Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_

**AP Biology Exam Review : Cell Structure and Transport (Unit 2)**

**Textbook Chapters:** 6 (A Tour of the Cell), 7 (Membrane Structure and Function)

**Helpful Videos and Animations:**

1. Bozeman Biology: Cell Membranes - <http://www.youtube.com/watch?v=y31DlJ6uGgE&list=PLFCE4D99C4124A27A&index=19>
2. Bozeman Biology: Transport Across Cell Membranes

<http://www.youtube.com/watch?v=RPAZvs4hvGA&list=PLFCE4D99C4124A27A>

1. Bozeman Biology: Compartmentalization - <http://www.youtube.com/watch?v=2rihCCBzqMc&list=PLFCE4D99C4124A27A>
2. Bozeman Biology: Cellular Organelles –

<http://www.youtube.com/watch?v=aczbMlSMr8U&list=PLFCE4D99C4124A27A>

**Topic Outline:**

1. The Difference between Prokaryotic and Eukaryotic Cells (organelles present, size, organization of DNA, etc.)
2. Structures and Functions of Eukaryotic Organelles (make sure you understand how the structure and molecular composition of each cell part gives it its unique functions)
* Nucleus (with nuclear membrane, nuclear pores, nucleolus, and chromatin)
* Ribosomes (free vs. bound… what kinds of proteins does each type create?)
* Endoplasmic Reticulum (smooth vs. rough)
* Golgi Apparatus
* Glysosomes
* Vacuoles (compare plant vs. animal vacuoles)
* Mitochondria
* Chloroplasts
* Peroxisomes
* Cytoskeleton (know the difference between microtubules, microfilaments, and intermediate filaments)
* Centrosomes + Centrioles
* Cilia and Flagella
* Extracellular Matrix
* Intercellular Junctions: three types in animal cells (tight junctions, desmosomes, and gap junctions) ; one type in plant cells (plasmodesmata)
1. Identify which organelles are found in plant vs. animal cells and identify each in an image
2. Describe the function of the endomembrane system in protein synthesis and secretion (be able to list / sequence all structures and processes involved)

***CC 2.B.3 –***

***a. Internal membranes facilitate cellular processes by minimizing competing interactions and by increasing surface area where reactions can occur.***

***b. Membranes and membrane-bound organelles in eukaryotic cells localize (compartmentalize) intracellular***

***metabolic processes and specific enzymatic reactions. [See also 4.A.2]***

***To demonstrate understanding, make sure you can explain examples like:***

* ***Endoplasmic reticulum***
* ***Mitochondria***
* ***Chloroplasts***
* ***Golgi***
* ***Nuclear envelope***

***c. Archaea and Bacteria generally lack internal membranes and organelles and have a cell wall.***

***CC 4.A.2 –***

***a. Ribosomes are small, universal structures comprised of two interacting parts: ribosomal RNA and protein.***

***In a sequential manner, these cellular components interact to become the site of protein synthesis where the***

***translation of the genetic instructions yields specific polypeptides.***

***b. Endoplasmic reticulum (ER) occurs in two forms: smooth and rough.***

***Evidence of student learning is a demonstrated understanding of each of the following:***

***1. Rough endoplasmic reticulum functions to compartmentalize the cell, serves as mechanical***

***support, provides site-specific protein synthesis with membrane-bound ribosomes and plays a role in***

***intracellular transport.***

***2. In most cases, smooth ER synthesizes lipids.***

***c. The Golgi complex is a membrane-bound structure that consists of a series of flattened membrane sacs***

***(cisternae).***

***Evidence of student learning is a demonstrated understanding of the following:***

***1. Functions of the Golgi include synthesis and packaging of materials (small molecules) for transport***

***(in vesicles), and production of lysosomes.***

***d. Mitochondria specialize in energy capture and transformation.***

***Evidence of student learning is a demonstrated understanding of each of the following:***

***1. Mitochondria have a double membrane that allows compartmentalization within the mitochondria***

***and is important to its function.***

***2. The outer membrane is smooth, but the inner membrane is highly convoluted, forming folds called***

***cristae.***

***3. Cristae contain enzymes important to ATP production; cristae also increase the surface area for ATP***

***production.***

***e. Lysosomes are membrane-enclosed sacs that contain hydrolytic enzymes, which are important in intracellular digestion, the recycling of a cell’s organic materials and programmed cell death (apoptosis). Lysosomes carry out intracellular digestion in a variety of ways.***

