AP Biology **Student Interactive Learning Guide**

North Salem University

MISSION: *Engage students to continuously learn, question, define and solve problems through critical and creative thinking.*

Fall 2023

The Ch. 8 study guide covers the structure and function of plasma membranes and how substances get into and out of cells. Some of this material was covered in your Honors/Regents Biology class. We will be going through the basics of this chapter rather quickly with a focus on the different functions of the plasma membrane not covered in your Honors/Regents Biology class. The Ch.11 Study Guide will focus on how external signals interact with receptors in the plasma membrane initiate the process of signal transduction to bring about an intracellular response. The activities and questions that follow should help you focus on the most important points of both chapters.

If you have any problems – please sign up for extra help after school

Chapter 8:
Membrane Structure and Function

Chapter 11:
Cellular Communication

Chapter 8: Membrane Structure and Function

OBJECTIVES:

Membrane Structure

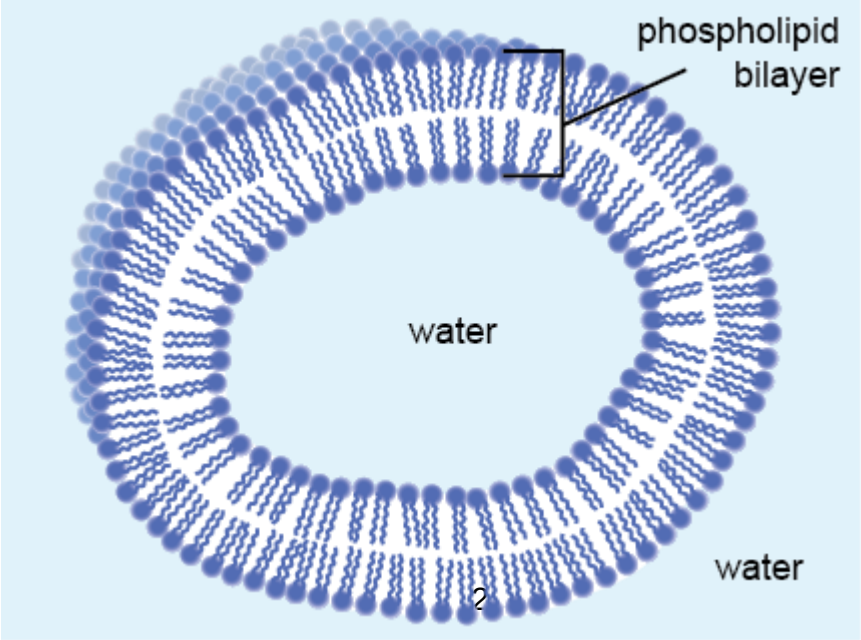
___1. Describe the properties of phospholipids and their arrangement in cellular membranes.
___2. Explain what freeze-fracture techniques reveal about the involvement of proteins in membranes.
___3. Describe the fluid properties of the cell membrane and explain how membrane fluidity is influenced by membrane composition.
___4. Describe how proteins and carbohydrates are spatially arranged in cell membranes and how they contribute to membrane function.

Traffic across Membranes

___5. Describe factors that affect the selective permeability of membranes.
___6. Describe the locations and functions of transport proteins.
___7. Define diffusion. Explain what causes diffusion and why it is a spontaneous process.
___8. Explain what regulates the rate of passive transport.
___9. Explain why a concentration gradient across a membrane represents potential energy.
___10. Distinguish between hypertonic, hypotonic, and isotonic solutions.
___11. Define osmosis and predict the direction of water movement based on differences in solute concentrations.
___12. Describe how living cells with and without walls regulate the balance of water content.

Evolution, Unity, and Diversity

___13. Explain how transport proteins are similar to enzymes.
___14. Explain how transport proteins facilitate diffusion.
___15. Explain how active transport differs from diffusion.
___16. Explain what mechanism can generate a membrane potential or electrochemical gradient.
___17. Explain how large molecules are transported across the cell membrane.
___18. Compare pinocytosis and receptor-mediated endocytosis.

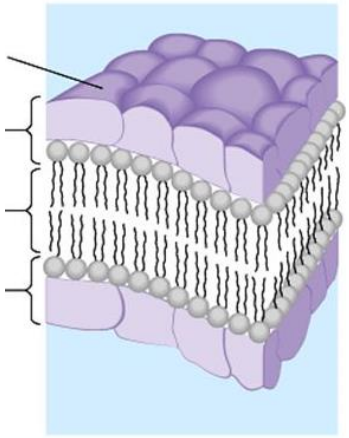


Guided Reading: Chapter 8

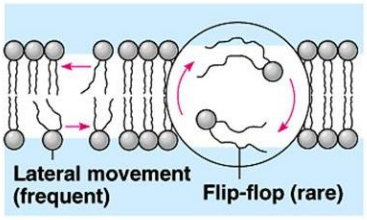
Part I. Membrane Structure

1. *Explain* what is meant when we say a molecule is **amphipathic**.

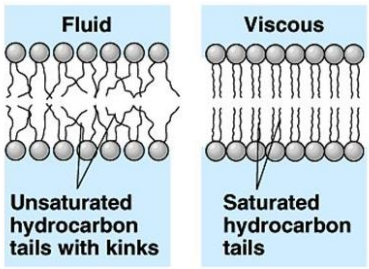
2. In the 1960s, the Davson-Danielli model of membrane structure was widely accepted. *Label* and use the diagram to the right to help you *describe* this model and *cite* two the evidence that was inconsistent with it. *(Figure 8.2)*



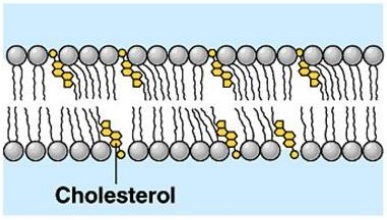
3. Who proposed the **fluid mosaic model** of membrane structure? When was it proposed? Use the diagrams below to help you *describe* the concept of membrane fluidity being sure to explain how cholesterol affects membrane fluidity. *(Figure 8.4)*



(a) Movement of phospholipids



(b) Membrane fluidity



(c) Cholesterol within the membrane

4. Membrane proteins are the mosaic part of the model. What is mosaic art?
Describe each of the two main categories: **integral proteins** and **peripheral proteins**.

