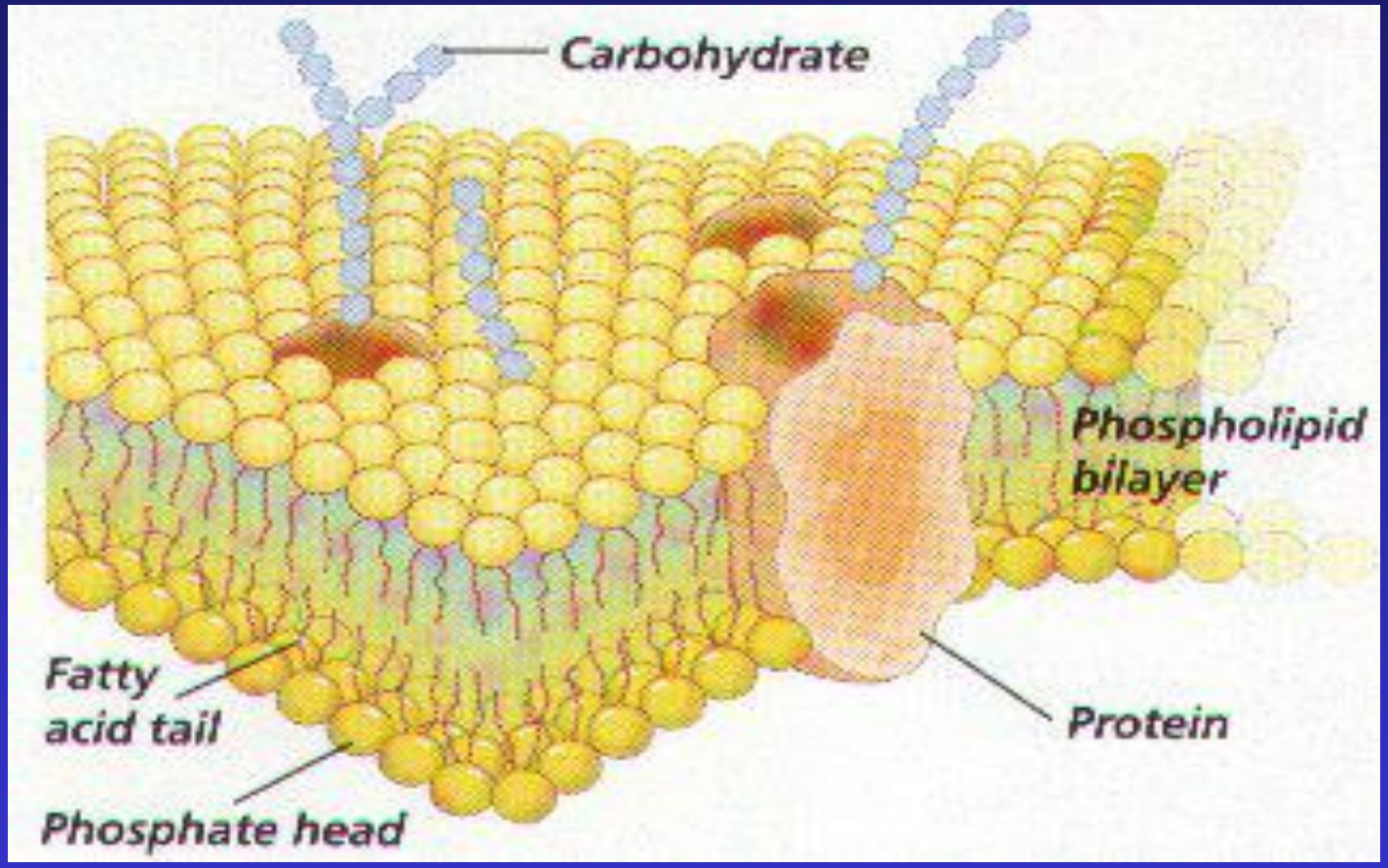
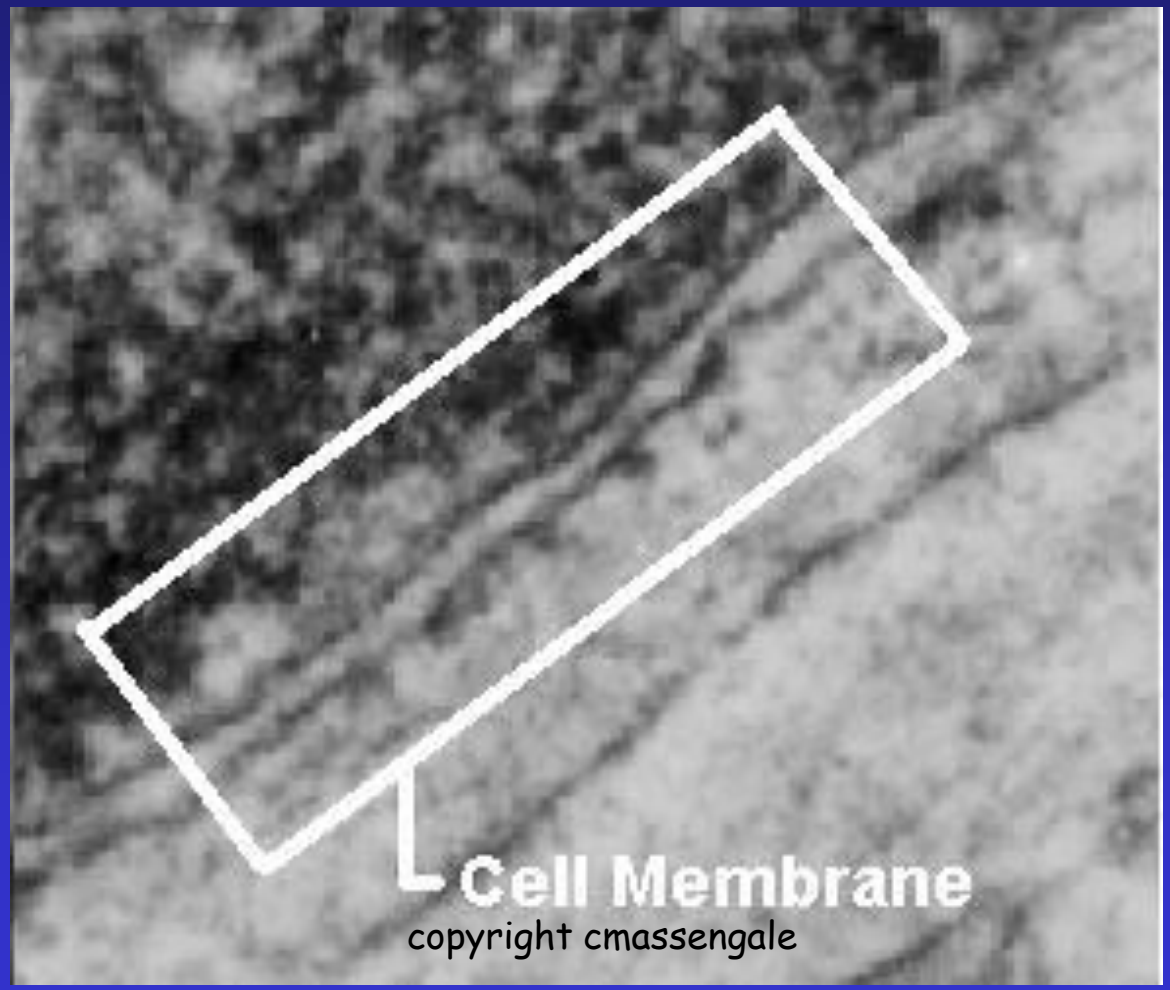
The Plasma Membrane -



Gateway to the Cell

Photograph of a Cell Membrane



Cell Membrane

The cell membrane is flexible and allows a unicellular organism to move

Homeostasis

- **Balanced** internal condition of cells
- Also called **equilibrium**
- **Maintained by plasma membrane** controlling what enters & leaves the cell

