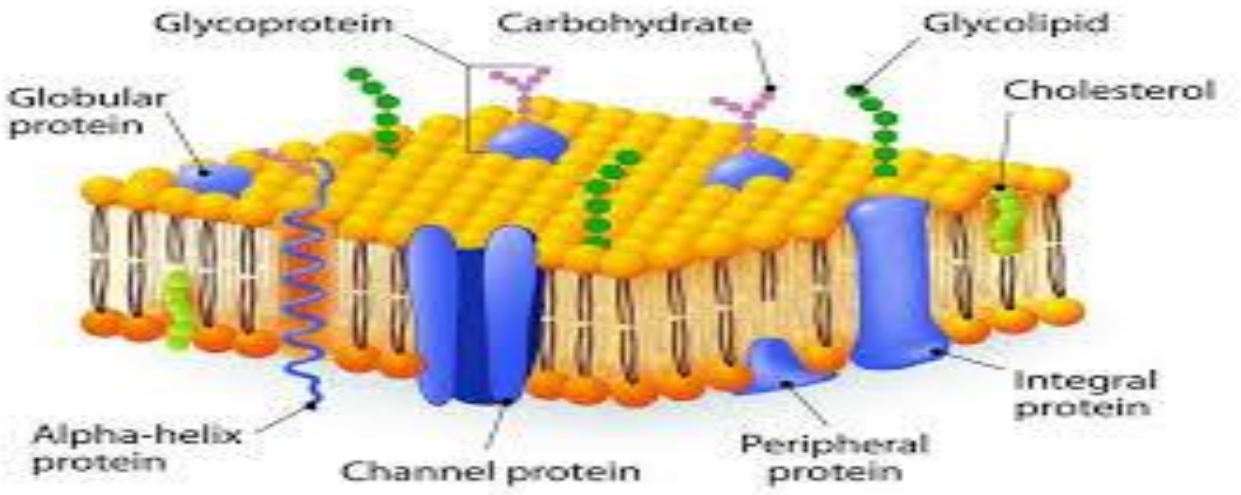
Structure and Function of the Cell Membrane and an Introduction to Energy

The modern understanding of the plasma membrane is referred to as the fluid mosaic model. The plasma membrane is composed of a bilayer of phospholipids. The membrane is studded with proteins, some of which span the membrane. Some of these proteins serve to transport materials into or out of the cell. Carbohydrates are attached to some of the proteins and lipids on the outward-facing surface of the membrane. These form complexes that function to identify the cell to other cells. The fluid nature of the membrane can be explained by the fatty acid tails, the presence of cholesterol embedded in the membrane, and the mosaic nature of the proteins and protein-carbohydrate complexes. Plasma membranes enclose the borders of cells, but rather than being a static bag, they are dynamic and constantly in flux.

aquaporin: channel protein that allows water through the membrane at a very high rate

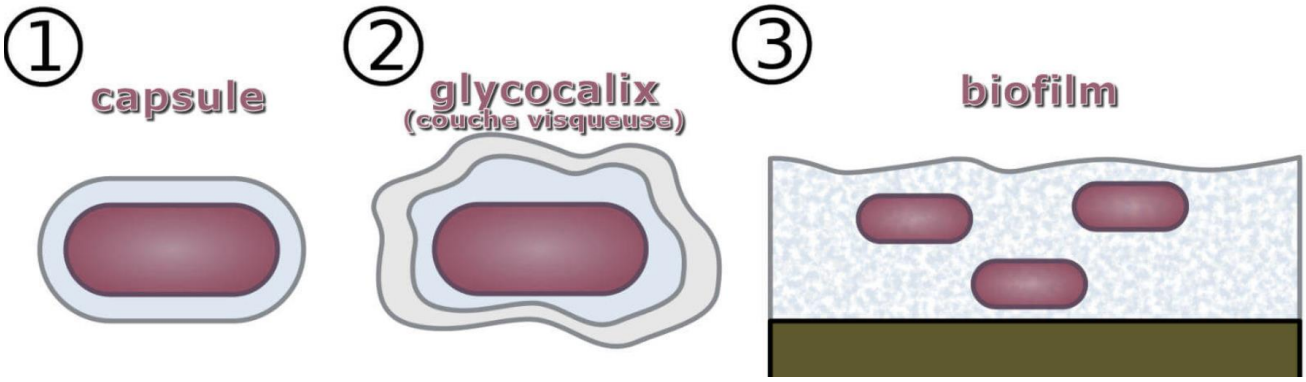
cholesterol: a lipid that plays an important role in membrane fluidity

fluid mosaic model: a model of the structure of the plasma membrane as a mosaic of components, including phospholipids, cholesterol, proteins, and glycolipids, resulting in a fluid rather than static character.