5. Briefly describe the functions of membrane proteins listed below. *(Figure 8.9)*

a) <u>Transport</u> -

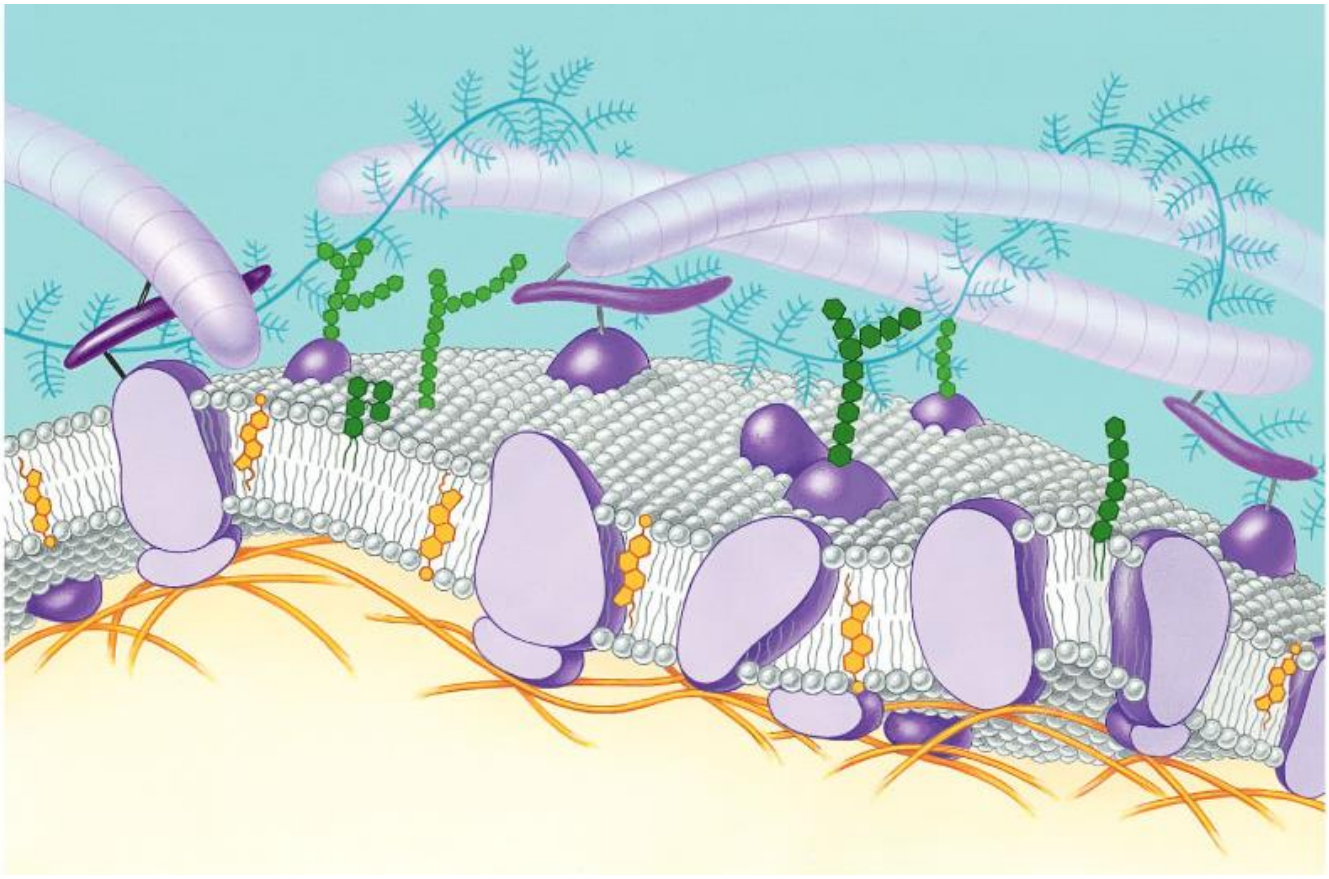
b) <u>Enzymatic Activity</u> -

c) <u>Signal Transduction</u> -

d) <u>Cell-Cell Recognition</u> -

9. *Label* the diagram below being sure to include the following structures: *(Figure 8.6)*

glycolipid	glycoprotein	carbohydrate	integral protein
peripheral protein	cholesterol	phospholipid	ECM fibers



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

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?