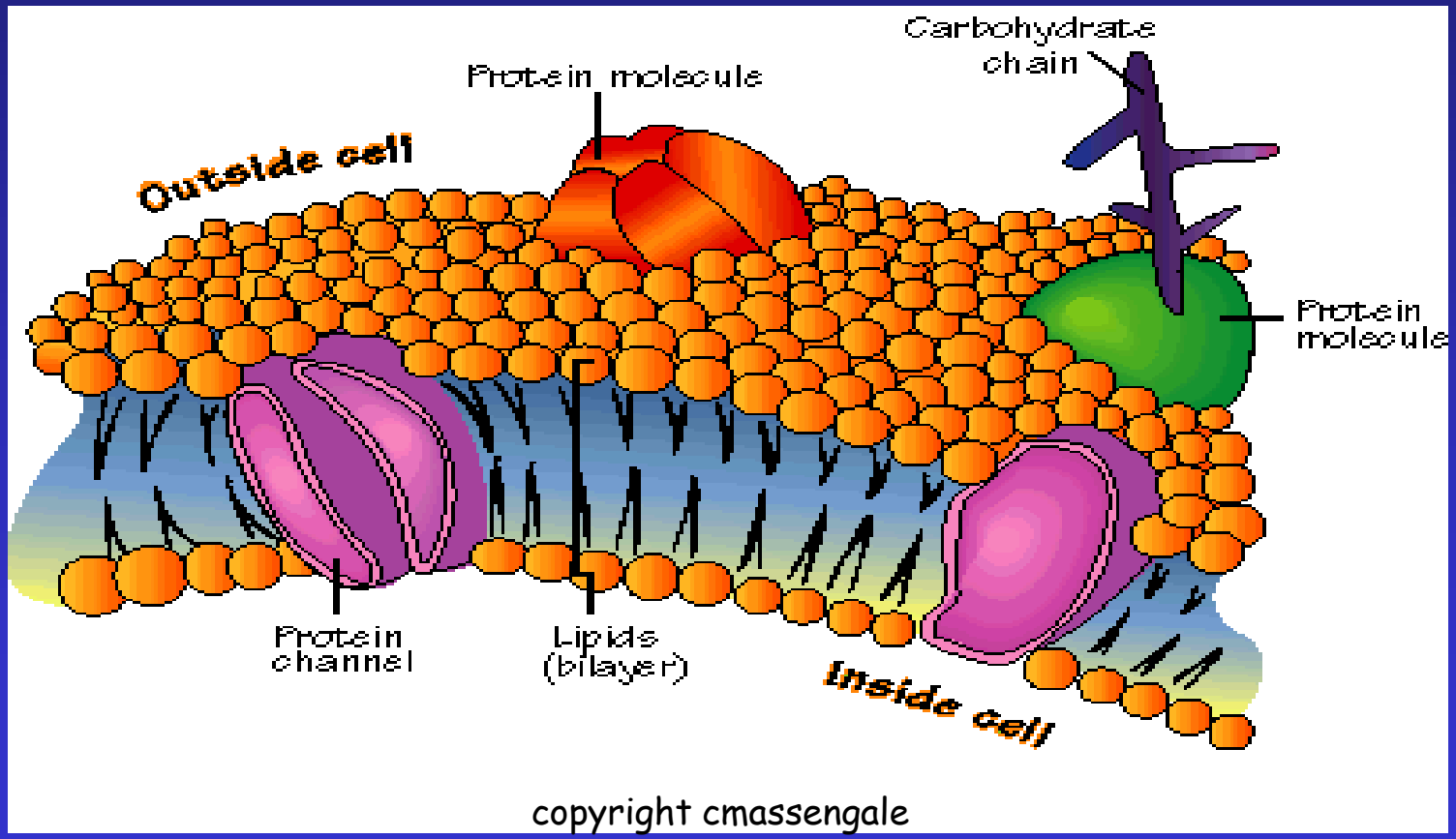
Functions of Plasma Membrane

- ✓ Protective barrier
- ✓ Regulate transport in & out of cell (selectively permeable)
- ✓ Allow cell recognition
- ✓ Provide anchoring sites for filaments of cytoskeleton

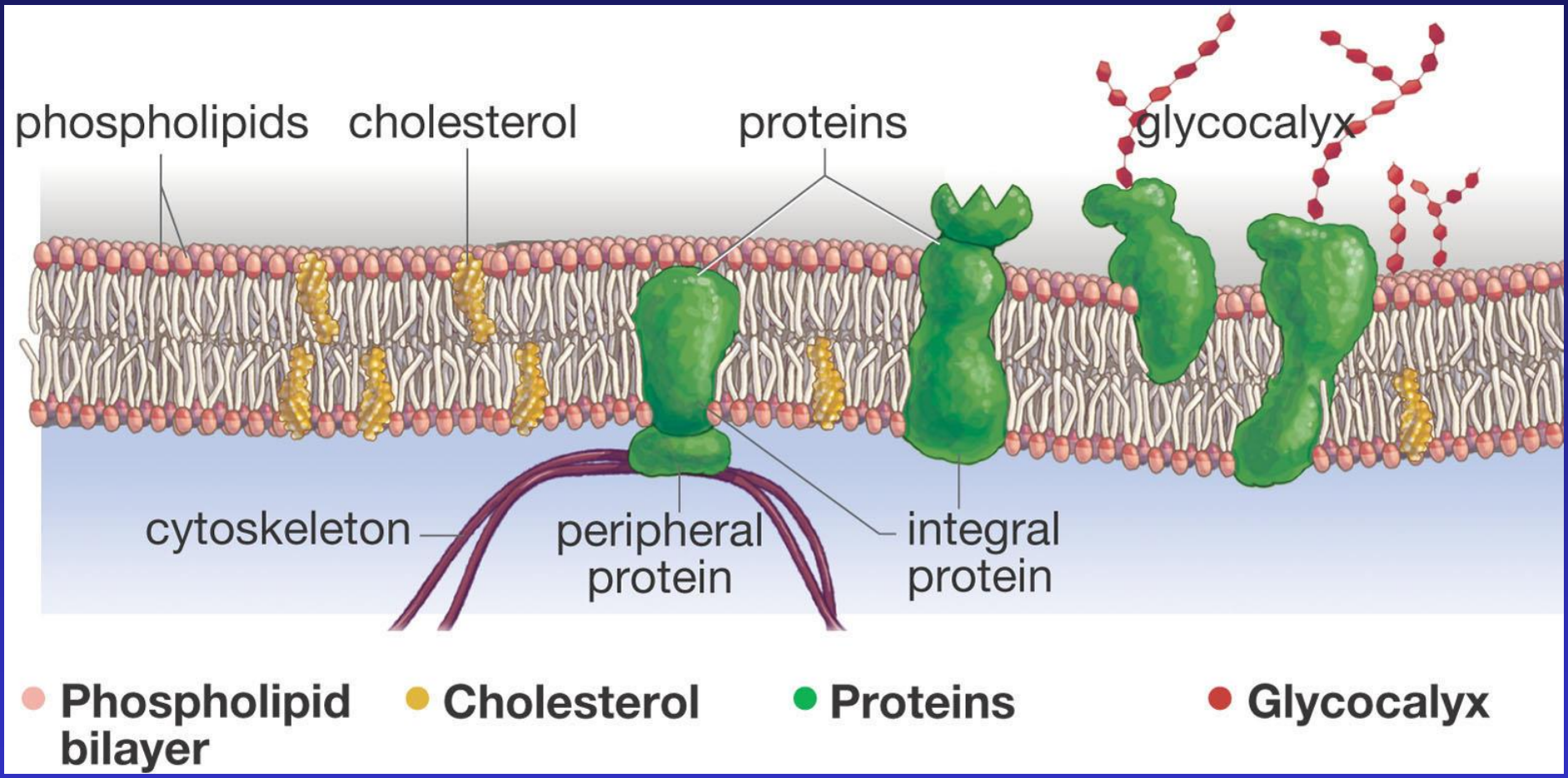
Functions of Plasma Membrane

- ✓ Provide a binding site for enzymes
- ✓ Interlocking surfaces bind cells together (junctions)
- ✓Contains the cytoplasm (fluid in cell)

Structure of the Cell Membrane



Membrane Components

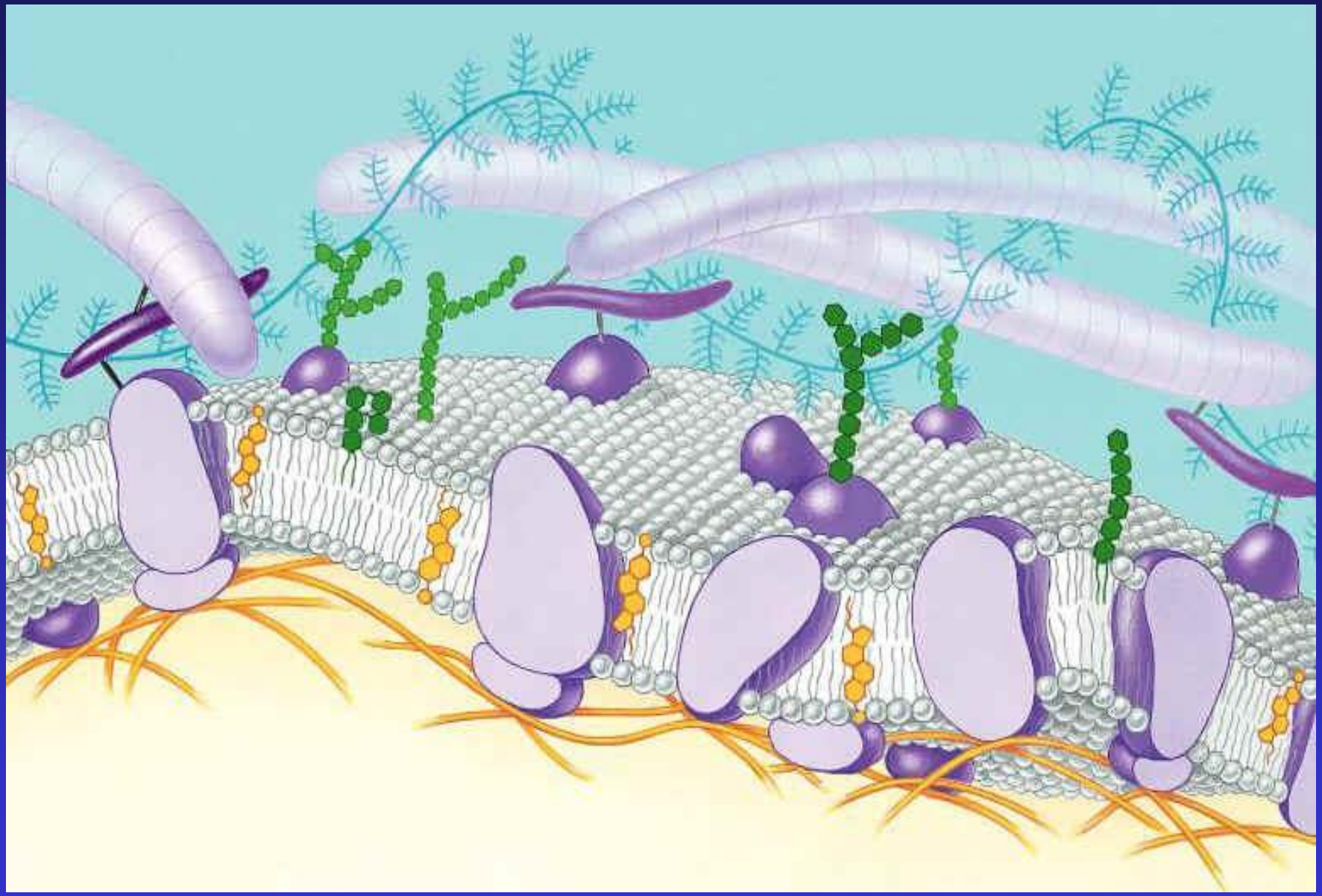


Phospholipids

Cholesterol

Proteins (peripheral and integral)

Carbohydrates (glucose)

