

Cell Review

A. Top "10" — If you learned anything from this unit, you should have learned:

1. Prokaryotes vs. eukaryotes
 - No internal membranes vs. membrane-bound organelles
2. Cell Size
 - Surface to volume ratio
 - Advantage of compartmentalization
3. Origin of Eukaryotic Cells
 - Endosymbiotic Theory – mitochondria and chloroplasts
4. Cell structures & the functions they perform
 - a. Controlling internal environment
 - cell membrane, membrane proteins & cell receptors
 - movement across membrane: diffusion, facilitated diffusion, osmosis, active transport
 - hypertonic, hypotonic, isotonic solutions
 - b. Protein production
 - nucleus & DNA
 - ribosomes
 - ER & vesicles
 - Golgi apparatus & vesicles
 - c. Energy production
 - mitochondria, chloroplasts
 - d. Cell reproduction
 - nucleus & DNA
 - centrioles & spindle fibers
 - e. Digestion
 - lysosomes & vesicle, vacuoles
 - f. Extracellular structures
 - Cell wall in plants
 - Extracellular matrix in animals
 - connecting junctions: plasmodesmata & gap junctions
 - barrier junctions: tight junctions, desmosomes
5. Cell Communication
 - a. cell-surface receptors
 - insulin
 - b. Intracellular receptors
 - c. Signal Transduction Pathway
 - acetylcholine (cytoplasmic response)
 - insulin (nuclear response)
 - d. Secondary messengers

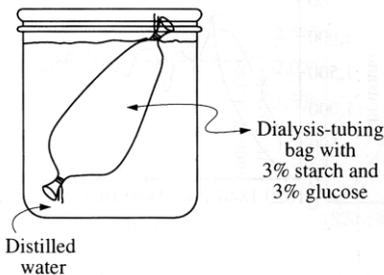
B. Sample Multiple Choice Questions

1. Which is a characteristic of mitochondria and chloroplasts that supports the endosymbiotic theory
 - A. Both have bacteria-like polysaccharide cell walls
 - B. Both can reproduce on their own outside the cell
 - C. Both contain DNA molecules
 - D. Both contain endoplasmic reticulum and Golgi bodies
 - E. Both contain ribosome that are identical to ribosomes of the eukaryotic cytoplasm
2. The organelle that is the major producer of ATP and is found in both heterotrophs and autotrophs is the
 - A. chloroplast
 - B. nucleus
 - C. ribosome
 - D. Golgi apparatus
 - E. mitochondrion

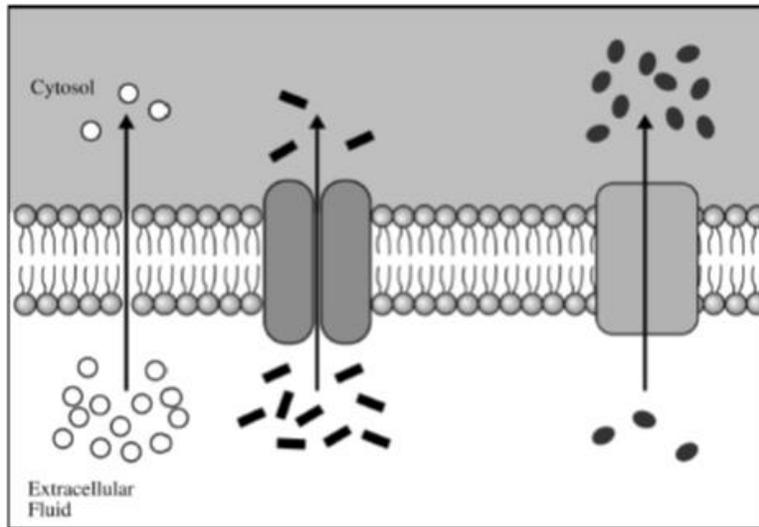
3. If plant cells are immersed in distilled water, the resulting movement of water into the cells is called
- conduction
 - active transport
 - transpiration
 - osmosis
 - facilitated diffusion

4. Which of the following is the primary role of the lysosome
- ATP synthesis
 - intracellular digestion
 - lipid transport
 - carbohydrate storage
 - protein synthesis

Questions 5 – 7: The following questions refer to an experiment in which a dialysis-tubing bag is filled with a mixture of 3% starch and 3% glucose and placed in a beaker of distilled water, as shown at right. After 3 hours, glucose can be detected in the water outside the dialysis-tubing bag, but starch cannot.