Part II. Traffic Across Membranes

14. Consider the following molecules that must cross the membrane. For each, tell how this is accomplished.

a) CO_2 -

b) Glucose -

c) H^+ -

d) O_2 -

e) H_2O –

15. BRIEFLY *define* the following terms:

a) diffusion -

b) concentration gradient -

c) passive transport -

d) osmosis -

e) isotonic -

f) hypertonic -

g) hypotonic -

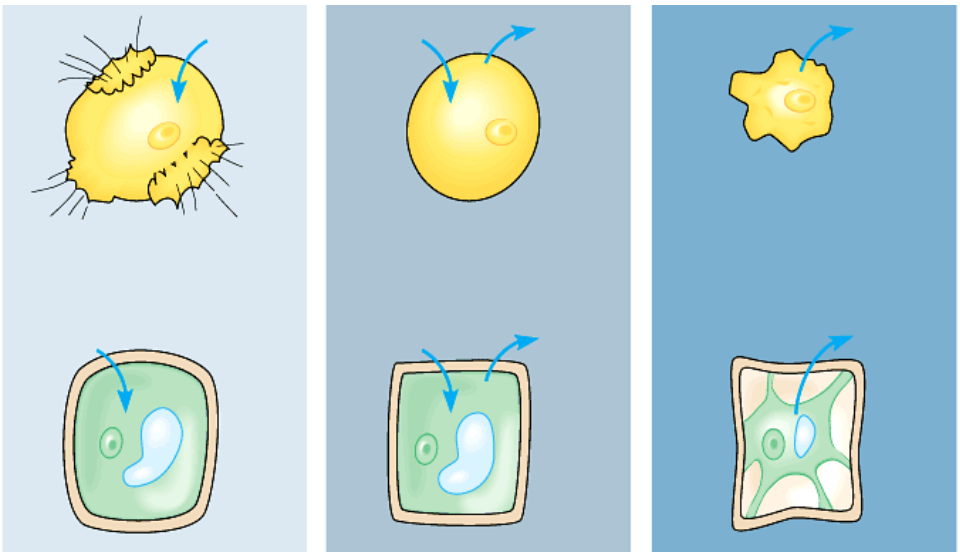
h) <u>turgid</u> -

i) <u>flaccid</u> -

j) <u>plasmolysis</u> –

16. What is **facilitated diffusion**? Is it active or passive? Cite two examples.

17. *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? *(Figure 8.12)*



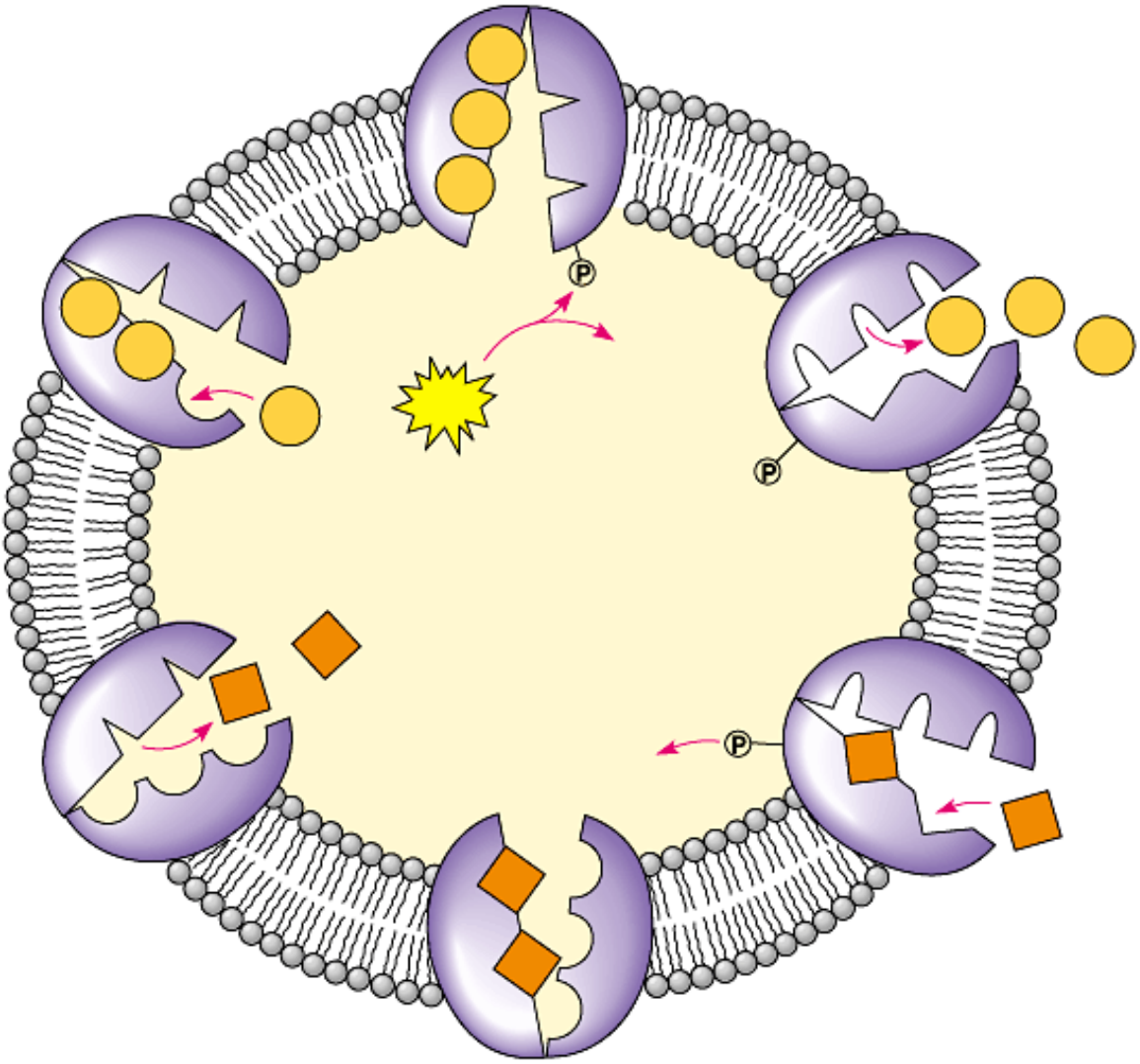
_____ _____ _____

18. Why doesn't the plant cell burst?

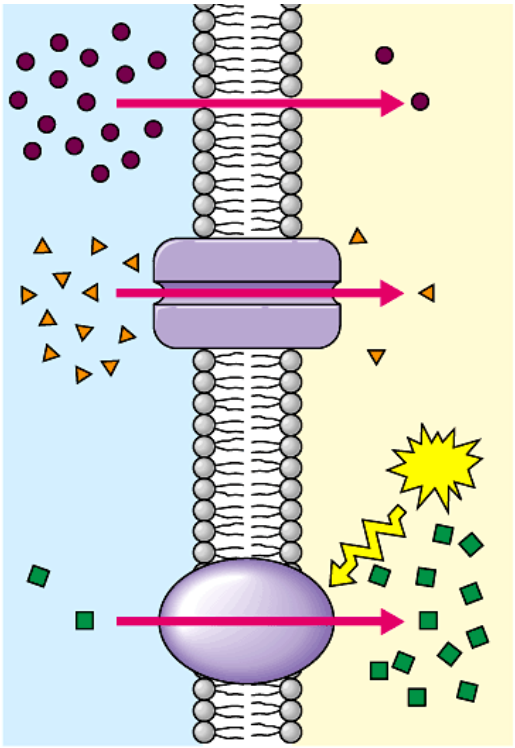
19. Why do paramecium need a **contractile vacuole** given the environment in which they live? (Figure 8.13)