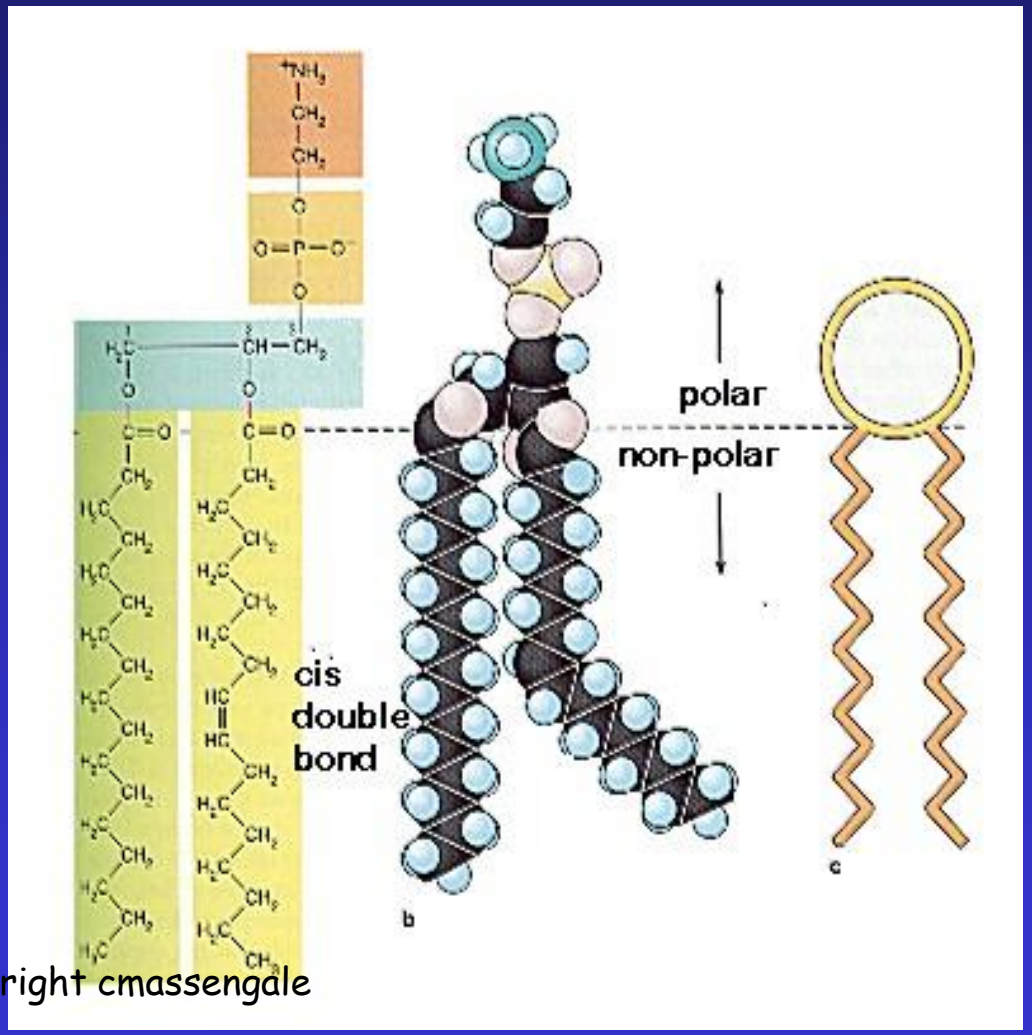


Phospholipids

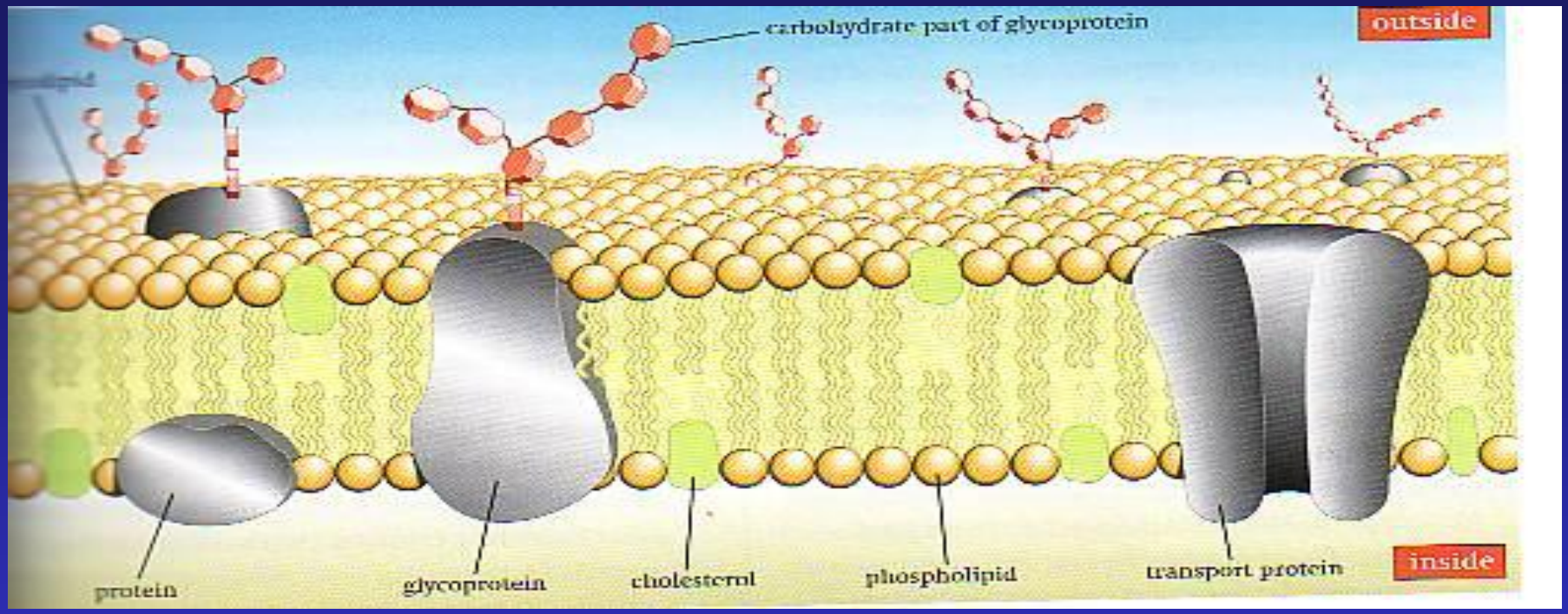
Make up the cell membrane

Contains 2 fatty acid chains that are nonpolar

Head is polar & contains a $-PO_4$ group & glycerol



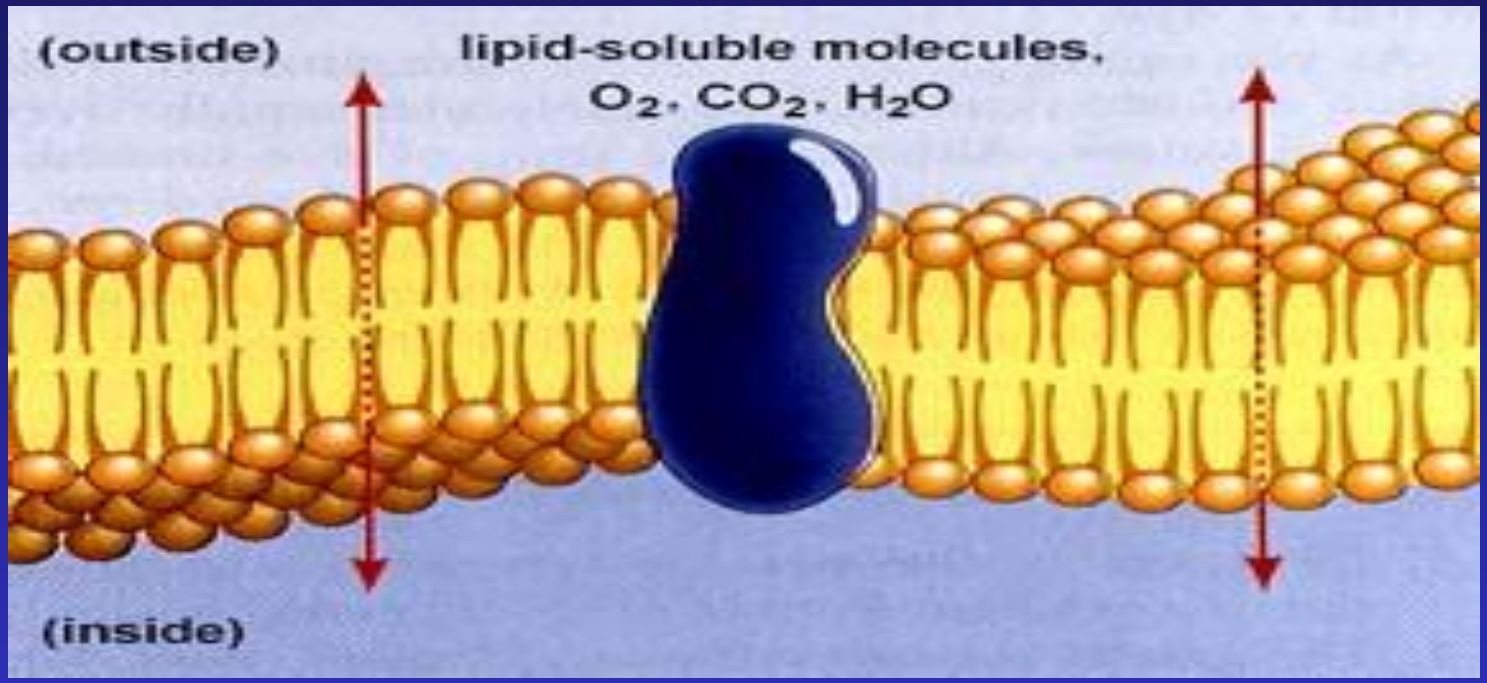
FLUID MOSAIC MODEL



FLUID- because individual phospholipids and proteins can move side-to-side within the layer, like it's a liquid.

MOSAIC- because of the pattern produced by the scattered protein molecules when the membrane is viewed from above.

