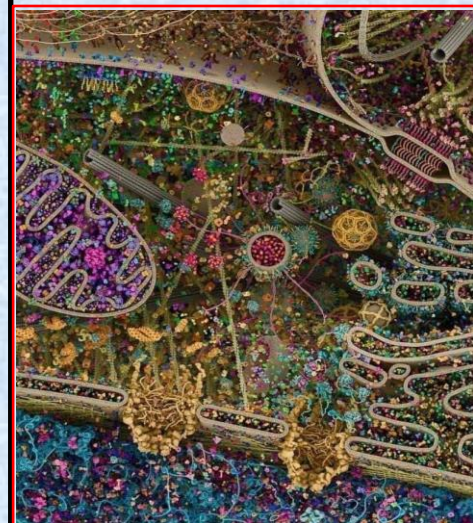


# General Animal Biology

Zoo-109

علم الأحياء

109- حين



For Pre-Medical Students



Common First Year

السنة الأولى المشتركة - المسار الصحي

1444-H - 2023

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

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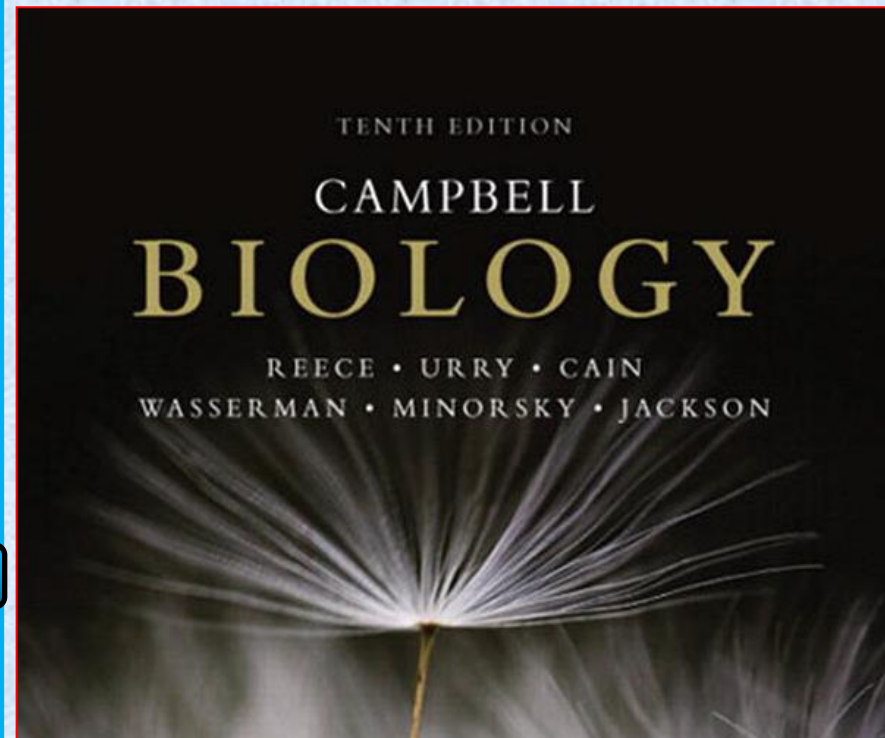
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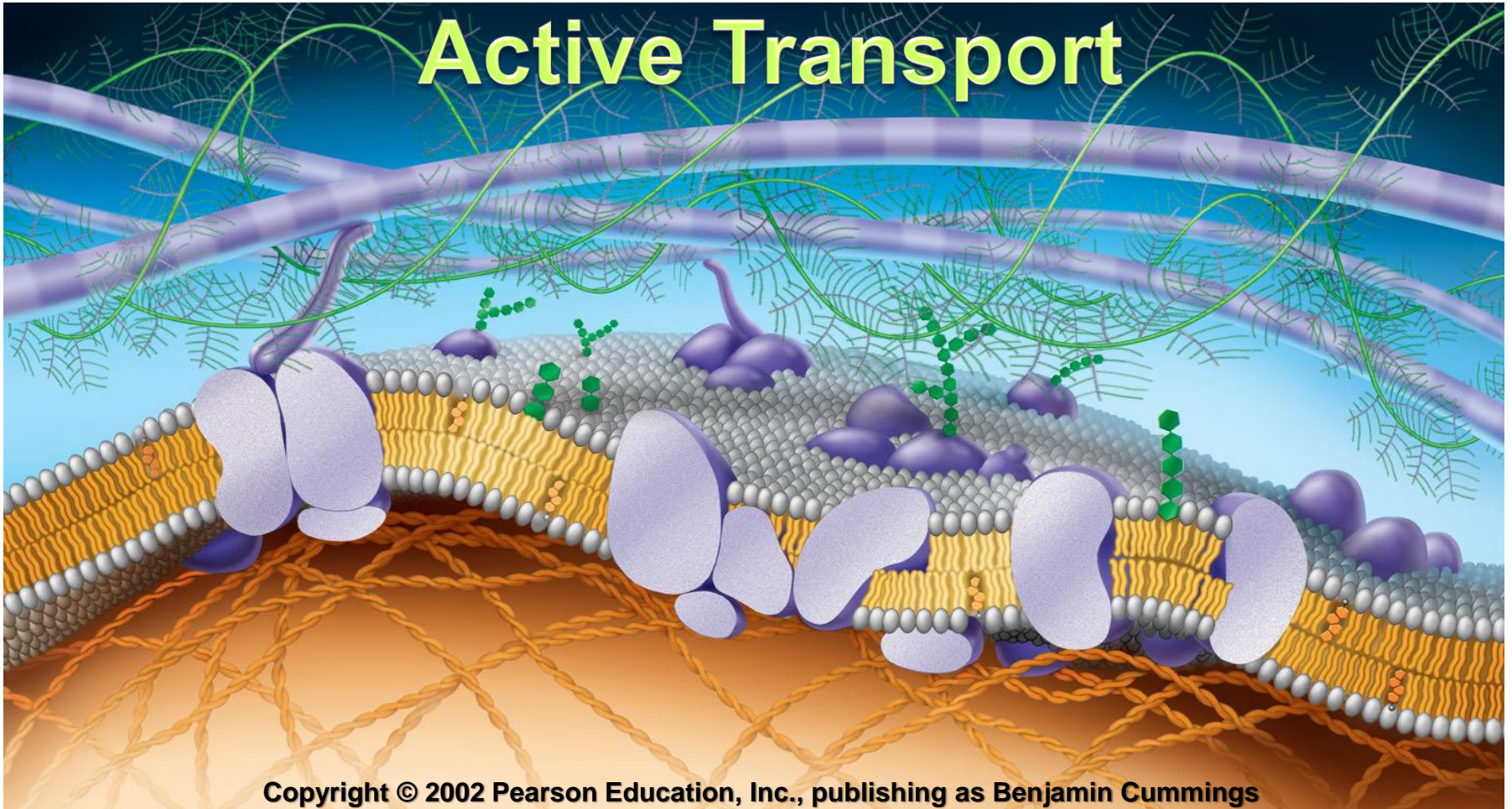
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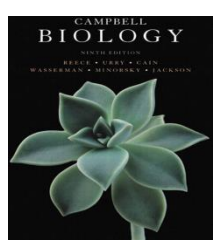


# بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

How things get into and out of the cell?

## Active Transport



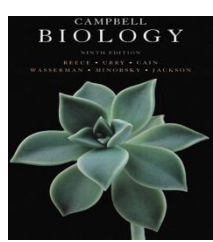


# Objectives



## B)- Active transport

- Transport of small molecules
- Transport of large molecules (macromolecules).
  - Exocytosis
  - Endocytosis
    - Phagocytosis
    - Pinocytosis
    - Receptor-mediated endocytosis



# Active transport: **pumping** ضخ of solutes against their concentration gradient ضد الإنحدار 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)**.

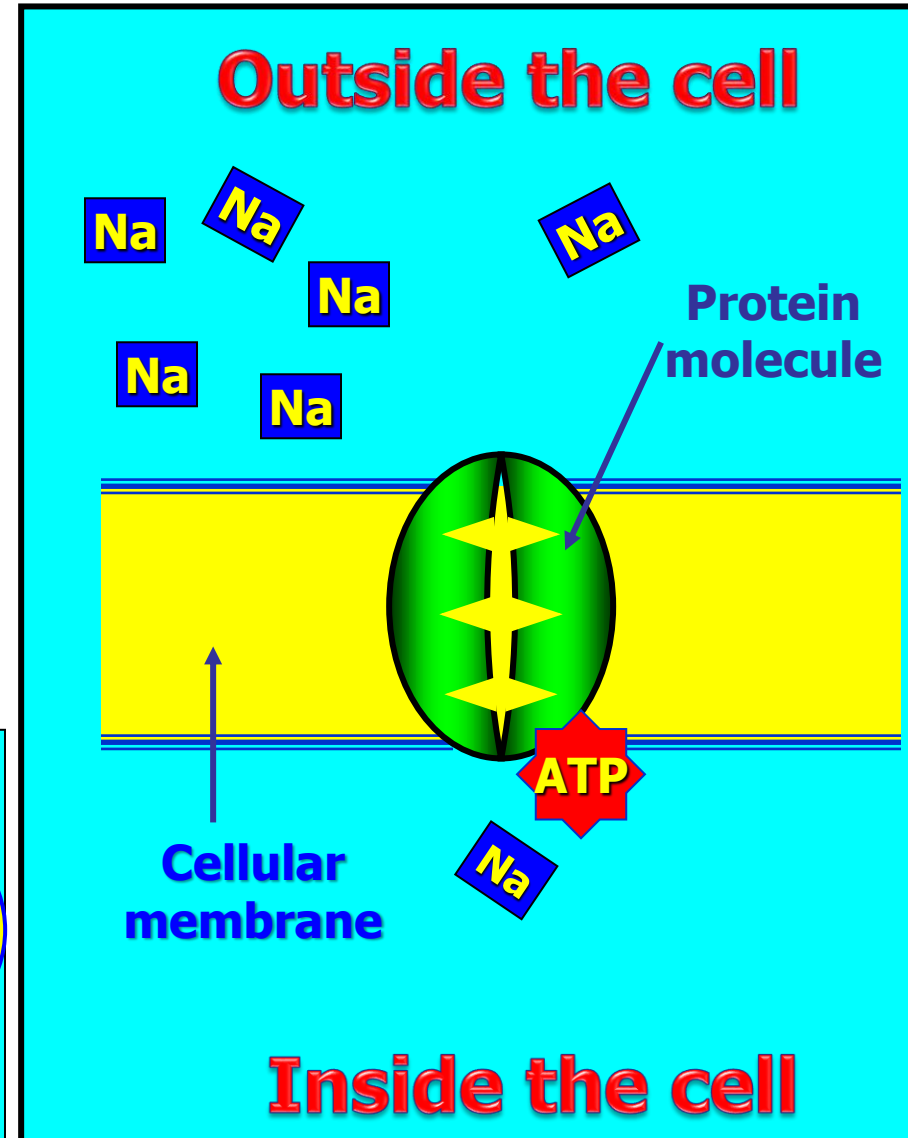
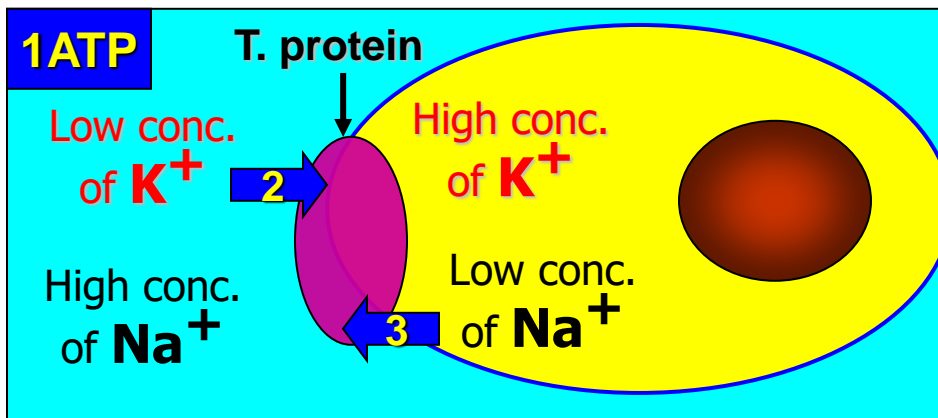