5. From the initial conditions and results described which of the following is a logical conclusion?
- The initial concentration of glucose in the bag is higher than the initial concentration of starch in the bag.
 - The pores of the bag are larger than the glucose molecules but smaller than the starch molecules.
 - The bag is not selectively permeable.
 - A net movement of water into the beaker has occurred.
 - The molarity of the solution in the bag and the molarity of the solution in the surrounding beaker are the same.
6. Which of the following best describes the conditions expected after 24 hours?
- The bag will contain more water than it did in the original condition.
 - The contents of the bag will have the same osmotic concentration as the surrounding solution.
 - Water potential in the bag will be greater than water potential in the surrounding solution.
 - Starch molecules will continue to pass through the bag.
 - A glucose test on the solution in the bag will be negative.
7. If, instead of the bag, a potato slice were placed in the beaker of distilled water, which of the following would be true of the potato slice?
- It would gain mass.
 - It would neither gain nor lose mass.
 - It would absorb solutes from the surrounding liquid.
 - It would lose water until water potential inside the cells is equal to zero.
 - The cells of the potato would increase their metabolic activity.
8. Mitochondria are found in most eukaryotic cells and contain their own DNA and ribosomes that are similar to those typical of many prokaryotic cells. Which of the following statements is justified by these observations?
- The mitochondrion is the only location in which eukaryotic cells can synthesize ATP.
 - An ancestral cell most likely engulfed an aerobic prokaryote in a relationship that proved beneficial to both cells.
 - Mitochondrial membranes provide abundant surface area for reactions because of the infoldings called cristae.
 - The mitochondrion plays a role in respiration, but also stores the cell's extra mRNA.



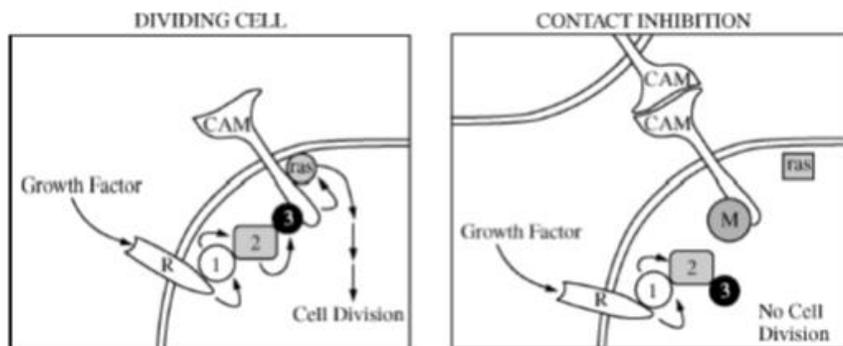
9. Which of the following scientific questions is most relevant to the model represented in the figure above.
- Is ATP required for the transportation of sugars across the outer mitochondrial membrane?
 - Do the types of phospholipids in a membrane affect the rate at which molecule enter the cell by passive diffusion?
 - Which molecular substance is actively transported across the plasma membrane.
 - How does temperature affect the movement of molecules into lysosomes.

10. A cell is treated with a drug that prevents the formation of new lysosomes. The cell continues to transcribe the genes that code for the hydrolytic enzymes normally found in the lysosomes and continues to translate mRNAs for those proteins on membrane bound ribosomes.

The hydrolytic enzymes are most likely to accumulate in which of the following cellular structures?

- Nucleus
- Mitochondria
- Smooth endoplasmic reticulum
- Golgi complex

11. Many human cells can be stimulated to divide by hormone like growth factors that bind to receptor proteins (R) on the plasma membrane and trigger an internal signal transduction cascade. In many cases, however, the process on contact inhibition prevents mitosis when cells are in direct contact with one another. Contact inhibition occurs when proteins called cell adhesion molecules (CAMs) interact, causing them to change shape so that the growth-factor signaling proteins that normally associate with CAMs are replaced by another protein, called M. Both pathways are depicted in the figures below.



Which of the following statements accurately uses the information presented to support the hypothesis that interruption of M function in a single body cell can result in cancer?

- Protein 3 will be prevented from interacting with CAMs, causing the cell cycle to stop permanently.
- The raw protein will remain bound to DNA, blocking expression of genes required for mitosis.
- Growth factor signaling can trigger mitosis in cells that are in direct contact with other cells.
- The receptor proteins of body cells will no longer bind to growth-factor proteins.