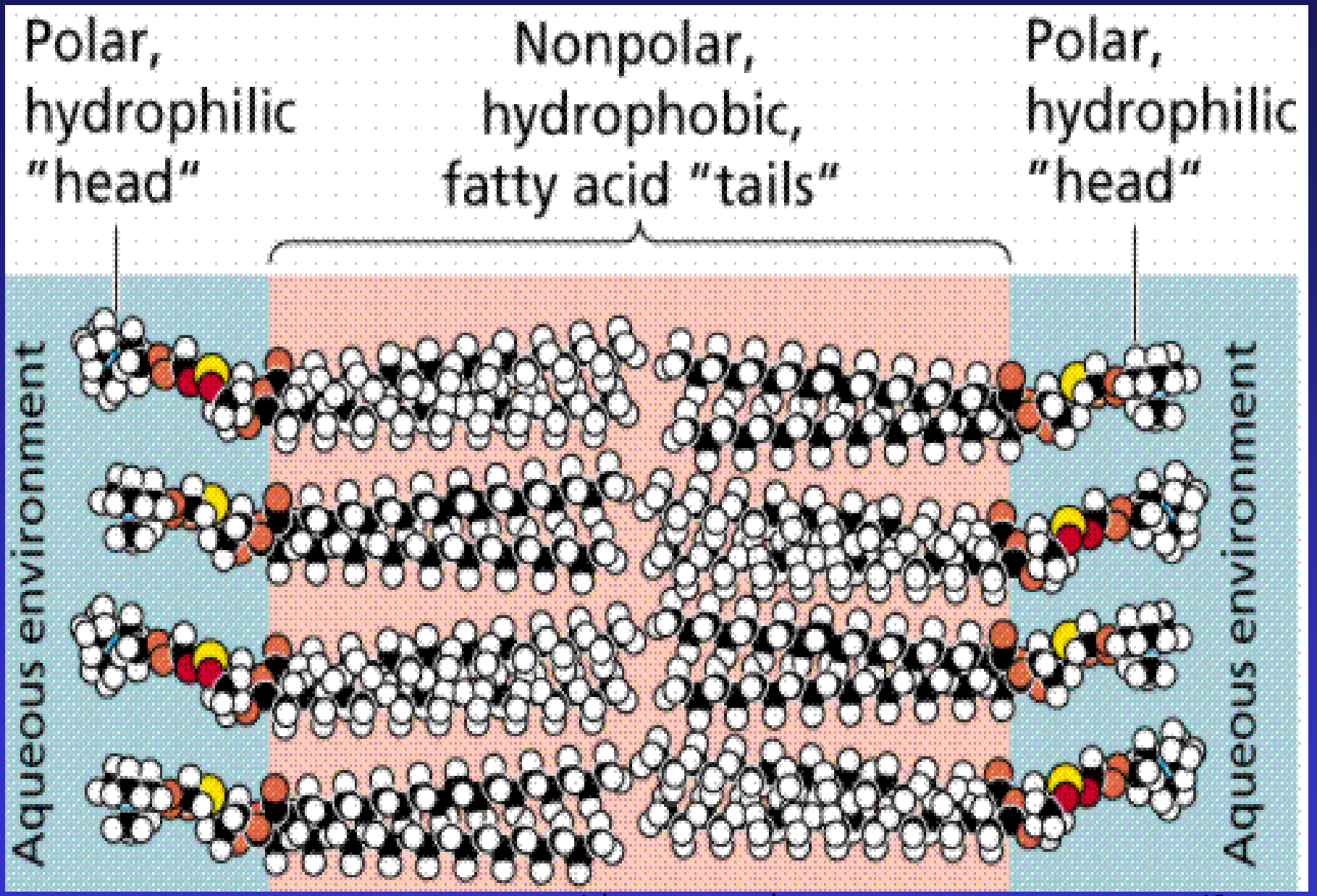
Cell Membrane



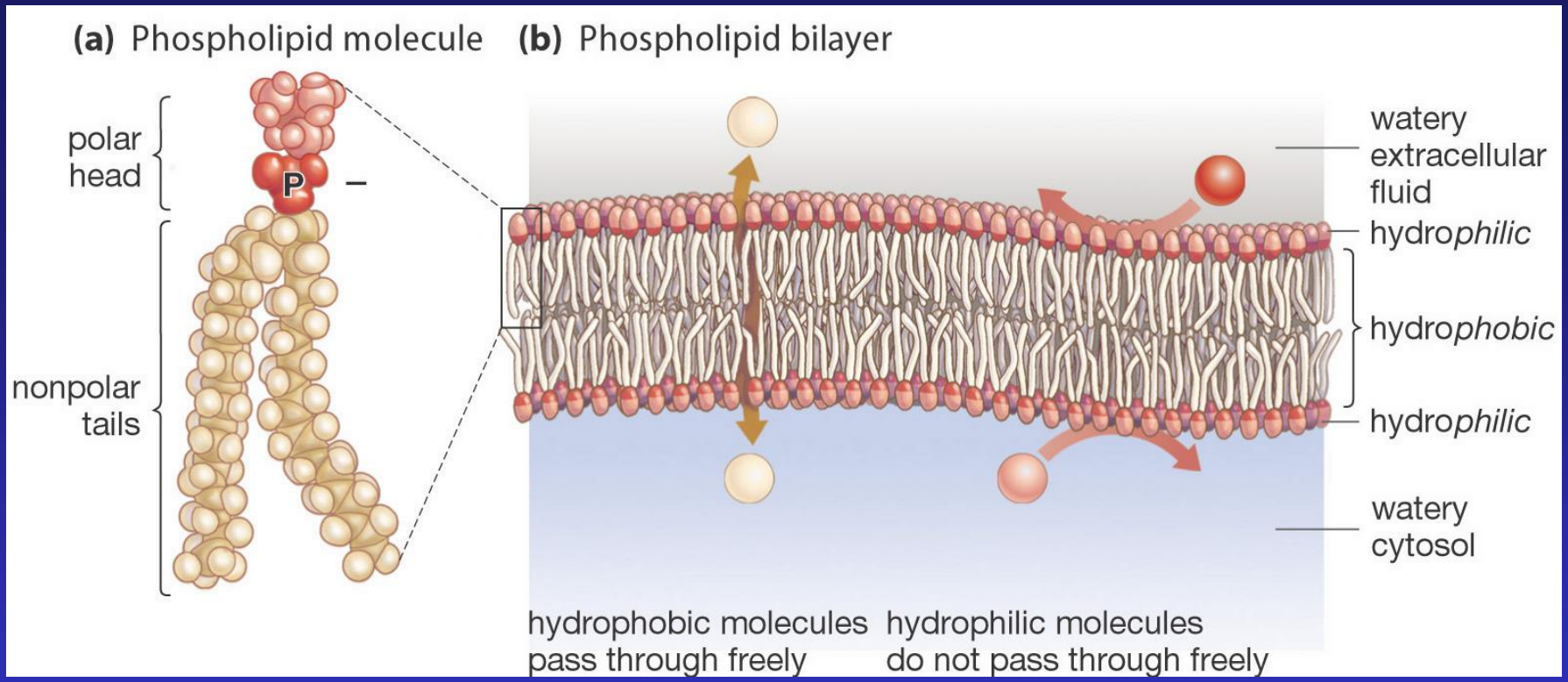
Polar heads are **hydrophilic** "water loving"

Nonpolar tails are **hydrophobic** "water fearing"

Makes membrane **"Selective"** in what crosses



Cell Membrane

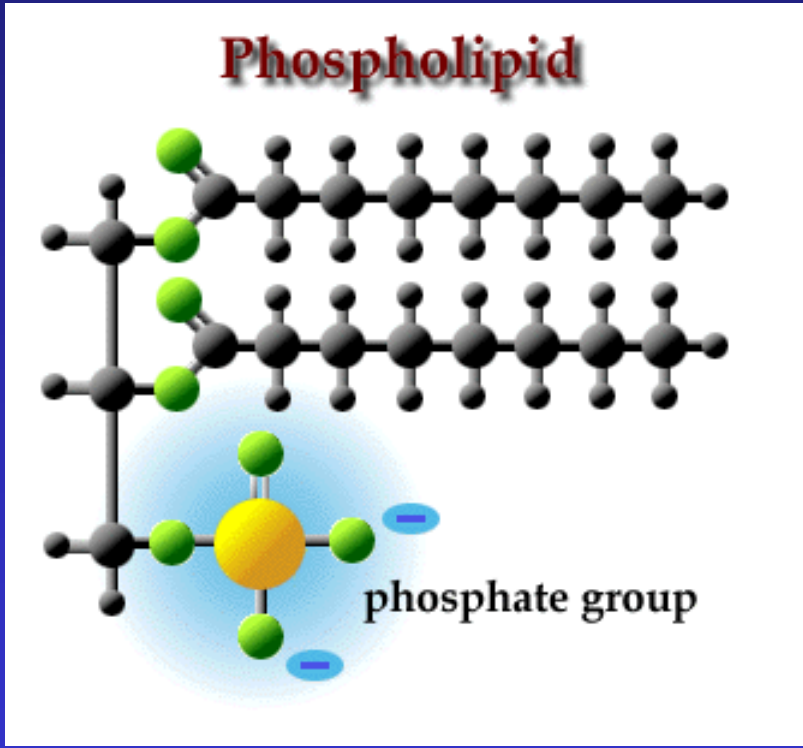


The cell membrane is made of 2 layers of **phospholipids** called the lipid **bilayer**