***f. A vacuole is a membrane-bound sac that plays roles in intracellular digestion and the release of cellular waste products. In plants, a large vacuole serves many functions, from storage of pigments or poisonous substances***

***to a role in cell growth. In addition, a large central vacuole allows for a large surface area to volume ratio.***

***g. Chloroplasts are specialized organelles found in algae and higher plants that capture energy through***

***photosynthesis.***

***Evidence of student learning is a demonstrated understanding of each of the following:***

***1. The structure and function relationship in the chloroplast allows cells to capture the energy available***

***in sunlight and convert it to chemical bond energy via photosynthesis.***

***2. Chloroplasts contain chlorophylls, which are responsible for the green color of a plant and are***

***the key light-trapping molecules in photosynthesis. There are several types of chlorophyll, but the***

***predominant form in plants is chlorophyll a.***

***3. Chloroplasts have a double outer membrane that creates a compartmentalized structure, which***

***supports its function. Within the chloroplasts are membrane-bound structures called thylakoids.***

***Energy-capturing reactions housed in the thylakoids are organized in stacks, called “grana,” to produce***

***ATP and NADPH2, which fuel carbon-fixing reactions in the Calvin-Benson cycle. Carbon fixation occurs***

***in the stroma, where molecules of CO2 are converted to carbohydrates.***

1. Structure of the Cell Membrane (understand the fluid mosaic model and identify the structure and function of molecules found within it – phospholipids, integral proteins, peripheral proteins, glycolipids, and glycoproteins)

***CC 2.B.1 –***

***a. Cell membranes separate the internal environment of the cell from the external environment.***

***b. Selective permeability is a direct consequence of membrane structure, as described by the fluid mosaic***

***model.***

***Evidence of student learning is a demonstrated understanding of each of the following:***

***1. Cell membranes consist of a structural framework of phospholipid molecules, embedded proteins,***

***cholesterol, glycoproteins and glycolipids.***

***2. Phospholipids give the membrane both hydrophilic and hydrophobic properties.***

***3. The hydrophilic phosphate portions of the phospholipids are oriented toward the aqueous external or internal environments, while the hydrophobic fatty acid portions face each other within the interior of the***

***membrane itself.***

***4. Embedded proteins can be hydrophilic, with charged and polar side groups, or hydrophobic, with***

***nonpolar side groups.***

***5. Small, uncharged polar molecules and small nonpolar molecules, such as N2, freely pass across the***

***membrane. Hydrophilic substances such as large polar molecules and ions move across the membrane***

***through embedded channel and transport proteins. Water moves across membranes and through***

***channel proteins called aquaporins.***

***c. Cell walls provide a structural boundary, as well as a permeability barrier for some substances to the internal environments.***

***Evidence of student learning is a demonstrated understanding of each of the following:***

***1. Plant cell walls are made of cellulose and are external to the cell membrane.***

***2. Other examples are cells walls of prokaryotes and fungi.***

1. Semi/Selective Permeability – which molecules can move through the phospholipid bilayer and which molecules must move with the help of a transport protein?
2. Passive Transport vs. Active Transport – up vs. down concentration gradient, use of energy?
3. Types of Passive Transport
* Simple Diffusion
* Facilitated Diffusion using channel or carrier proteins (what is the difference between these two types transport proteins?)
* Osmosis (hypertonic, hypotonic, isotonic) – be able to predict the movement of water across a semi-permeable membrane based on solute OR water concentration (Hint: you must know how to analyze a “U-tube” problem)

Associated Vocabulary: lysis (animal cells), flaccid (plant cell), plasmolyzed (plant cell), turgid / turgo pressure (plant cell)

1. Types of Active Transport
* Protein pumps (know how the sodium (Na+) / potassium (K+) pump works!)
* Co-transport
* Bulk Transport: Exocytosis vs. Endocytosis (3 Types: phagocytosis, pinocytosis, and receptor-mediated endocytosis)

