

Active Learning Exercise 4

Structure & Function of Cells and Membranes

Reference: Chapters 6 & 7 (*Biology by Campbell/Reece, 8th ed.*)

Cell Structure and Function (Reference: Chapter 6, *Biology, 8th ed.*)

1. Why is the study of cell structure and function important?

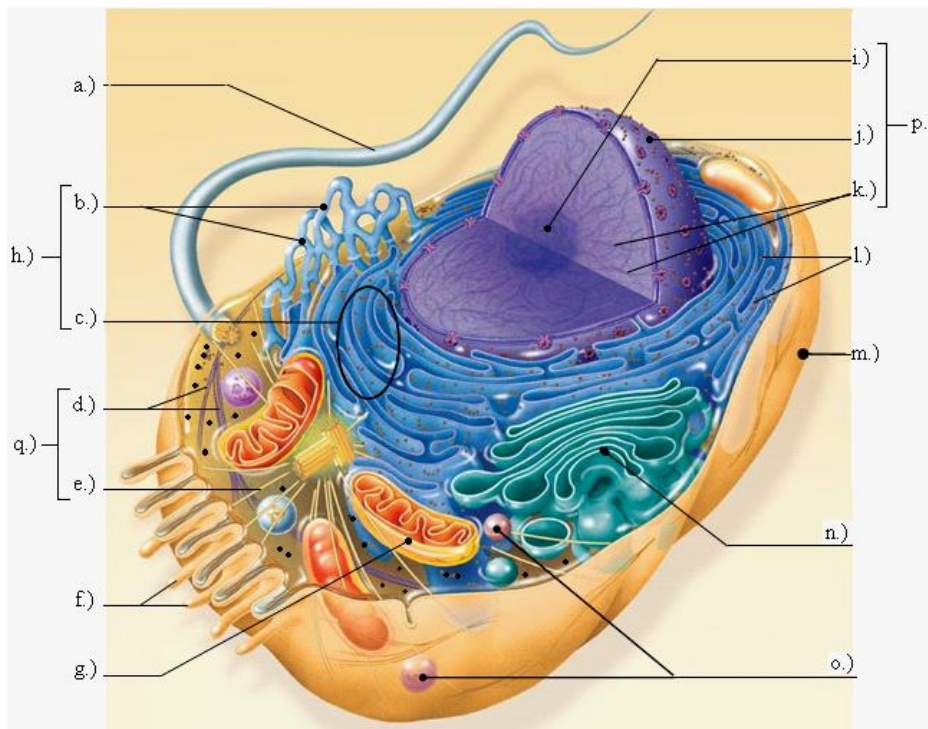
2. Explain what cell fractionation is and what it is used for.

3. a.) What are the major differences between prokaryotic and eukaryotic cells? Cite examples of each cell type.

- b.) Based on their cell structures, which cell type most likely evolved first: i.) prokaryotic cells or ii.) eukaryotic cells? Circle your choice and explain your reasoning.

4. Why is it highly improbable that you will find a large predatory 40 kg cell on the slithering down the sidewalk? *Hint:* Discuss the selective advantage of cells being small and relate your response to how the surface area to volume ratio changes as cell size increases, and the efficiency of movement of substances (e.g. nutrients and waste products) by simple diffusion into, out of, and within cells.

