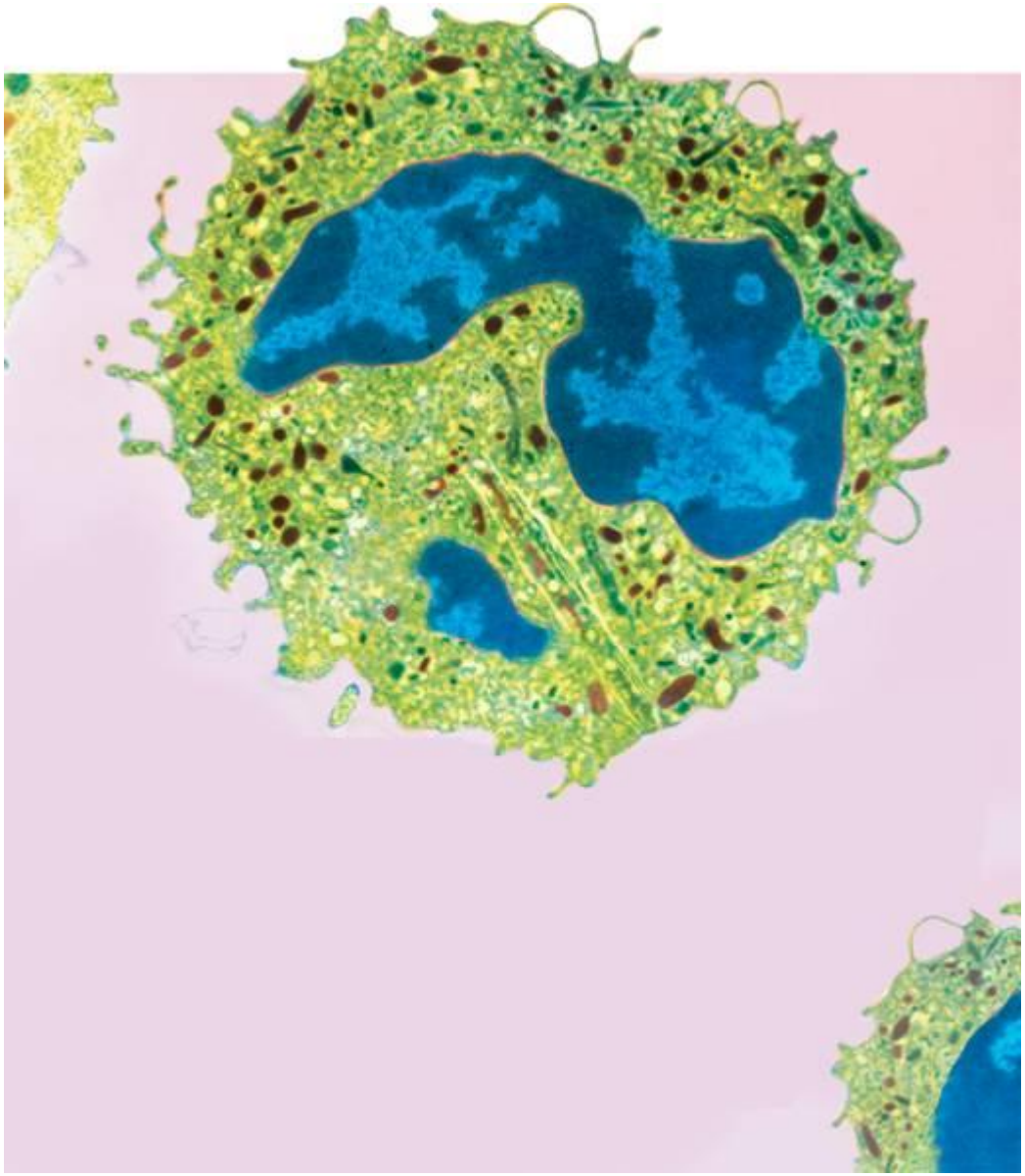
7-3 Cell Boundaries



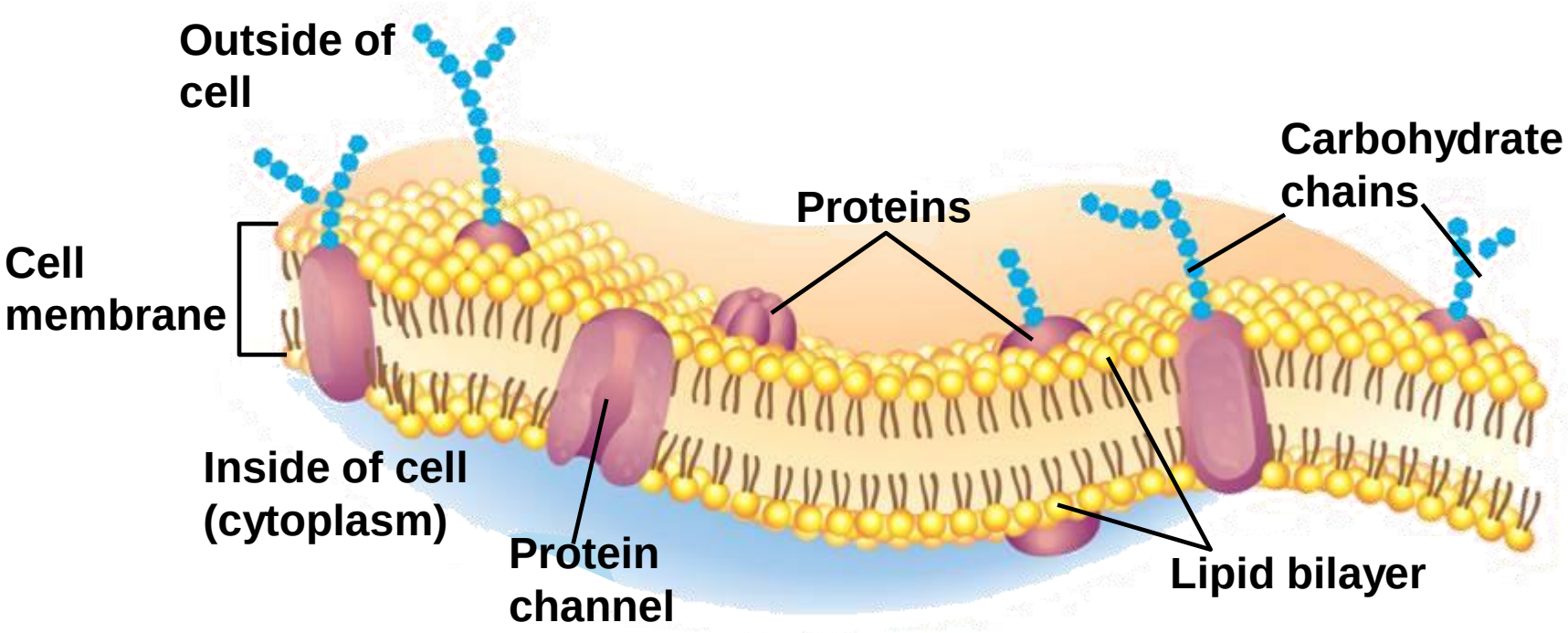
All cells are surrounded by a thin, flexible barrier known as the **cell membrane**.

Many cells also produce a strong supporting layer around the membrane known as a **cell wall**.