***CC 2.B.2 –***

***a. Passive transport does not require the input of metabolic energy; the net movement of molecules is from***

***high concentration to low concentration.***

***Evidence of student learning is a demonstrated understanding of each of the following:***

***1. Passive transport plays a primary role in the import of resources and the export of wastes.***

***2. Membrane proteins play a role in facilitated diffusion of charged and polar molecules through a***

***membrane.***

***To demonstrate understanding, make sure you can explain examples like:***

***● Glucose transport***

***● Na+/K+ transport***

***3. External environments can be hypotonic, hypertonic or isotonic to internal environments of cells.***

***b. Active transport requires free energy to move molecules from regions of low concentration to regions of***

***high concentration.***

***Evidence of student learning is a demonstrated understanding of each of the following:***

***1. Active transport is a process where free energy (often provided by ATP) is used by proteins***

***embedded in the membrane to “move” molecules and/or ions across the membrane and to establish***

***and maintain concentration gradients.***

***2. Membrane proteins are necessary for active transport.***

***c. The processes of endocytosis and exocytosis move large molecules from the external environment to the***

***internal environment and vice versa, respectively.***

***Evidence of student learning is a demonstrated understanding of each of the following:***

***1. In exocytosis, internal vesicles fuse with the plasma membrane to secrete large macromolecules out***

***of the cell.***

***2. In endocytosis, the cell takes in macromolecules and particulate matter by forming new vesicles***

***derived from the plasma membrane.***

1. Importance of having a large membrane surface area 🡪 efficient transport of materials into and out of the cell (be able to calculate the surface area to volume ratio of various cells and predict which one will be most efficient with regard to membrane transport)

***CC 2.A.3 –***

***b. Surface area-to-volume ratios affect a biological system’s ability to obtain necessary resources or eliminate waste products.***

***Evidence of student learning is a demonstrated understanding of each of the following:***

***1. As cells increase in volume, the relative surface area decreases and demand for material resources***

***increases; more cellular structures are necessary to adequately exchange materials and energy with the***

***environment. These limitations restrict cell size.***

***2. The surface area of the plasma membrane must be large enough to adequately exchange materials;***

***smaller cells have a more favorable surface area-to-volume ratio for exchange of materials with the***

***environment.***

**Practice Multiple Choice Questions**

1. Which of the following is a major cause of the size limits for certain types of cells?

|  |  |
| --- | --- |
| a. | the evolution of larger cells after the evolution of smaller cells |
| b. | the difference in plasma membranes between prokaryotes and eukaryotes |
| c. | the evolution of eukaryotes after the evolution of prokaryotes |
| d. | the need for a surface area of sufficient area to allow the cell's function |
| e. | the observation that longer cells usually have greater cell volume |

*Use the following to answer the next question. All three are involved in maintenance of cell shape.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **Microtubules (tubulin polymers)** | **Microfilaments (actin filaments)** | **Intermediate filaments** |
| Structure | Hollow tubes; wall consists of 13 columns of tubulin molecules | Two intertwined strands of actin, each a polymer of actin subunits | Fibrous proteins supercoiled into thicker cables |
| Diameter | 25 nm with 15-nm lumen | 7 nm | 8-12 nm |
| Main functions | Cell motility | Cell motility | Anchorage |

2. Centrioles, cilia, flagella, and basal bodies have remarkably similar structural elements and arrangements. This leads us to which of the following as a probable hypothesis?

|  |  |
| --- | --- |
| a. | Disruption of one of these types of structure should necessarily disrupt each of the others as well. |
| b. | Loss of basal bodies should lead to loss of all cilia, flagella, and centrioles. |
| c. | Motor proteins such as dynein must have evolved before any of these four kinds of structure. |
| d. | Evolution of motility, of cells or of parts of cells, must have occurred only once. |
| e. | Natural selection for motility must select for microtubular arrays in circular patterns. |

3. Which of the following makes it necessary for animal cells, although they have no cell walls, to have intercellular junctions?

|  |  |
| --- | --- |
| a. | Cell membranes do not distinguish the types of ions and molecules passing through them. |
| b. | Large molecules, especially proteins, do not readily get through one, much less two adjacent cell membranes. |
| c. | Cell-to-cell communication requires physical attachment of one cell to another. |
| d. | Maintenance of connective tissue shape requires cells to adhere to one another. |
| e. | The relative shapelessness of animal cells requires a mechanism for keeping the cells aligned. |

4. Cells of the pancreas will incorporate radioactively labeled amino acids into proteins. This "tagging" of newly synthesized proteins enables a researcher to track their location. In this case, we are tracking an enzyme secreted by pancreatic cells. What is its most likely pathway?

|  |  |
| --- | --- |
| a. | ER  Golgi  nucleus |
| b. | Golgi  ER  lysosome |
| c. | nucleus  ER  Golgi |
| d. | ER  Golgi  vesicles that fuse with plasma membrane |
| e. | ER  lysosomes  vesicles that fuse with plasma membrane |

