The Fluid Mosaic Membrane
Modeling Membrane Structure and Osmosis

Living cells are surrounded by a cell membrane. The structure of the membrane allows it to function as a selectively permeable barrier separating the cell's internal cytoplasmic solution from the external environment. The currently accepted model of structure for this membrane is referred to as the fluid-mosaic model. The major components of the cell membrane are described below.

a. Membrane proteins—there are two main types of proteins in the membrane, peripheral and integral. Integral proteins span the distance of the lipid bilayer. Peripheral proteins are not embedded and are loosely attached to the surface of the membrane. Proteins in the membrane may serve as transport proteins, chemical receptors, enzymes, regulators of cell to cell recognition, cell connections, and attachment sites for cytoskeletal structures. These proteins are irregularly distributed throughout the membrane and for this reason the membrane is described as a mosaic.

Bilayer

b. Phospholipids—are arranged in a double layer. These phospholipids are composed of a phosphate head region and a hydrocarbon tail region. The phospholipids are not static but can move laterally within the membrane. This is why the membrane is said to be fluid.

c. Cholesterol—helps keep the phospholipids spaced apart which adds to the fluidity of the membrane.

Name Tags

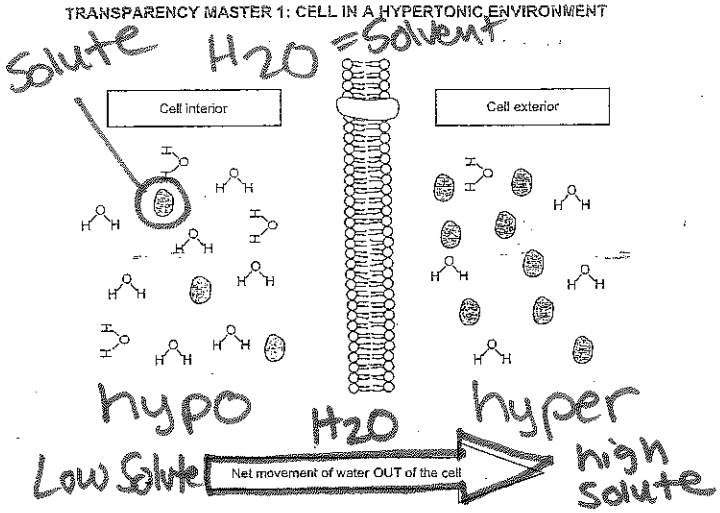
d. Surface carbohydrates—the surface carbohydrates function in cell recognition, cell signaling, and cell adhesion.

Stick together

This selectively permeable membrane is important in the cell's ability to maintain homeostasis or the condition of equilibrium. Collectively, the components of the cell membrane allow it to be selectively permeable, allowing small, uncharged particles to move by passive transport through the membrane while preventing the passage of large or charged substances. Large or charged substances must have a special pathway through the membrane.

Water will move through the membrane with relative ease from an area of high water concentration to an area of low water concentration. In comparing two solutions, a solution is said to be hypertonic if it contains a higher concentration of solutes than another. The solution with the smaller number of dissolved substances (or solutes) is called hypotonic. When comparing two solutions that are of equal solute concentration, they are referred to as isotonic. Hypertonic solutions have lower water concentrations and will gain water from hypotonic solutions. Cells placed in distilled water, for example, will gain water as it moves through the selectively permeable membrane from an area of high water concentration to an area of lower water concentration. An understanding of this phenomenon will allow us to explain why cells will gain or lose water in various settings.

TRANSPARENCY MASTER 1: CELL IN A HYPERTONIC ENVIRONMENT



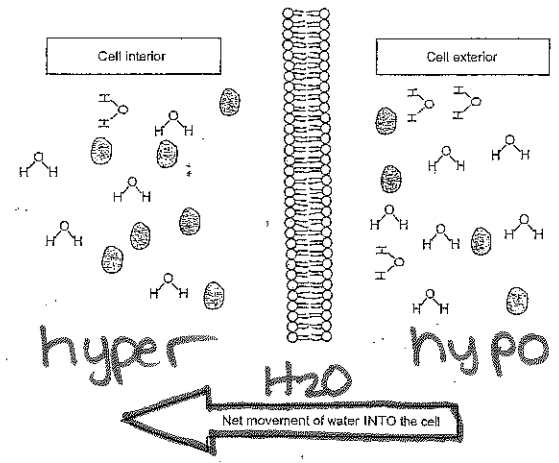
The solution in the cell's cytoplasm is hypotonic in comparison to the exterior solution.

The solution outside the cell is hypertonic in comparison to the interior solution.

When placed in a hypertonic solution, the cell will lose water as water moves from an area of high concentration of water to a lower concentration of water.