# 1)- Transport of small molecules (Ions)

## Sodium-potassium pump

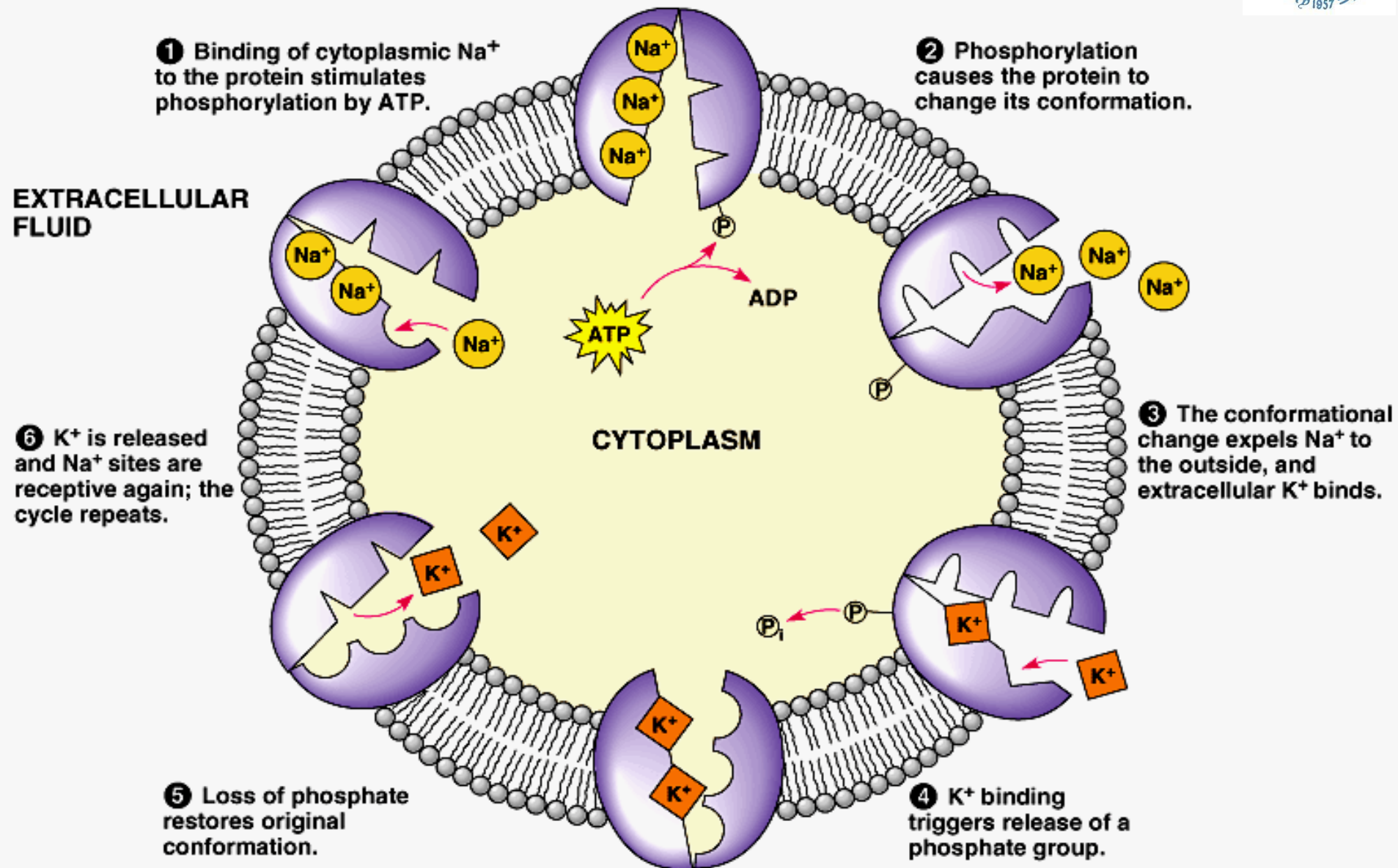
It actively maintains the gradient of sodium ( $\text{Na}^+$ ) and potassium ions ( $\text{K}^+$ ) across the membrane.