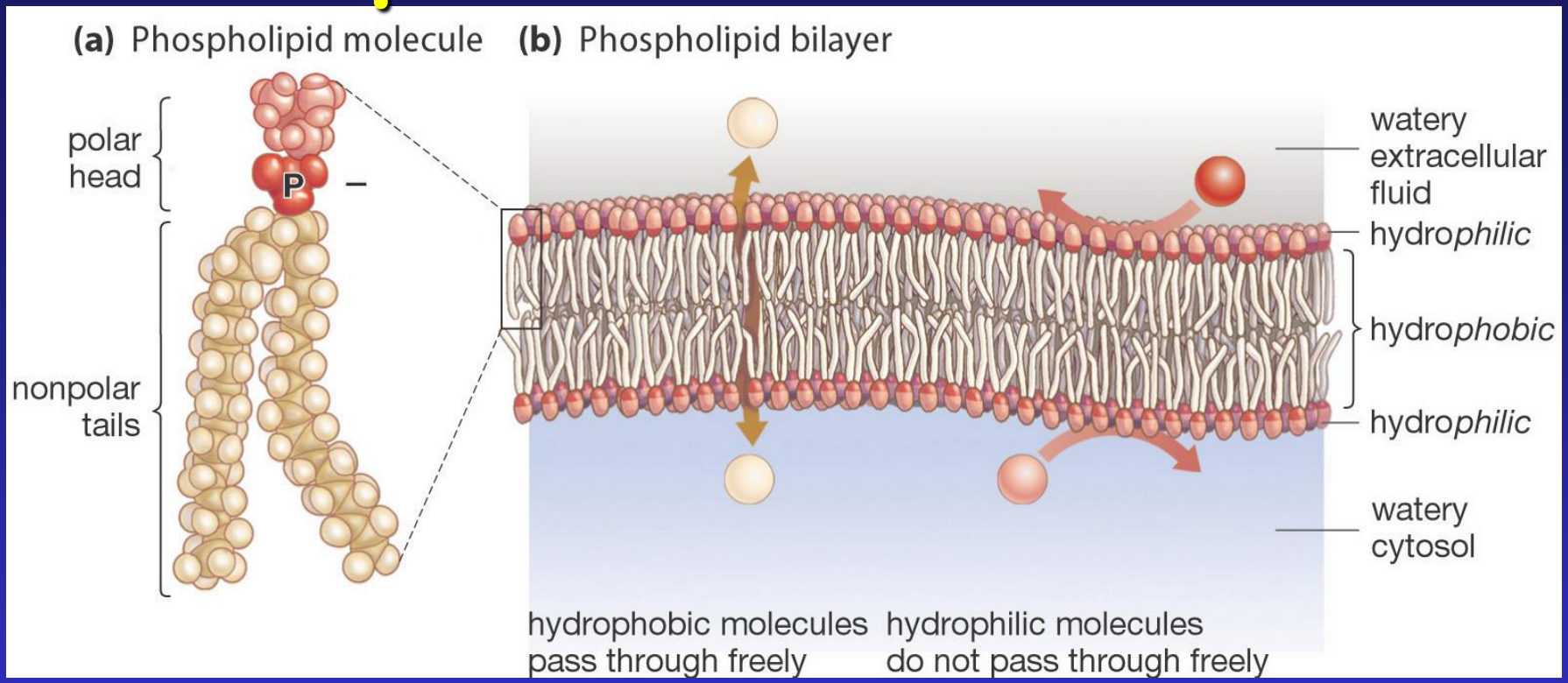
Hydrophobic molecules pass **easily**; hydrophilic **DO NOT**

Solubility

- Materials that are soluble in lipids can pass through the cell membrane easily



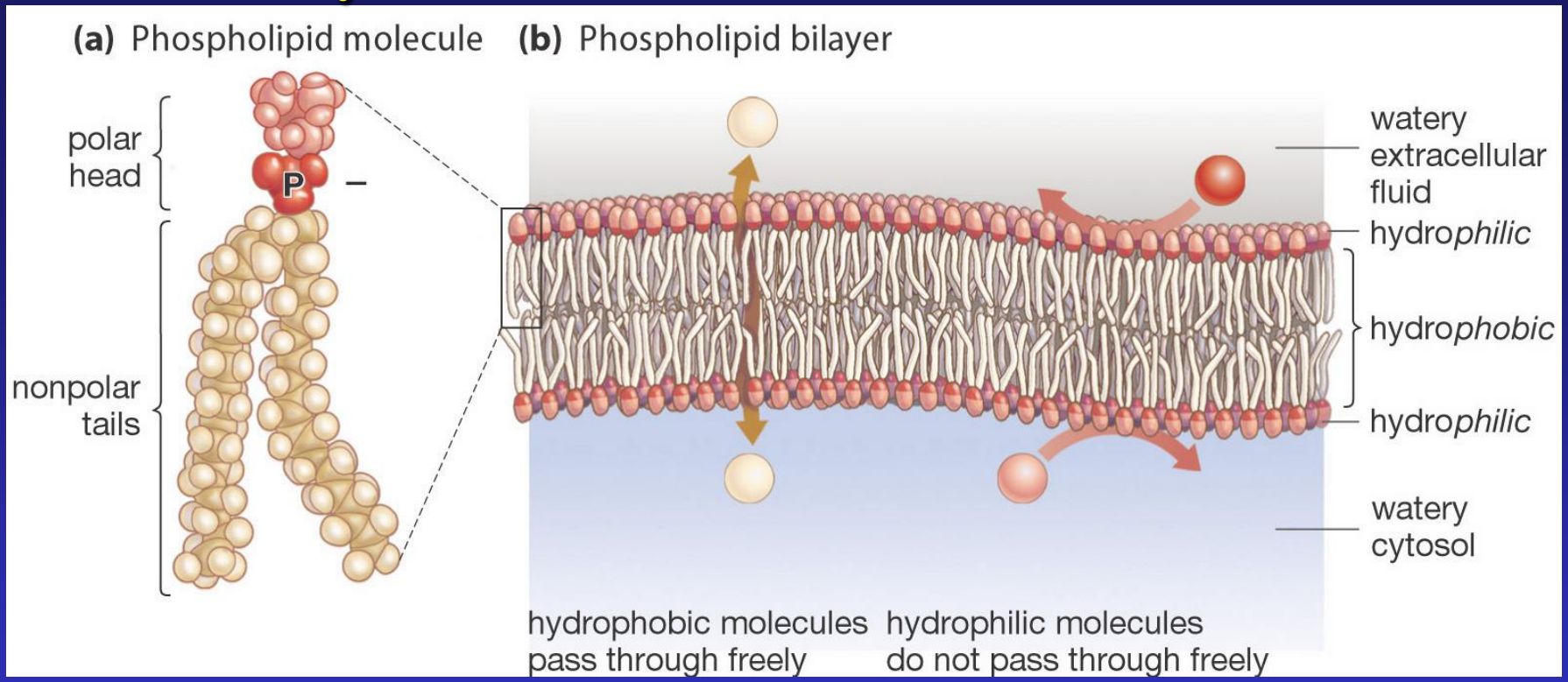
Semipermeable Membrane



Small molecules and larger hydrophobic molecules move through easily.

e.g. O_2, CO_2, H_2O

Semipermeable Membrane

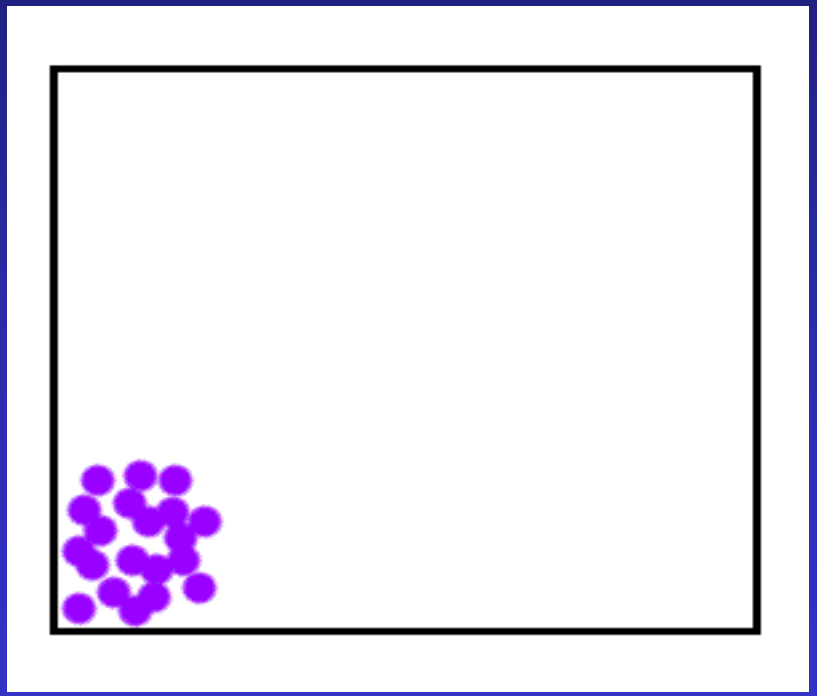


Ions, hydrophilic molecules larger than water, and large molecules such as proteins do not move through the membrane on their own.

