

Objectives for Test Two: Chapters 6-7 and part of 36
Cells, Membranes, Cell Transport and Translocation in Plants

You should be able to:

1. Identify the advantages and disadvantages of a light microscope versus the two different kinds of electron microscopes. Label a diagram of a light microscope.
2. Given a sketch through a microscope like ours under a given power, estimate the size of the cell or organism.
3. Distinguish between field of view and depth of field.
4. List steps to the proper method for finding a cell and focusing the image for a light microscope like ours.
5. Identify the contributions of Leeuwenhoek and Hooke to our early understanding of cells
6. Explain how the structure of a prokaryotic cell compares and contrasts to that of a eukaryotic cell. Label a diagram of a prokaryotic cell, a plant cell and an animal cell.
7. Distinguish between the cellular structures of plant cells and animal cells. LAB: Recognize a plant cell in a drawing; recognize an animal cell.
8. Explain the advantage to a cell of having
9. Understand the **structure, function and interactions** of the following organelles:
 - a. Ribosomes
 - b. Golgi apparatus (*cis and trans* faces)
 - c. Vesicle
 - d. Mitochondrion (inner and outer membranes, cristae, matrix, intermembrane space)
 - e. Cytoskeleton (microfilaments, microtubules, intermediate fibers)
 - f. Cilia and Flagella
 - g. Centriole (centrosome)
 - h. Lysosome (three functions all dependent upon hydrolytic enzymes)
 - i. Peroxisome
 - j. Rough and smooth endoplasmic reticulum (different structure, different functions, signal sequences on proteins)
 - k. Vacuole (Central, Contractile, Transport, Food, Vesicle)
 - l. Chloroplast (chlorophyll, thylakoid, granum)
 - m. Leucoplast
 - n. Nucleolus
 - o. Chromatin / chromosomes
 - p. Nucleus (nuclear envelope, nuclear pores)
 - q. Cell membrane – details of its structure are important
 - r. Cell wall (primary, secondary, plasmodesmata)
 - s. Animal cell junctions (just recognize terms: tight junction, gap junction, desmosome)
10. Discuss how various cell organelles would be involved in order for a cell to manufacture and release a protein from its cell membrane.
11. Give examples of how the smooth ER is specialized in some cells.
12. Explain why cells so small (surface area to volume ratio). Explain why a cell might have many convolutions.
13. Explain the structure (fluid mosaic model) and function of the cell membrane.
14. Describe structural changes in membranes for organisms that live in cold environments and those that live in warm environments.
15. Describe how passive transport (diffusion, osmosis, facilitated diffusion) is accomplished in cells.
16. Distinguish between endocytosis (phagocytosis and pinocytosis) and exocytosis.
17. Predict the relative permeability of based on their size, polarity and charge.
18. Explain why aquaporins are needed by cells.
19. Describe how cells maintain water homeostasis. Use the terms hypertonic, hypotonic, and isotonic to correctly compare the internal and external environments of cells. Tell which environment will cause (a) plasmolysis and (b) increased turgor pressure. Explain how turgor pressure is valuable to plants.
20. Given various situations, predict the direction that solutes and water will move by diffusion and osmosis.
21. Describe how active transport, as in the sodium-potassium pump, and co-transport, as in the co-transport of sucrose into plant cells, are accomplished in cells. (Why does Gatorade have both sugar AND salt in it – not just because you burn up the sugar and sweat out the salt.)
22. In plant cells, explain the role of proton pumps in setting up an electrochemical gradient and a membrane potential.
23. Explain how co-transport can help move molecules across plant cell membranes.
24. Relate the concept of water potential to the transport of water in a plant. How would humidity for example, change the water potential of the outside air and thus decrease transpiration?