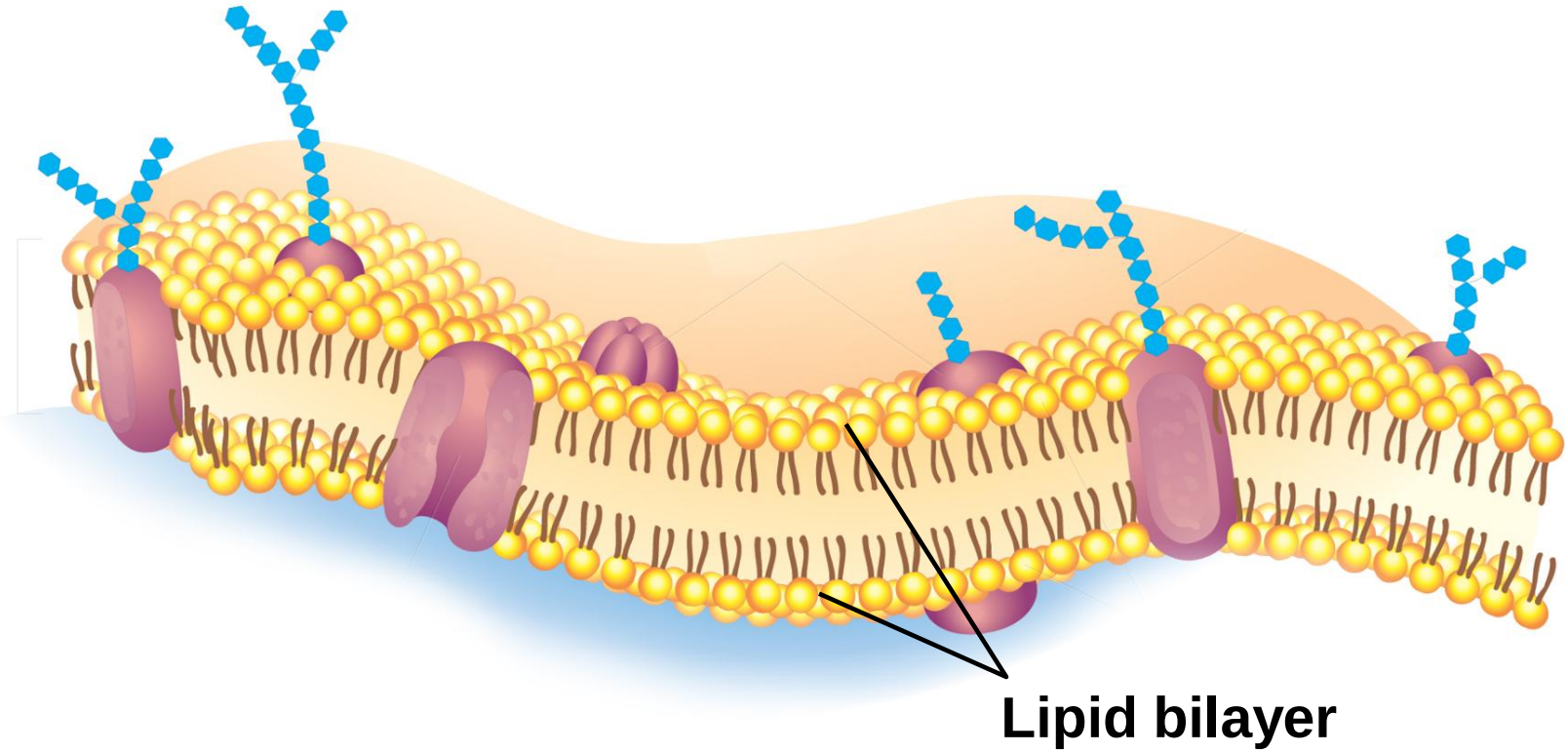
Cell Membrane

The cell membrane regulates what enters and leaves the cell and also provides protection and support.