fluid mosaic model

glycocalyx: a fuzzy-appearing coating around the cell formed from glycoproteins and other carbohydrates attached to the cell membrane.



glycolipid: a combination of carbohydrates and lipids

glycoprotein: a combination of carbohydrates and proteins.

integral protein: protein integrated into the membrane structure that interacts extensively with the membrane lipids' hydrocarbon chains and often spans the membrane

peripheral protein: protein at the plasma membrane's surface either on its exterior or interior side

phospholipid: a major constituent of the membranes of cells; composed of two fatty acids and a phosphate group attached to the glycerol backbone.

In living systems, diffusion of substances into and out of cells is mediated by the plasma membrane. Some materials diffuse readily through the membrane, but others are hindered, and their passage is only made possible by protein channels and carriers.

Passive forms of transport, such as diffusion and osmosis, move materials without expending energy. Substances diffuse from areas of high concentration to areas of low concentration. This process continues until the substance is evenly distributed in a system. In solutions of more than one substance, each type of molecule diffuses according to its own concentration gradient. Many factors can affect the rate of diffusion, including concentration gradient, the sizes of the particles that are diffusing, and the temperature of the system.

Water also can move freely across the cell membrane of all cells, either through protein channels or by slipping between the lipid tails of the membrane itself. Osmosis is the movement of water molecules through a semipermeable membrane from an area of low solute concentration to an area of high solute concentration.

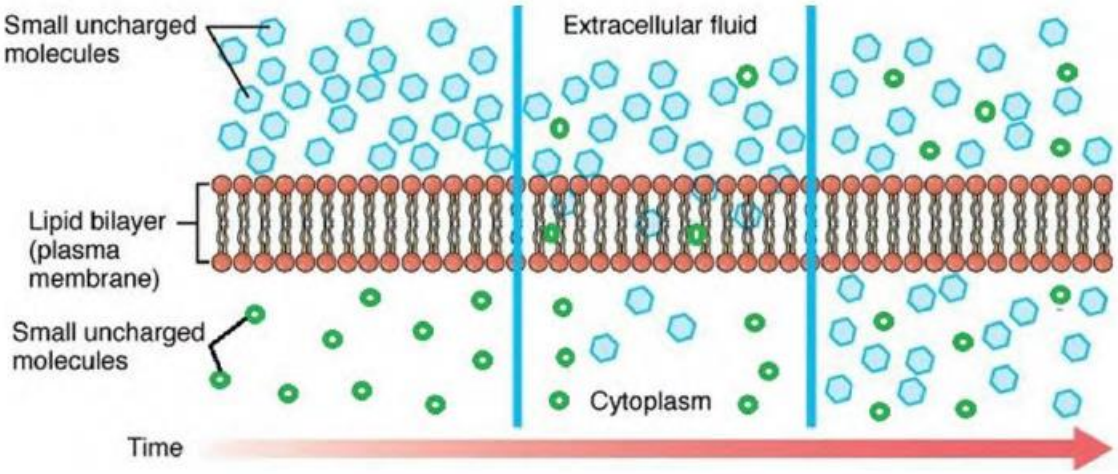
Two solutions that have the same concentration of solutes are said to be isotonic. Osmosis occurs when there is an imbalance of solutes outside of a cell versus inside the cell. A solution that has a higher concentration of solutes than another solution is said to be hypertonic, and water molecules tend to diffuse into a hypertonic solution. In contrast,

a solution that has a lower concentration of solutes than another solution is said to be hypotonic, and water molecules tend to diffuse out of a hypotonic solution.

