

Chapter 7: Membrane Structure and Function

- 7.1 *Explain the fluid mosaic model, describing the components of the membrane.*
- 7.2 *Discuss how membrane structure results in selective permeability.*
- 7.3 *Use examples to demonstrate the processes of diffusion, osmosis, and facilitated diffusion.*
- 7.4 *Describe the process of active transport.*
- 7.5 *Identify the mechanisms a cell uses to transport materials across the membrane in bulk.*

Transport of materials across the membrane is an essential cell function, so you will need to understand the component molecules and their functions. There is considerable vocabulary associated with the movement of materials and concentrations on either side of the membrane, which you will need to accurately describe transport.

Study Tip: Make a visual study guide of the plasma membrane as suggested on p. 126 of the textbook. Add details to the membrane as you read the chapter. Drawing the details will help with visualizing movement into and out of the membrane.

The inbound and outbound traffic pattern across membranes is summarized in the opening page diagram. What are the important differences among these means of transport?

- a. **Passive transport**
- b. **Active transport**
- c. **Bulk transport**

Concept 7.1 *Cellular membranes are fluid mosaics of lipids and proteins*

LO 7.1: *Explain the fluid mosaic model, describing the components of the membrane.*

1. Phospholipids are *amphipathic*. Explain what this means.

2. The currently accepted model of the plasma membrane is the *fluid mosaic model*. Describe this model.

3. What is meant by *membrane fluidity*?

4. Describe how each of the following can affect membrane fluidity:
 - a. decreasing temperature

 - b. phospholipids with unsaturated hydrocarbon chains

 - c. cholesterol

 - d. increasing the number of saturated hydrocarbon tails

5. Membrane proteins are the *mosaic* part of the model. Describe each of the two main categories:

integral proteins

peripheral proteins

6. Study Figure 7.7 in your text. Use it to briefly describe the following major functions of membrane proteins.

Function	Description
Transport	
Enzymatic activity	
Signal transduction	
Cell-cell recognition	
Intercellular joining	
Attachment to cytoskeleton and ECM	

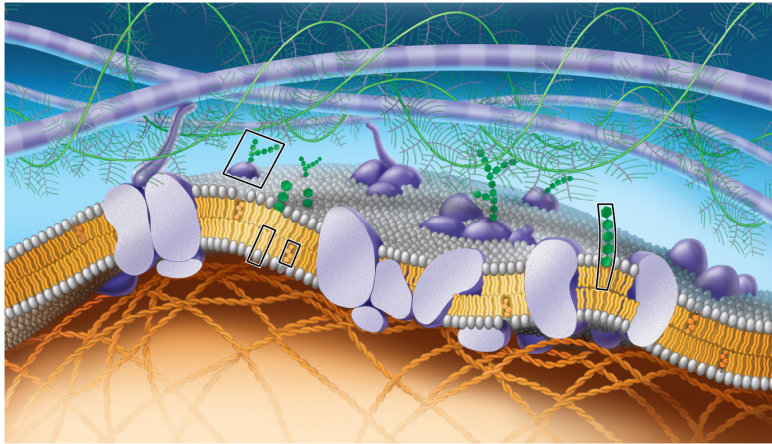
7. Membrane carbohydrates are important in cell-cell recognition. What are two examples of this?

8. Distinguish between *glycolipids* and *glycoproteins*.

Glycolipids

Glycoproteins

9. Label the following components of an animal cell membrane on the figure. Note the role of each component.



glycolipid

glycoprotein

integral protein

peripheral protein

cholesterol

phospholipid

ECM fibers

cytoskeleton microfilaments

integrins (go back to Chapter 6, Figure 6.28)

Concept 7.2 Membrane structure results in selective permeability

LO 7.2: Discuss how membrane structure results in selective permeability.

10. Carefully study Figure 7.9. Notice how the organelles you learned about in Chapter 6 work cooperatively to create new membranes. The outside membrane of a vesicle becomes the _____ of the cell membrane.
11. Distinguish between *channel proteins* and *carrier proteins*.
12. Are transport proteins specific? Cite an example that supports your response.
13. Peter Agre received the Nobel Prize in 2003 for the discovery of *aquaporins*. What are they?
14. Consider the following materials that must cross the membrane. For each, tell how it is moved across.