Types of Transport Across Cell Membranes

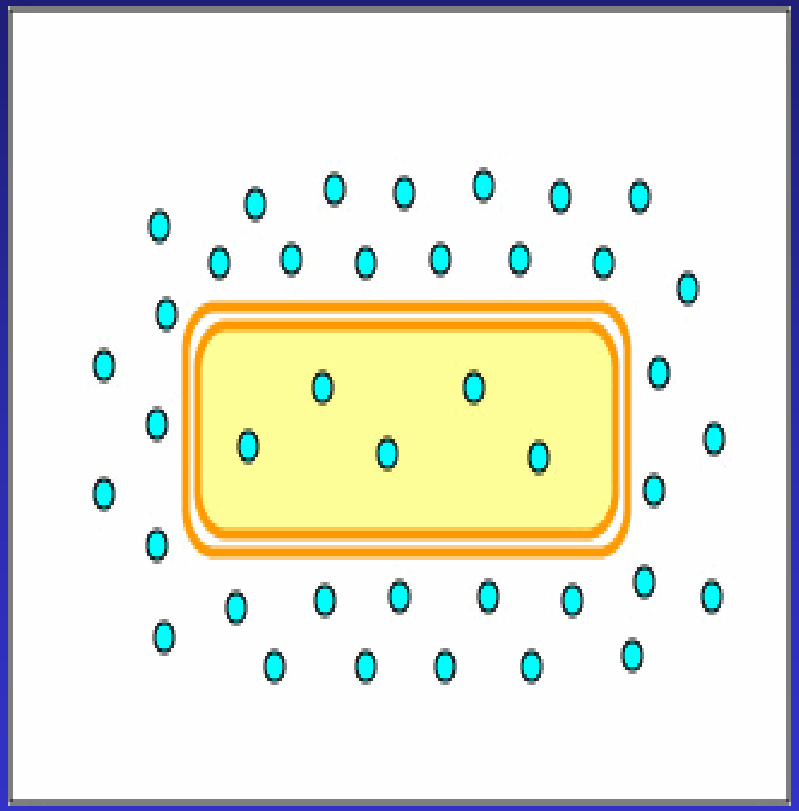
Simple Diffusion

- Requires NO energy
- Molecules move from area of HIGH to LOW concentration

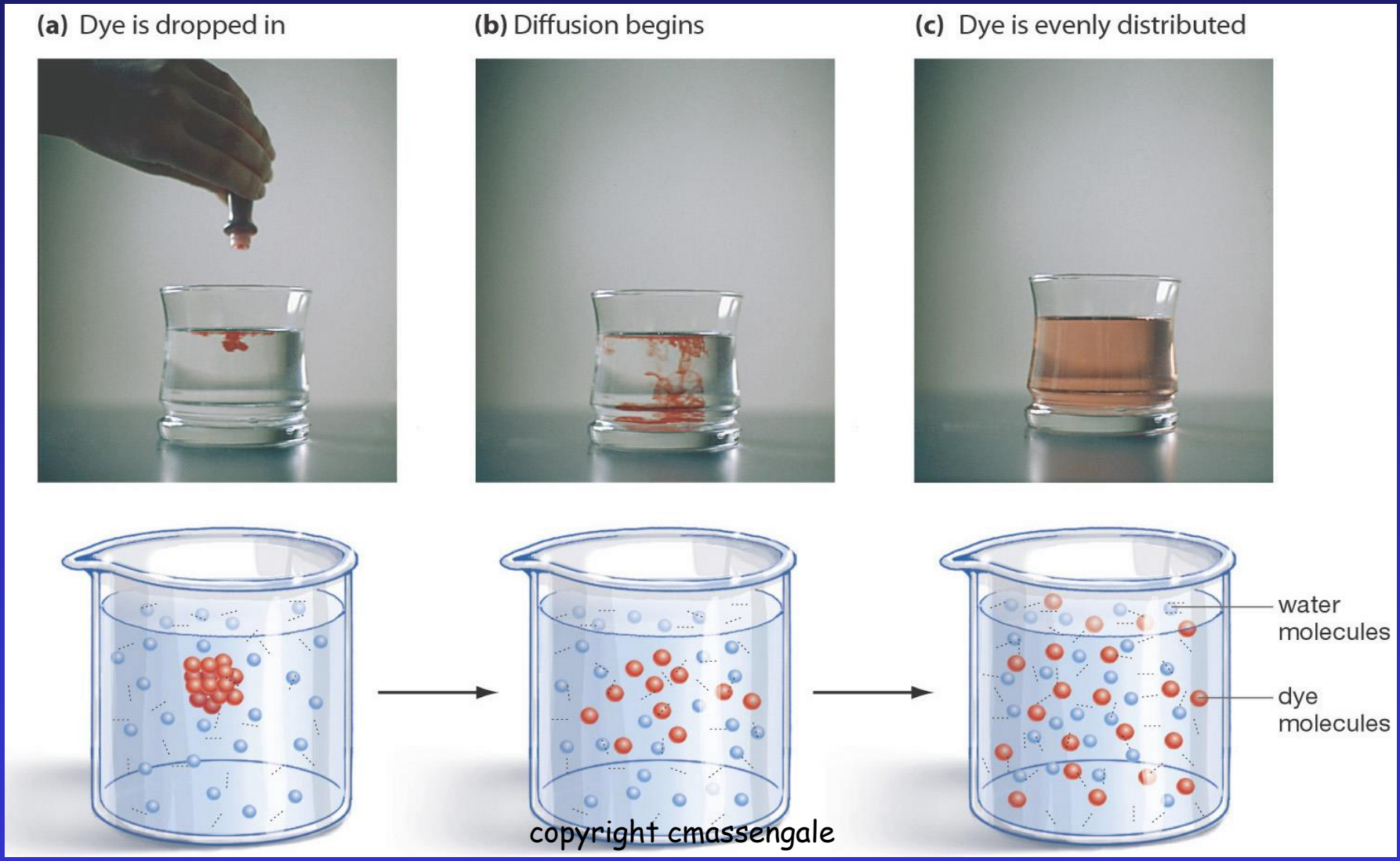


DIFFUSION

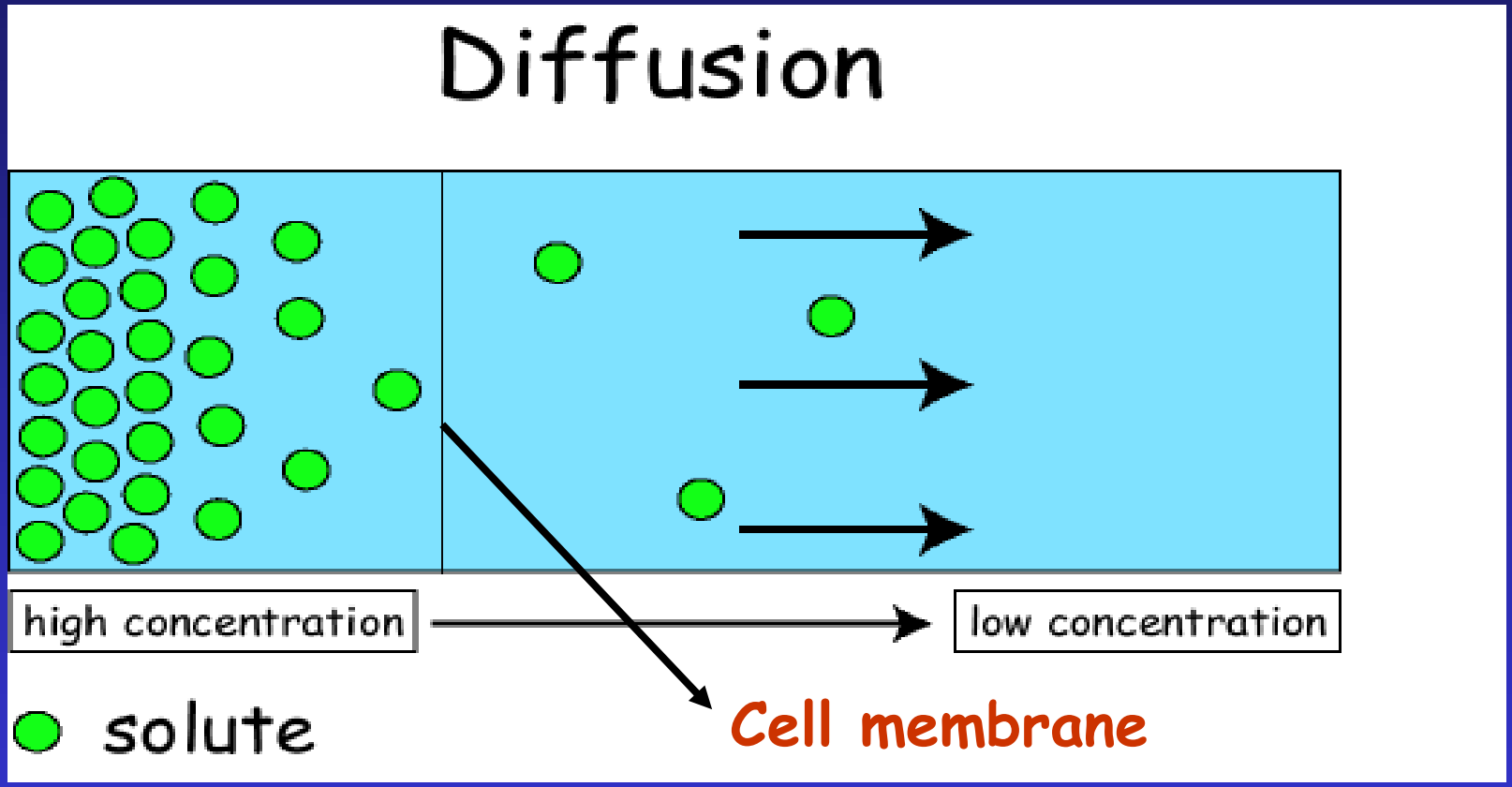
Diffusion is a PASSIVE process which means no energy is used to make the molecules move, they have a natural KINETIC ENERGY