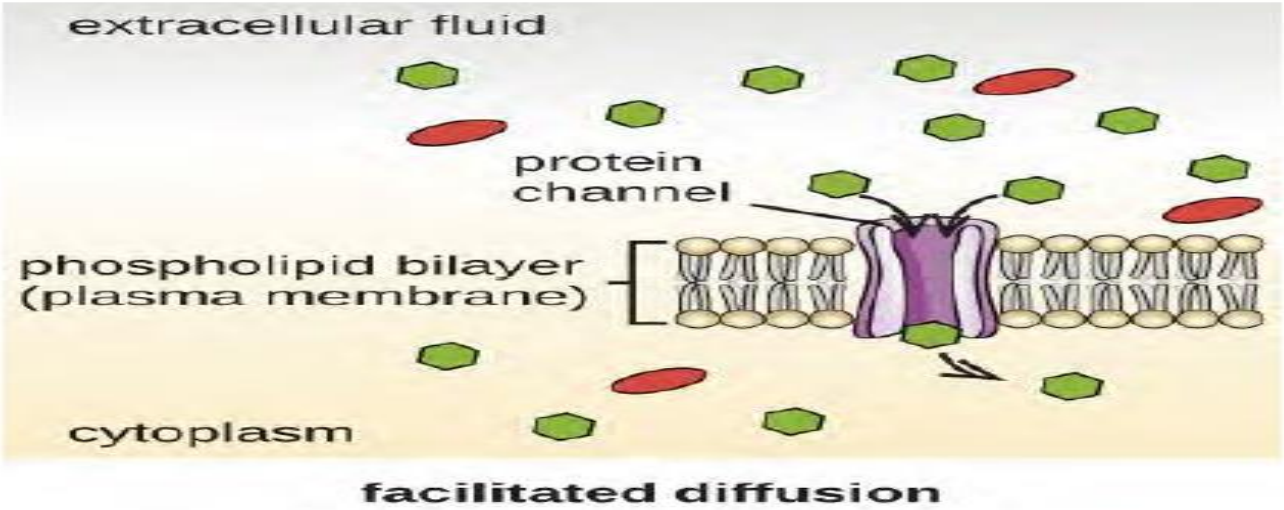
transport: the method of transporting materials into or out of a cell that requires energy

concentration gradient: an area of high concentration across from an area of low concentration

diffusion: a passive process of transport where solutes move from an area of high concentration to an area of low concentration until equilibrium is met .



facilitated transport: a process by which solutes moves down a concentration gradient (from high to low concentration) using integral membrane proteins.

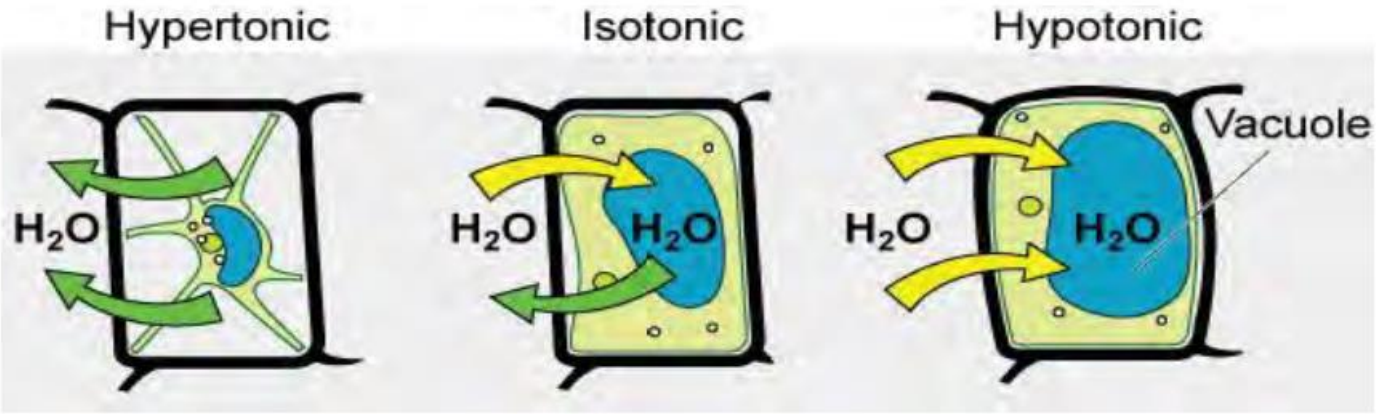


facilitated diffusion

hypertonic: describes a solution in which extracellular fluid has a higher osmolarity than the fluid inside the cell

hypotonic: describes a solution in which extracellular fluid has a lower osmolarity than the fluid inside the cell

isotonic: describes a solution in which the extracellular fluid has the same osmolarity as the fluid inside the cell.