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

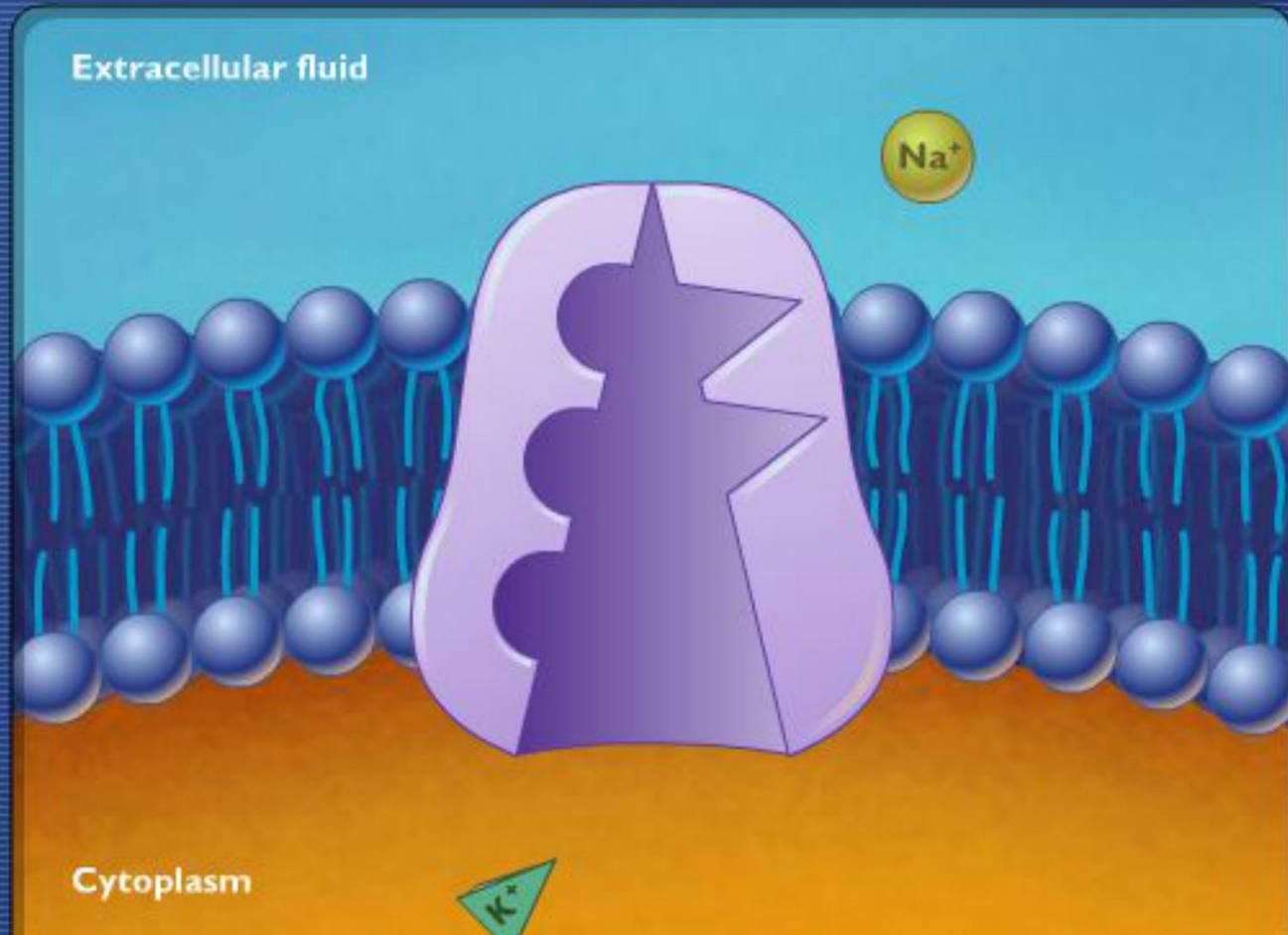




# Sodium-potassium pump

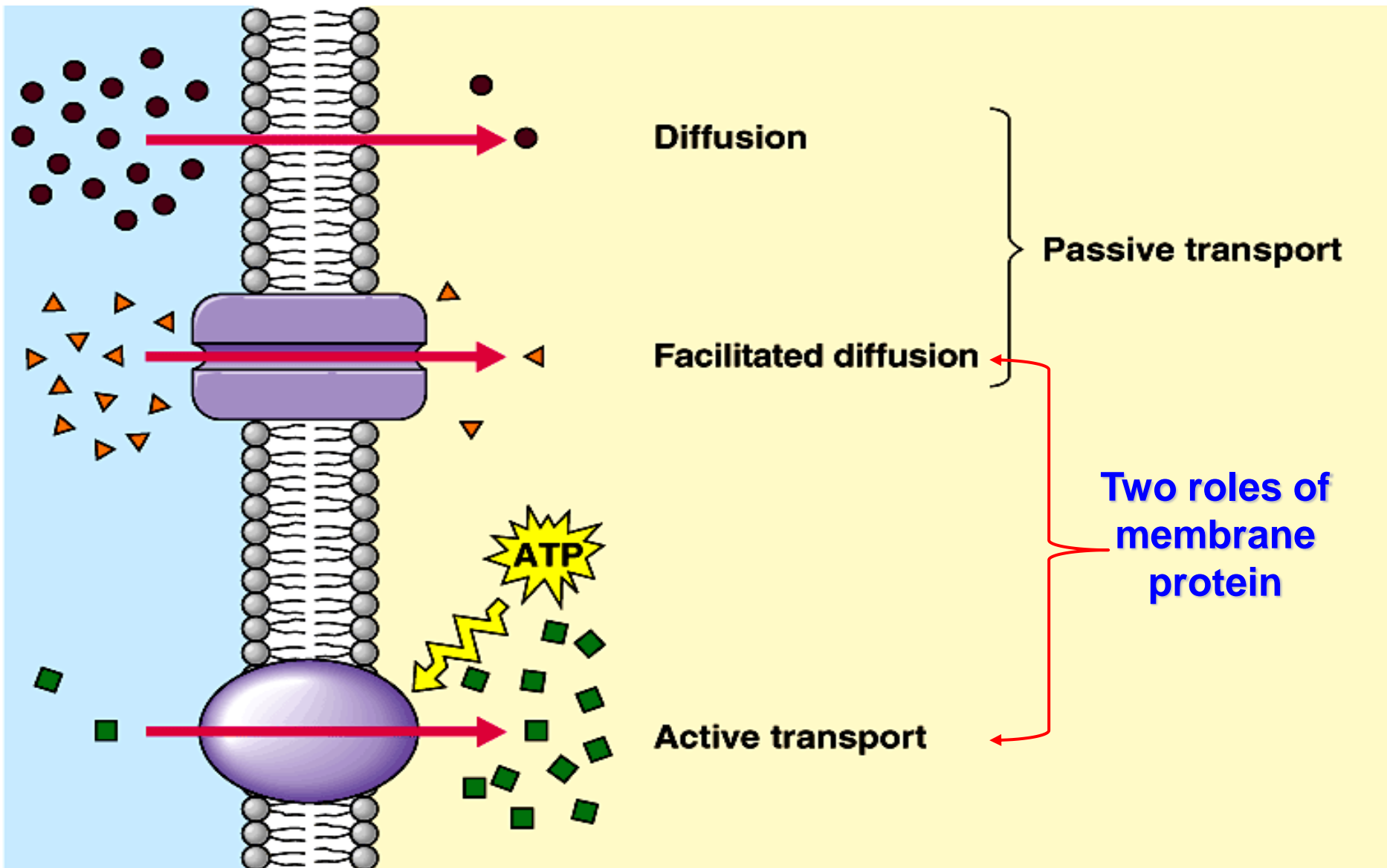


# Sodium-Potassium Exchange Pump



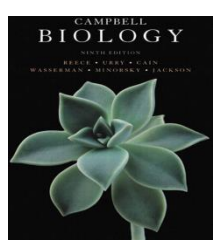
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The sodium-potassium pump is an active transport mechanism that is driven by the breakdown of ATP and works through a series of conformational changes in a trans-membrane protein.



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