5. Which of the following is one of the ways that the membranes of winter wheat are able to remain fluid when it is extremely cold?

|  |  |
| --- | --- |
| a. | by increasing the percentage of unsaturated phospholipids in the membrane |
| b. | by increasing the percentage of cholesterol molecules in the membrane |
| c. | by decreasing the number of hydrophobic proteins in the membrane |
| d. | by co-transport of glucose and hydrogen |
| e. | by using active transport |

6. What kinds of molecules pass through a cell membrane most easily?

|  |  |
| --- | --- |
| a. | large and hydrophobic |
| b. | small and hydrophobic |
| c. | large polar |
| d. | ionic |
| e. | monosaccharides such as glucose |

7. A cell whose cytoplasm has a concentration of 0.02 molar glucose is placed in a test tube of water containing 0.02 molar glucose. Assuming that glucose is not actively transported into the cell, which of the following terms describes the tonicity of the external solution relative to the cytoplasm of the cell?

|  |  |
| --- | --- |
| a. | turgid |
| b. | hypertonic |
| c. | hypotonic |
| d. | flaccid |
| e. | isotonic |

8. Proton pumps are used in various ways by members of every kingdom of organisms. What does this most probably mean?

|  |  |
| --- | --- |
| a. | Proton pumps must have evolved before any living organisms were present on the earth. |
| b. | Proton pumps are fundamental to all cell types. |
| c. | The high concentration of protons in the ancient atmosphere must have necessitated a pump mechanism. |
| d. | Cells with proton pumps were maintained in each Kingdom by natural selection. |
| e. | Proton pumps are necessary to all cell membranes. |

9. In receptor-mediated endocytosis, receptor molecules initially project to the outside of the cell. Where do they end up after endocytosis?

|  |  |
| --- | --- |
| a. | on the outside of vesicles |
| b. | on the inside surface of the cell membrane |
| c. | on the inside surface of the vesicle |
| d. | on the outer surface of the nucleus |
| e. | on the ER |

10. In what way do the membranes of a eukaryotic cell vary?

|  |  |
| --- | --- |
| a. | Phospholipids are found only in certain membranes. |
| b. | Certain proteins are unique to each membrane. |
| c. | Only certain membranes of the cell are selectively permeable. |
| d. | Only certain membranes are constructed from amphipathic molecules. |
| e. | Some membranes have hydrophobic surfaces exposed to the cytoplasm, while others have hydrophilic surfaces facing the cytoplasm. |

11. Celery stalks that are immersed in fresh water for several hours become stiff and hard. Similar stalks left in a 0.15 *M* salt solution become limp and soft. From this we can deduce that the cells of the celery stalks are

|  |  |
| --- | --- |
| a. | hypotonic to both fresh water and the salt solution. |
| b. | hypertonic to both fresh water and the salt solution. |
| c. | hypertonic to fresh water but hypotonic to the salt solution. |
| d. | hypotonic to fresh water but hypertonic to the salt solution. |
| e. | isotonic with fresh water but hypotonic to the salt solution. |

12.The phosphate transport system in bacteria imports phosphate into the cell even when the concentration of phosphate outside the cell is much lower than the cytoplasmic phosphate concentration. Phosphate import depends on a pH gradient across the membrane–more acidic outside the cell than inside the cell. Phosphate transport is an example of

|  |  |
| --- | --- |
| a. | passive diffusion. |
| b. | facilitated diffusion. |
| c. | active transport. |
| d. | osmosis. |
| e. | cotransport. |

13. Why are lipids and proteins free to move laterally in membranes?

|  |  |
| --- | --- |
| a. | The interior of the membrane is filled with liquid water. |
| b. | Lipids and proteins repulse each other in the membrane. |
| c. | Hydrophilic portions of the lipids are in the interior of the membrane. |
| d. | There are only weak hydrophobic interactions in the interior of the membrane. |
| e. | Molecules such as cellulose can pull them in various directions. |

14. Tay–Sachs disease is a human genetic abnormality that results in cells accumulating and becoming clogged with very large, complex, and undigested lipids. Which cellular organelle must be involved in this condition?

|  |  |
| --- | --- |
| a. | the endoplasmic reticulum |
| b. | the Golgi apparatus |
| c. | the lysosome |
| d. | mitochondrion |
| e. | membrane–bound ribosomes |

