PEER-LED TEAM LEARNING
ANATOMY & PHYSIOLOGY

WORKSHOP MODULE 7: CELL MEMBRANES & TRANSPORT

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I. Introduction

The chemical environment inside living cells differs markedly from the environment outside the cell. **Cell membranes** regulate the ongoing exchange between the intracellular and extra-cellular environments, making it possible for cells to get vital raw materials (examples: oxygen, sugars, amino acids), rid themselves of wastes (examples: carbon dioxide, urea), and maintain a healthy electrical balance (membrane potential—next week's workshop). It is the objective of this module to gain a deeper understanding of cell membrane structure and the processes of **transport** that systematically move molecules in and out of cells. Especially we will focus here on **diffusion** and **osmosis**, two passive means of exchange.

Prepare for your workshop by reading in your textbook (Chapter 3: pages 98-102, 106-115) and completing the Pre-Workshop Activities below. Show your work in these pages.

II. Pre-Workshop Activities

Activity A. Matching:

___active transport	A. Movement of molecules down the concentration gradient
___phospholipid	B. When placed in such a solution the cell swells and bursts
___fluid mosaic model	C. Movement of water molecules towards salt across a semipermeable membrane.
___passive transport	D. When placed in such a solution the cell remains stable
___pinocytosis	E. When placed in such a solution the cell shrivels
___osmosis	F. A secretory vesicle uses this method to expel its contents outside the cell
___phagocytosis	G. It has a hydrophilic head and a hydrophobic tail.
___ facilitated diffusion	H. A process by which the cell engulfs water (liquid)
___ simple diffusion	I. A process by which the cell engulfs solid objects such as a pathogen
___ endocytosis	J. The molecular arrangement of the cell membrane is described in this way.
___ exocytosis	K. This type of transport requires a protein but not ATP
___ hypertonic	L. This type of transport requires both a protein pump and ATP.
___ hypotonic	M. Any type of transport that does not require ATP
___ isotonic	N. Cholesterol is picked up by liver cells using this method.

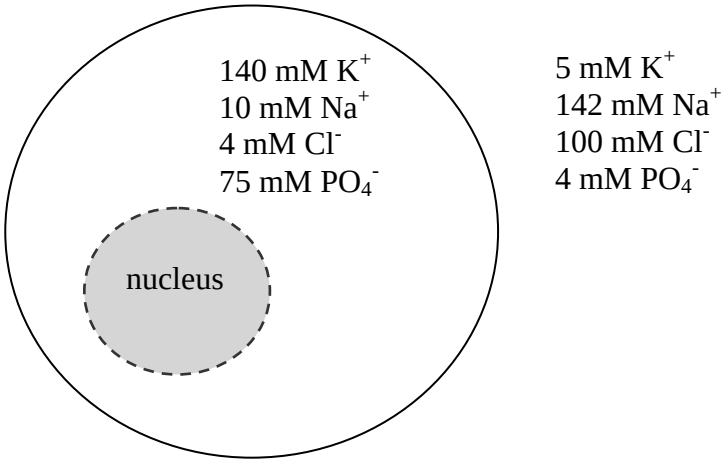
Activity B. Organization of Cell Membrane. Follow the instructions below to develop you own diagram of the cell membrane. Add components as described. If more information is needed refer to your text book.

1. In the space below draw from memory, if possible, the following elements and label them.
   a) Draw a single phospholipid molecule: label the hydrophilic and hydrophobic ends.
   b) No add additional phospholipids to form a phospholipid bilayer with the molecules in correct orientation. Leave one gap in your patch to insert other elements. Label the outside (top) and the inside (bottom) of the cell.
   c) Add water molecules in the correct positions.
   d) Draw an integral protein in the gap in your drawing. Show it with a carbohydrate attached forming a glycoprotein. Label the parts.
   e) Label the pathway of O_2, CO_2, and H_2O across the membrane as indicated by arrows. You may want to draw another membrane protein for the water…

Activity C. Gradients. Use the figure to the right to answer questions about gradients (assume that the volume of fluid inside the cell is the same as the volume of fluid outside of the cell).

1. How many concentration gradients can you identify? Draw an arrow from high concentration to low for each solute.

2. Explain what a concentration gradient is using the figure as an illustration for your points.



3. Describe what is meant by a semi-permeable membrane.

III. Workshop Activities

Activity A. Draw a membrane: round robin. In turn, each member of the group should add an element to the drawing as described. The student, with the help of others in the group should answer questions associated with the drawing. Each student should make his/her own drawing in the space below.

1. (2 students) Draw a long section of phospholipid bilayer with 4 gaps to allow others to insert elements. Label the hydrophobic and hydrophilic areas of the membrane and the specific molecular parts (phosphate group, fatty acids). Identify the cytoplasm and extracellular fluid on either side of the membrane.

2. In one gap insert a transport type protein that is a gated channel. Explain what it does. Suggest one molecule or ion that might cross it. If the channel conducts Na^+ ions, what will happen when the gate opens? What process is involved?

3. In a second gap insert a receptor protein and show the position of a ligand that could bind with the receptor. Explain the process that goes on here (what happens after the ligand binds?). What is one example of a ligand?

4. In a third gap insert a cell recognition protein—a glycoprotein. Label the parts. Explain what it does.

5. In the fourth gap insert a protein that is an electrogenic pump (means that it generates an electrochemical gradient). Explain what it does and give an example.

Activity B: Pair problem solving: Representing transport processes. Each pair of students takes one or two of the following problems. Spend 5-10 min working on them. When the group is reassembled, the pair should present their solutions to the rest of the group and answer questions and make corrections if needed.

1. A white blood cell called a macrophage encounters an invading bacterium in the tissue. The bacterium is too large to pass through its cell membrane, but the macrophage is able to ingest it anyway.
   a) Name the process by which this bacterium is taken into the cell.

   b) Draw a simple diagram of the process using several sketches to show the stages.

   c) Name the organelle where the bacterium will be destroyed.

   d) Name the process by which the wastes produced from this destruction is expelled by the cell.

2. Small molecules are passing from inside the cell across the membrane to the extracellular fluid. The cell expends no energy, nor are there any special channels involved. The rate of movement is rapid for a while and then slows to a steady rate.
   a) Name the process that brings about this movement of molecules across the cell membrane.

   b) Draw a simple diagram of the process using several sketches to show the stages.

   c) Why has the rate of movement across the membrane changed from rapid to steady?

3. A large protein is manufactured in the ER and must now leave the cell.
   a) What are the stages in which this is accomplished by the cell?

   b) Which organelles are involved?

   c) Draw a cell and number the stages in your diagram.

4. A cell has too many Na^+ ions in its cytoplasm and must use energy to lower the internal concentration back to normal levels (since normally the Na^+ concentration is much higher outside the cell than in).

   a) Name the type of transport involved in getting the Na^+ out of the cell.

   b) Draw a simple diagram to indicate the process

   c) Explain how this type of transport differs from simple diffusion.

Activity C. Osmosis and Diffusion Problems

A cell takes up lots of sugar molecules from food consumed by the organism. The cell begins to swell.

1. Suggest what is causing the swelling.

2. Draw what's happening.

3. Suggest several ways that the cell might restore itself to its original size.

Sarah is diagnosed with diabetes. A classic symptom of diabetes is high levels of sugar in the urine. She has the following symptoms: polyuria (excessive volume of urine) and polydypsia (excessive thirst). Based on what you have learned about osmosis explain why she suffers from these symptoms. Answer this question in not less than *five* phrases. Hint: start with the level of sugar in the urine…where does water want to go?

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