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

21. The **sodium-potassium pump** is an important system for you to know and will come in to play when we study the human nervous system. *Label* and use the diagram below to understand how it works. Be sure to *summarize* each step and to label each of the following in the diagram: extracellular fluid, cytoplasm, Na+, K+, ATP, ADP, P, transport protein. *(Figure 8.15)*



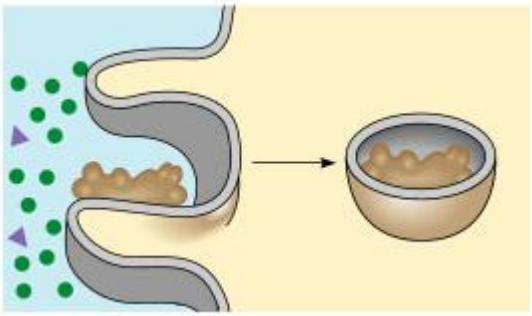
22. On the diagram below, add these labels: **facilitated diffusion** with a carrier protein, facilitated diffusion with a channel protein, active transport with a carrier protein, simple diffusion. For each type of transport, state an example of a material that is moved in this manner.



23. *Contrast* between **ENDOcytosis** and **EXOcytosis**?

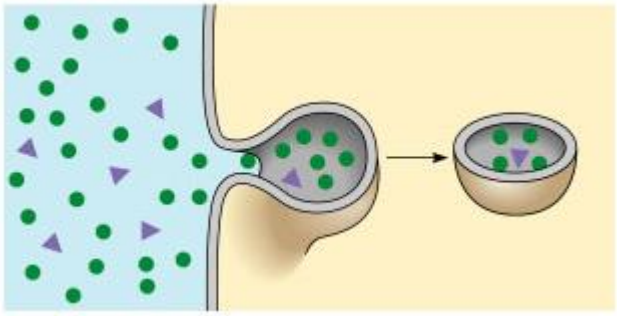
24. *Label* the diagram to the right and use it to help *explain* the process of **phagocytosis**.

phagocytosis



25. *Label* the diagram to the right and use it to help *explain* the process of **pinocytosis**.

pinocytosis



Chapter 11: Cell Communication

OBJECTIVES:

An Overview of Cell Signaling

___1. Describe the basic signal-transduction pathway of yeast. Explain why we believe these pathways in yeast, mammals, and plants evolved before the first multicellular organisms appeared on Earth.
___2. Describe the three main stages of cell signaling.

Signal Reception and the Initiation of Transduction

___3. Describe the nature of a ligand-receptor interaction and state how such interactions initiate a signal- transduction system.
___4. Compare and contrast G-protein-linked receptors and ligand-gated ion channels.

Signal-Transduction Pathways

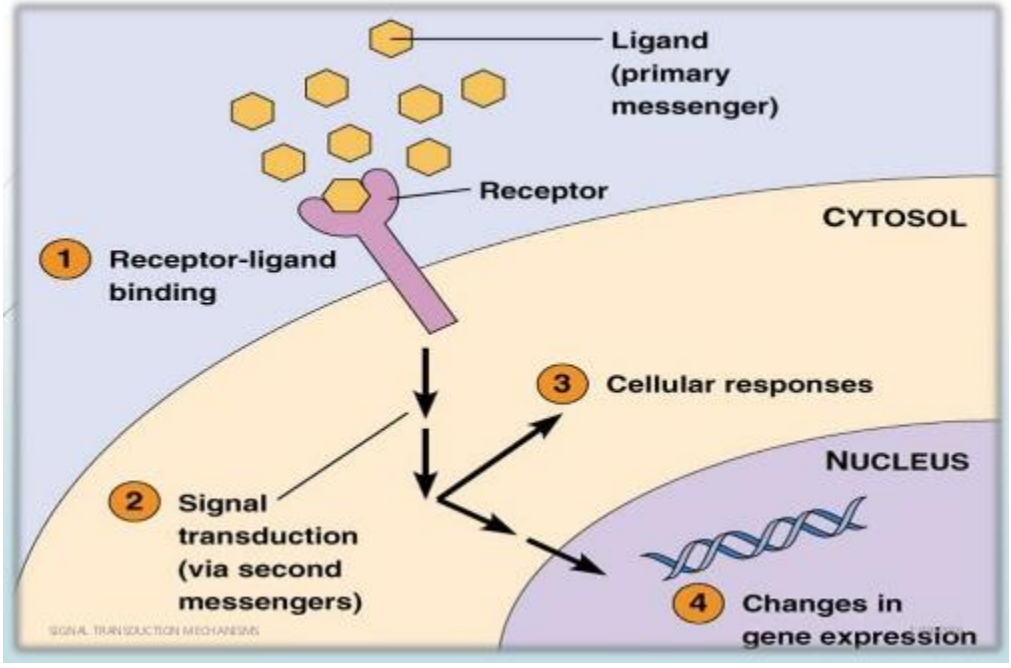
___5. Describe how phosphorylation propagates signal information.
___6. Describe how cyclic AMP is formed and how it propagates signal information.

Cellular Responses to Signals

___7. Describe how signal information is transduced into cellular responses in the cytoplasm and in the nucleus.

Evolution, Unity, and Diversity

___8. Describe how target cells discriminate among signals and how the same signal can elicit multiple cellular responses.