Diffusion of Liquids



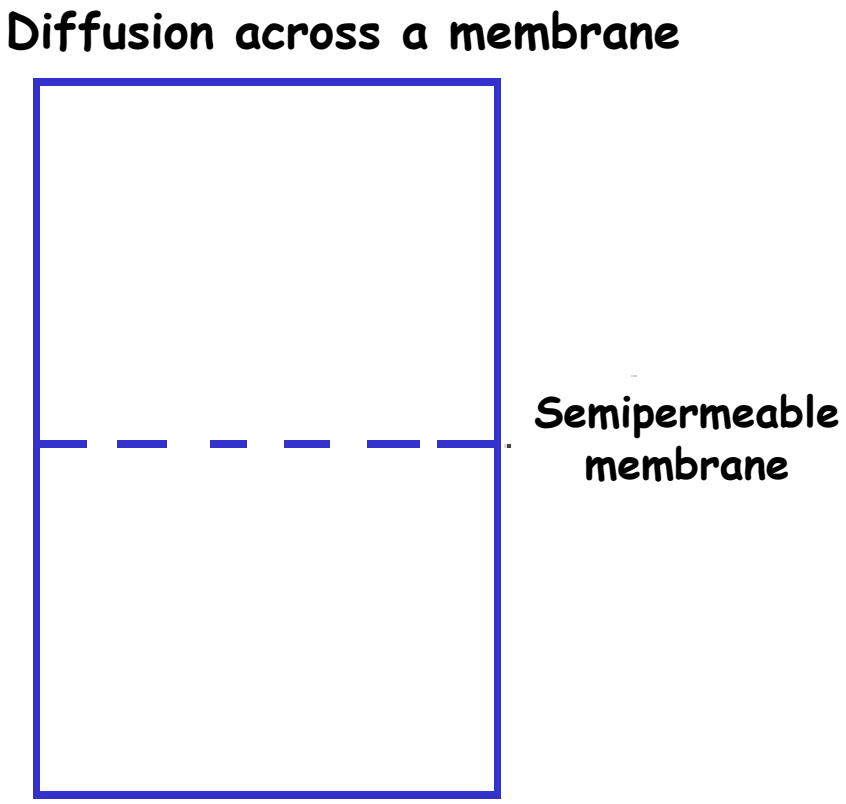
Diffusion through a Membrane



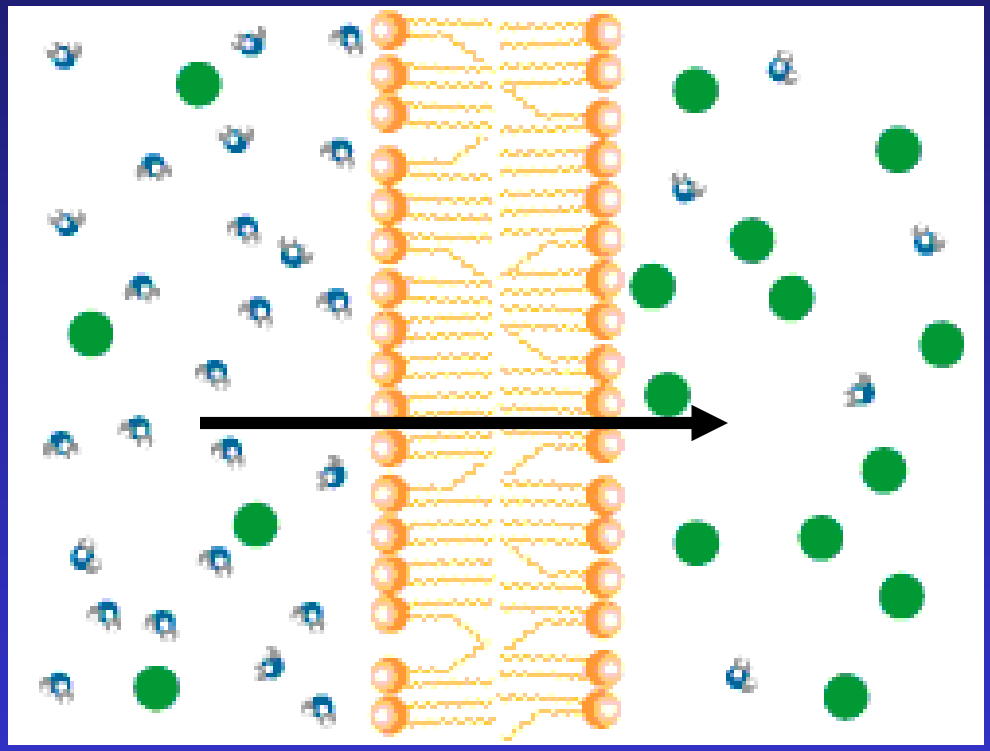
Solute moves DOWN concentration gradient (HIGH to LOW)

Osmosis

- Diffusion of water across a membrane
- Moves from HIGH water potential (low solute) to LOW water potential (high solute)



Diffusion of H_2O Across A Membrane

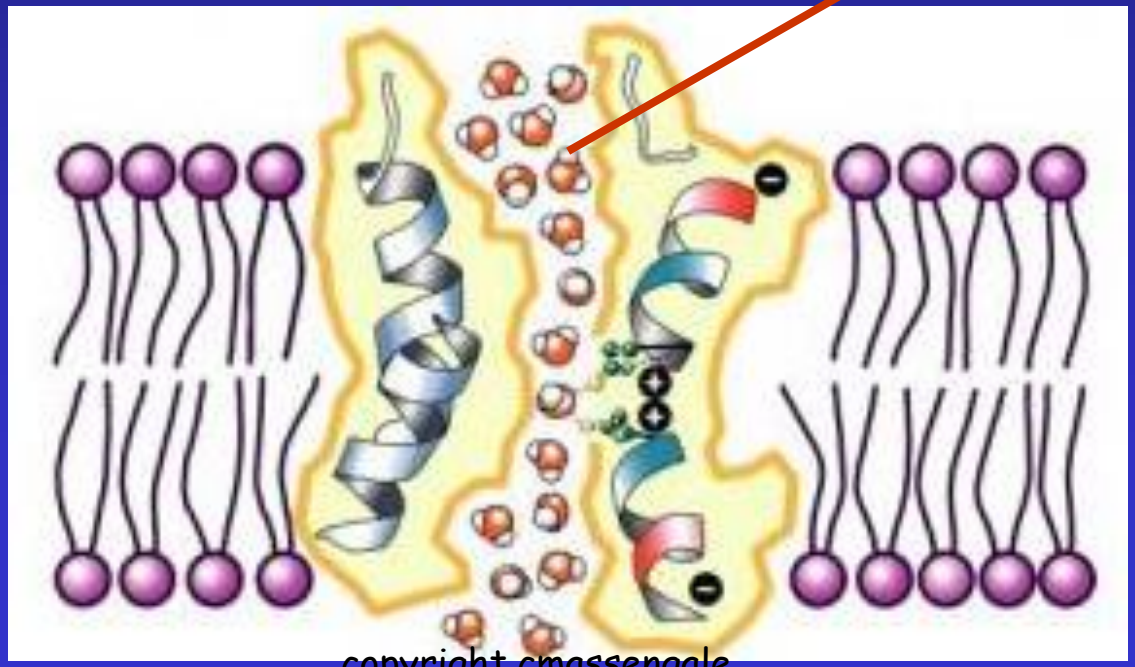


High H_2O potential
Low solute concentration

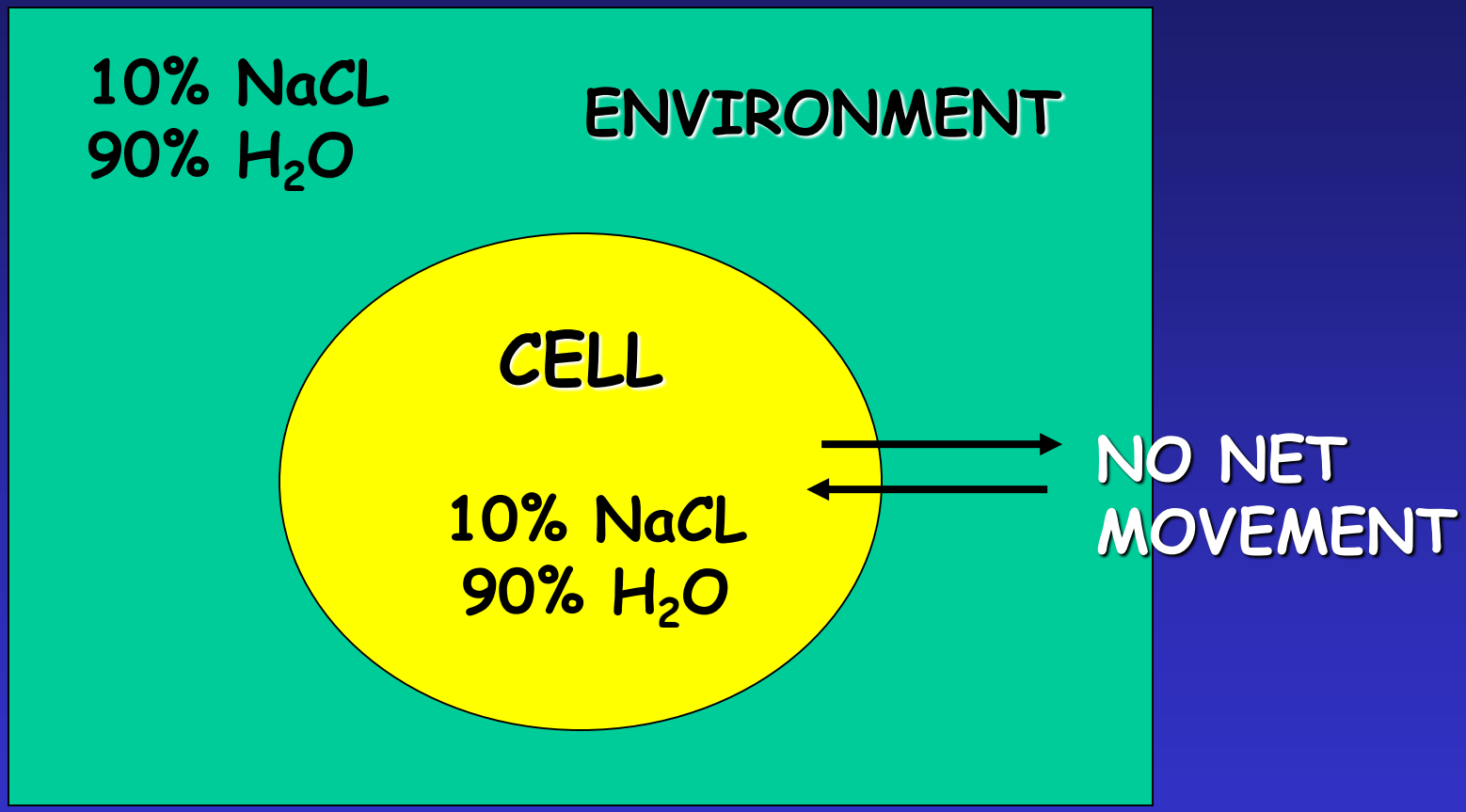
Low H_2O potential
High solute concentration

