

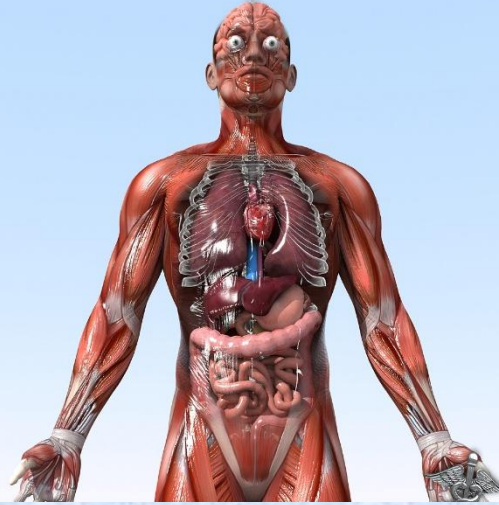
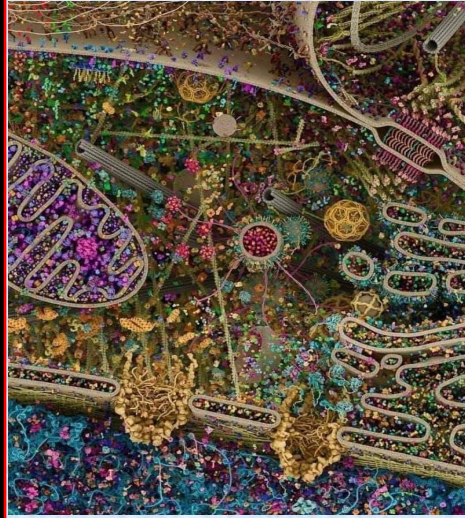
General Animal Biology

ZOO-109

علم الأحياء

-109

حين



For Pre-Medical
Students



Common First
Year

السنة الأولى المشتركة - المسار الصحي

1447-H - 2026

Reference: Campbell, N. A. and Reece, J. B. (2014). *Biology* (10th edition). Pearson Education. Inc. USA.

عهاة الةلم الالكرونل والةلم عن بعء
E-learning Deanship



King Saud University

جامعة الملك سعود

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College of Science,

Zoology Department

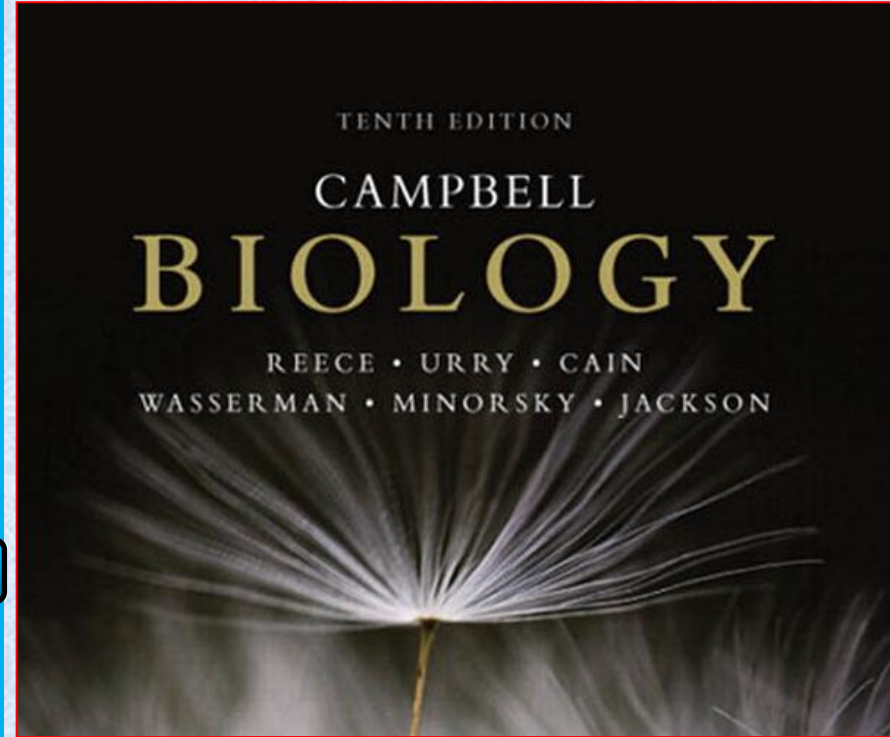
TENTH EDITION

CAMPBELL

BIOLOGY

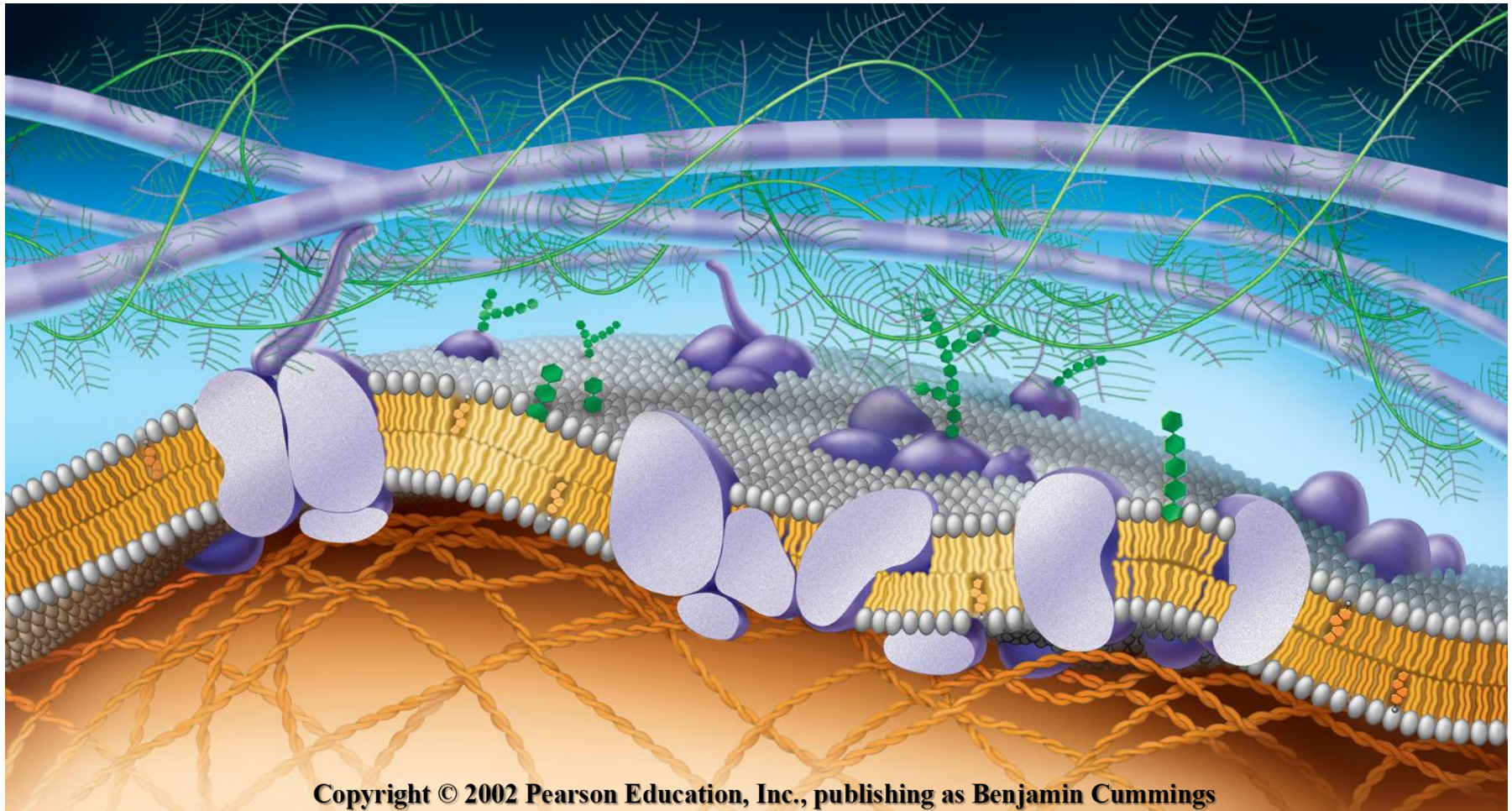
REECE • URRY • CAIN

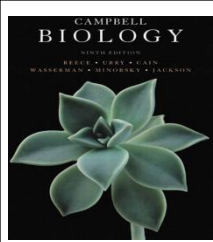
WASSERMAN • MINORSKY • JACKSON



بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

How things get into and out of the cell?





Objectives



A)- Structure of Cell Membrane:

Cell membrane is mosaics of structure and function.

- The plasma membrane has a unique collection of proteins.
- These proteins may provide a variety of major cell functions.
- Specific proteins facilitate passive transport.

B)- Functions of Cell Membrane:

I. Selective Permeability.

II. Passive Transport.

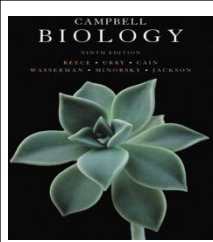
1. Diffusion

2. Osmosis

▪ *Osmoregulation*

3. Facilitated Diffusion.

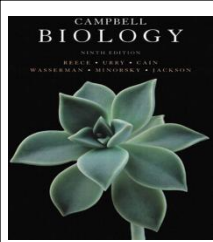
III. Active Transport (will be studied in the next lecture)