TEACHER PAGES

TRANSPARENCY MASTER 2: CELL IN A HYPOTONIC ENVIRONMENT

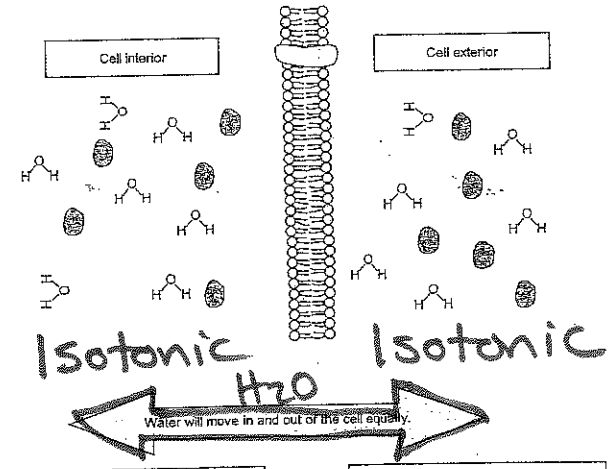


The solution in the cell's cytoplasm is hypertonic in comparison to the exterior solution.

The solution outside the cell is hypotonic in comparison to the interior solution.

When placed in a hypotonic solution, the cell will gain water as water moves from an area of high concentration of water to a lower concentration of water.

TRANSPARENCY MASTER #3: CELL IN AN ISOTONIC ENVIRONMENT



The solution in the cell's cytoplasm is isotonic in comparison to the exterior solution.

The solution outside the cell is isotonic in comparison to the interior solution.

When placed in an isotonic solution, the cell will have an equal movement of water in and out of the cell.

TEACHER PAGES

Name _____

Period _____

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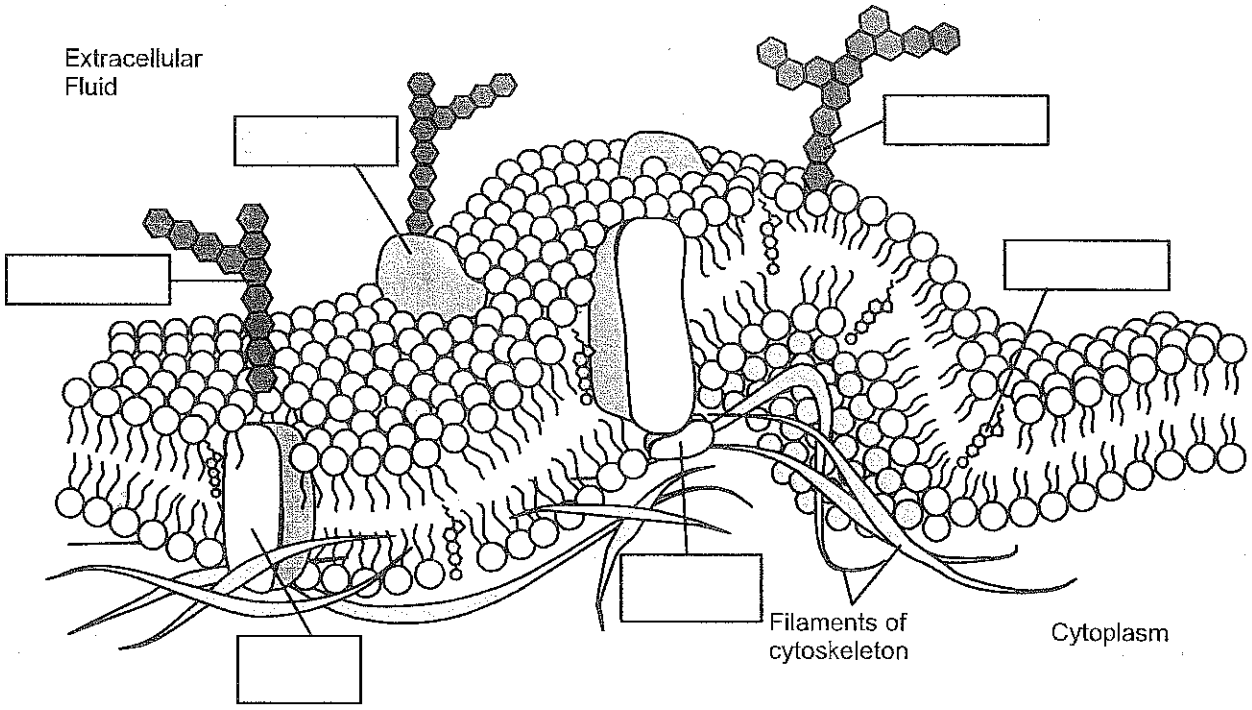
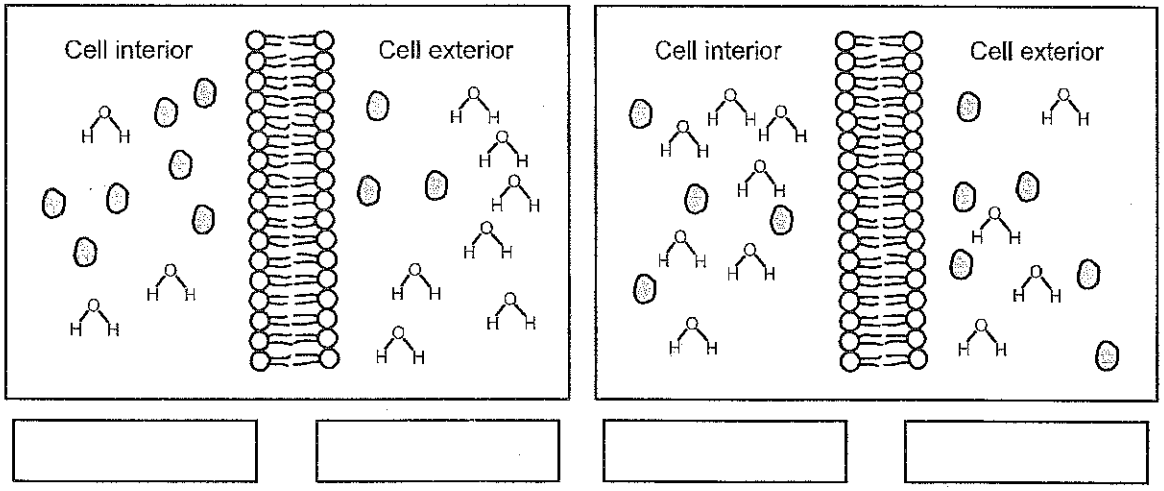
PART I