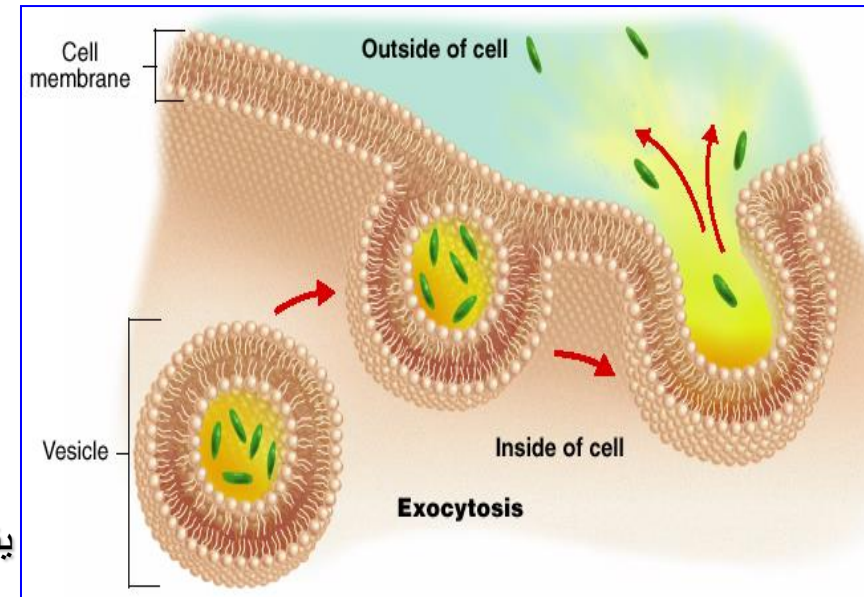


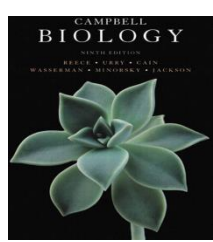
- ❖ Small molecules and water enter or leave the cell through the lipid bilayer or by transport proteins as described previously.
- ❖ However, large molecules, such as **polysaccharides**, **proteins** and **lipoprotein particles** cross the membrane by vesicles أوعية.

### 1. Exocytosis الإخراج الخلوي:

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

When the two membranes come in contact **تلامس**, the bilayers fuse **يندمج** and spill **يُفرع** the contents to the outside.