A) Structure of Cell Membrane



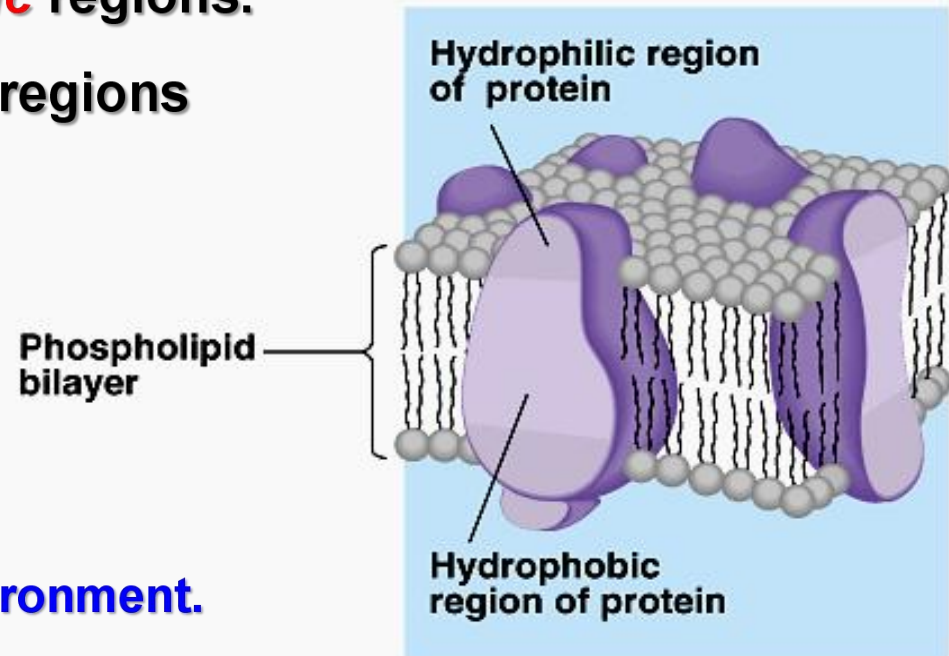
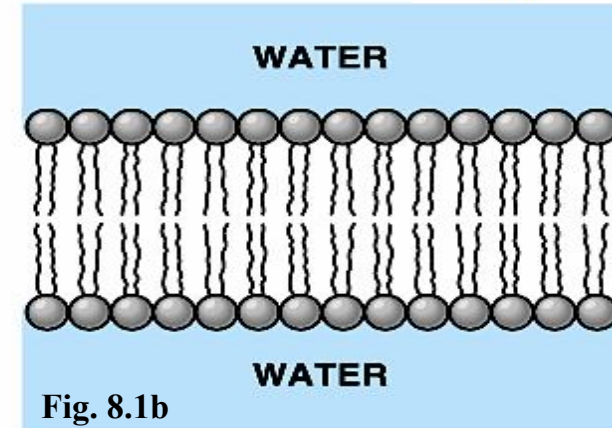
- ❖ The plasma membrane separates the living cell from its nonliving surroundings.
- ❖ This thin barrier, 8 nm thick, controls traffic into and out of the cell.
- ❖ Like other membranes, the plasma membrane is **selectively permeable** مُنْفَذٌ إِخْتِيَارِيًّا: allowing some substances to cross more easily than others.
- ❖ The most abundant lipids in the cell membrane are **phospholipids**.
- ❖ Phospholipids and most other membrane constituents are **amphipathic molecules**.
 - ❖ **Amphipathic molecules** have both **hydrophobic** and **hydrophilic** regions.

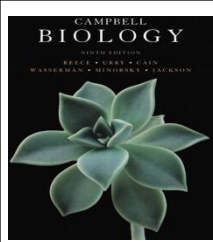


A) Structure of Cell Membrane



- ❖ The lipid molecules in the bilayer **طبقة مزدوجة** are arranged as **hydrophobic fatty acid tails** that are sheltered **محمية** from water while the **hydrophilic phosphate groups** interact with water.
- ❖ Some membrane proteins are **amphipathic**, with **hydrophobic** and **hydrophilic** regions.
- ❖ If at the surface, the hydrophilic regions would be in contact with water.
 - ❖ In this fluid mosaic model, the **hydrophilic regions of proteins** and **heads of phospholipids** are in contact with water, while the hydrophobic regions are in a non-aqueous **لا مائي** environment.





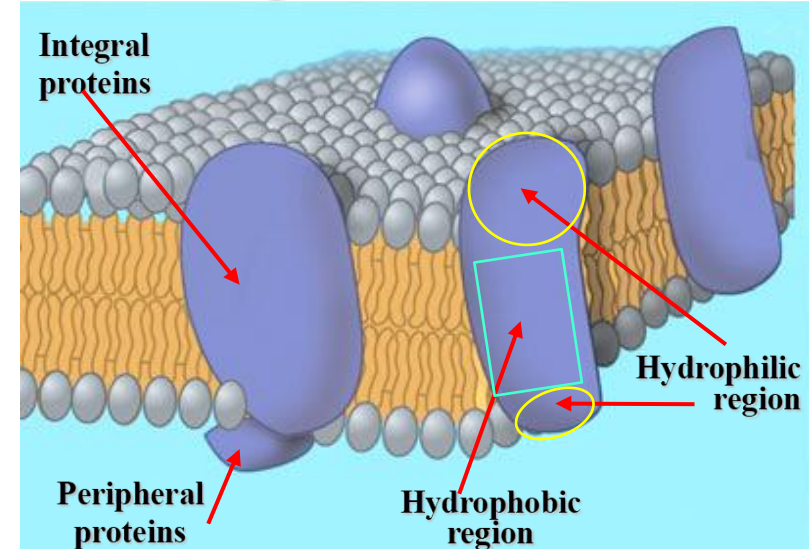
A) Structure of Cell Membrane

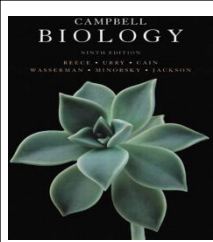


The plasma membrane has a unique collection of proteins.

There are two populations of MEMBRANE PROTEINS.

1. Peripheral protein طرفي (**hydrophilic**) is not embedded in the lipid bilayer at all. Instead, it is loosely bounded to the surface of the protein, often connected to the other population of membrane proteins.
2. Integral protein مُنغمس penetrates the hydrophobic core of the lipid bilayer, often completely spanning the membrane (*a transmembrane protein*). It is **amphipathic**, because of the following two facts:
 - I. Where it is in contact with the core, it has a **hydrophobic** region.
 - II. Where it is in contact with the aqueous environment outside the membrane, it has a **hydrophilic** region.





B)- Functions of cell membrane



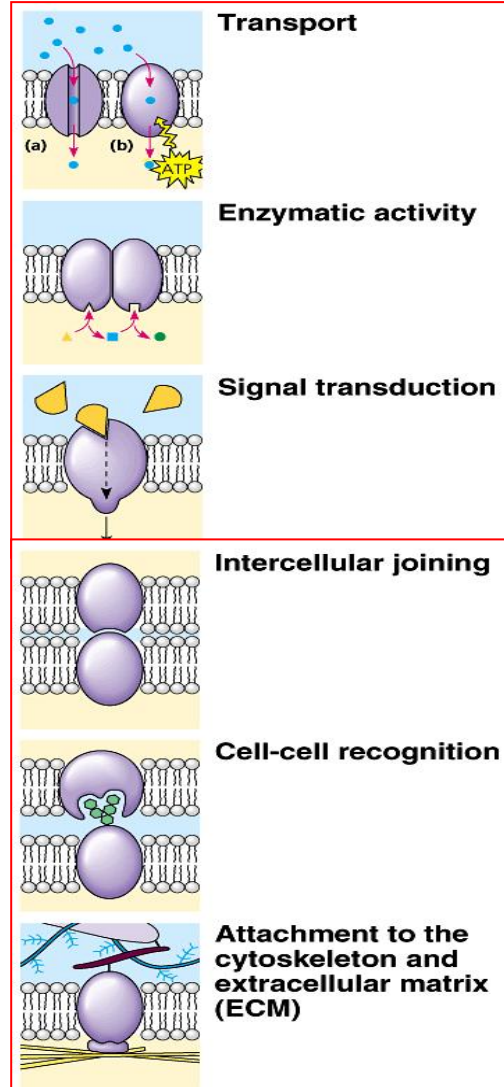
The membrane proteins may provide a variety of major cellular functions:

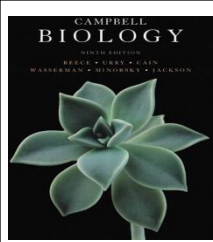
Aquaporins (*channel proteins*): are transport proteins that function by having a hydrophilic channel that facilitate the passage of **water** molecules through the membrane in certain cells. Without aquaporins, only a tiny fraction of water molecules would pass through the cell membrane.

Carrier protein (*glucose transporter*): in the plasma membrane of red blood cells transports **glucose** across the membrane 50,000 time faster than glucose can pass through on its own.

Nonpolar molecules, such as **hydrocarbons**, **CO₂**, and **O₂**, are hydrophobic and can therefore dissolve in the lipid bilayer of the membrane and cross it easily, without the aid of membrane proteins.

Thus, the selective permeability of a cell membrane depends on both the selective barrier of the lipid bilayer and the specific transport proteins built into the membrane



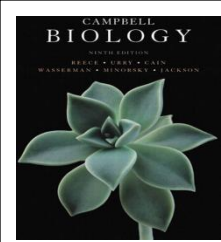


B) Functions of cell membrane



I- Selective permeability النفذية الانتقائية

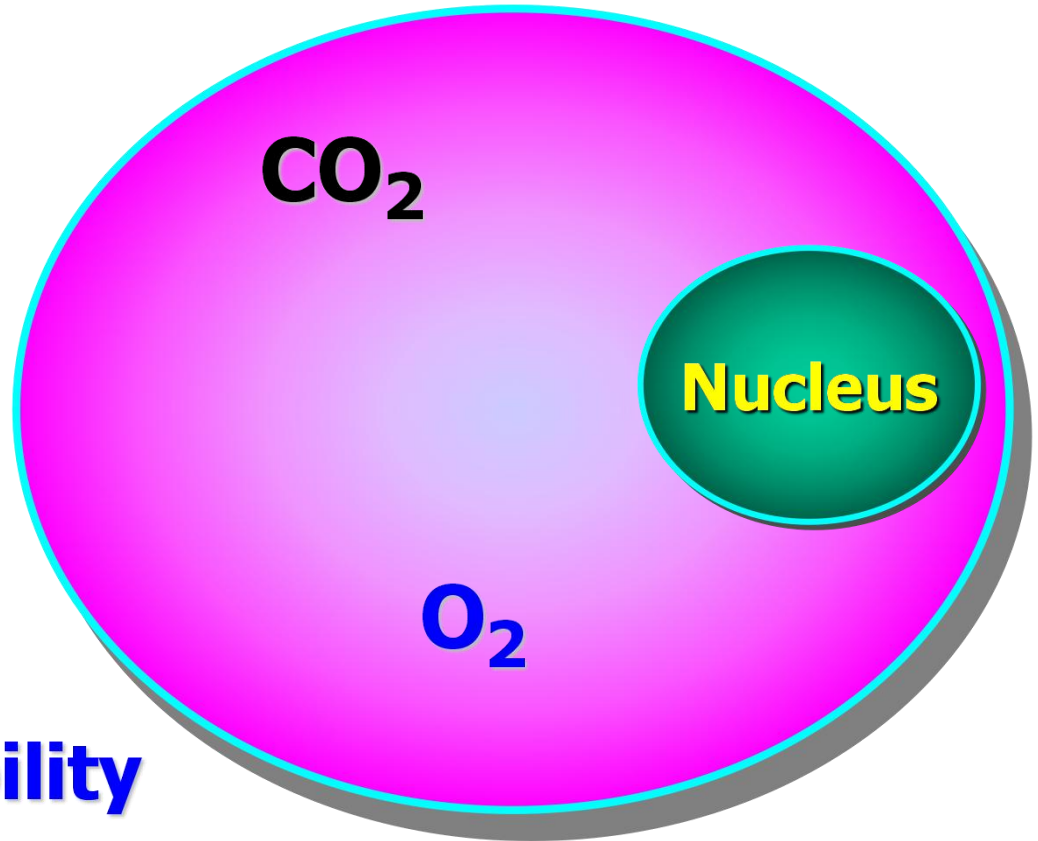
- ❖ It is a steady traffic العبور المنتظم of small molecules and ions across the plasma membrane in both directions.
 - ❖ For example, **sugars**, **amino acids**, and other nutrients, enter a muscle cell, while metabolic waste products leave it.
 - ❖ The cell absorbs **O₂** and expels **CO₂**.
 - ❖ It also regulates concentrations of inorganic ions, like **Na⁺**, **K⁺**, **Ca²⁺**, and **Cl⁻**, by passing them across the membrane.
- ❖ Ions and polar molecules like **H₂O** and glucose pass through channel proteins as described in the previous slide.
 - Thus membrane proteins assist and regulate يساعد و ينظم the transport of ions and polar molecules.



