molecules like oxygen and carbon dioxide can simply pass between the shifting phospholipids. Large, polar molecules usually need to be transported into the cell by a protein. Read about the different types of passive transport on pages 130-134 and then answer the questions on the next page.*

10. Suppose someone has added a teaspoon of sugar to a cup of hot water and watched the sugar dissolve. Now someone adds a cube of sugar to that same cup. (circle answer)

    a) Where is there more orderly arrangement of sugar molecules? **a) Cup** or **b) Cube**

    b) Is the entropy of sugar higher in the **a) Cup** or **b) Cube**

    c) As you watch, the entropy of the sugar cube will go **a) up** or **b) down**

11. Define diffusion: _____

    _____

12. Give a molecular level explanation as to why the diffusion of ethanol is faster in air than in water _____

    _____

13. What is the diffusion of water called? _____

14. Water generally osmoses from areas of _____ water concentration to areas of _____ water concentration

Circle the correct answer for questions 15 & 16

15. If a cell contains a lot of solute, its concentration of water would be **high** or **low**

    This cell would be **hypertonic** or **hypotonic** to its environment?

    This environment would be **hypertonic** or **hypotonic** to the cell?

16. If a cell contains very little solute, its concentration of water would be **high** or **low**

    This cell would be **hypertonic** or **hypotonic** to its environment?

    This environment would be **hypertonic** or **hypotonic** to the cell?

17. If a cell contains the same amount of solute as its environment, it is said to be _____

18. Plant, bacterial and fungal cells respond to hypotonic solutions differently than animal cells.

    Explain why this is so. _____

19. In a hypertonic solution an animal cell will _____and a plant cell will _____

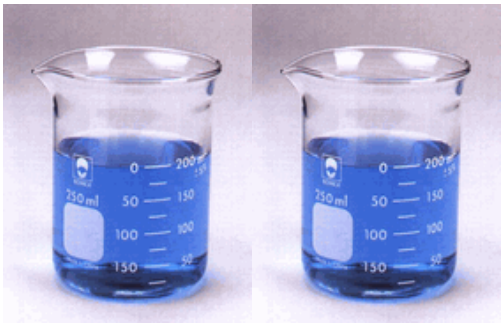
    In an isotonic solution a plant cell will appear _____ or limp. In a hypotonic solution, an animal cell will _____ and a plant cell will appear_____ or firm.

20. How can an amoeba, lacking a cell wall, survive in fresh water? _____

    _____

British botanists were quick to point out that in the case of plant, bacterial and fungal cells, ***water <u>does</u> <u>not</u> always move from areas of high water concentration to areas of low water concentration****. They correctly indicated that plant cells, in distilled water, have equal amounts of water moving in and out, even though water is much more concentrated outside the cell. These botanists noted that in order to truly understand how water moves, you have to account for the pressure that can develop within cells with cell walls. Therefore, they constructed the concept of water potential (ψ) to quantitatively determine the movement of water into/out of cells. Now turn to pg 8-13 in your lab manual for the symbols and formulas needed to complete the required calculations below. If you have 7th grade math skills and a calculator, you* ***<u>can</u>*** *do this!*

Beaker A
2.0 M Sucrose @ 27 °C



Beaker B
2.0 M NaCl @ 27 °C

<u>Symbols and Values for Beaker A</u>

	Write the symbol	*Write the Value (include the unit, if any)*
Pressure Potential	_____	_____
Ionization Constant	_____	_____
Molar Concentration	_____	_____
Pressure Constant	_____	_____
Temperature (in K)	_____	_____

<u>Calculations for Beaker A</u>

Solute Potential _____ = _____
(Write the symbol) *(Write the formula)*

Solute Potential _____
(Show the calculation with the units)

Solute Potential = _____
(Write the value)

Show the formula for calculation of water potential in the space below. Utilize word followed by symbols.

_____ = _____ + _____

Now substitute the appropriate values for beaker A

Ψ Beaker A = _____ + _____

Ψ Beaker A = _____

Now lets do the same for beaker B

Symbols and Values for Beaker B

	Write the symbol	*Write the Value (include the unit, if any)*
Pressure Potential	_____	_____
Ionization Constant	_____	_____
Molar Concentration	_____	_____
Pressure Constant	_____	_____
Temperature (in K)	_____	_____

Calculations for Beaker B

Solute Potential _____ = _____
(Write the symbol) *(Write the formula)*

Solute Potential _____
(Show the calculation with the units)

Solute Potential = _____
(Write the value)

Show the formula for calculation of water potential in the space below. Utilize word followed by symbols.

_____ = _____ + _____

Now substitute the appropriate values for beaker B

Ψ Beaker B = _____ + _____

Ψ Beaker B = _____

And now for the part that is really important!

Which beaker has the greatest water potential? _____

If the two beakers were connected by a membrane permeable only to water, the net movement of water would be

(a) Beaker A to Beaker B (b) Beaker B to Beaker A

Now use the words " up" or "down" to answer the following:

If temperature goes up, ψ goes _____. If pressure goes up, ψ goes _____

If molar concentration goes up, ψ goes _____

21. Oxygen is a larger molecule than water. However, O_2 diffuses more quickly across a phospholipid bilayer than H_2O. Explain how this is possible. _____

Do O_2 and H_2O molecules move with, or against the concentration gradient?_____

Is this an active or passive transport mechanism?_____

22. Molecules that are large or polar cannot diffuse though the non-polar tails of the phospholipids. Yet many large, polar molecules like tyrosine (amino acid) passively enter a cell on a regular basis. Explain how this is possible. _____

_____

Is this with, or against the concentration gradient? _____

23. Describe what happens as sodium ions leave the cell by active transport _____

_____

_____

24. Compare and contrast facilitated diffusion and active transport in two ways. (2 similarities and 2 differences)

_____

_____

25. Describe the location and function of carbohydrates associated with the cell membrane.

_____

_____

26. What is endocytosis? _____

How do phagocytosis and pinocytosis differ?_____

_____

27. How is receptor mediated endocytosis more efficient than pinocytosis? _____

_____

28. What takes place during exocytosis? _____

_____