25. Explain the process of sugar transport through the phloem of a plant. Distinguish between a source and a sink.
26. Explain how cotransport is used to load sucrose at its source. Compare this transport to that used at the sink. Why are they different?
27. Be comfortable with all procedures, outcomes, calculations, and concepts from AP Lab #4 (pages S51 –S60) and the lab handouts I gave you. Such items as the following are important:
 - a. Terms: aquaporins, diffusion concentration gradients, kinetic energy, osmosis, hypertonic, hypotonic, isotonic, water potential, turgor pressure, pressure potential, solute potential
 - b. Explain how one can test for the presence of glucose and starch. Predict how glucose and starch will move across membranes. Design an experiment to test your predictions.
 - c. Explain what color phenolphthalein changes in base and in acid.
 - d. Predict the direction of water movement given values of water potential. (Will water move into or out of plant cell if the cell has a higher water potential than the surrounding environment?)
 - e. Predict what would happen if you applied salt water to a plant.
 - f. Explain how increasing solute concentration and increase pressure affects water potential.
 - g. Define pressure potential for pure water open to the environment.
 - h. **Calculate** a solute potential using the equation $-iCRT$ given values for I, R, T, and data to determine C.
 - i. **Calculate** the surface area to volume ratio for various sized three dimensional shapes.
 - j. Given data, **calculate** the percent change in mass for dialysis bags or plant cell tissues.
 - k. Design an experiment to investigate the rate of osmosis in a model system (say when sucrose concentrations are varied).
 - l. Design an experiment to measure and then **calculate** the water potential of potato or other type of cell. Use a graph to obtain needed data.
 - m. Design an experiment using agar, phenolphthalein and weak HCl to maximize a mass to time ratio for entry of acid into the block. How does this serve as an analogy for cell size?
 - n. Using what you have learned in this lab, explain why root cells have so many root hairs.
 - o. When a person in the hospital receives an IV solution, the solution is not pure water. It contains some salts. Explain why it would be dangerous to receive pure water.
 - p. Sketch and label an elodea cell and a red onion cell that have been placed in tap water and in salt water. Explain reasons for your sketches.
 - q. If potatoes were placed in a dry area for several days before running an experiment to determine their water potential, explain the effect this treatment would have on the potato cell's water potential.
 - r. When potatoes are in the ground, do they swell with water when it rains? If not, how do you explain that, and if so, what would be the advantage or disadvantage.
 - s. Identify at least one cell organelle that has many convolutions and explain how this relates to its function.
 - t. Predict whether osmosis occurs when a cell is in an isotonic solution. Explain your reasoning.
28. In your text, pg. 124, try all questions except #11. In your text, pg. 141, try all questions (#8 is challenging). In your text, pg. 784, try these questions: #2, 3, 9.

Some Examples of Short Free Response Questions: (2-3 sentences): These might be the actual questions.

1. In eukaryotic cells, ribosomes are found both free in the cytosol and attached to the endoplasmic reticulum (ER). Proteins produced on the attached ribosomes are delivered to the ER, while proteins produced on free ribosomes are delivered to the cytosol. **Briefly explain**, in one or two sentences each, the two processes in terms of the following:
 - (a) ONE ultimate destination of a protein produced on an attached ribosome, and ONE general function of the protein (You do not need to identify the specific protein.)
 - (b) ONE ultimate destination of a protein produced on a free ribosome, and ONE general function of the protein (You do not need to identify the specific protein.)
2. During an investigation of a freshwater lake, an AP Biology student discovers a previously unknown microscopic organism. Further study shows that the unicellular organism is eukaryotic. **Identify THREE** organelles that should be present in the eukaryotic organism and **describe in one sentence each** the function of each organelle.
3. Membranes are essential components of all cells. **Identify TWO** macromolecules that are components of the plasma membrane in a eukaryotic cell and **explain in one sentence each** how the structure determines function of each.

4. The relationship of structure to function is one of the major themes in biology. Describe the structure of membrane proteins and then **explain** how their function of active transport and facilitated diffusion is related to this structure. (three sentences)
5. Cells transport substances across their membranes. Choose ONE (or I might choose one for you) of the following four types of cellular transport.
 - Osmosis
 - Active Transport
 - Facilitated Diffusion
 - Endocytosis

For this one,

- a) **describe** the transport process and **explain** how the organization of cell membranes functions in the movement of specific molecules across membranes; and
- b) **explain** the significance of each type of transport to a specific cell (you may use different cell types as examples.)

Your answer for this question would be 3-4 sentences.

6. A laboratory assistant prepared solutions 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 B 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. (4 sentences)
7. Describe contributions of three different organelles that would be involved with the production and processing of a protein that will eventually be exported from a eukaryotic cell. (3 sentences)
8. Indicate the two ways in which a nonphotosynthetic prokaryotic cell would differ in structure from a generalized eukaryotic plant cell. (2 sentences)
9. Describe the structural arrangement and function of the membranes associated with the Golgi apparatus. (2 sentences)
10. Distinguish between the functions of smooth and rough endoplasmic reticulum. (2 sentences)
11. Using sugar transport as an example, explain the process of cotransport. (3 sentences)
12. Compare the transport process used at the source (say a leaf) of a plant and that used at the sink of plant (say a root) regarding sugar movement. (3 sentences)

The Essay to write outside of class is #156:

The following experiment was designed to test whether different concentration gradients affect the rate of diffusion. In this experiment, four solutions (0%, 1%, 5%, and 10% NaCl) were tested under identical conditions. Fifteen 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 g/L in the water outside each 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%, 1% and 10% NaCl solutions. Explain your predictions.
- (c) Farm lands located near coastal regions are being threatened by encroaching sea water seeping into the soil. In terms of water movement into or out of plant cells, **explain** why sea water could decrease crop production. Include a discussion of water potential in your answer.