Cell Membrane

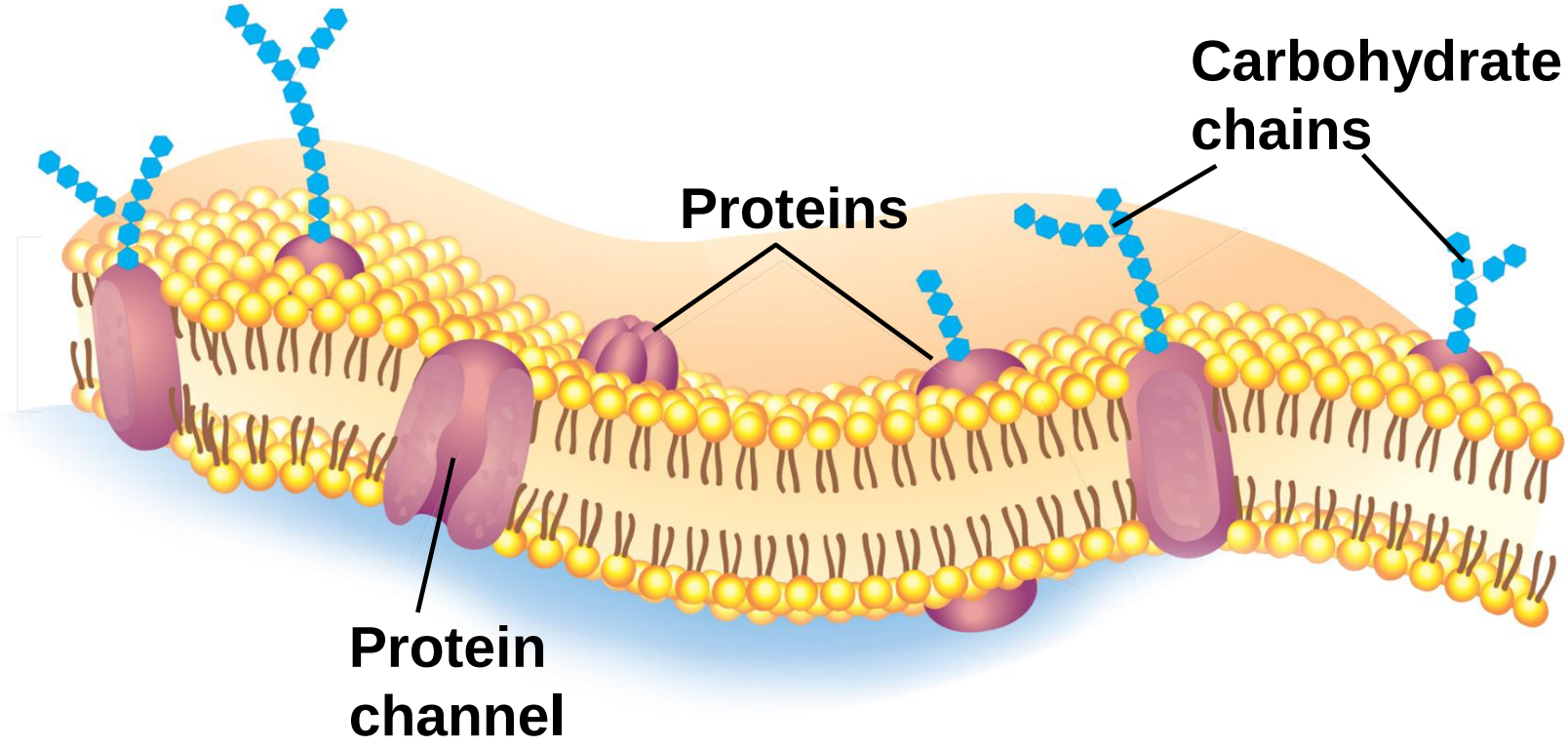


The composition of nearly all cell membranes is a double-layered sheet called a **lipid bilayer**.