B) Functions of cell membrane

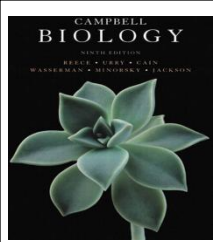
CO₂

O₂



Selective Permeability

The cell is able to **take up** تنتقي particular molecules and **exclude** تتجنب others



B) Functions of cell membrane

II- Passive transport الإنتقال السلبي

- ❖ It involves the movement of molecules across the cell membrane without the need of energy.
- ❖ Thus, No ENERGY is required to move substances across membrane (water, lipids, and other lipid soluble substances).
- ❖ Rather, the CONCENTRATION GRADIENT represents potential energy and, thus, drives the diffusion of the molecules.

Three types of Passive transport:

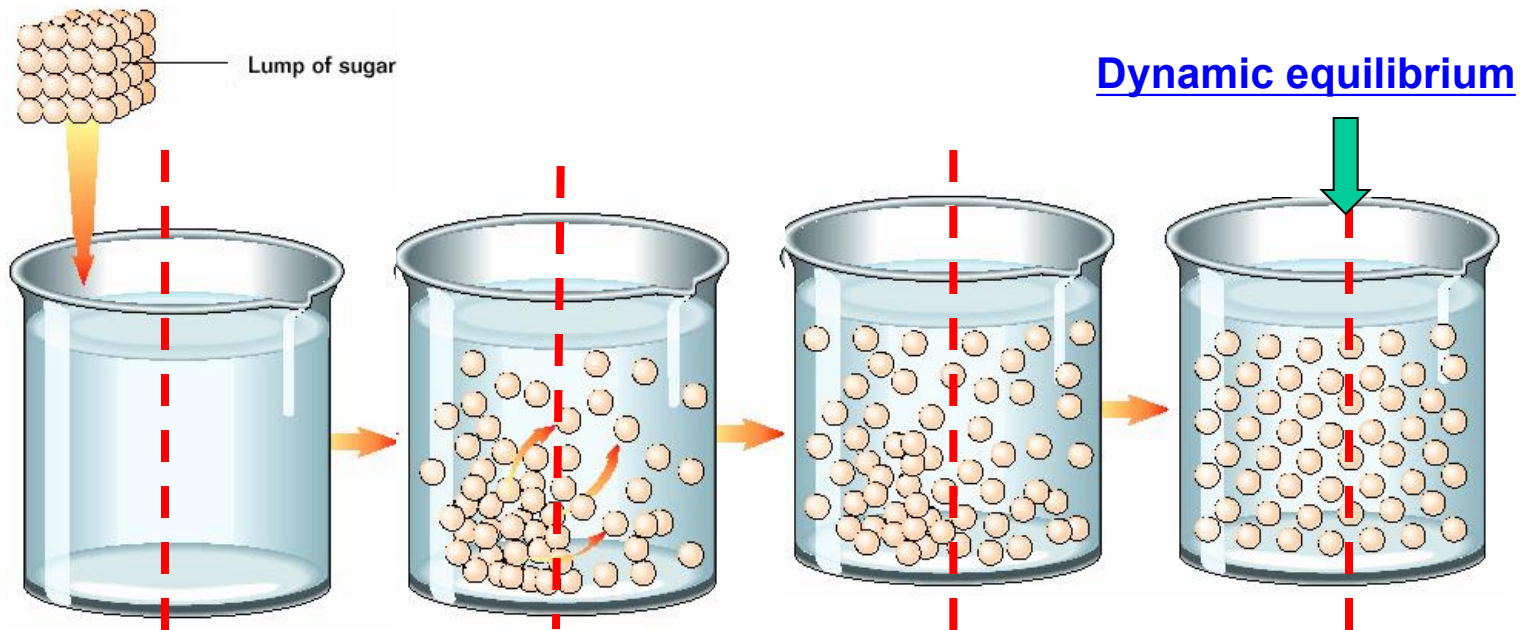
1. Diffusion
2. Osmosis
3. Facilitated Diffusion

1)- Diffusion:

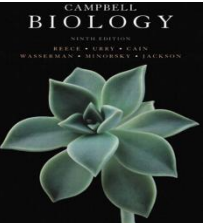
The passive transport of solute molecules جزيئات المُذاب

It is the tendency إبتعداد of the solute molecules of a substance to spread out للإنتشار in the available space randomly عشوائيا.

- For example, a permeable membrane غشاء منفذ separating a solution with **sugar molecules** from **pure water**, sugar molecules will cross the barrier randomly.
- The sugar molecules will cross the membrane until both solutions have equal concentrations of the sugar (dynamic equilibrium التبادل الديناميكي).

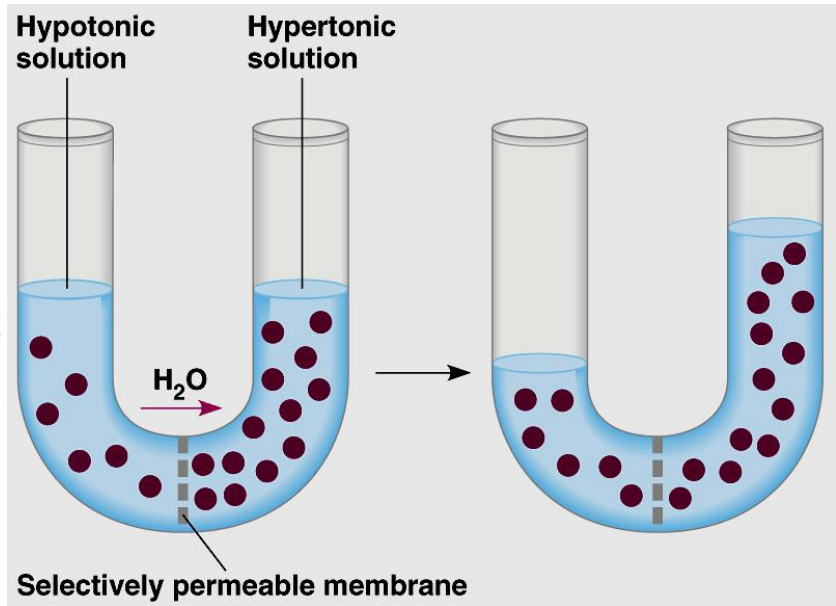


- A substance will diffuse from where it is **more concentrated** to where it is **less concentrated**, i.e. (down its concentration gradient) في اتجاه مُنحدر التركيز.



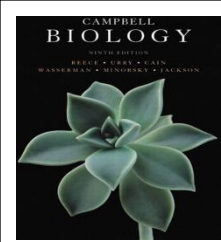
2). **Osmosis** (Principal of water movement): the passive transport of solvent molecule (**water molecules**)_ (جزيئات الماء (المذيب))

➤ **Osmosis:**
It is the passive transport in which water diffuses across a selectively permeable membrane from the **hypotonic** solution to the **hypertonic** solution until the solutions become **isotonic**.



➤ **Types of solutions.**

- The solution with the higher concentration of solutes is **hypertonic**.
- The solution with the lower concentration of solutes is **hypotonic**.
- Solutions with equal concentrations of solutes are **isotonic**.

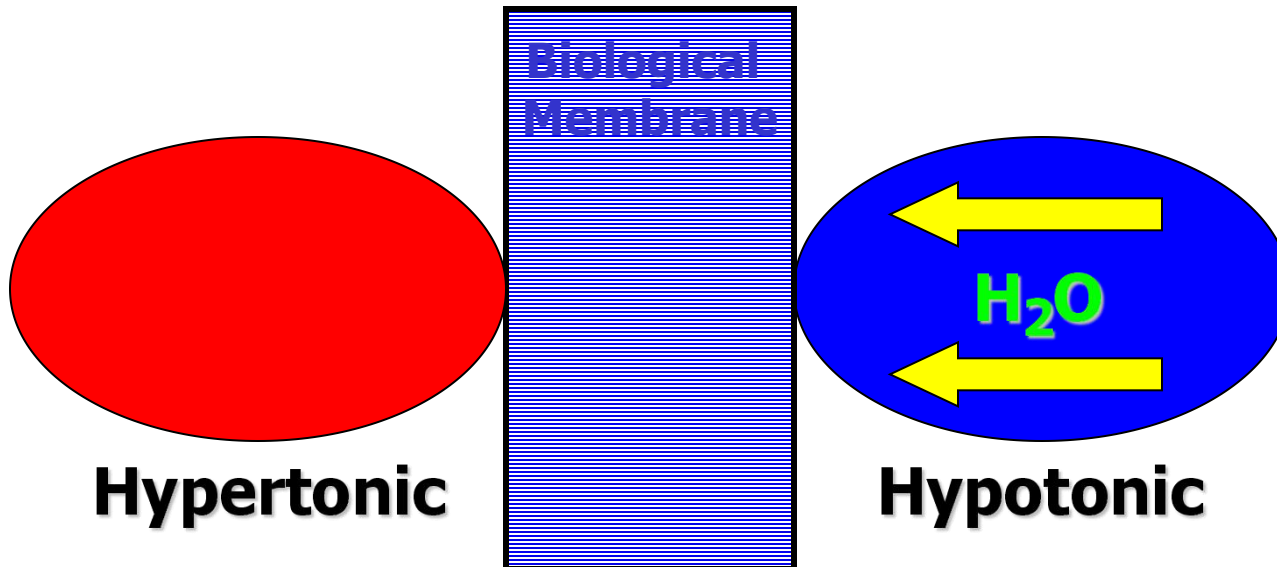


Summary:

Types of solutions and Osmosis



- **Hypertonic solution:** عالي التركيز
Contains high concentration of solute molecules.
- **Hypotonic solution:** منخفض التركيز
Contains low concentration of solute molecules.
- **Isotonic solutions:** متعادل
Contain equal concentrations of solute molecules.