15. One of the key innovations in the evolution of eukaryotes from a prokaryotic ancestor is the endomembrane system. What eukaryotic organelles or features might have evolved as a part of, or as an elaboration of, the endomembrane system?

|  |  |
| --- | --- |
| a. | plasma membrane |
| b. | chloroplasts |
| c. | mitochondria |
| d. | nuclear envelope |
| e. | none of these |

16. Why isn't the mitochondrion classified as part of the endomembrane system?

|  |  |
| --- | --- |
| a. | It is a static structure. |
| b. | Its structure is not derived from the ER or Golgi. |
| c. | It has too many vesicles. |
| d. | It is not involved in protein synthesis. |
| e. | It is not attached to the outer nuclear envelope. |

17. A biologist ground up some plant leaf cells and then centrifuged the mixture to fractionate the organelles. Organelles in one of the heavier fractions could produce ATP in the light, whereas organelles in the lighter fraction could produce ATP in the dark. The heavier and lighter fractions are most likely to contain, respectively,

|  |  |
| --- | --- |
| a. | mitochondria and chloroplasts. |
| b. | chloroplasts and peroxisomes. |
| c. | peroxisomes and chloroplasts. |
| d. | chloroplasts and mitochondria. |
| e. | mitochondria and peroxisomes. |

18. Mammalian blood contains the equivalent of 0.15 *M* NaCl. Seawater contains the equivalent of 0.45 *M* NaCl. What will happen if red blood cells are transferred to seawater?

|  |  |
| --- | --- |
| a. | Water will leave the cells, causing them to shrivel and collapse. |
| b. | NaCl will be exported from the red blood cells by facilitated diffusion. |
| c. | The blood cells will take up water, swell, and eventually burst. |
| d. | NaCl will passively diffuse into the red blood cells. |
| e. | The blood cells will expend ATP for active transport of NaCl into the cytoplasm. |

The solutions in the arms of a U-tube are separated at the bottom of the tube by a selectively permeable membrane. The membrane is permeable to sodium chloride and water but not to glucose. Side A is filled with a solution of 0.4 *M* glucose and 0.5 *M* sodium chloride (NaCl), and side B is filled with a solution containing 0.8 *M* glucose and 0.4 *M* sodium chloride. Initially, the volume in both arms is the same. Refer to the figure to answer the following questions.



19. At the beginning of the experiment,

|  |  |
| --- | --- |
| a. | side A is hypertonic to side |
| b. | side A is hypotonic to side B. |
| c. | side A is isotonic to side B. |
| d. | side A is hypertonic to side B with respect to glucose. |
| e. | side A is hypotonic to side B with respect to sodium chloride. |

20. If you examine side A after three days, you should find

|  |  |
| --- | --- |
| a. | a decrease in the concentration of NaCl and glucose and an increase in the water level. |
| b. | a decrease in the concentration of NaCl, an increase in water level, and no change in the concentration of glucose. |
| c. | no net change in the system. |
| d. | a decrease in the concentration of NaCl and a decrease in the water level. |
| e. | no change in the concentration of NaCl and glucose and an increase in the water level. |



Human immunodeficiency virus (HIV) infects cells that have both CD4 and CCR5 cell surface molecules. The viral nucleic acid molecules are enclosed in a protein capsid, and the protein capsid is itself contained inside an envelope consisting of a lipid bilayer membrane and viral glycoproteins. One hypothesis for viral entry into cells is that binding of HIV membrane glycoproteins to CD4 and CCR5 initiates fusion of the HIV membrane with the plasma membrane, releasing the viral capsid into the cytoplasm. An alternative hypothesis is that HIV gains entry into the cell via receptor -mediated endocytosis, and membrane fusion occurs in the endocytotic vesicle. To test these alternative hypotheses for HIV entry, researchers labeled the lipids on the HIV membrane with a red fluorescent dye.

21.What would be observed by live–cell fluorescence microscopy immediately after HIV entry if the red fluorescent lipid dye–labeled HIV membrane fuses with the target cell plasma membrane?

|  |  |
| --- | --- |
| a. | A spot of red fluorescence will be visible on the infected cell's plasma membrane, marking the site of membrane fusion and HIV entry. |
| b. | The red fluorescent dye–labeled lipids will appear in the infected cell’s interior. |
| c. | A spot of red fluorescence will diffuse in the infected cell's cytoplasm. |
| d. | A spot of red fluorescence will remain outside the cell after delivering the viral capsid. |
| e. | Fluorescence microscopy does not have enough resolution to visualize fluorescently labeled HIV virus particles. |

Cystic fibrosis is a genetic disease in humans in which the CFTR protein, which functions as a chloride ion channel, is missing or nonfunctional in cell membranes.