The lipid bilayer gives cell membranes a flexible structure that forms a barrier between the cell and its surroundings.

Most cell membranes contain protein molecules embedded in the lipid bilayer, some of which have carbohydrate molecules attached to them.



The main function of the cell wall is to provide support and protection for the cell.

Cell Walls

Cell walls are found in plants, algae, fungi, and many prokaryotes.

The cell wall lies outside the cell membrane.

Most cell walls are porous enough to allow water, oxygen, carbon dioxide, and certain other substances to pass through easily.

Diffusion Through Cell Boundaries

Every living cell exists in a liquid environment.

The cell membrane regulates movement of dissolved molecules from the liquid on one side of the membrane to the liquid on the other side.

Measuring Concentration

A solution is a mixture of two or more substances.

The substances dissolved in the solution are called solutes.

The **concentration** of a solution is the mass of solute in a given volume of solution, or mass/volume.

Diffusion

Particles in a solution tend to move from an area where they are more concentrated to an area where they are less concentrated.

This process is called **diffusion**.

When the concentration of the solute is the same throughout a system, the system has reached **equilibrium**.

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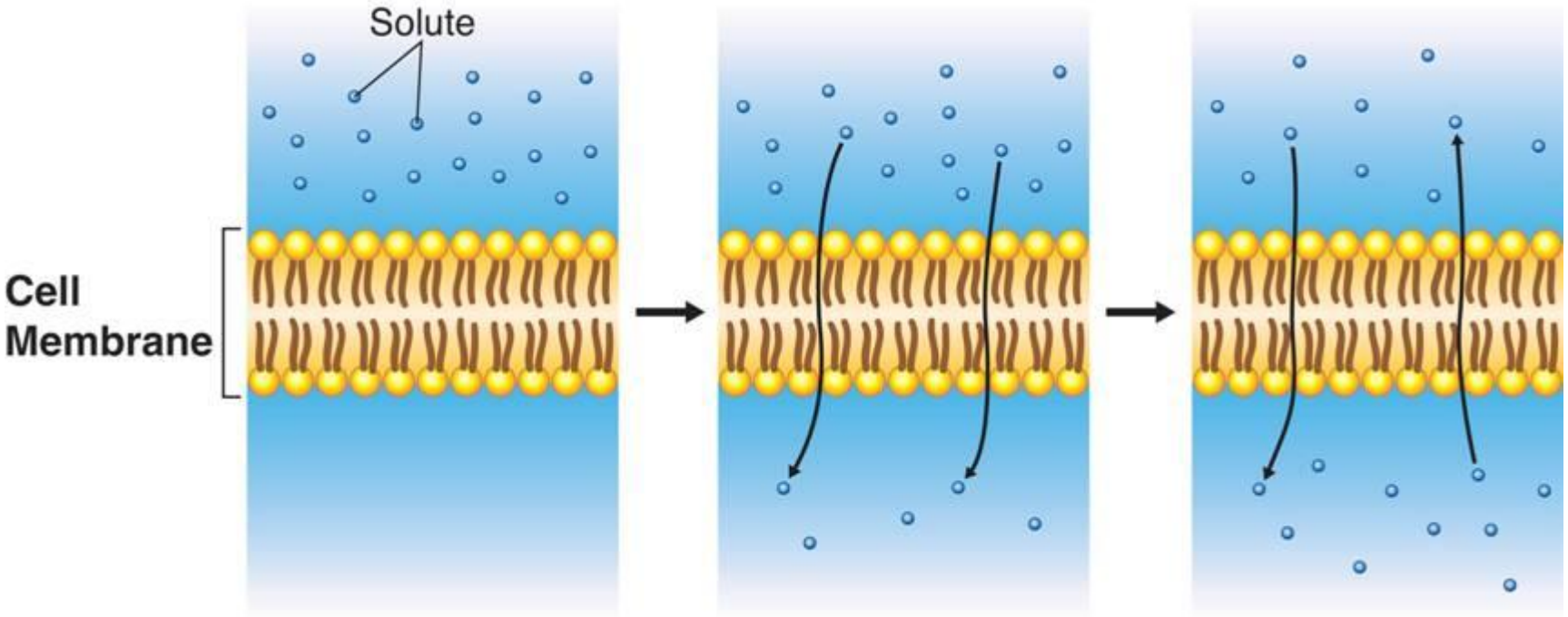
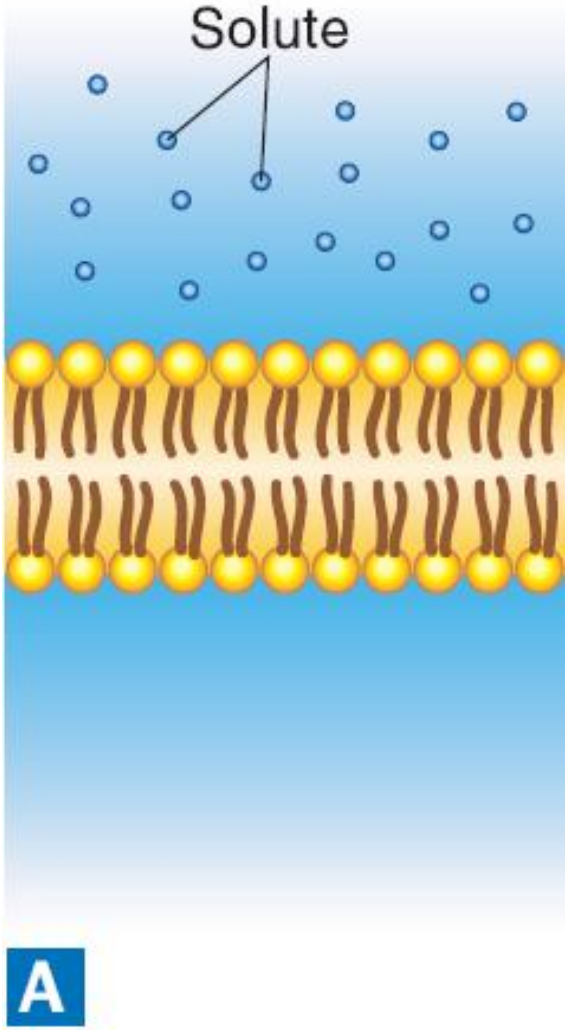
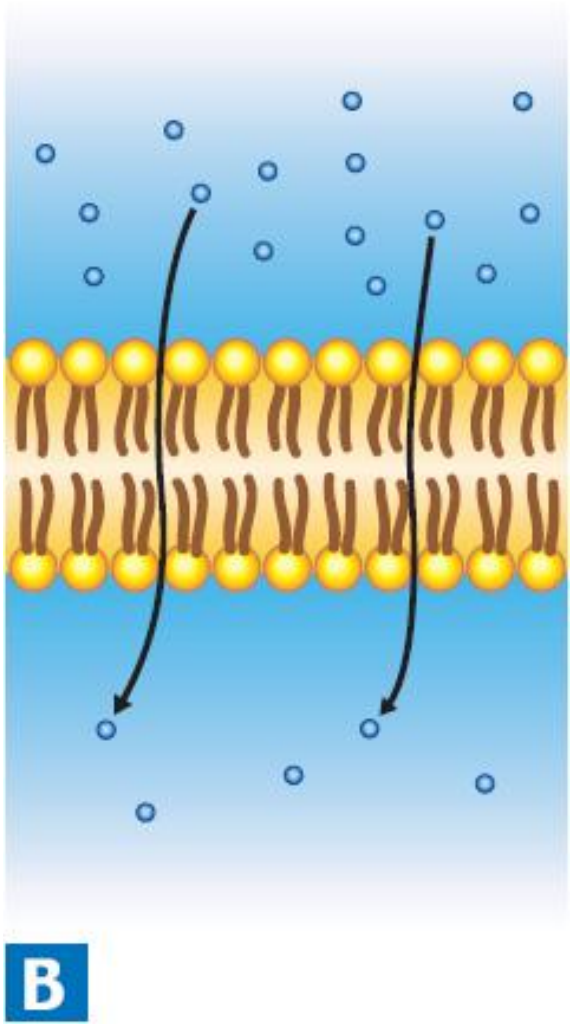
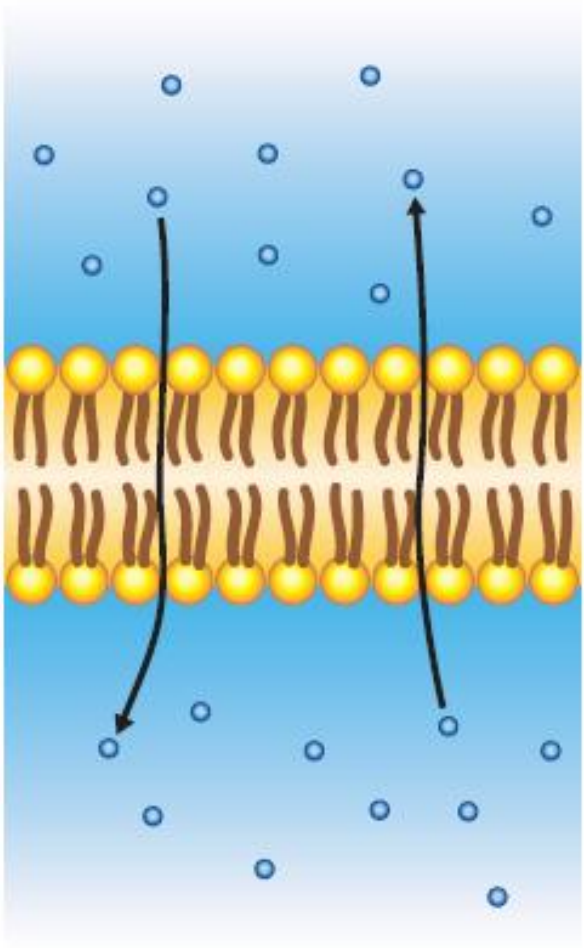




There is a higher concentration of solute on one side of the membrane as compared to the other side of the membrane.