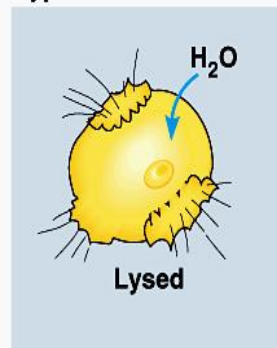




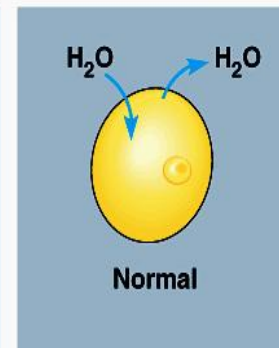
Osmoregulation التوازن الأسموزي

- The cell in a **hypertonic** environment will lose water تفقد ماء, shrink تنكمش, and die.
- A cell in a **hypotonic** solution will gain water تسحب ماء, swell, and burst.
- Nothing will happen for a cell in an **isotonic** solution
 - ✓ Organisms without rigid walls have osmotic problems in either a **hypertonic** or **hypotonic** environment and must have adaptations for **osmoregulation** to maintain الحفاظ على their internal environment.
 - ✓ Example, **Paramecium** has a specialized organelle (**the contractile vacuole**), that functions as a pump to force يطرد water out of the cell.

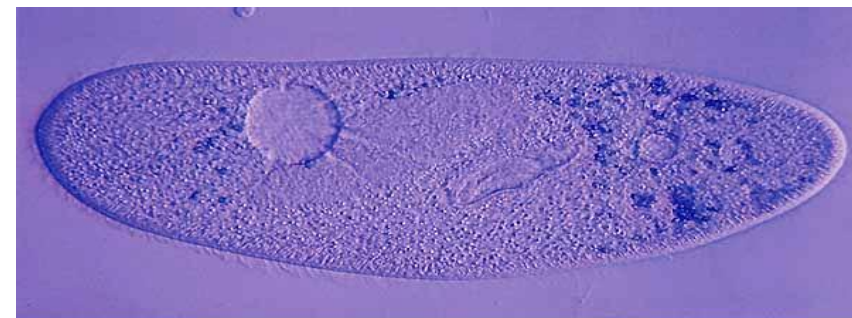
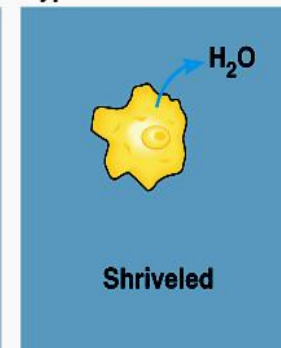
Hypotonic solution

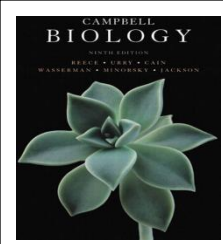


Isotonic solution



Hypertonic solution

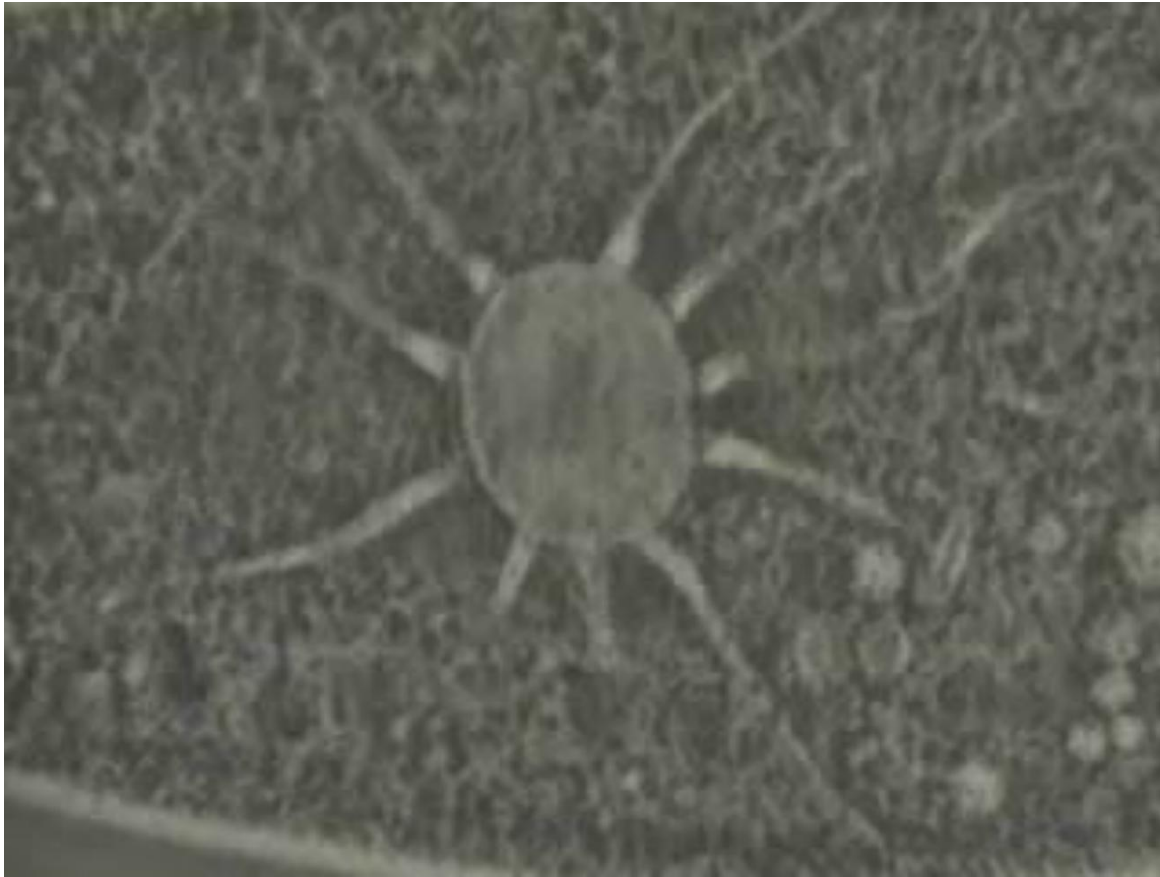


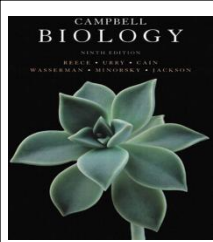


Osmoregulation: in Paramecium



The contractile vacuole



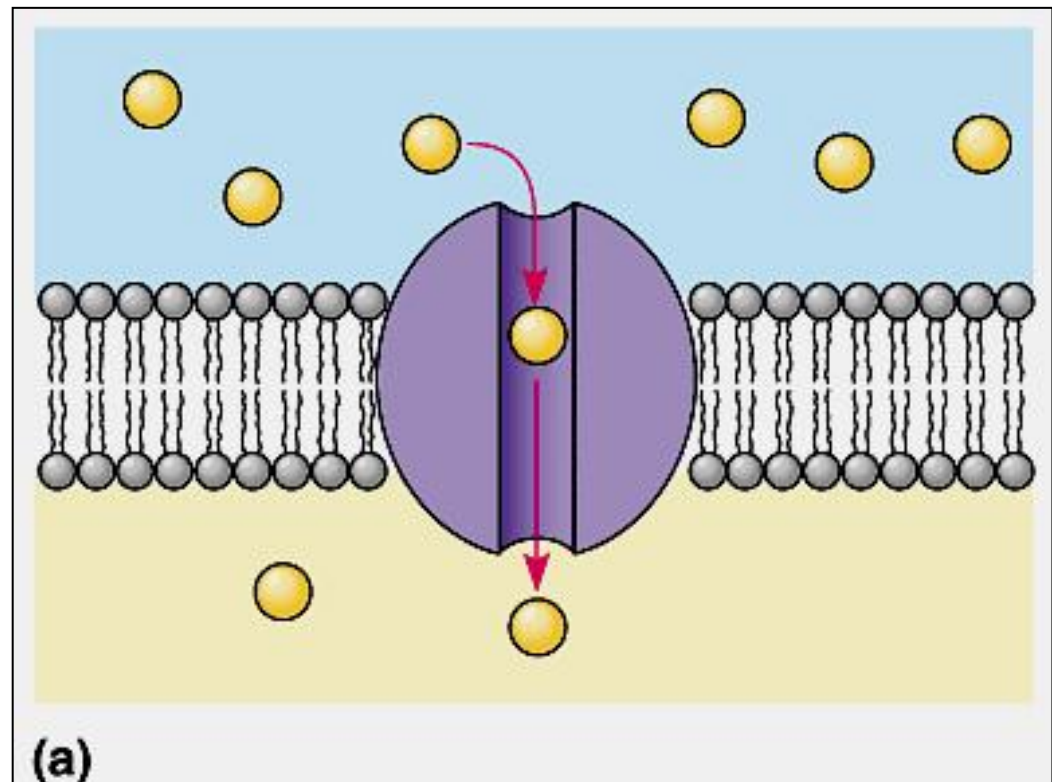


3)- Facilitated Diffusion:

Specific proteins facilitate **تسهّل** passive transport



- Many polar molecules and ions diffuse passively through the lipid bilayer with the help of **transport proteins** (**gated channels** **قنوات مُبَوِّبَة**).
- The passive movement of molecules down its concentration gradient *via* a transport protein is called **facilitated diffusion**.
- Many transport proteins simply provide **channels** allowing a specific molecules or ions to cross the membrane.