C. Sample Free Response Questions

1. Membranes are essential components of all cells.

- a. Identify THREE macromolecules that are components of the plasma membrane in a eukaryotic cell and discuss the structure and function of each.
- b. Explain how membranes participate in THREE of the following biological processes.
 - muscle contraction **old curriculum**
 - fertilization of an egg **old curriculum**
 - chemiosmotic production of ATP
 - intercellular signaling

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

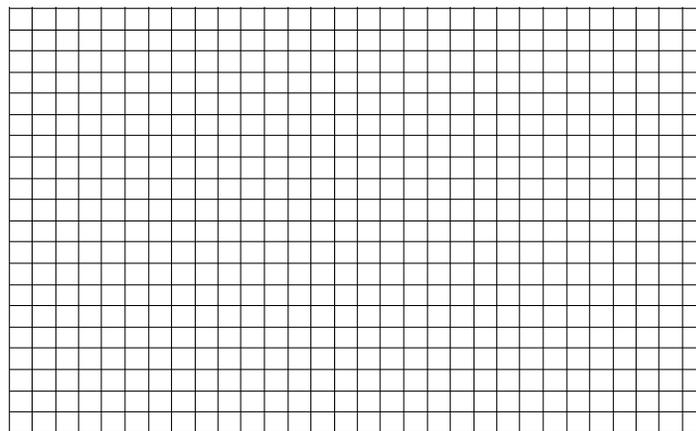
- a. Describe the structure and function of TWO eukaryotic membrane-bound organelles other than the nucleus.
- b. Prokaryotic and eukaryotic cells have some non-membrane-bound components in common. Describe the function of TWO of the following and discuss how each differs in prokaryotes and eukaryotes.
 - DNA
 - cell wall
 - ribosomes

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

3. The following experiment was designed to test whether different concentration gradients affect the rate of diffusion. In this experiment, four solutions (0% NaCl, 1% NaCl, 5% NaCl, and 10% NaCl) were tested under identical conditions. Fifteen milliliters (mL) of 0% NaCl were put into a bag formed of dialysis tubing that is permeable to Na⁺, Cl⁻, and water. The same was done for each NaCl solution. Each bag was submerged in a separate beaker containing 300 mL of distilled water. The concentration of NaCl in mg/L in the water outside the bag was measured at 40-second intervals. The results from the 5% bag are shown in the table below.

CONCENTRATION IN mg/L OF NaCl OUTSIDE THE 5% NaCl BAG	
Time (seconds)	NaCl (mg/L)
0	0
40	130
80	220
120	320
160	400

- a. On the axes provided, graph the data for the 5% NaCl solution
- b. Using the same set of axes, draw and label three additional lines representing the results that you would predict for the 0% NaCl, 1% NaCl, and 10% NaCl solutions. explain your predictions.
- c. Farmlands located near coastal regions are being threatened by encroaching seawater seeping into the soil. In terms of water movement into or out of plant cells, explain why seawater could decrease crop production. Include a discussion of water potential in your answer.



Essential Content from textbook

Chapter 4: The Working Units of Life

Concept 4.1: Cells Provide Compartments for Biochemical Reactions

- Cell size can be limited by the surface area to volume ratio
- The cell membrane forms the outer surface of every cell
- Cells are classified as either prokaryotic or eukaryotic

Concept 4.2: Prokaryotic Cells Do Not Have a Nucleus

- Prokaryotic cells share certain features

Concept 4.3 Eukaryotic Cells Have a Nucleus and Other Membrane-Bound Compartments

- Compartmentalization is the key to eukaryotic cell function
- Ribosomes are factories for protein synthesis
- The nucleus contains most of the cell's DNA
- The endomembrane system is a group of interrelated organelles
- Some organelles transform energy

Concept 4.4: The Cytoskeleton Provides Strength and Movement

- Cilia and flagella provide mobility
- Biologists manipulate living systems to establish cause and effect

Concept 4.5 Extracellular Structures Provide Support and Protection for Cells and Tissues

- The plant cell wall is an extracellular structure
- The extracellular matrix supports tissue functions in animals
- Cell junctions connect adjacent cells

Chapter 5: Cell Membranes and Signaling

Concept 5.1: Biological Membranes Have a Common Structure and Are Fluid

- Lipids form the hydrophobic core of the membrane
- Proteins are important components of membranes
- Cell membrane carbohydrates are recognition sites

Concept 5.2: Passive Transport across Membrane Requires No Input of Energy

- Simple diffusion takes place through the phospholipid bilayer
- Osmosis is the diffusion of water across membranes
- Diffusion may be aided by channel proteins
- Carrier proteins aid diffusion by binding substances

Concept 5.3: Active Transport Moves Solutes against Their Concentration Gradient

- Different energy sources distinguish different active transport systems

Concept 5.4: Large Molecules Cross Membranes via Vesicles

- Exocytosis moves materials out of the cell
- Macromolecules and particles enter the cell by endocytosis
- Receptor endocytosis often involves coated vesicles

Concept 5.5: The Membrane Plays a Key Role in a Cell's Response to Environmental Signals

- Cells are exposed to many signals and may have different responses
- Receptors can be classified by location and function
- Many receptors are associated with the cell membrane

Concept 5.6: Signal Transduction Allows the Cell to Respond to Its Environment

- Cell functions change in response to environmental signals
- Second messengers can stimulate signal transduction
- A signaling cascade involves enzyme regulation and signal amplification
- Signal transduction is highly regulated