Solute particles move from the side of the membrane with a higher concentration of solute to the side of the membrane with a lower concentration of solute. The solute particles will continue to diffuse across the membrane until equilibrium is reached.



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When equilibrium is reached, solute particles continue to diffuse across the membrane in both directions.

Diffusion depends upon random particle movements. Therefore, substances diffuse across membranes without requiring the cell to use energy.

Osmosis

Osmosis is the diffusion of water through a selectively permeable membrane.

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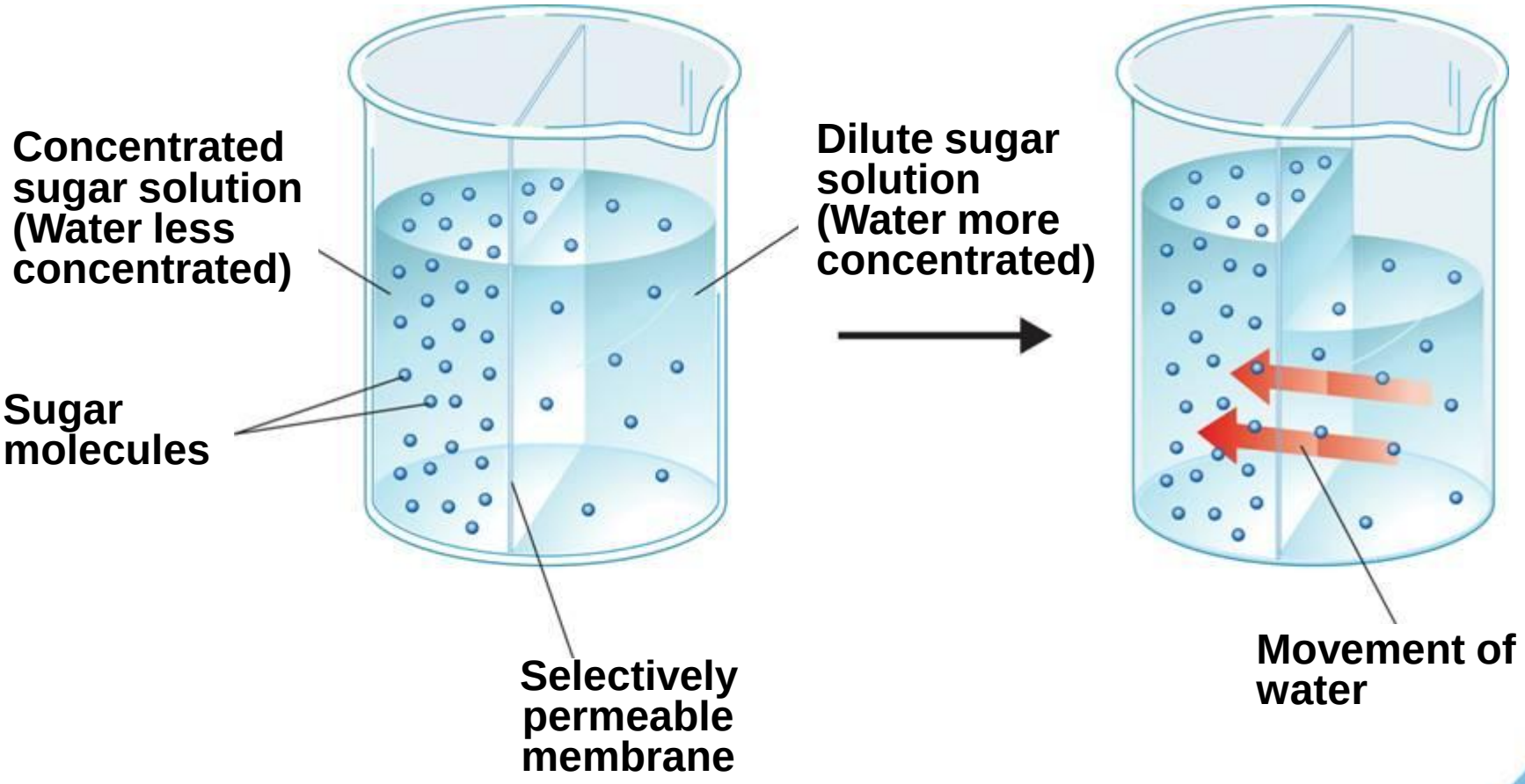
How Osmosis Works



Water tends to diffuse from a highly concentrated region to a less concentrated region.

If you compare two solutions, the more concentrated solution is **hypertonic** (“above strength”).

The more dilute solution is **hypotonic** (“below strength”).

When concentrations of solutions are the same on both sides of a membrane, the solutions are **isotonic** (“same strength”).

Osmotic Pressure

Osmosis exerts a pressure known as osmotic pressure on the hypertonic side of a selectively permeable membrane.