## Transport of large molecules (macromolecules)

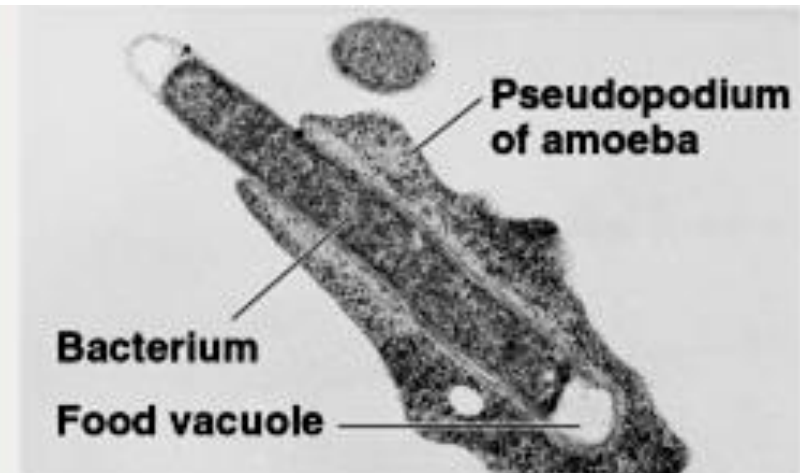
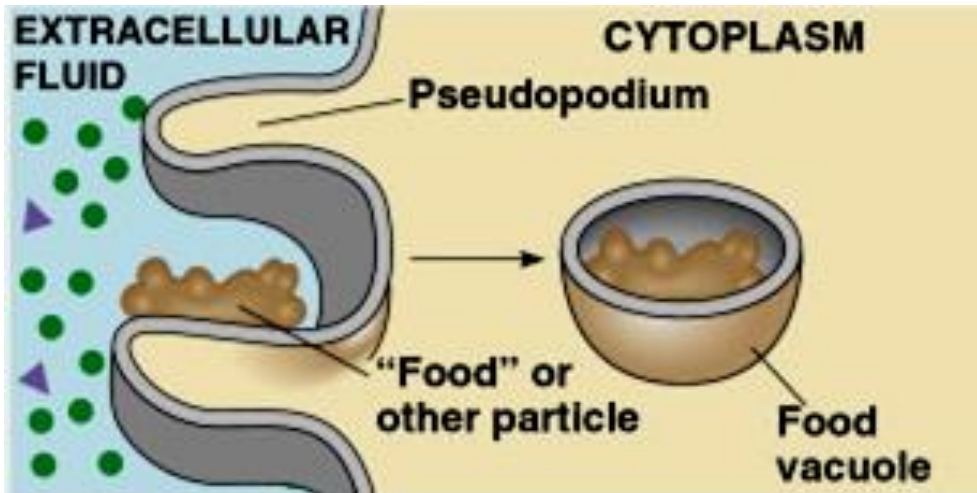


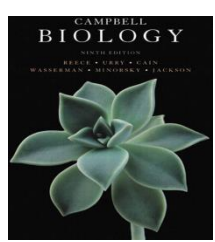
### 2- Endocytosis الإدخال الخلوي:

A cell brings in macromolecules and particulate matter by forming new vesicles from the plasma membrane and include the following:

#### A)- Phagocytosis الإبتلاع الخلوي:

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

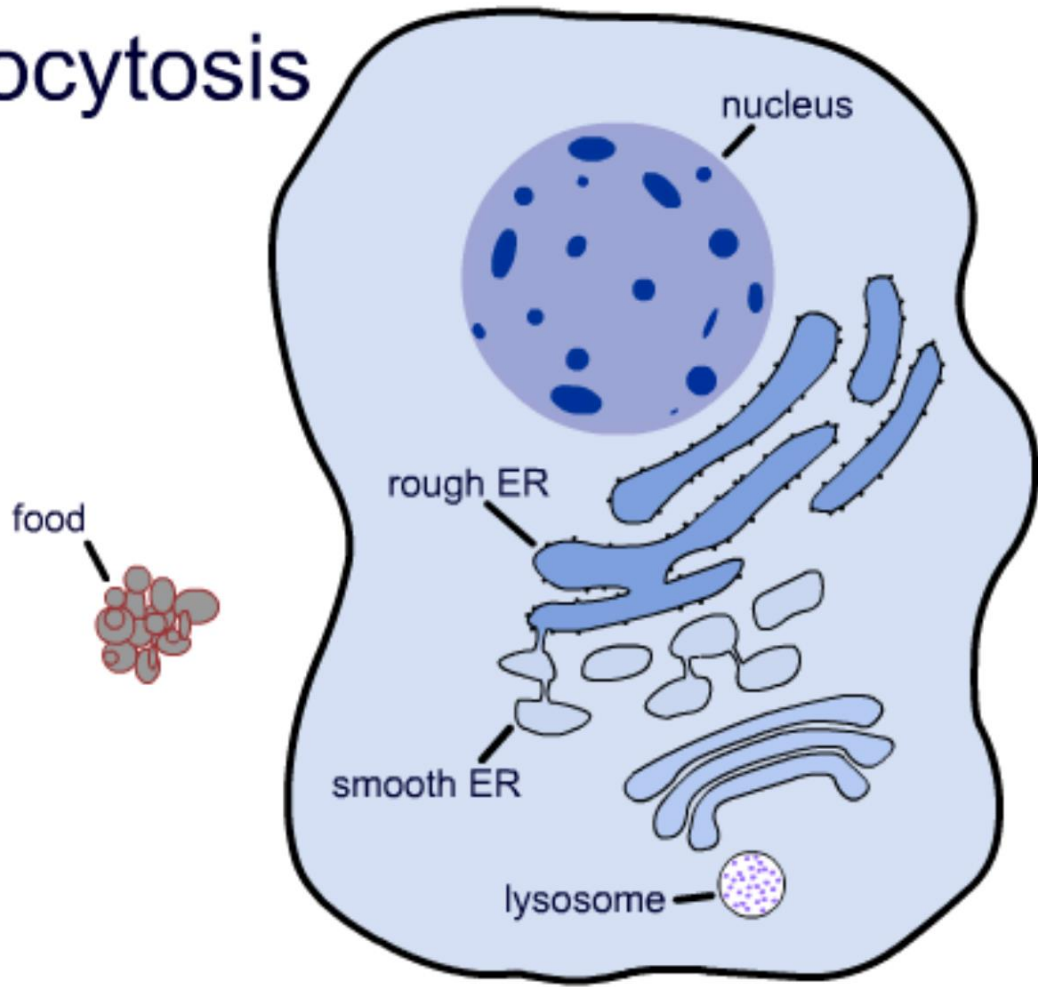


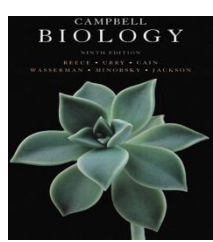


# Phagocytosis



## Phagocytosis





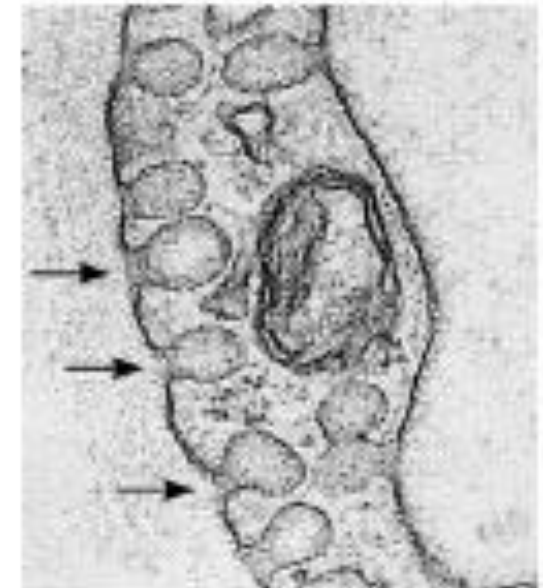
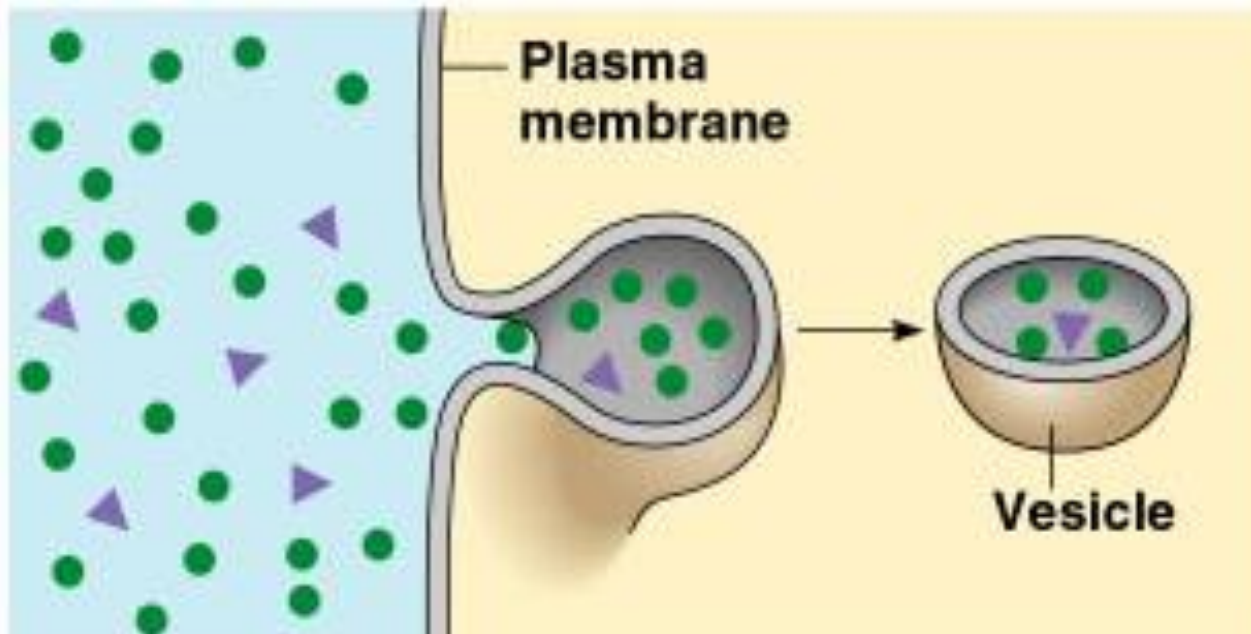
## Transport of large molecules (macromolecules)

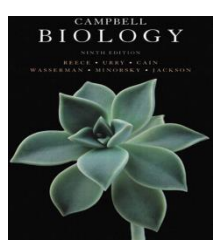


### B)- Pinocytosis, الشرب الخلوي “cellular drinking”.

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

- This is a non-specific process عملية غير متخصصة.