Material	Method of Transport
CO ₂	
Glucose	
H ⁺	
O ₂	
H ₂ O	

Concept 7.3 *Passive transport is diffusion of a substance across a membrane with no energy investment*

LO 7.3: *Use examples to demonstrate the processes of diffusion, osmosis, and facilitated diffusion.*

15. As you work through this concept, define the following terms as they are encountered:

diffusion

concentration gradient

passive transport

osmosis

isotonic

hypertonic

hypotonic

turgid

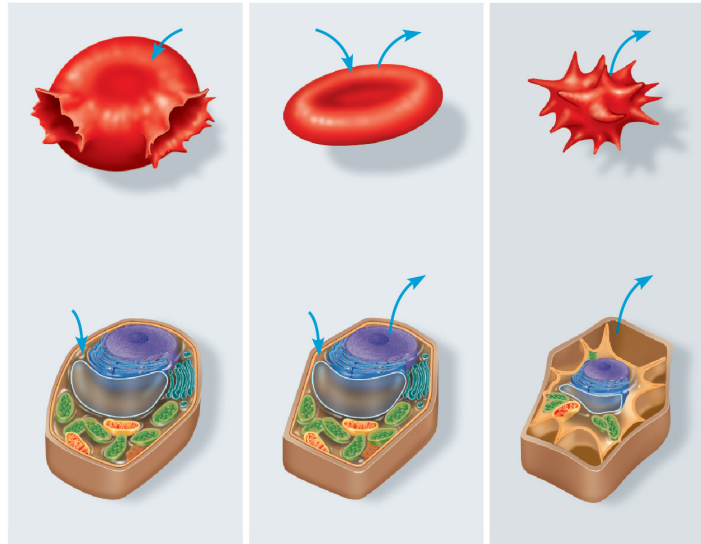
flaccid

plasmolysis

16. On your *Study Tip* diagram, add diffusion of two solutes as illustrated in Figure 7.11(b). How does the diffusion of one solute affect the diffusion of the second solute?

17. Using Figure 7.12 as a guide, add an example of osmosis to your *Study Tip* diagram.

18. In the following figure, label the *hypotonic solution*, *isotonic solution*, and *hypertonic solution*. What is indicated by the *blue arrows*? Label them. Which cell is *lysed*? *Turgid*? *Flaccid*? *Plasmolyzed*? Apply all these labels.



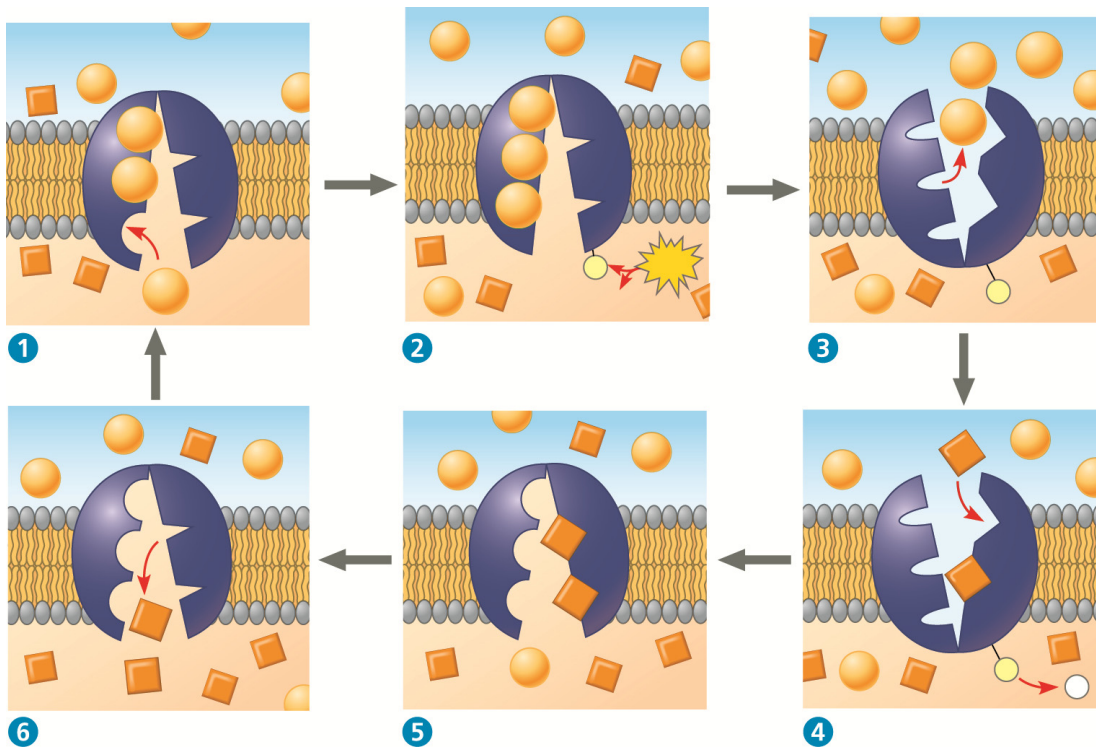
19. Why does the red blood cell burst when placed in a hypotonic solution, but the plant cell does not?
20. What is *facilitated diffusion*? Is it active or passive? Add two types of facilitated diffusion transport proteins to your *Study Tip* diagram.