osmolality: the total amount of substances dissolved in a specific amount of solution

osmosis: the transport of water through a semipermeable membrane from an area of low solute concentration to an area of high solute concentration. Water also moves from an area of high water concentration to an area of low water concentration until equilibrium is met.

passive transport: a method of transporting material that does not require energy

selectively permeable: the characteristic of a membrane that allows some substances through but not others

simple diffusion: a process where solutes move directly through the membrane from an area of high concentration to an area of low concentration until equilibrium is met

solute: a substance dissolved in another to form a solution

tonicity: the amount of solute in a solution.

Here are 40 multiple-choice questions (MCQs) on the topic of the cell membrane and an introduction to energy, with the correct answers in **bold**:

1. What is the modern understanding of the plasma membrane referred to as?

   a) Phospholipid Bilayer

   b) Lipid Model

   c) **Fluid Mosaic Model**

d) Channel Protein

e) Cell Theory

2. Which of the following is the primary component of the plasma membrane?

a) Carbohydrates

b) **Phospholipids**

c) Proteins

d) Nucleic Acids

e) Glycogen

3. What characteristic of the plasma membrane explains its fluid nature?

a) Nucleotides

b) **Fatty acid tails and cholesterol**

c) Carbohydrates

d) Enzymes

e) ATP

4. What role do carbohydrates play on the plasma membrane?

a) Energy Storage

b) **Cell identification**

c) Protein Synthesis

d) Membrane Flexibility

e) Cell Division

5. Which protein allows water to pass through the plasma membrane at a high rate?

a) **Aquaporin**

b) Cholesterol

c) Glycoprotein

d) Peripheral Protein

e) Integral Protein

6. What is the function of cholesterol in the plasma membrane?

a) **Regulates membrane fluidity**

b) Energy Production

c) Facilitates transport

d) Cell division

e) Protein synthesis

7. What term describes the coating around the cell formed from glycoproteins and carbohydrates?

a) Phospholipid Bilayer

b) Fluid Mosaic Model

c) **Glycocalyx**

d) Integral Protein

e) Peripheral Protein

8. What type of protein spans the membrane and interacts with the membrane lipids?

a) Glycoprotein

b) **Integral Protein**

c) Peripheral Protein

d) Glycolipid

e) Aquaporin

9. Which of the following is an example of passive transport?

a) Endocytosis

b) Exocytosis

c) **Diffusion**

d) Phagocytosis

e) Active Transport

10. What process involves water movement through a semipermeable membrane?

a) Diffusion

b) **Osmosis**

c) Endocytosis

d) Exocytosis

e) Facilitated Transport

11. A solution with the same solute concentration inside and outside the cell is called:

a) Hypotonic

b) Hypertonic

c) **Isotonic**

d) Osmotic

e) Selective

12. What happens to a cell in a hypertonic solution?

a) Water moves into the cell

b) **Water moves out of the cell**

c) Water moves both ways equally

d) The cell remains unchanged

e) The cell bursts

13. Which term describes the movement of solutes from high concentration to low concentration?

a) **Diffusion**

b) Osmosis

c) Tonicity

d) Endocytosis

e) Exocytosis

14. Which of the following processes requires energy?

a) Diffusion

b) Osmosis

c) Facilitated Transport

d) **Active Transport**

e) Simple Diffusion

15. In facilitated transport, what helps solutes move across the membrane?

a) **Integral Membrane Proteins**

b) Lipid Tails

c) Glycocalyx

d) Cholesterol

e) ATP

16. What is the term for the total amount of substances dissolved in a solution?

a) Isotonicity

b) Hypertonicity

c) Diffusion

d) **Osmolarity**

e) Membrane Fluidity

17. What does a selectively permeable membrane allow?

a) Everything to pass

b) **Some substances to pass, but not others**

c) Only water to pass

d) Only large molecules to pass

e) No substances to pass

18. What is the major function of phospholipids in the plasma membrane?

a) **Form the bilayer structure**

b) Transport materials

c) Cell signaling

d) Energy storage