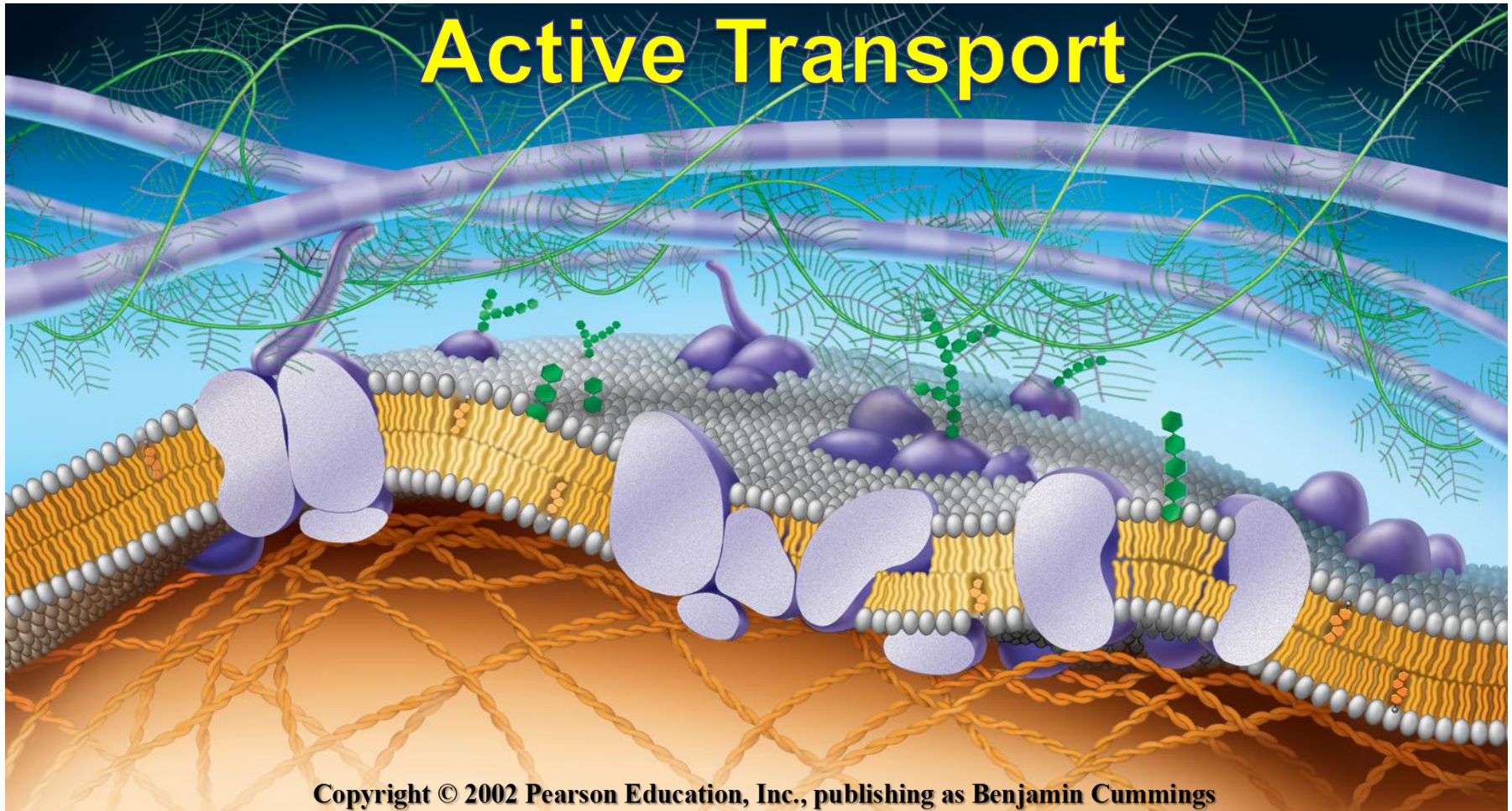


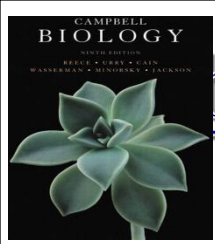
III- Active Transport: will be studied in the next lecture

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

How things get into and out of the cell?

Active Transport





Objectives



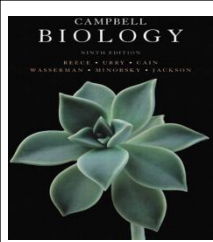
B)- Active transport

A. Transport of small molecules

B. Transport of large molecules (macromolecules).

- Exocytosis
- Endocytosis
 - Phagocytosis
 - Pinocytosis





Active transport: **pumping** ^{ضخ} of solutes against their concentration gradient ^{ضد التدرج التركيزي}



- Some facilitated transport proteins can move solutes against their concentration gradient, from the side where they are **less concentrated** to the side where they are **more concentrated**.
- This active transport requires metabolic **energy via ATP**.
- Active transport is critical ^{بالأهمية} for a cell to maintain its internal concentrations of small molecules.
- Active transport is performed by specific proteins embedded in the membranes called **transport protein (T. protein)**.

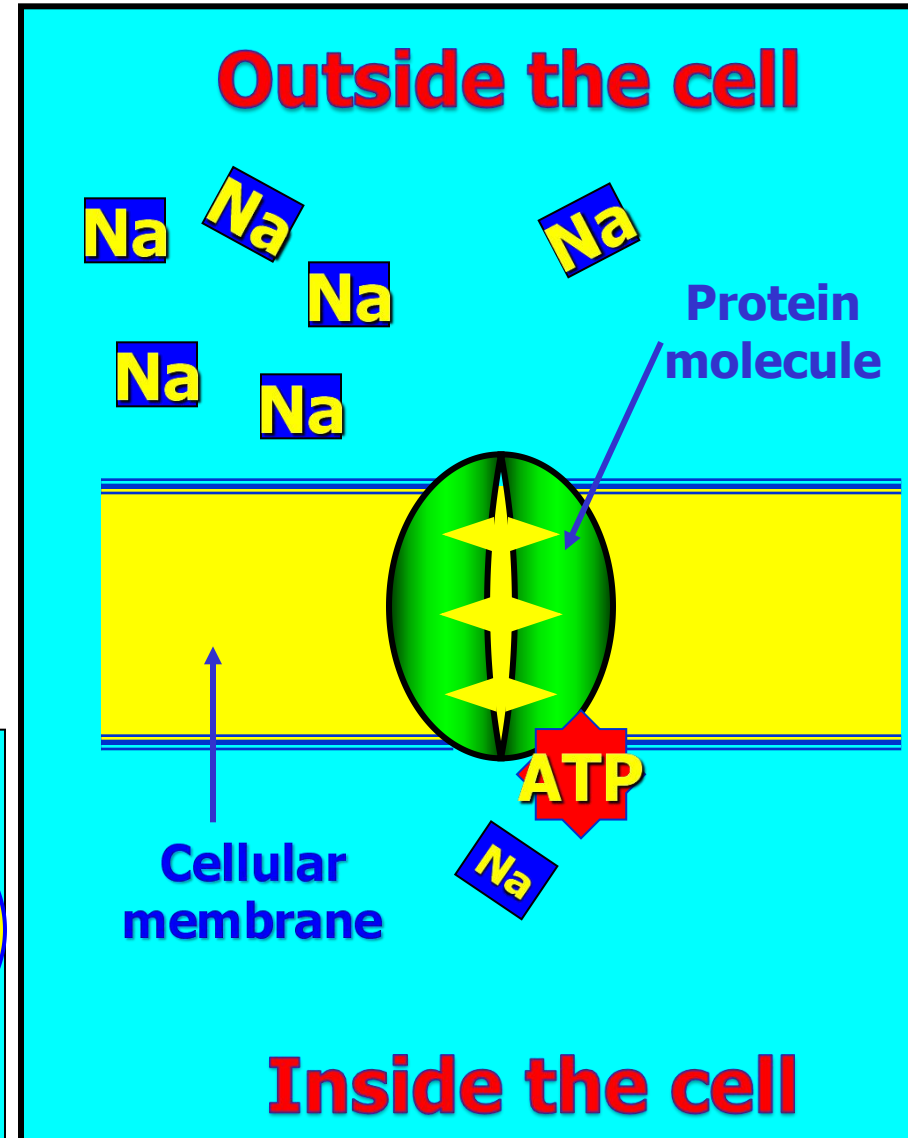
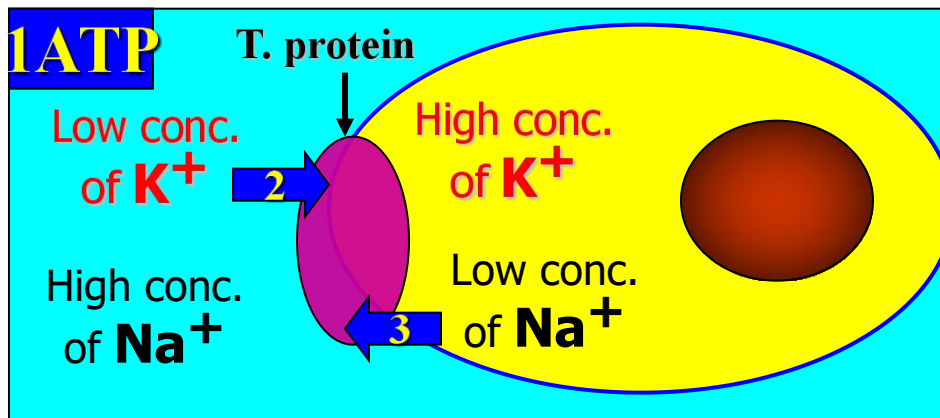


1)- Transport of small molecules (Ions)