Because the cell is filled with salts, sugars, proteins, and other molecules, it will almost always be hypertonic to fresh water.

If so, the osmotic pressure should produce a net movement of water into the cell. As a result, the volume of the cell will increase until the cell becomes swollen or bursts.

Cells in large organisms are not in danger of bursting because they are bathed in fluids, such as blood, that are isotonic.

Other cells are surrounded by tough cell walls that prevent the cells from expanding even under tremendous osmotic pressure.

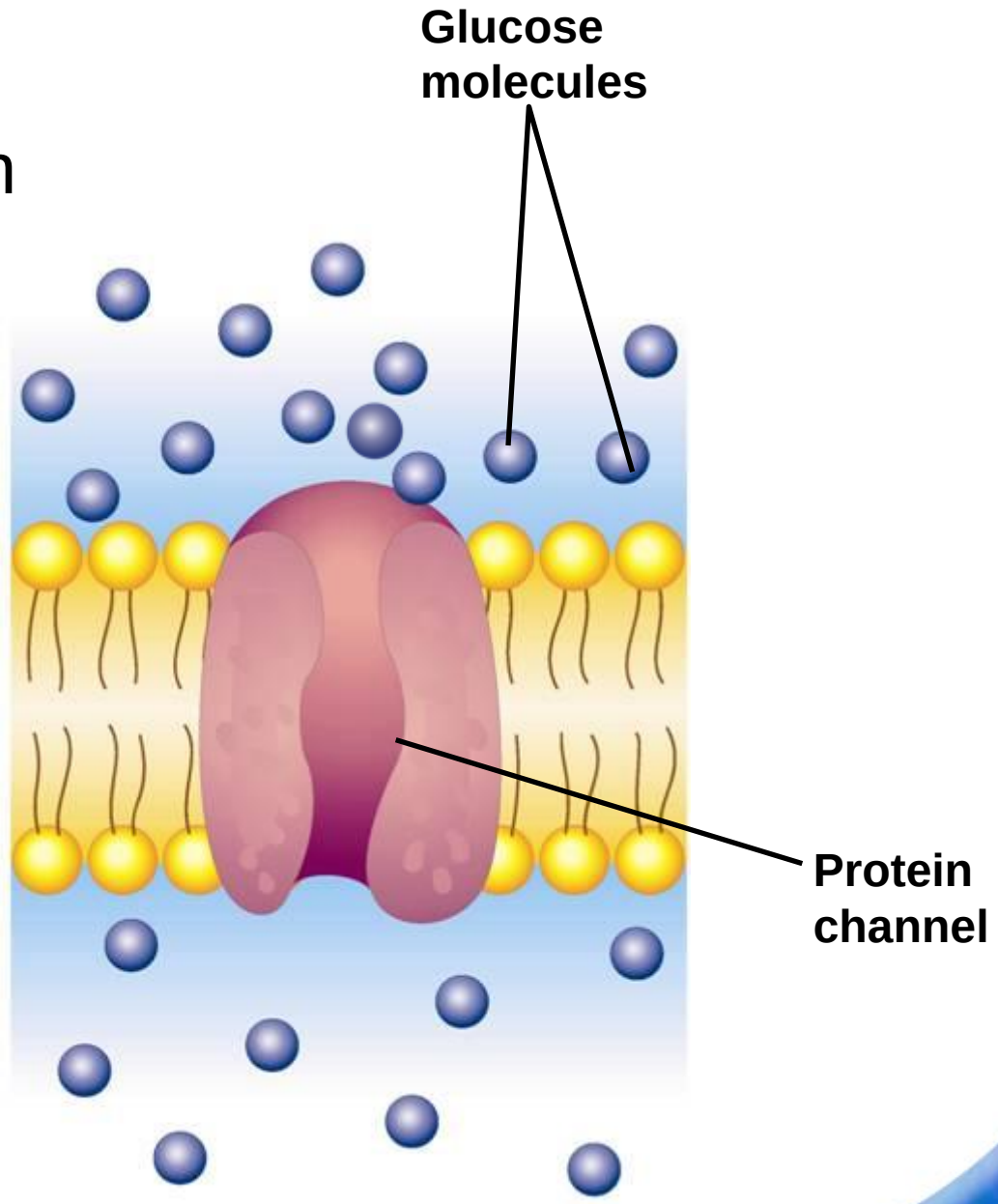
Facilitated Diffusion

Cell membranes have protein channels that act as carriers, making it easy for certain molecules to cross.

The movement of specific molecules across cell membranes through protein channels is known as **facilitated diffusion**.

Hundreds of different protein channels have been found that allow particular substances to cross different membranes.

Facilitated Diffusion



Although facilitated diffusion is fast and specific, it is still diffusion.

Therefore, facilitated diffusion will only occur if there is a higher concentration of the particular molecules on one side of a cell membrane as compared to the other side.

Active Transport

Sometimes cells move materials in the opposite direction from which the materials would normally move—that is against a concentration difference. This process is known as **active transport**.

Active transport requires energy.