Concept 7.4 Active transport uses energy to move solutes against their gradients

LO 7.4: Describe the process of active transport.

21. Describe *active transport*. What type of transport proteins are involved, and what is the role of ATP in the process?

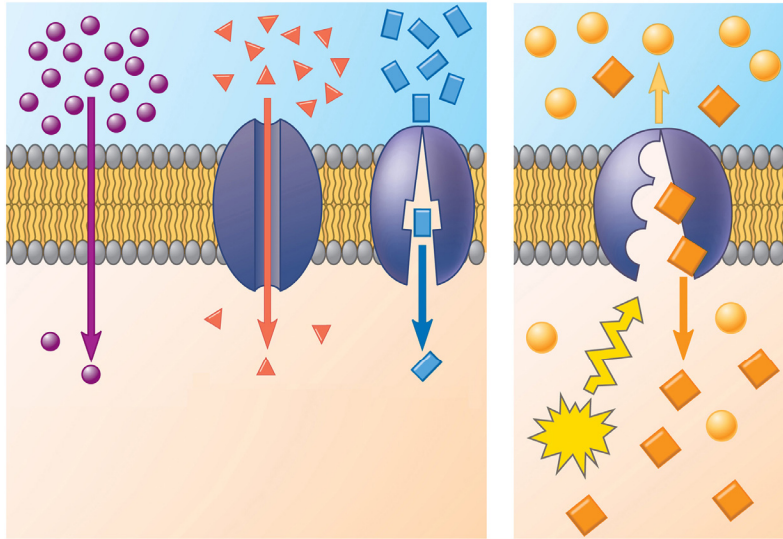
22. The *sodium-potassium pump* is an important system that demonstrates active transport. Use the following diagram to understand how it works. Use these terms to label the figures, and briefly summarize what is occurring in each step: *extracellular fluid*, *cytoplasm*, Na^+ , K^+ , *ATP*, *ADP*, *P*, and *transport protein*.



SUMMARY: SODIUM-POTASSIUM PUMP

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

23. On the following diagram, add these labels: *facilitated diffusion with a carrier protein*, *facilitated diffusion with a channel protein*, *active transport with a carrier protein*, and *simple diffusion*. Below each type of transport, give an example of a material that is moved in this manner.



24. What is *membrane potential*? Which side of the membrane is positive?
25. What are the two forces that drive the diffusion of ions across the membrane? What is the combination of these forces called?
26. What is *cotransport*? Explain how understanding it is used in our treatment of diarrhea.
27. Using Figure 7.19 as a guide, add cotransport to the *Study Tip* diagram.

Concept 7.5 Bulk transport across the plasma membrane occurs by exocytosis and endocytosis

LO 7.5: Identify the mechanisms a cell uses to transport materials across the membrane in bulk.

28. Define each of the following, and give a specific cellular example:

exocytosis

endocytosis

receptor-mediated endocytosis

phagocytosis

pinocytosis

29. What is the key feature of receptor-mediated endocytosis?

30. Are the processes you described in question 28 active or passive transport? Explain your response.

Test Your Understanding, p. 142

Now you should be ready to test your knowledge. Place your answers here:

1. ____ 2. ____ 3. ____ 4. ____ 5. ____

6. Answer all parts and draw arrows on the diagram below as instructed for parts b and d.