The Sodium-Potassium Pump

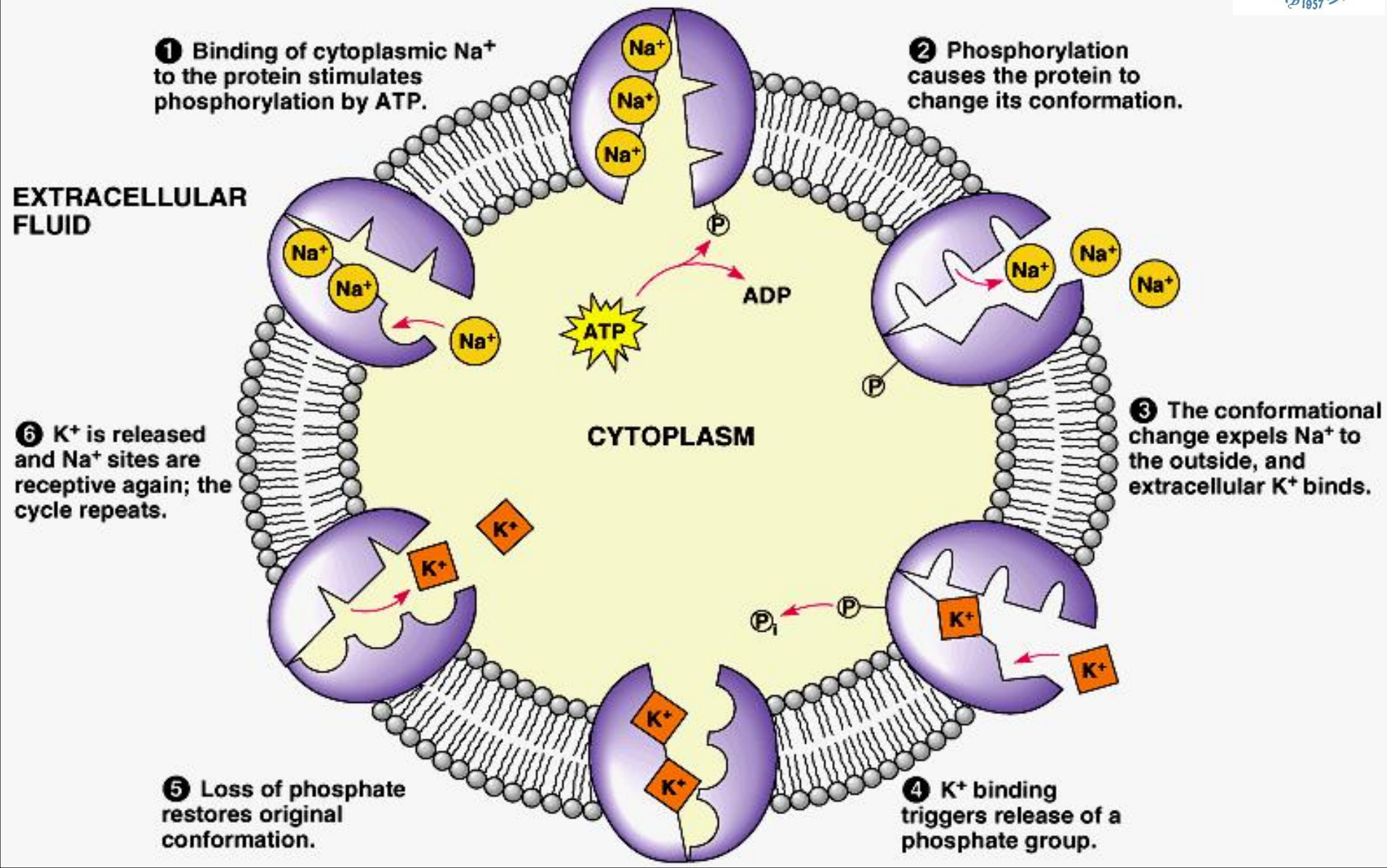
It actively maintains the gradient of sodium (Na^+) and potassium ions (K^+) across the membrane.

- The animal cell has higher concentrations of K^+ and lower concentrations of Na^+ inside the cell.
- The sodium-potassium pump (T. protein) uses the energy of **1 ATP** to pump **3 Na^+** ions out and **2 K^+** ions in.

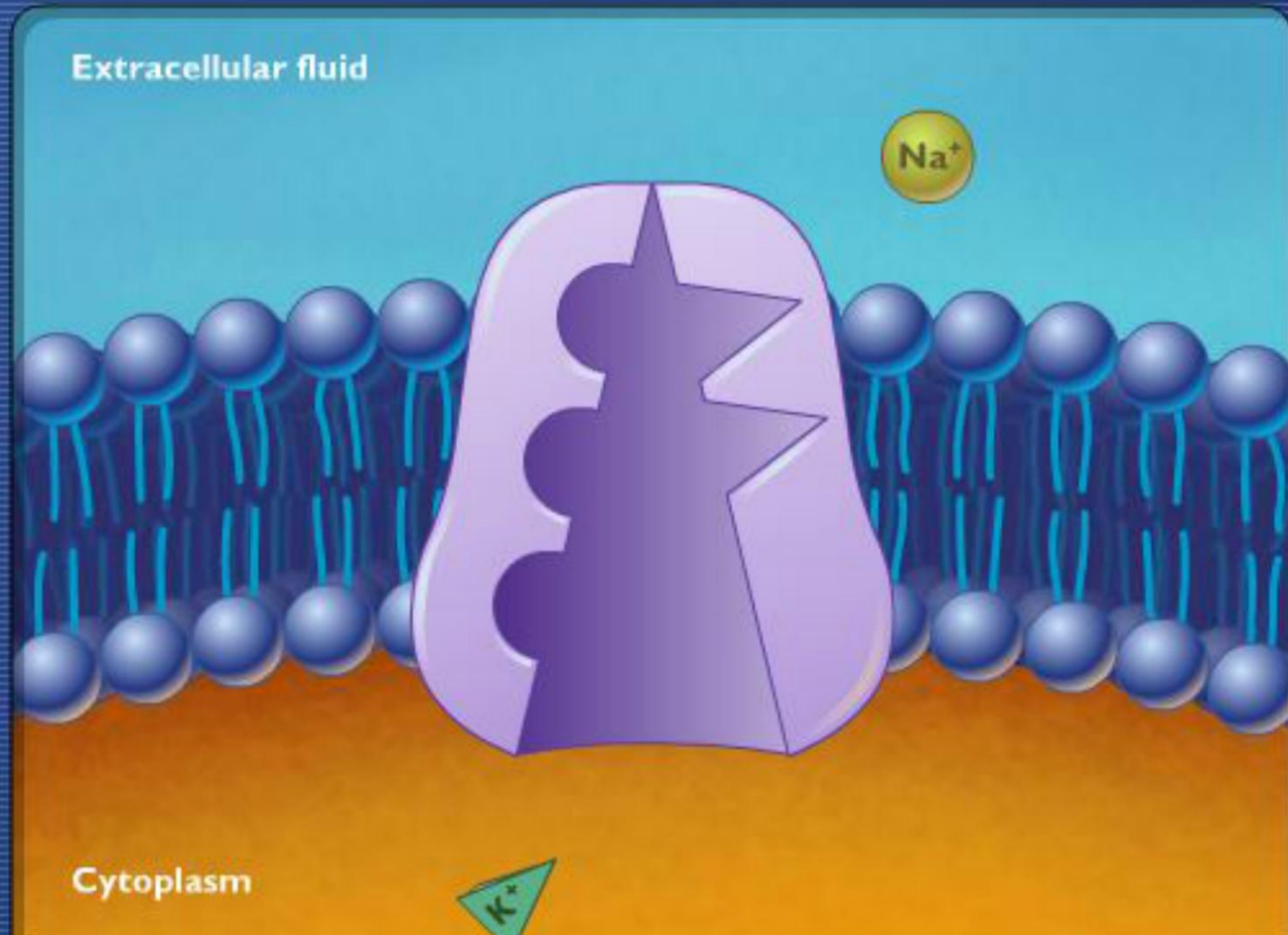




Sodium-potassium pump

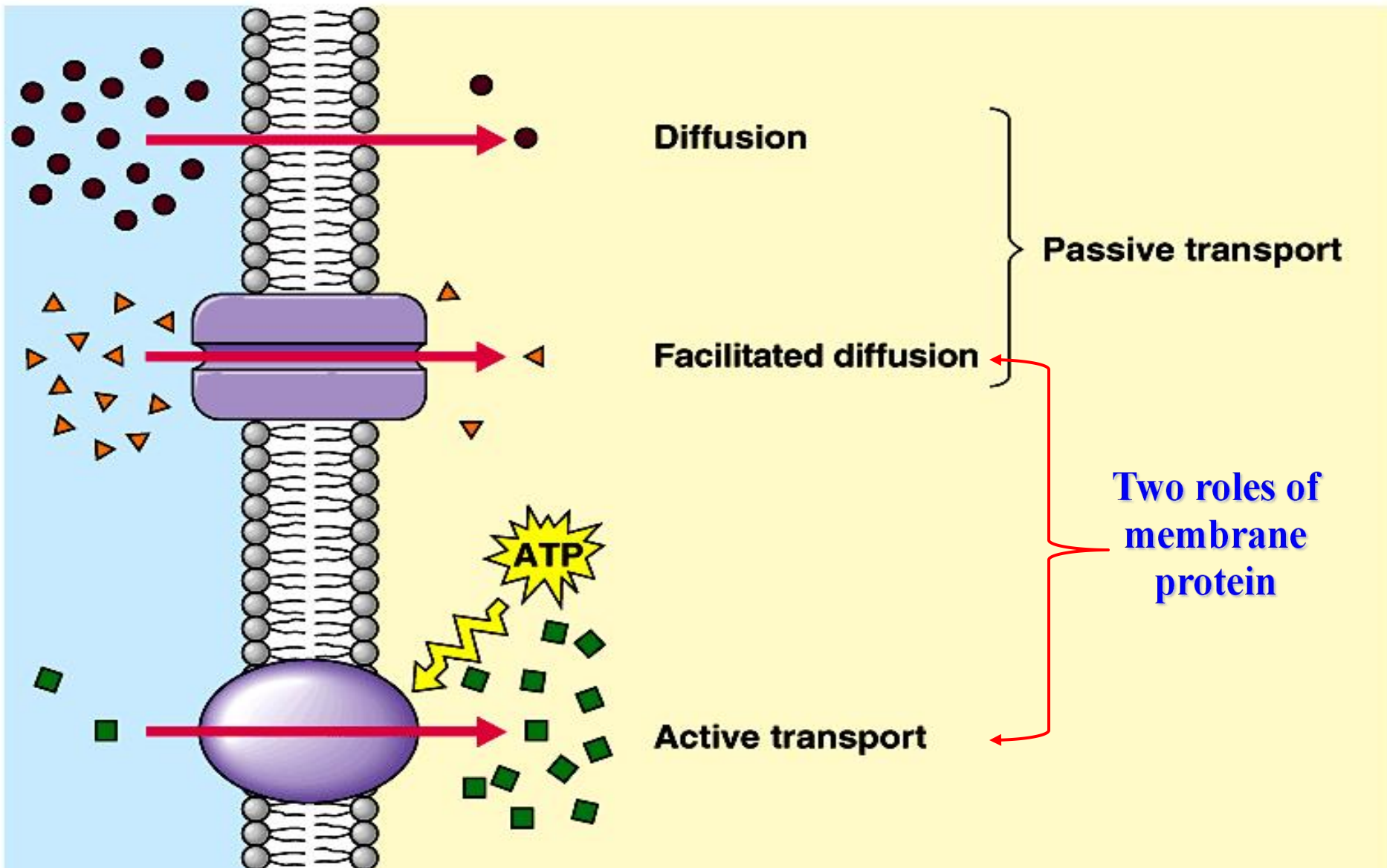


Sodium-Potassium Exchange Pump

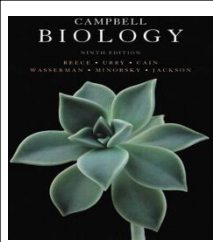


▶ Play
⏸ Pause
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🔊 Audio
📄 Text

The sodium-potassium pump is an active transport mechanism that is driven by the breakdown of ATP and works through a series of conformational changes in a trans-membrane protein.