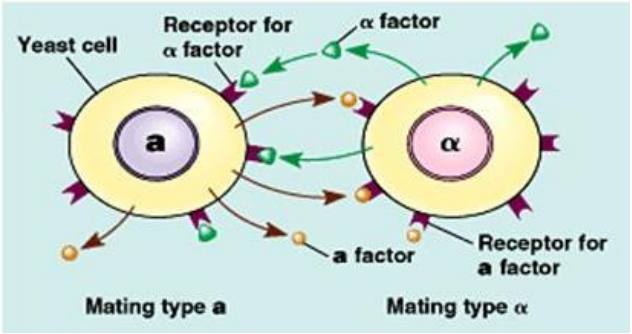


Guided Reading: Chapter 11

Part I. An Overview of Cell Signaling

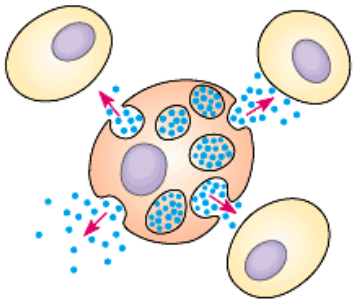
31. What is a signal transduction pathway?

32. Use the diagram to the right to help you *explain* how yeast mating serve as an example of a signal transduction pathway? *(Figure 11.1)*

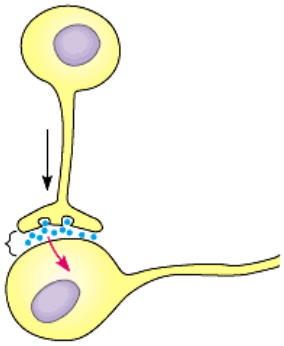


33. *Label* the diagrams below and use them to help you *describe* the 3 basic methods of local and long distance cell communication that takes place in animals? State one specific example of each.

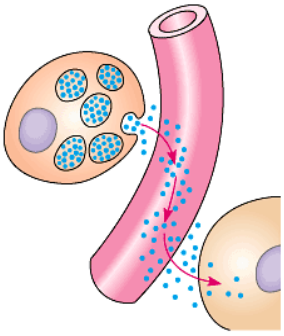
Paracrine Signaling



Synaptic Signaling



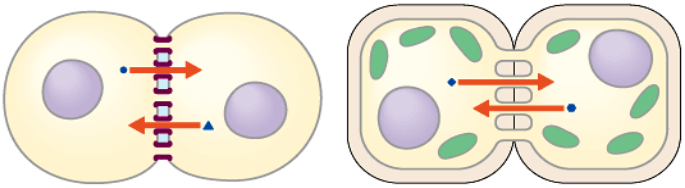
Hormonal Signaling



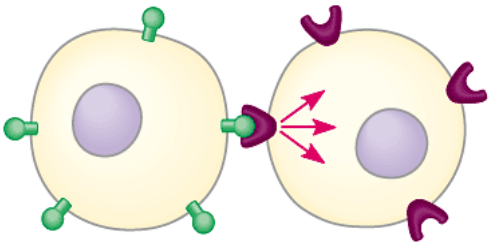
Example	**Example**	**Example**

34. *Label* the diagrams below and use them to help you describe the 2 basic methods of communication by direct contact between cells.(Figure 11.4)

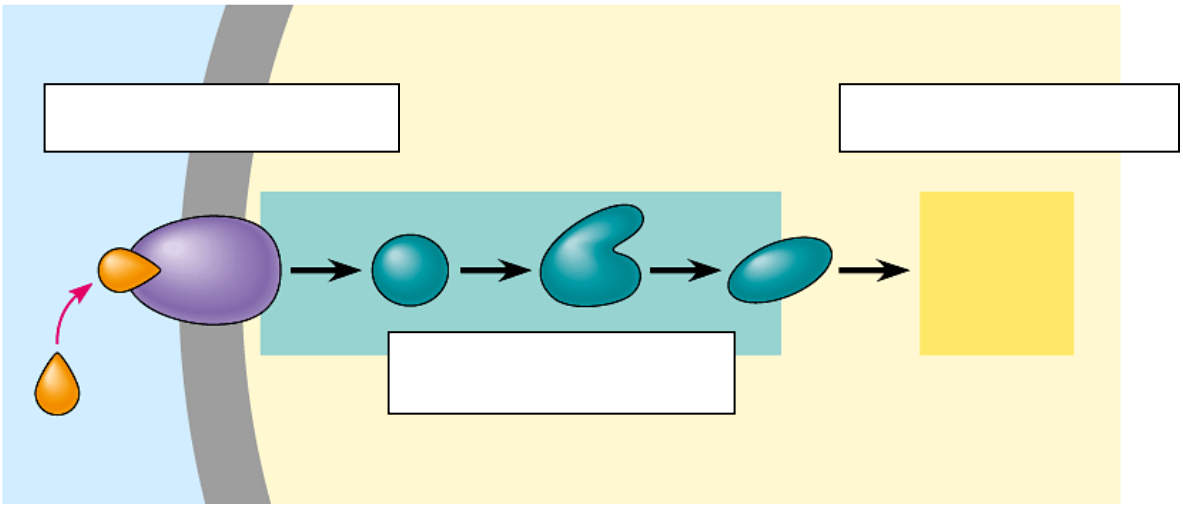
Cell Junctions



Cell-Cell Recognition



35. A signal transduction pathway has three stages. Use Figure **11.5** to label these three stages in the diagram below, and then briefly explain each step.

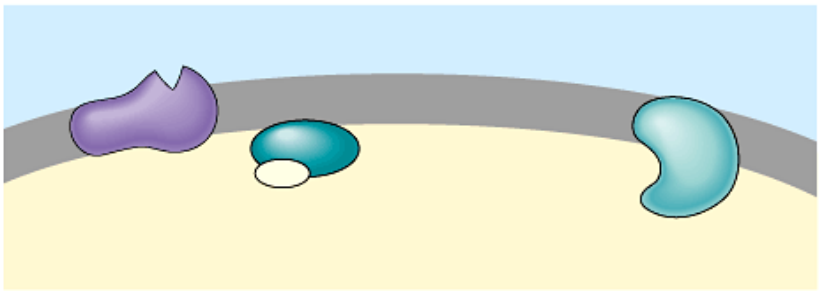


Reception: **Transduction:** **Response:**

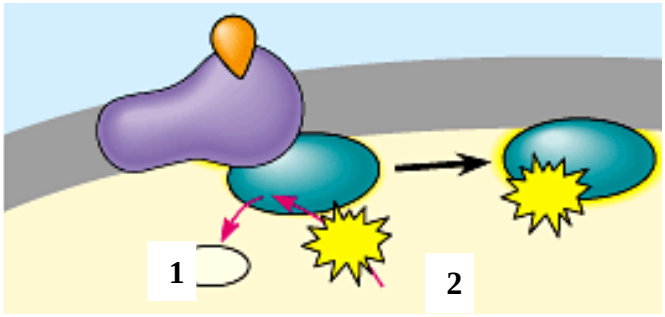
Part II. Signal Reception and the Initiation of Transduction