Molecular Transport

In active transport, small molecules and ions are carried across membranes by proteins in the membrane.

Energy use in these systems enables cells to concentrate substances in a particular location, even when diffusion might move them in the opposite direction.

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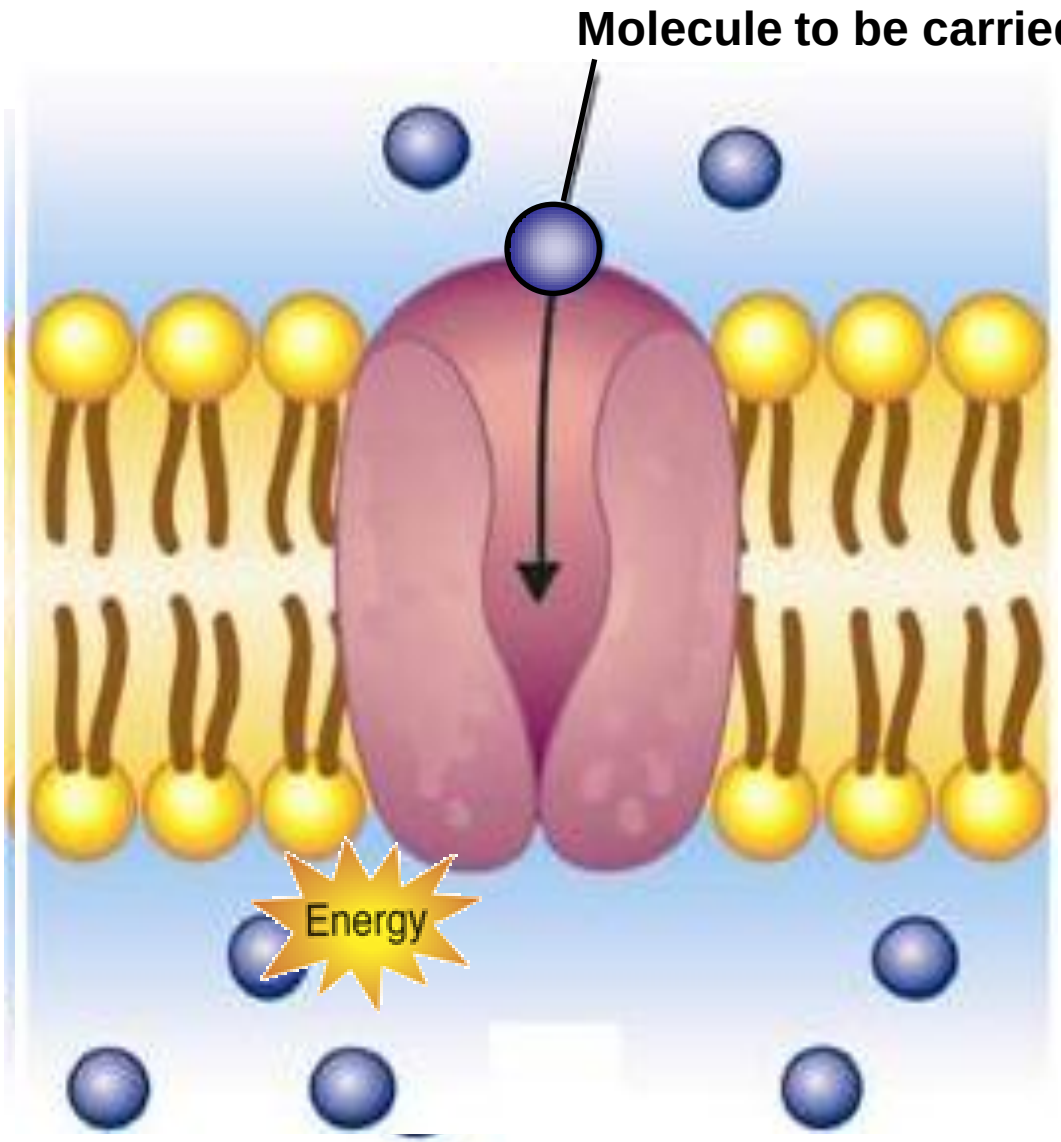
Active Transport



Endocytosis and Exocytosis

Large molecules and even solid clumps of material may undergo active transport by means of the cell membrane.

Endocytosis is the process of taking material into the cell by means of infoldings, or pockets, of the cell membrane.

The pocket breaks loose from the outer portion of the cell membrane and forms a vacuole within the cytoplasm.

Two examples of endocytosis are:

- phagocytosis
- pinocytosis

In **phagocytosis**, extensions of cytoplasm surround a particle and package it within a food vacuole. The cell then engulfs it.

Phagocytosis requires a considerable amount of energy.

In **pinocytosis**, tiny pockets form along the cell membrane, fill with liquid, and pinch off to form vacuoles within the cell.

Exocytosis

Many cells also release large amounts of material from the cell, in a process called exocytosis.

During **exocytosis**, the membrane of the vacuole surrounding the material fuses with the cell membrane, forcing the contents out of the cell.

END OF SECTION