22. If the sodium ion concentration outside the cell increases, and the CFTR channel is open, in what direction will chloride ions and water move across the cell membrane?

|  |  |
| --- | --- |
| a. | Chloride ions will move out of the cell, and water will move into the cell. |
| b. | Both chloride ions and water will move out of the cell. |
| c. | Chloride ions will move into the cell, and water will move out of the cell. |
| d. | Both chloride ions and water will move into the cell. |
| e. | The movement of chloride ions and water molecules will not be affected by changes in sodium ion concentration outside the cell. |

23. A patient has had a serious accident and lost a lot of blood. In an attempt to replenish body fluids, distilled water–equal to the volume of blood lost–is transferred directly into one of his veins. What will be the most probable result of this transfusion?

|  |  |
| --- | --- |
| a. | It will have no unfavorable effect as long as the water is free of viruses and bacteria. |
| b. | The patient's red blood cells will shrivel up because the blood fluid has become hypotonic compared to the cells. |
| c. | The patient's red blood cells will swell because the blood fluid has become hypotonic compared to the cells. |
| d. | The patient's red blood cells will shrivel up because the blood fluid has become hypertonic compared to the cells. |
| e. | The patient's red blood cells will burst because the blood fluid has become hypertonic compared to the cells. |

24. Which of the following processes includes all others?

|  |  |
| --- | --- |
| a. | osmosis |
| b. | diffusion of a solute across a membrane |
| c. | facilitated diffusion |
| d. | passive transport |
| e. | transport of an ion down its electrochemical gradient |



25. Based on the figure to the right, which of these experimental treatments would increase the rate of sucrose transport into the cell?

|  |  |
| --- | --- |
| a. | decreasing extracellular sucrose concentration |
| b. | decreasing extracellular pH |
| c. | decreasing cytoplasmic pH |
| d. | adding an inhibitor that blocks the regeneration of ATP |
| e. | adding a substance that makes the membrane more permeable to hydrogen ions |

*Read the following information and refer to Figure 7.4 to answer the following question.*

Five dialysis bags, constructed from a semi-permeable membrane that is impermeable to sucrose, were filled with various concentrations of sucrose and then placed in separate beakers containing an initial concentration of 0.6 *M* sucrose solution. At 10-minute intervals, the bags were massed (weighed) and the percent change in mass of each bag was graphed.



**Figure 7.4**

26.Which line represents the bag that contained a solution isotonic to the 0.6 molar solution at the beginning of the experiment?

A, B, C, D, E

**Practice Long Response Questions**

1. 2006:1

A major distinction between prokaryotes and eukaryotes is the presence of membrane-bound organelles in eukaryotes.

a. Describe the structure and function of TWO eukaryotic membrane-bound organelles other than the nucleus.

b. Prokaryotic and eukaryotic cells have some non-membrane-bound components in common. Describe the function of TWO of the following and discuss how each differs in prokaryotes and eukaryotes.

* DNA
* cell wall
* ribosomes

c. Explain the endosymbiotic theory of the origin of eukaryotic cell and discuss an example of evidence supporting this theory.

2. Cells transport substances across their membranes. Choose THREE of the following four types of cellular transport: Osmosis, Active Transport, Facilitated Diffusion, Endocytosis/Exocytosis

For each of the three transport types you choose,

* 1. Describe the transport process
	2. Explain how the organization of cell membranes functions in the movement of specific molecules across membranes
	3. Explain the significance of each type of transport to a specific cell (you may use different cell types as examples.)

3. A laboratory assistant prepared solution of 0.8 *M*, 0.6 *M*, 0.4 *M*, and 0.2 *M* sucrose, but forgot to label them. After realizing the error, the assistant randomly labeled the flasks containing these four unknown solutions as flask A, flask B, flask C, and flask D.

Design an experiment, based on the principles of diffusion and osmosis, that the assistant could use to determine which of the flasks contains each of the four unknown solutions. Include in your answer (a) a description of how you would set up and perform the experiment: (b) the results you would expect from your experiments: and (c) an explanation of those results based on the principles involved. (Be sure to clearly state the principles addressed in your discussion.)