e) Protein synthesis

19. What occurs when water moves into a cell placed in a hypotonic solution?

a) **Cell swells**

b) Cell shrinks

c) No change

d) Cell bursts

e) Water leaves the cell

20. What term describes solutes moving through the lipid bilayer directly?

a) Osmosis

b) Facilitated Diffusion

c) **Simple Diffusion**

d) Active Transport

e) Selective Permeability

21. What is a glycolipid?

a) Protein and lipid combination

b) Carbohydrate and protein combination

c) **Carbohydrate and lipid combination**

d) Carbohydrate and enzyme combination

e) Protein and enzyme combination

22. What happens in an isotonic solution?

a) Water enters the cell

b) Water leaves the cell

c) **Water moves equally in both directions**

d) The cell swells

e) The cell shrinks

23. Which protein is located only on the exterior or interior surface of the plasma membrane?

a) Integral Protein

b) Channel Protein

c) **Peripheral Protein**

d) Glycoprotein

e) Aquaporin

24. What does "tonicity" refer to?

a) The movement of water

b) The movement of solutes

c) **The amount of solute in a solution**

d) The structure of the membrane

e) The energy of a system

25. Which process is a passive method of transport?

a) **Osmosis**

b) Active Transport

c) Endocytosis

d) Exocytosis

e) Phagocytosis

26. What is the main feature of a hypertonic solution?

a) **Higher osmolarity outside the cell**

b) Lower osmolarity outside the cell

c) Equal osmolarity inside and outside

d) More water inside the cell

e) No water movement

27. What drives the movement of water during osmosis?

a) Protein channels

b) **Solute concentration differences**

c) ATP

d) Cholesterol

e) Temperature

28. What type of transport involves the movement of materials against the concentration gradient?

a) Passive Transport

b) Diffusion

c) Osmosis

d) **Active Transport**

e) Facilitated Transport

29. What is the function of glycoproteins in the plasma membrane?

a) **Cell signaling and recognition**

b) Energy production

c) Transport of ions

d) Membrane fluidity

e) ATP synthesis

30. Which process does not require energy?

a) **Passive Transport**

b) Active Transport

c) Endocytosis

d) Exocytosis

e) Protein Synthesis

31. What is the purpose of facilitated diffusion?

a) Transport of water

b) Movement of large molecules

c) **Movement of solutes using integral proteins**

d) Transport of gases

e) Active transport of ions

32. In which of the following conditions does water move out of the cell?

a) Hypotonic

b) **Hypertonic**

c) Isotonic

d) Osmolarity

e) Facilitated Diffusion

33. Which of the following processes involves moving materials into the cell?

a) **Endocytosis**

b) Exocytosis

c) Osmosis

d) Diffusion

e) Active Transport

34. What describes the movement of water in a hypotonic solution?

a) Water moves out

b) Water stays still

c) **Water moves into the cell**

d) Water evaporates

e) Water moves equally in both directions

35. What is a solute?

a) The liquid in a solution

b) **A substance dissolved in another substance**

c) Water in osmosis

d) A solid

e) A membrane protein

36. What type of protein is typically involved in active transport?

a) **Integral Protein**

b) Peripheral Protein

c) Glycoprotein

d) Glycolipid

e) Phospholipid

37. What happens to a cell placed in an isotonic solution?

a) Cell swells

b) Cell shrinks

c) **No net movement of water**

d) Cell bursts

e) Water enters the cell

38. What role do channel proteins play in the plasma membrane?

a) **Allow specific molecules to pass through**

b) Control cell division

c) Produce ATP

d) Signal other cells

e) Store energy

39. What process allows gases like oxygen and carbon dioxide to cross the plasma membrane?

a) Facilit

ated Transport

b) **Simple Diffusion**

c) Osmosis

d) Active Transport

e) Endocytosis

40. In osmosis, water moves from:

a) High solute concentration to low solute concentration

b) **Low solute concentration to high solute concentration**

c) High temperature to low temperature

d) High water concentration to high solute concentration

e) Low temperature to high temperature