Both diffusion and facilitated diffusion are forms of passive transport of molecules **down their concentration gradient**. While active transport requires an investment of energy to move molecules **against their concentration gradient**.



2)- Transport of large molecules (macromolecules)

Large molecules are transported by Exocytosis and endocytosis

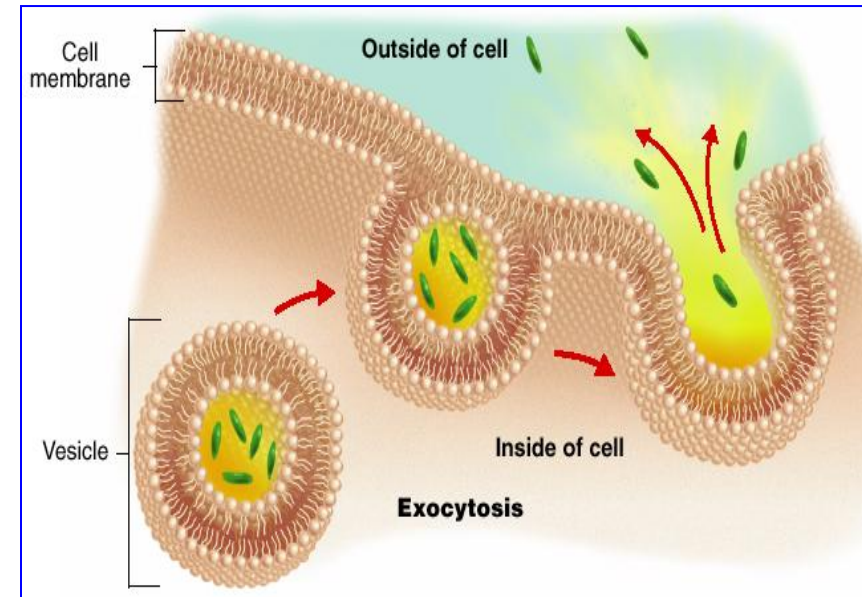


- ❖ Small molecules and water enter or leave the cell through the lipid bilayer or by transport proteins as described previously.
- ❖ However, large molecules, such as polysaccharides, proteins and lipoprotein particles cross the membrane by vesicles أوعية.

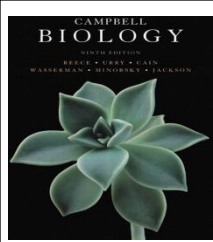
1. Exocytosis الإخراج الخلوي:

A transport vesicle budded from ^{ينشأ من} the Golgi apparatus is moved by cytoskeleton to the plasma membrane.

When the two membranes come in ^{يتلاقح} the bilayers fuse ^{يُفرغ} the contents to



the outside.



Transport of large molecules

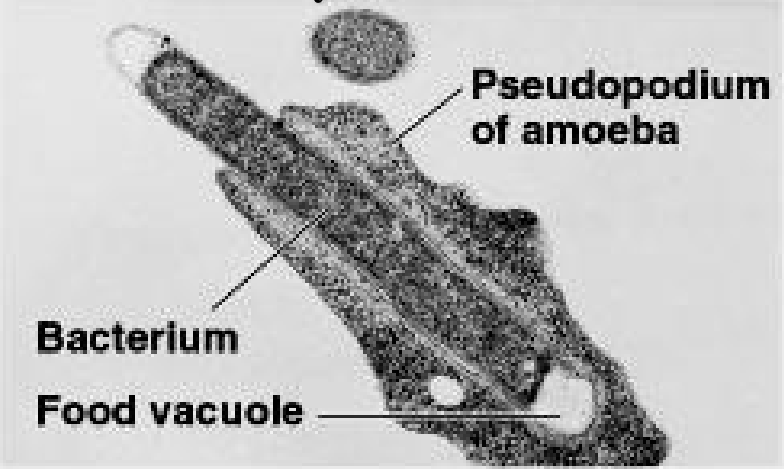
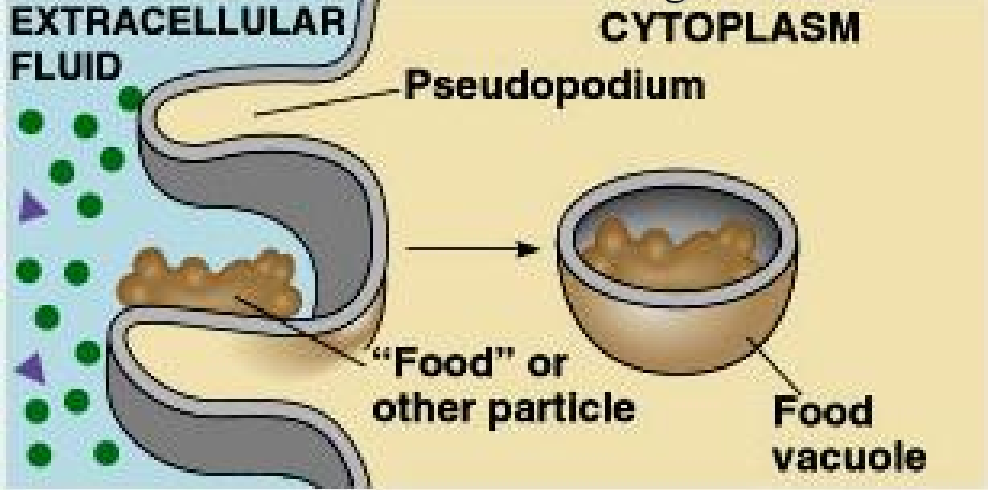
(macromolecules)

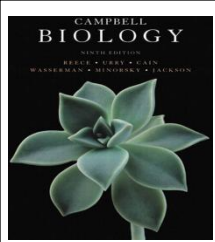


2- Endocytosis الإدخال الخلوي:

A cell brings in macromolecules and particulate matter by forming new vesicles from the plasma membrane and includes 3 mechanisms:

- Called “**cellular eating**”. The cell engulfs **تبتلع** a particle by extending pseudopodia **أقدام كاذبة** around it and packaging it **تغلفها** in a large vacuole.
- The contents of the vacuole are digested when the vacuole fuses with a lysosome.