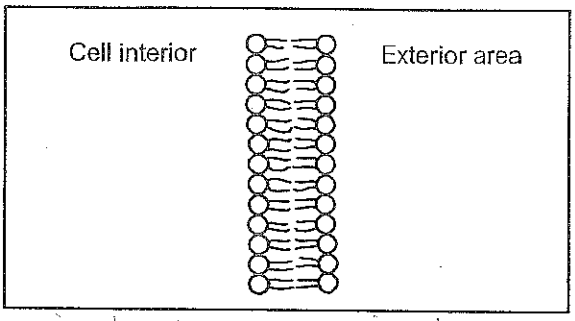


Fig. 4

isotonic isotonic

Draw an isotonic solution

ANALYSIS

PART I: MEMBRANE STRUCTURE CHART

Structure

Functional cellular event	Membrane structural component involved
Hydrogen ions (H^+) are being pumped to the inside of the membrane	
Big $C_6H_{12}O_6$ Glucose is entering the cell.	
Small H_2O Water is entering the cell.	
Small CO_2 Carbon dioxide is diffusing out of the cell	
The cell is recognized as belonging to a specific name tags tissue.	
Intermediate filaments of the cytoskeleton are anchored in place.	

PART II: OSMOTIC PREDICTIONS

Water in or out

Cell Type	If placed in this solution	Predicted results
Liver cell	Hypotonic	
Onion cell	Hypertonic	
Cheek cell	Isotonic	
Red blood cell	Hypotonic	
Potato cell	Hypertonic	

CONCLUSION QUESTIONS

_____ 1. Which of the following statements is supported by the fluid-mosaic model of membrane structure?
   a. The cell membrane is a phospholipid layer divided by carbohydrates.
   b. The cell membrane is a protein layer in which large lipids are found.
   c. The cell membrane is composed of carbohydrates floating in a sea of lipids.
   d. The cell membrane is a lipid layer in which proteins float.

_____ 2. A red blood cell placed in distilled water will swell and burst due to the movement of
   a. salt from the distilled water diffusing into the cell
   b. water molecules moving by osmosis into the cell
   c. water from the red blood cell moving into the distilled water
   d. salt from the red blood cell moving into the distilled water

_____ 3. The pathway taken by water molecules into the cell is
   a. through the cholesterol molecules
   b. between the globular proteins
   c. between the fluid phospholipids
   d. through the peripheral proteins

_____ 4. If excess fertilizer is placed around the root of a tomato plant, the leaves of the plant will shrivel and turn brown. All of the statements help explain why EXCEPT
   a. The fertilizer makes the soil solution hypotonic to the root cells.
   b. The water moves out of the root cells by osmosis into the soil.
   c. The plant's roots are in a hypertonic solution.
   d. Water is moving from an area of high water concentration to low water concentration.

_____ 5. Which of the following terms is most closely associated with the selective permeability of the cell membrane?
   a. hydrolysis
   b. hypothesis
   c. homeostasis
   d. homologous

_____ 6. A cell that has deformity or irregularities in transport proteins may not be able to
   a. allow water to enter the cell
   b. prevent carbon dioxide from entering the cell
   c. move small particles out of the cell
   d. move large particles into the cell

_____ 7. Which of the following is a true statement regarding the following situation?
   a. the exterior is hypotonic
   b. there will be a net movement of water out of the cell
   c. this diagram could be of an animal cell in distilled water
   d. the cell's internal solution is hypotonic