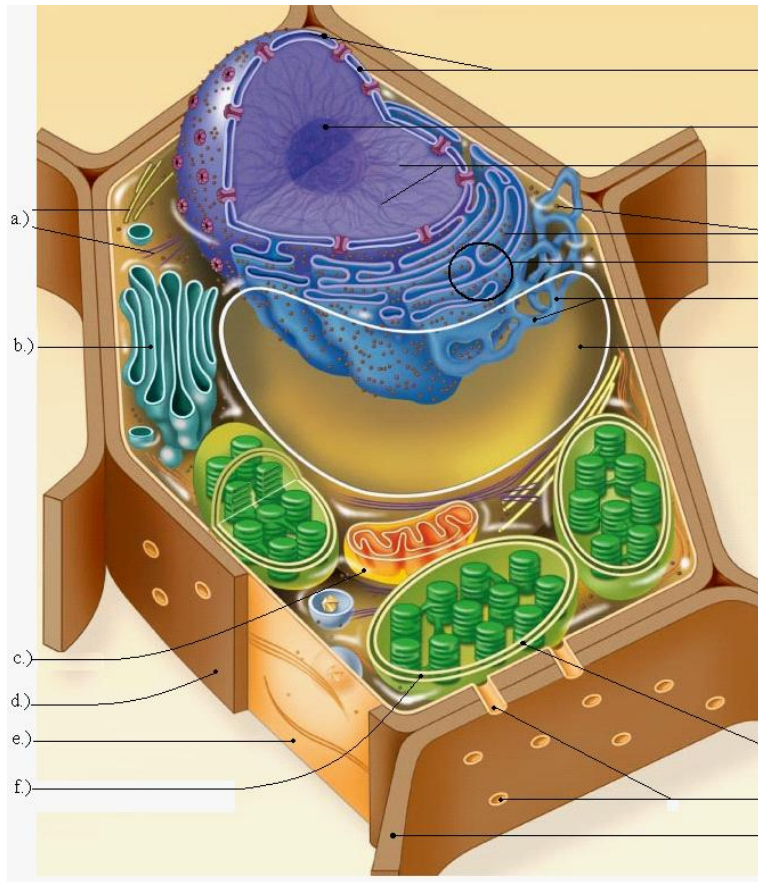
5. Below is a diagram of a “typical” *animal cell*. After studying the structures in your textbook identify the labeled structures below without referring to your text or any other outside source.



Name of structure

a.)
b.)
c.)
d.)
e.)
f.)
g.)
h.)
i.)
j.)
k.)
l.)
m.)
n.)
o.)
p.)

6. Below is a diagram of a “typical” *plant cell*. After studying the structures in your textbook name the labeled structures below without referring to your text or any other outside source.



Name of structure

- | |
|-----|
| a.) |
| b.) |
| c.) |
| d.) |
| e.) |
| f.) |
| g.) |
| h.) |
| i.) |
| j.) |
| k.) |
| l.) |
| m.) |
| n.) |
| o.) |
| p.) |
| q.) |
| r.) |

7. Why is there really no such thing as a “typical” animal cell or “typical” plant cell? (Hint: structure determines function!)
8. List the major structural and resulting functional differences, between “typical” plant and animal cells?

9. Complete the column entitled “Specific Functions”. Now cover this column with a sheet of paper. Can you now name the primary functions of the cell organelles listed in the table? If not, review the structures and their functions until you can.

General Function(s)	Organelle(s)	Specific Functions
Genetic control of the cell	Nucleus <ul style="list-style-type: none"> • Chromosomes • Nucleolus 	<ul style="list-style-type: none"> • •
Manufacture of macromolecules and perform metabolic functions	• Ribosomes	
	• Rough ER	
	• Smooth ER	
	• Golgi Apparatus	
	• Lysosomes	
	• Vacuoles	Food vacuole: Contractile vacuole: Central vacuole (plants):
	• Peroxisomes	
Energy processing	• Mitochondria	
	• Chloroplasts (in some plants and protists)	
Support, movement, and communication between cells	• Cytoskeleton	
	• Cell wall (in archaea, plants, fungi, and some protists)	
	• Intercellular junctions (<u>Plasmodesmata</u> in plants; <u>Tight junctions</u> , <u>desmosomes</u> , and <u>gap junctions</u> in animals)	

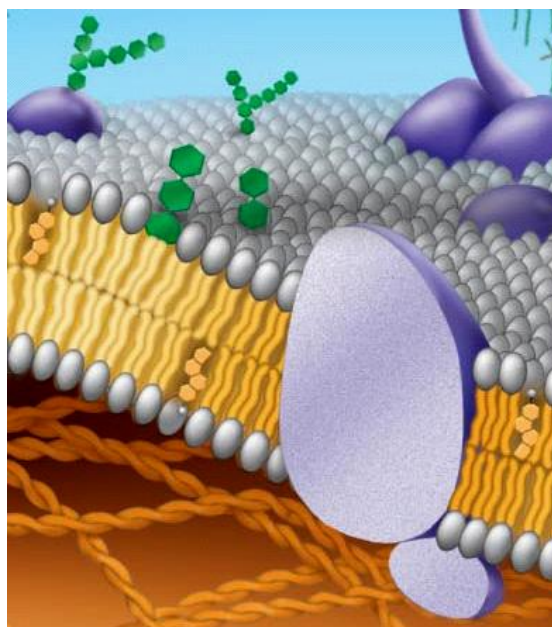
10. Lipase, a glycoprotein, is one of the many digestive enzymes found in a lysosome where it functions to digest fat molecules into fatty acids and glycerol. Trace the biosynthetic route the enzyme takes to its home in the lysosome:

_____ ER → transport vesicle → _____ →
 _____ → lysosome

Membrane Structure and Function (Reference: [Chapter 7, Biology, 8th ed.](#))

11. a.) Use a ruler to neatly label each of the following in the diagram of a plasma membrane below.