36. *Define* the term *ligand*. (*This term is not restricted to cell signaling. You will see it in other situations during the year.*)

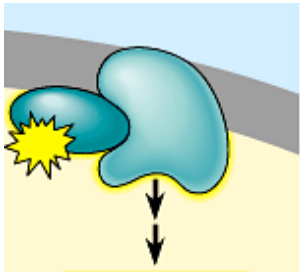
37. The text will explain three major types of membrane receptors in Figures 11.7. 11.8 and 11.9. (*We will only focus on 2.*) This material is of fundamental importance, so we will work thorough the specific figures for each type of membrane receptor. The first example is a ***G protein-linked receptor***.
In the first figure, label the components of the INACTIVE FORM and then describe the role of the three components.



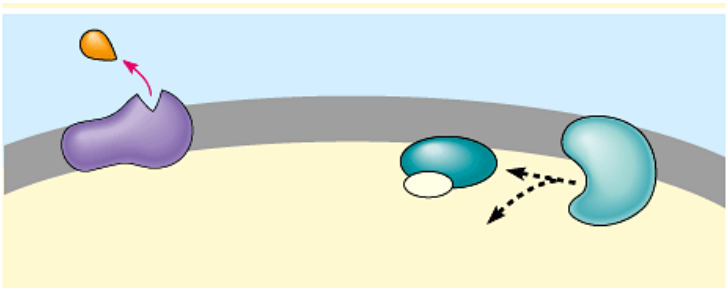
38. Label and then describe what happens in steps 1 and 2.



39. Label then describe what happens in step 3.

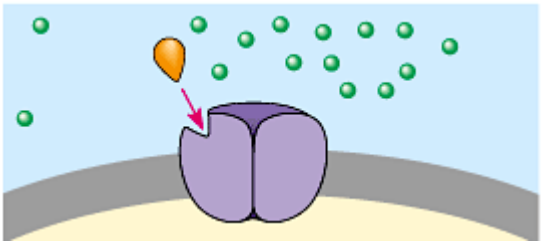


40. Equally important to starting a signal is stopping a signal. (*Failure to do so can lead to serious problems, like cancer*.) *Label* and then *describe* how the signal is halted.

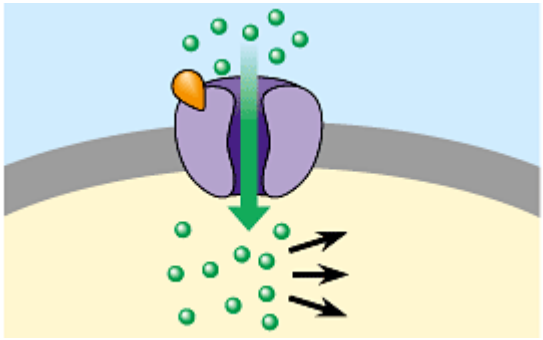


41. What activates a G protein?

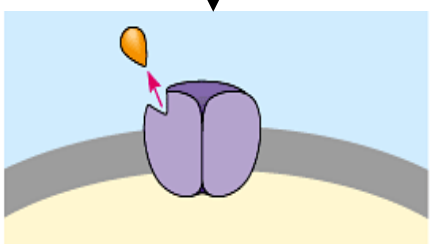
42. Moving to *ion channel receptors*, the example in Figure 11.9 shows the flow of ions into the cell. Ion channel receptors can also stop the flow of ions. These comparatively simple membrane receptors are explained in three steps. In the first step, *label* the diagram and then *explain* the role of the labeled molecules.



43. *Label* the diagram and then *explain* what has happened with the binding of the ligand to the receptor.



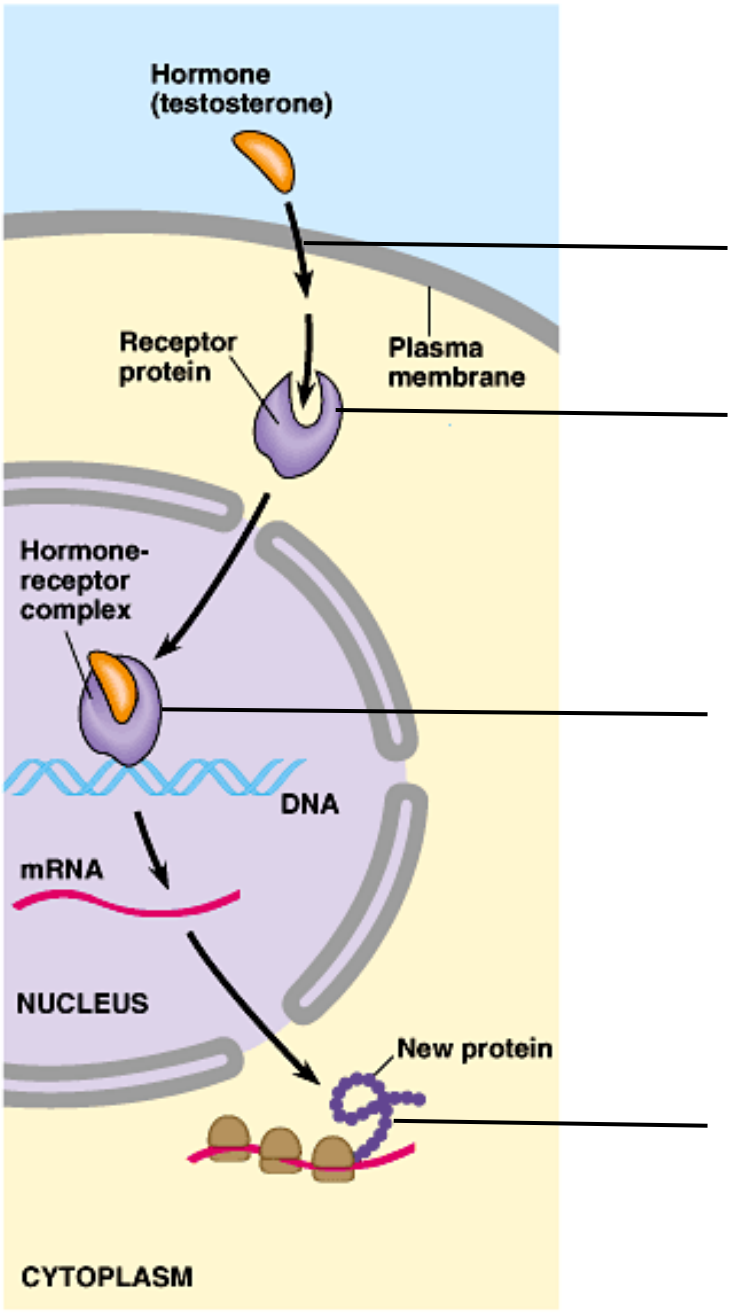
44. The ligand attachment to the receptor is brief. *Label* the diagram and *explain* what happens as the ligand dissociates.