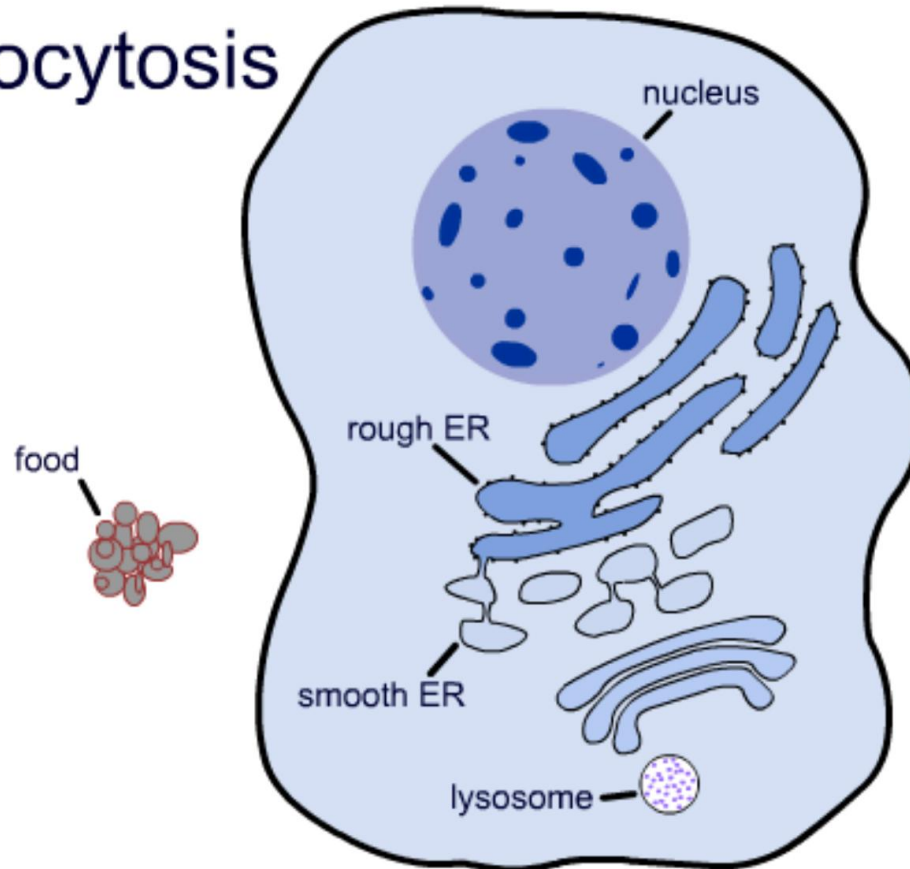




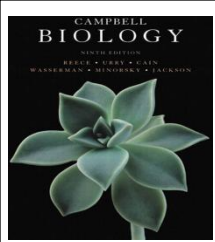
Phagocytosis



Phagocytosis



<https://www.youtube.com/watch?v=TNK3WyEI3r8>



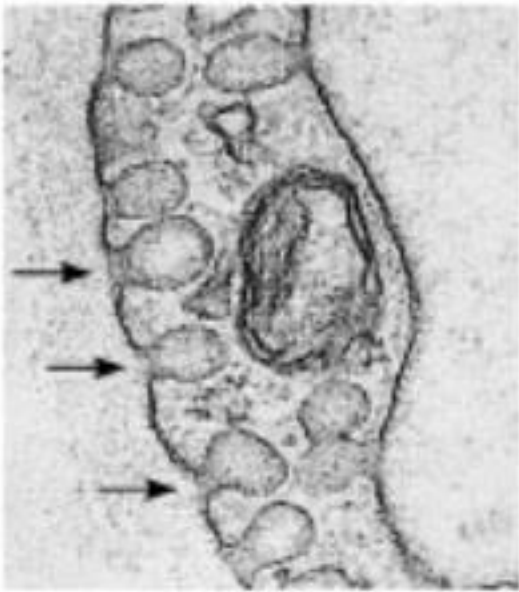
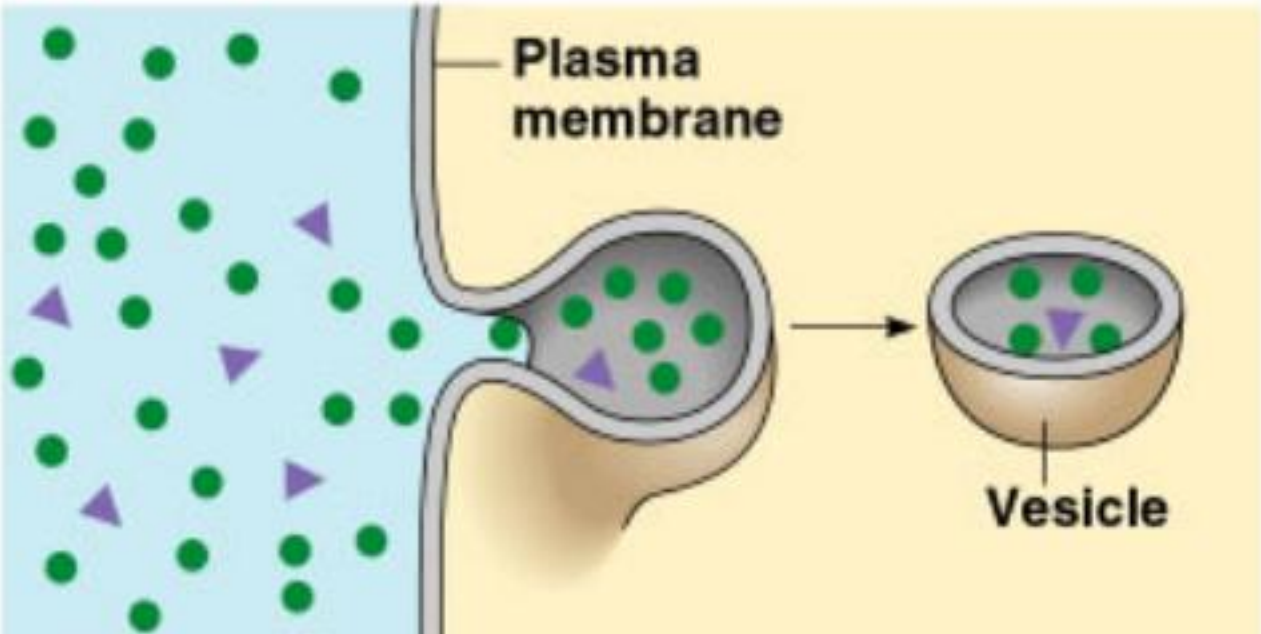
Transport of large molecules

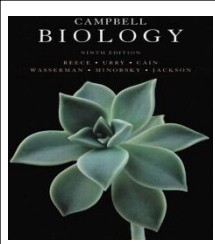
(macromolecules)



B)- Pinocytosis, الشرب الخلوي “cellular drinking”.

A cell creates a vesicle around droplets of extracellular fluid *السائل الموجود خارج الخلية*.



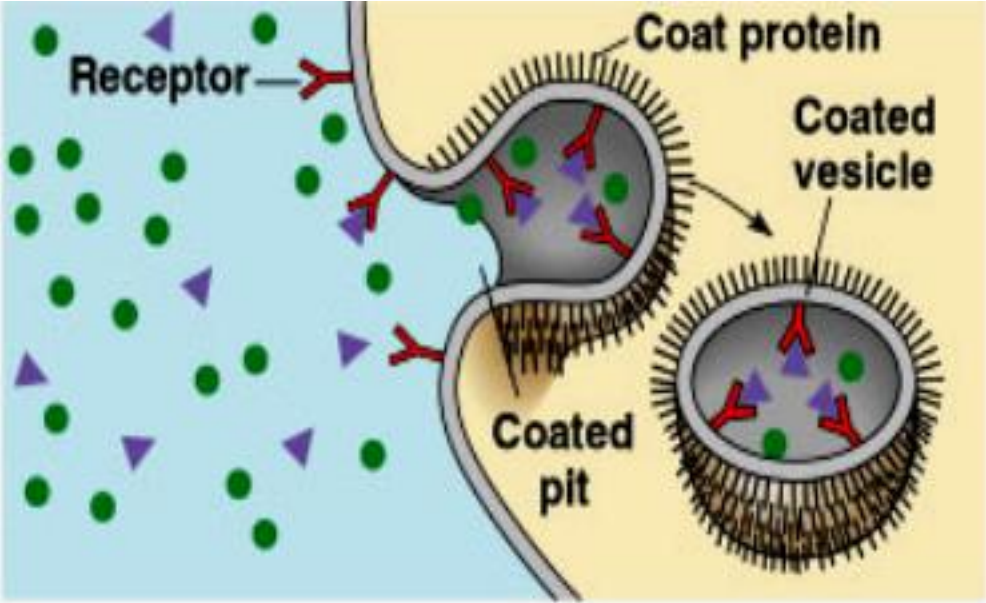


Transport of large molecules

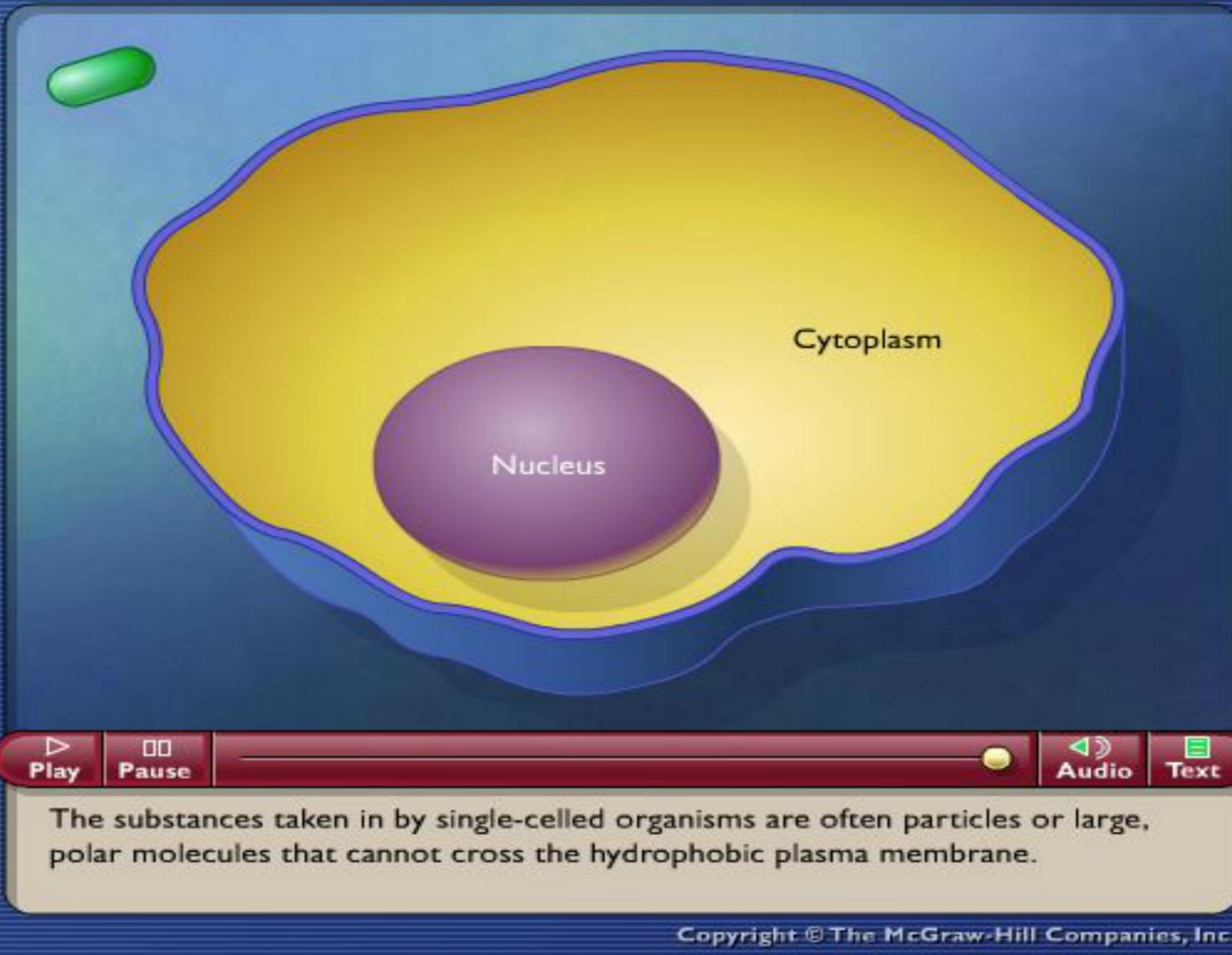
(macromolecules)



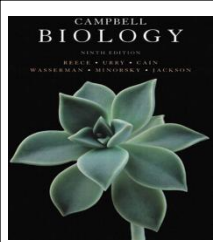
C)- Receptor-mediated endocytosis: *الإدخال الخلوي عن طريق المستقبلات المتخصصة*



It Is called (Selective eating) which is very specific in what substances are being transported.



https://www.youtube.com/watch?v=JO_a6NJeYRE



Summary



Cell Transport

Passive

Diffusion

(Solute molecules)

Osmosis

(Solvent molecules)

Facilitated diffusion

(T. protein)

Active

Small Molecules/ions

(T. protein)
(Na⁺-K⁺ pump)

Large molecules

(Membrane)

Endocytosis

Exocytosis

Phagocytosis

Cellular eating

Pinocytosis

Cellular drinking

Receptor-mediated endocytosis

Selective eating

TENTH EDITION
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BIOLOGY

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WASSERMAN • MINORSKY • JACKSON

عمادة التعليم الإلكتروني والتعلم عن بعد
E-learning Deanship



King Saud University
جامعة الملك سعود

**College of
Science,
Zoology
Department
(Zoo-109)**

جامعة
الملك سعود
King Saud University



Thank you very much

شكراً جزيلاً

Zoology Department