Carbohydrate	Glycolipid	Hydrophobic tails of phospholipid
Cholesterol	Glycoprotein	Integral protein
Cytoplasmic side	Hydrophilic head of phospholipid	Peripheral protein
Cytoskeleton	Hydrophilic regions of protein	Phospholipid bilayer
Extracellular side	Hydrophobic regions of protein	

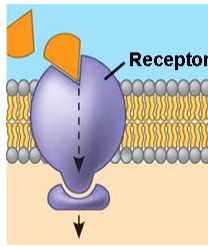


- b.) Describe the ***fluid mosaic model*** for plasma membranes. What makes the membrane fluid? What parts constitute the mosaic? What forces hold the phospholipid molecules together?

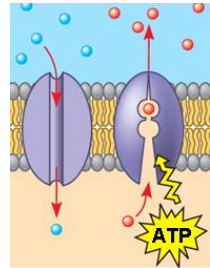
12. Which of the following amino acids would most likely be present in the *transmembrane domain* of an *integral membrane protein*?
- a.) a charged amino acid like lysine
 - b.) a polar amino acid like serine
 - c.) a special amino acid like glycine or proline
 - d.) a hydrophobic amino acid like valine
 - e.) any of the above, with no preference
13. An animal cell membrane will be *more fluid* at room temperature if it contains...
- a.) more cholesterol.
 - b.) longer chain fatty acids.
 - c.) more cis-unsaturated and polyunsaturated fatty acids.
 - d.) more unsaturated fatty acids.
 - e.) any of the above
14. The carbohydrate molecules covalently linked to a protein (i.e. to form a *glycoprotein*) in the lumen of the rough ER may end up on the...
- a.) cytoplasmic face of the plasma membrane.
 - b.) extracellular face of the plasma membrane.
 - c.) cytoplasmic face of a secretory vesicle.
 - d.) any of the above
15. How do *hydrophilic substances* (e.g. polar molecules and ions) enter and leave cells if they are unable to pass through the lipid bilayer of the plasma membrane?
16. Although ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, is a polar molecule, it passes readily through the lipid bilayer of the plasma membrane of animal cells, but at high concentrations ethanol kills cells by dissolving the plasma membrane causing lysis of the cell. Explain these observations.

17. Use the following terms to identify the kind of membrane function illustrated in the diagrams below and then briefly *in your own words* describe each function: **Transport**, **Enzyme activity**, **Signal transduction**, **Cell-cell recognition**, **Intercellular joining**, **Attachment to the cytoskeleton & extracellular matrix**

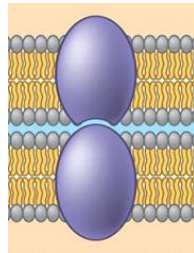
a.)



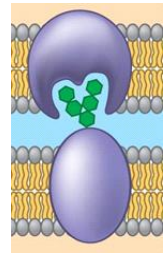
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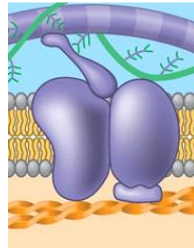
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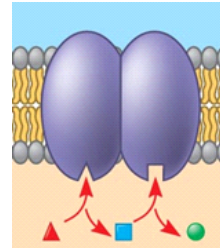
e.)



c.)



f.)



18. What is the major function of membrane **glycoproteins** and **glycolipids**?

19. a.) What is diffusion?

b.) Why does diffusion occur?

20. Complete the following table by indicating whether each substance is hydrophobic or hydrophilic, has a high or low permeability through the lipid bilayer of a plasma membrane, and then explain the reason behind the substance's permeability.