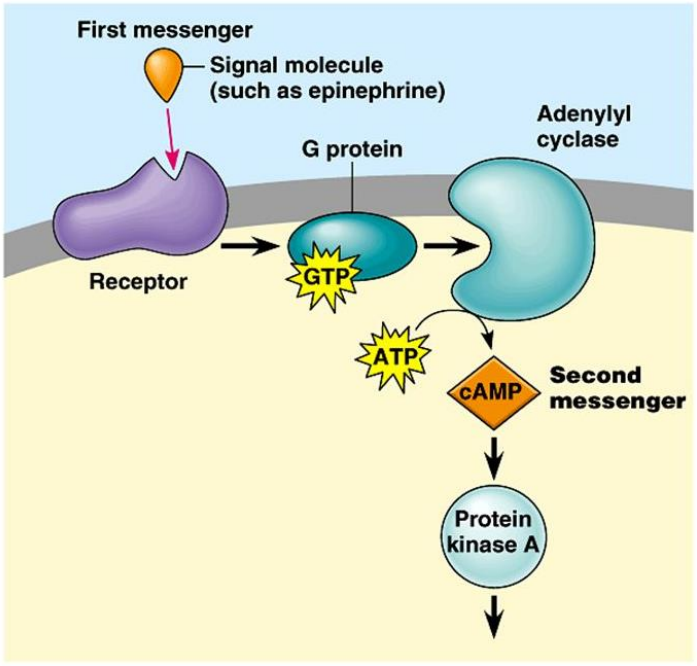
45. In what body system are *ligand-gated ion channels* and *voltage-gated ion channels* of particular importance?

Part III. Signal Transduction Pathways

46. This diagram below uses testosterone, a hydrophobic hormone, to detail how intracellular receptors work. At each line, add an explanation of what is happening in the cell. *(Figure 11.10)*



47. Two common *second messengers* are cyclic AMP (cAMP) and calcium ions (Ca2+).
Explain the role of the second messenger cAMP in the diagram to the right. (*Figure 11.13*)



Chapter 8/11 - Review Questions

___1) The fluid mosaic model describes the plasma membrane as consisting of -
A) a phospholipid bilayer with embedded carbohydrates.
B) two layers of phospholipids with cholesterol sandwiched between them.
C) carbohydrates and phospholipids that can drift in the membrane.
D) diverse proteins embedded in a phospholipid bilayer.

___2) Membrane phospholipids -
A) have hydrophobic heads that face the center of the membrane and are shielded from water.
B) have hydrophilic tails that face outward and are exposed to water.
C) are able to drift about in the plasma membrane
D) remain fluid because they are tightly packed against one another.

___3) The cholesterol associated with animal cell membranes -
A) is attached to membrane proteins and extends into the watery environment surrounding the cell.
B) helps to stabilize the cell membrane at body temperature.
C) is an abnormality resulting from a diet high in cholesterol.
D) helps solidify the membranes when the room temperature is below freezing.

___4) A major function of glycoproteins and glycolipids in the cell membrane is to -
A) glue cells together to form tissues.
B) allow the cells of an embryo to sort themselves into tissues and organs.
C) attach the cell membrane to the cytoskeleton.
D) help the cell retain its shape.

___5) When physicians perform an organ transplant, they choose a donor whose tissues match those of the recipient as closely as possible. Which of the following cell components are being matched?
A) plasma membrane phospholipids
B) plasma membrane proteins
C) cell-surface carbohydrates
D) plasma membrane cholesterols

___6) Most of the functions of a cell membrane, including transport and enzymatic function, are performed by -
A) glycolipids.
B) proteins.
C) phospholipids.
D) cholesterol.

___7) Relaying a message from a membrane receptor to a molecule that performs a specific function within a cell is called -
A) signal transduction.
B) inhibition.
C) competition.
D) selective permeability.

___8) Plasma membranes are selectively permeable. This means that -
A) anything can pass into or out of a cell as long as the membrane is intact and the cell is healthy.
B) the plasma membrane allows some substances to enter or leave a cell more easily than others.
C) glucose cannot enter the cell.
D) plasma membranes must be very thick.

___9) All cells are enclosed by a plasma membrane that is similar in _____ and _____.
A) thickness . . . composition
B) permeability . . . content
C) lucidity . . . texture
D) structure . . . function

___10) Small, nonpolar, hydrophobic molecules such as fatty acids -
A) easily pass through a membrane's lipid bilayer.
B) very slowly diffuse through a membrane's lipid bilayer.
C) require transport proteins to pass through a membrane's lipid bilayer.
D) are actively transported across cell membranes.