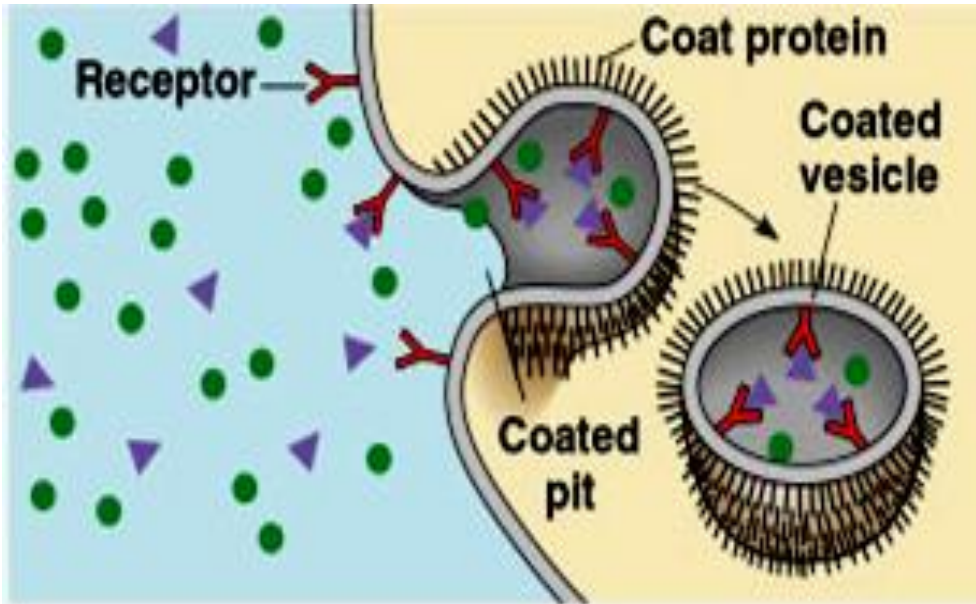




## Transport of large molecules (macromolecules)



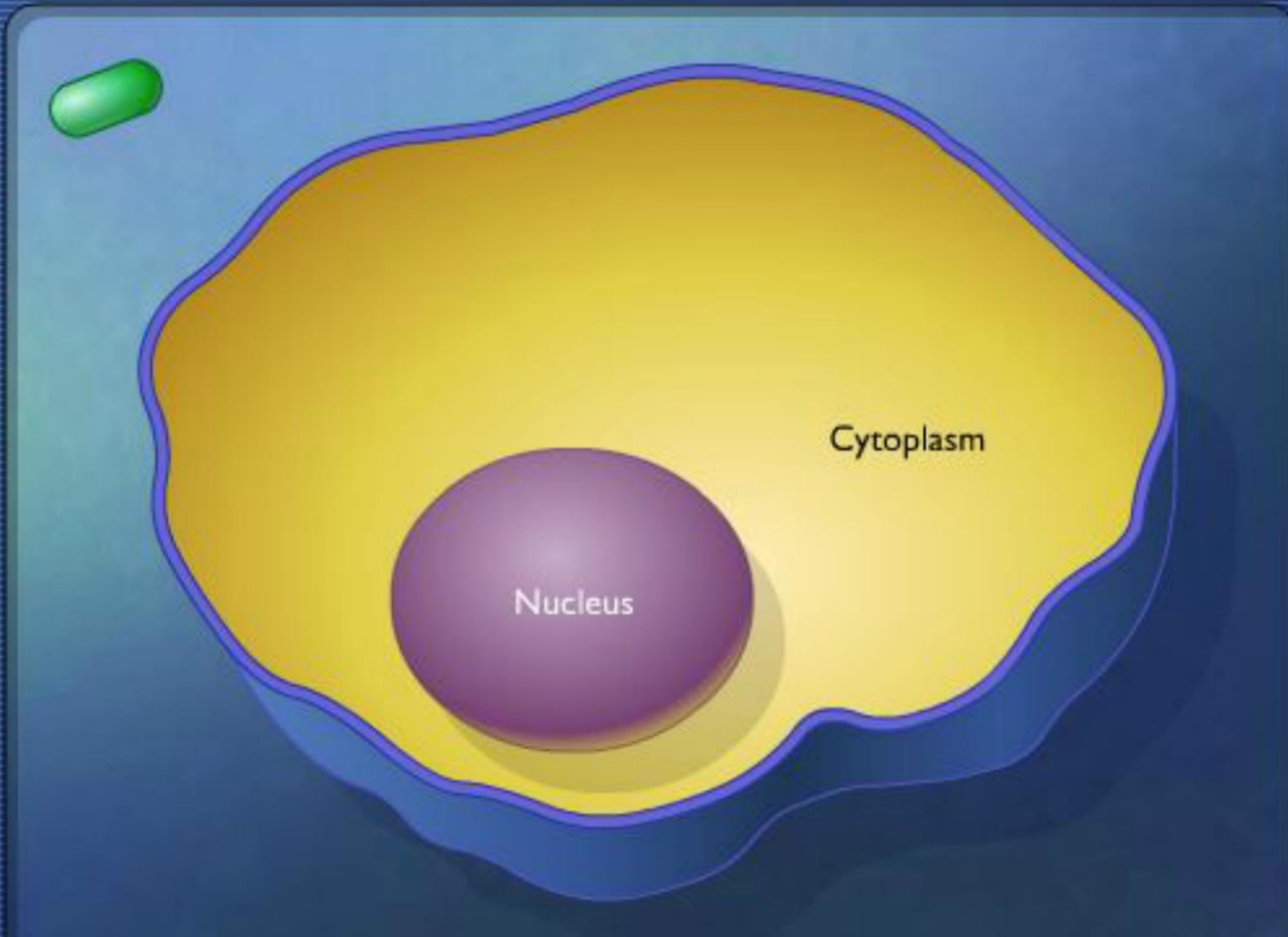
### C)- Receptor-mediated endocytosis: الإدخال الخلوي عن طريق المستقبلات المتخصصة



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

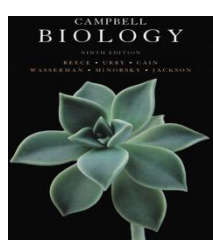
- It is triggered **تُستحث** when extracellular substances bind to **special receptors** **مُستقبِلات خاصة** on the membrane surface. This triggers the formation of a vesicle
- It enables a cell to take large quantities of specific materials that may be in low concentrations in the environment.

# Endocytosis and Exocytosis



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The substances taken in by single-celled organisms are often particles or large, polar molecules that cannot cross the hydrophobic plasma membrane.



# Summary



## Cell Transport

### Passive

#### Diffusion

(Solute molecules)

#### Osmosis

(Solvent molecules)

#### Facilitated diffusion

(T. protein)

### Active

#### Small Molecules/ions

(T. protein)  
(Na<sup>+</sup>-K<sup>+</sup> pump)

#### Large molecules

(Membrane)

#### Endocytosis

#### Exocytosis

#### Phagocytosis

Cellular eating

#### Pinocytosis

Cellular drinking

#### Receptor-mediated endocytosis

Selective eating

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**Thank you very much**

**شكراً جزيلاً**

**Zoology Department**