Substance	Hydrophobic or Hydrophilic?	Lipid Bilayer Permeability (High or Low)	Explanation of Permeability through Lipid Bilayer
Nonpolar Molecules			
Polar Molecules			
Inorganic Ions			
Oxygen			
Carbon Dioxide			
Glucose			

21. Which of the following molecules will *diffuse* most quickly across a *lipid bilayer membrane*?

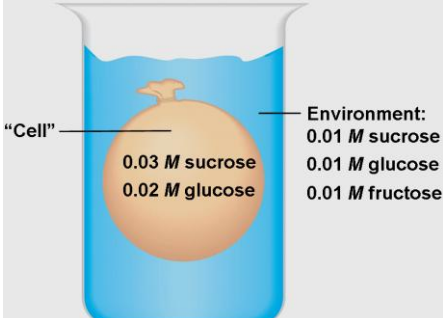
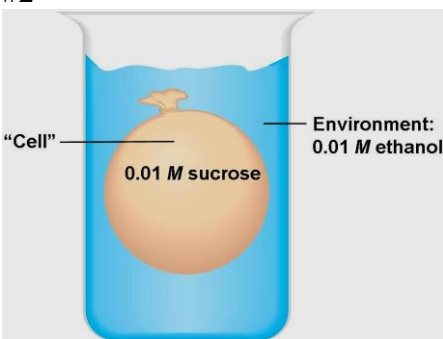
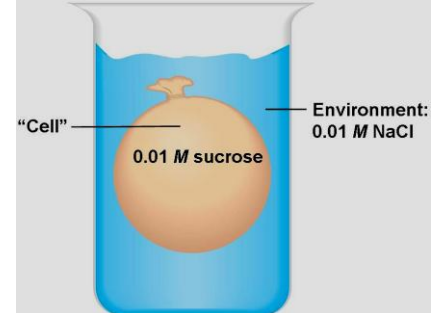
a.) H_2O b.) O_2 c.) H_2PO_4^- d.) glucose e.) Na^+

22. What is *osmosis* and what causes it to occur?

23. For each example below identify the type of molecular motion involved as *simple diffusion*, *facilitated diffusion*, *osmosis* or *active transport*.

Example	Type of molecular motion
a.) The movement of O_2 molecules the blood plasma into an actively contracting muscle cell	
b.) An animal cell loses water and crenates (shrivels up) when placed in sea water.	
c.) When placed in a hypotonic solution, water moves into the cell through an aquaporin channel.	
d.) The movement of glucose molecules into the central vacuole from the cytosol of a plant cell	

24. Determine the tonicity (hypo-, hyper- or isotonic) of the “cell” and the environment for each experiment below and predict the net movement of water and the solutes by circling the appropriate responses. Assume the “cell membrane” is permeable to all solutes. Hint: with the exception of NaCl, an ionic compound, all solutes are molecular compounds.

Experiment	“Cell”	Environment	Net movement of water	Net movement of solute
#1 	Hypotonic or Hypertonic or Isotonic?	Hypotonic or Hypertonic or Isotonic?	Into “Cell” or Out of “Cell” Or at Equilibrium?	Fructose: Into Cell or Out of Cell? Sucrose: Into Cell or Out of Cell? Glucose: Into Cell or Out of Cell?
#2 	Hypotonic or Hypertonic or Isotonic?	Hypotonic or Hypertonic or Isotonic?	Into “Cell” or Out of “Cell” Or at Equilibrium?	Sucrose: Into Cell or Out of Cell? Ethanol: Into Cell or Out of Cell?
#3 	Hypotonic or Hypertonic or Isotonic?	Hypotonic or Hypertonic or Isotonic?	Into “Cell” or Out of “Cell” Or at Equilibrium?	Sucrose: Into Cell or Out of Cell? NaCl: Into Cell or Out of Cell?

25. Explain the difference between **active transport** and **passive transport** mechanisms, giving an example of each. Hint: Discuss with respect to energy and concentration gradients.

26. Distinguish between the following:

a.) *Facilitated diffusion* and *active transport*

b.) *Exocytosis* and *endocytosis*

27. Identify each statement as **TRUE** or **FALSE**.

- a.) _____ If a dead but intact cell is placed in a solution hypotonic to the cell contents, osmosis will not occur.
- b.) _____ When two solutions separated by a selectively permeable membrane reach osmotic equilibrium, water molecules no longer move between the solutions.
- c.) _____ The rate of osmosis increases with increasing differences in solute concentrations between two solutions separated by a selectively permeable membrane.
- d.) _____ Osmosis is due to diffusion of water molecules across a selectively permeable membrane.
- e.) _____ Water movement into a cell through aquaporin channels requires energy investment by the cell.
- f.) _____ Seawater is a hypertonic solution.
- g.) _____ Diffusion is due to random movements of molecules.

28. Illustrate below how a *macrophage* (a type of white blood cell that resembles amoeba that are found in the tissues and blood of mammals, including humans!) would ingest a bacterial cell, digest it and then excrete the indigestible waste. Label all of the important structures involved.