___11) Which of the following substances would have the most trouble crossing a biological membrane by diffusing through the lipid bilayer?
A) O_2
B) CO_2
C) Na^+
D) a small, nonpolar molecule such as butane (C_4H_{10})

___12) Oxygen crosses a plasma membrane by -
A) osmosis.
B) active transport.
C) pinocytosis.
D) passive transport.

___13) Which of the following statements regarding diffusion is *false*?
A) Diffusion is a result of the thermal energy of atoms and molecules.
B) Diffusion requires no input of energy into the system.
C) Diffusion occurs when particles spread from areas where they are less concentrated to areas where they are more concentrated.
D) Diffusion occurs even after equilibrium is reached and no net change is apparent.

___14) Diffusion does not require the cell to expend ATP. Therefore, diffusion is considered a type of -
A) exocytosis.
B) passive transport.
C) active transport.
D) endocytosis.

___15) Osmosis can be defined as -
A) the diffusion of water.
B) the diffusion of nonpolar molecules.
C) active transport.
D) the diffusion of a solute.

___16) When two aqueous solutions that differ in solute concentration are placed on either side of a semipermeable membrane and osmosis is allowed to take place, the water will -
A) exhibit a net movement to the side with lower free water concentration.
B) exhibit a net movement to the side with higher free water concentration.
C) exhibit a net movement to the side with lower solute concentration.
D) exhibit an equal movement in both directions across the membrane.

___17) Some protozoans have special organelles called contractile vacuoles that continually eliminate excess water from the cell. The presence of these organelles tells you that the environment -
A) is isotonic to the protozoan.
B) is hypotonic to the protozoan.
C) contains a higher concentration of solutes than the protozoan.
D) is hypertonic to the protozoan.

___18) A cell that neither gains nor loses water when it is immersed in a solution must be -
A) isotonic to its environment.
B) hypertonic to its environment.
C) hypotonic to its environment.
D) metabolically inactive.

___19) In a hypotonic solution, an animal cell will -
A) lyse.
B) experience turgor.
C) neither gain nor lose water.
D) shrivel.

___20) If placed in tap water, an animal cell will undergo lysis, whereas a plant cell will not. What accounts for this difference?
A) the expulsion of water by the plant cell's central vacuole
B) the relative impermeability of the plant cell wall to water
C) the fact that plant cells are isotonic to tap water
D) the relative inelasticity and strength of the plant cell wall

___21) A plant cell in a hypotonic solution -
A) becomes turgid because of an inflow of water.
B) bursts because of an inflow of water.
C) shrivels because of an outflow of water.
D) wilts because of an outflow of water.

___22) You are adrift in the Atlantic Ocean, and, being thirsty, drink the surrounding seawater. As a result, -
A) you quench your thirst.
B) your cells become turgid.
C) you dehydrate yourself.
D) your cells lyse from excessive water intake.

___23) Facilitated diffusion across a biological membrane requires _____ and moves a substance _____ its concentration gradient.
A) energy and transport proteins . . . down
B) transport proteins . . . down
C) energy and transport proteins . . . against
D) transport proteins . . . against

___24) The molecules responsible for membrane transport are -
A) steroids.
B) phospholipids.
C) carbohydrates.
D) proteins.

___25) Which of the following statements is *true* among all types of passive transport?
A) Proteins are needed to transport molecules across the membrane.
B) The concentration gradient is the driving force.
C) Only small polar molecules are able to cross the plasma membrane.
D) Ions never cross the plasma membrane by passive transport.

___26) Aquaporins -
A) allow water to cross the plasma membrane via facilitated diffusion.
B) allow water to cross the plasma membrane against its concentration gradient.
C) allow for the active transport of water.
D) are found in all cells.

___27) Which of the following processes can move a solute against its concentration gradient?
A) osmosis
B) passive transport
C) facilitated diffusion
D) active transport

___28) Which of the following statements regarding active transport is *false*?
A) Active transport uses ATP as an energy source.
B) Active transport can move a solute against its concentration gradient.
C) Active transport requires the cell to expend energy.
D) Active transport is driven by the concentration gradient.

___29) Certain cells that line the stomach synthesize a digestive enzyme and secrete it into the stomach. This enzyme is a protein. Which of the following processes could be responsible for its secretion?
A) endocytosis
B) exocytosis
C) diffusion
D) pinocytosis

___30) The process of a white blood cell engulfing a bacterium is -
A) osmosis.
B) receptor-mediated endocytosis.
C) pinocytosis.
D) phagocytosis.

___31) Which of the following is characterized by a cell releasing a signal molecule into the environment, followed by a number of cells in the immediate vicinity responding?
A) hormonal signaling
B) endocrine signaling
C) paracrine signaling
D) synaptic signaling

___32) Which of the following types of signaling is represented in the figure to the right?
A) autocrine
B) paracrine
C) hormonal
D) synaptic

___33. In the figure to the right, the dots in the space between the two structures represent which of the following?
A) receptor molecules
B) neurotransmitters
C) signal transducers
D) hormones

___34) Yeast are able to communicate with each other -
A) by close cell-to-cell contact.
B) only if they can touch each other and have merged cell walls.
C) through chemical signaling.
D) with pseudopodia.

___35) In multicellular organisms, the coordination of cellular activities relies on -
A) cell receptors that detect transcription factors.
B) the availability of certain "key" nutrients as cells divide.
C) cell-to-cell signaling and signal transduction pathways.

___36) To initiate a signal transduction pathway, a signal binds to a receptor protein usually located in the -
A) nucleus.
B) ER
C) plasma membrane.
D) cytoplasm.

___37) Transcription factors attach to -
A) DNA.
B) signal molecules.
C) plasma membrane receptors.
D) mRNA.

___38) A signal outside a cell triggers changes in the transcription and translation inside the cell through -
A) post-translational editing.
B) protein activation.
C) signal transduction pathways.
D) protein breakdown.

___39) Signal transduction pathways -
A) are found strictly in multicellular organisms, which require cell-to-cell communication.
B) are limited for use in sexual identification.
C) originally evolved in vertebrates.
D) are mechanisms of communication that probably evolved in ancient prokaryotes.