Aquaporins

- Water Channels
- Protein pores used during OSMOSIS



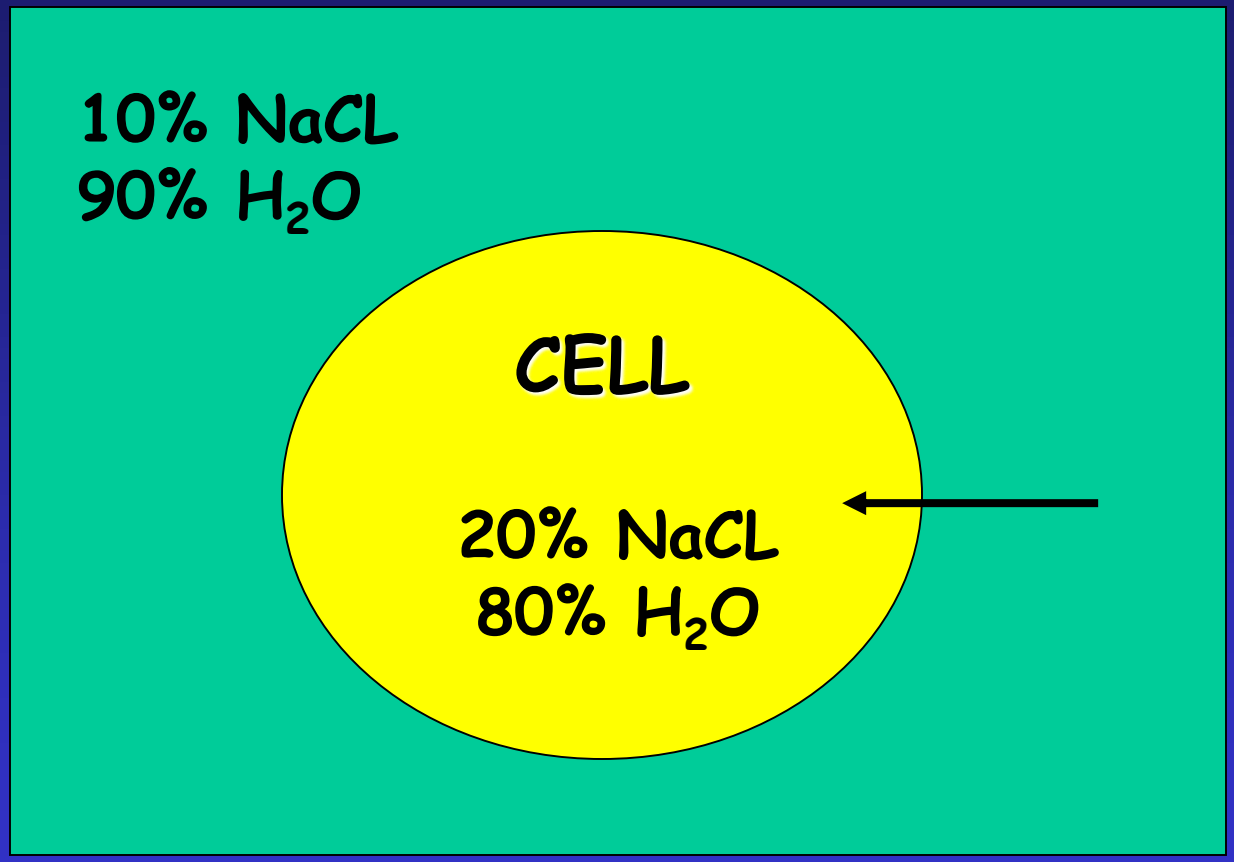
Cell in Isotonic Solution



What is the direction of water movement?

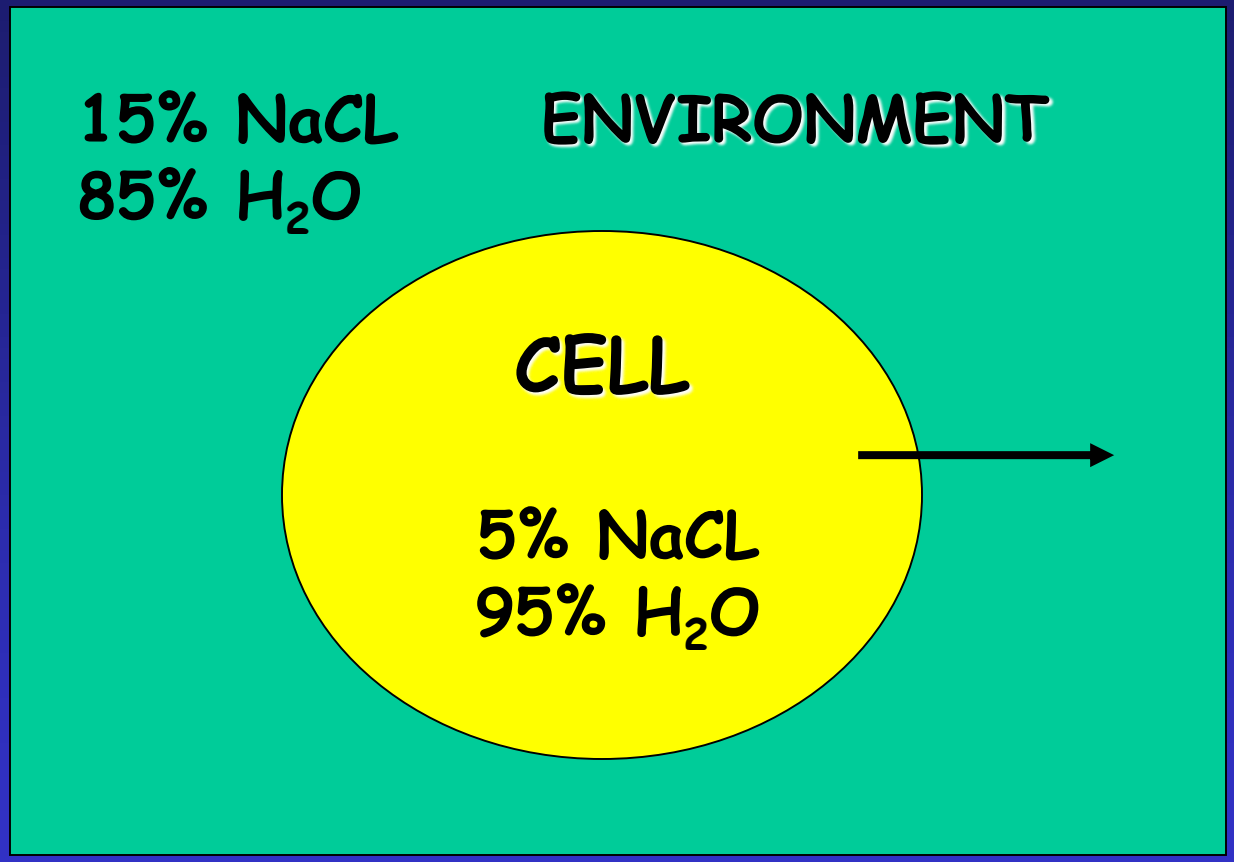
The cell is at _____equilibrium_____.

Cell in Hypotonic Solution



What is the direction of water movement?

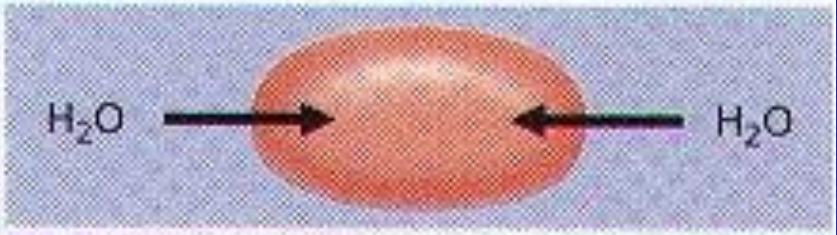
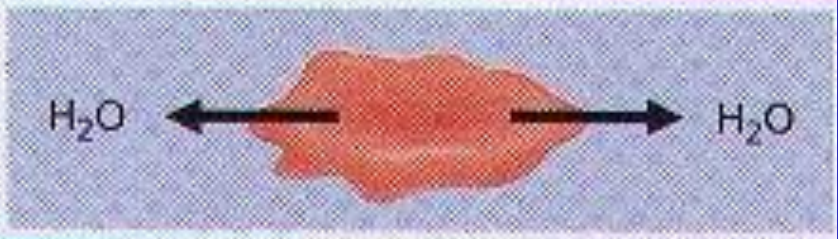
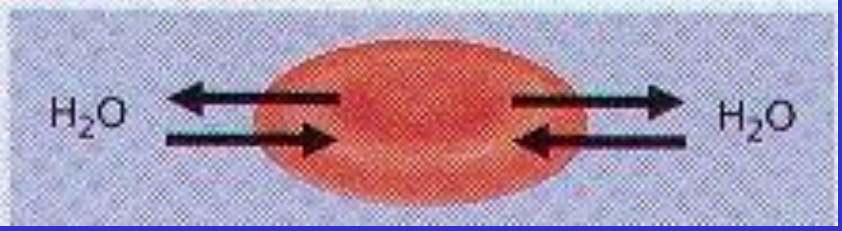
Cell in Hypertonic Solution

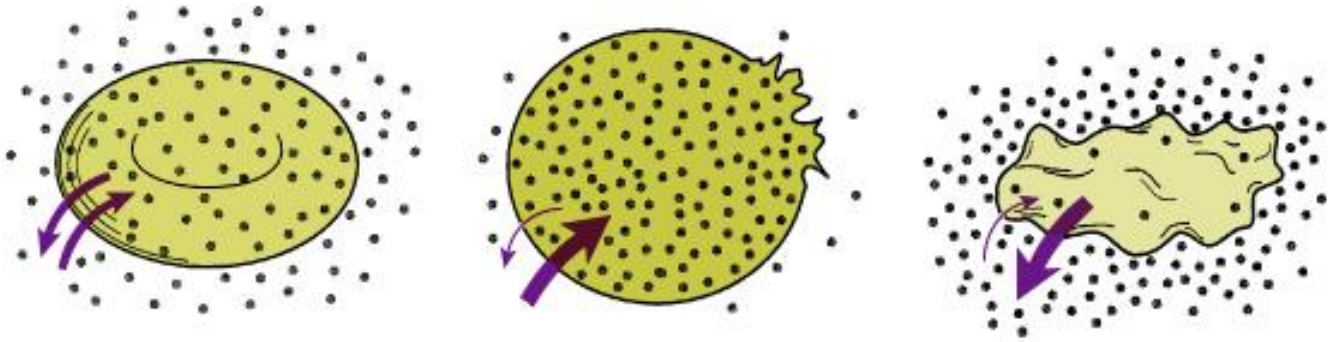


What is the direction of water movement?

Cells in Solutions

TABLE 5-1 Direction of Osmosis

Condition	Net movement of water	
External solution is hypotonic to cytosol	into the cell	
External solution is hypertonic to cytosol	out of the cell	
External solution is isotonic to cytosol	none	



Isotonic Solution

↓

NO NET MOVEMENT OF H_2O (equal amounts entering & leaving)

Hypotonic Solution

↓

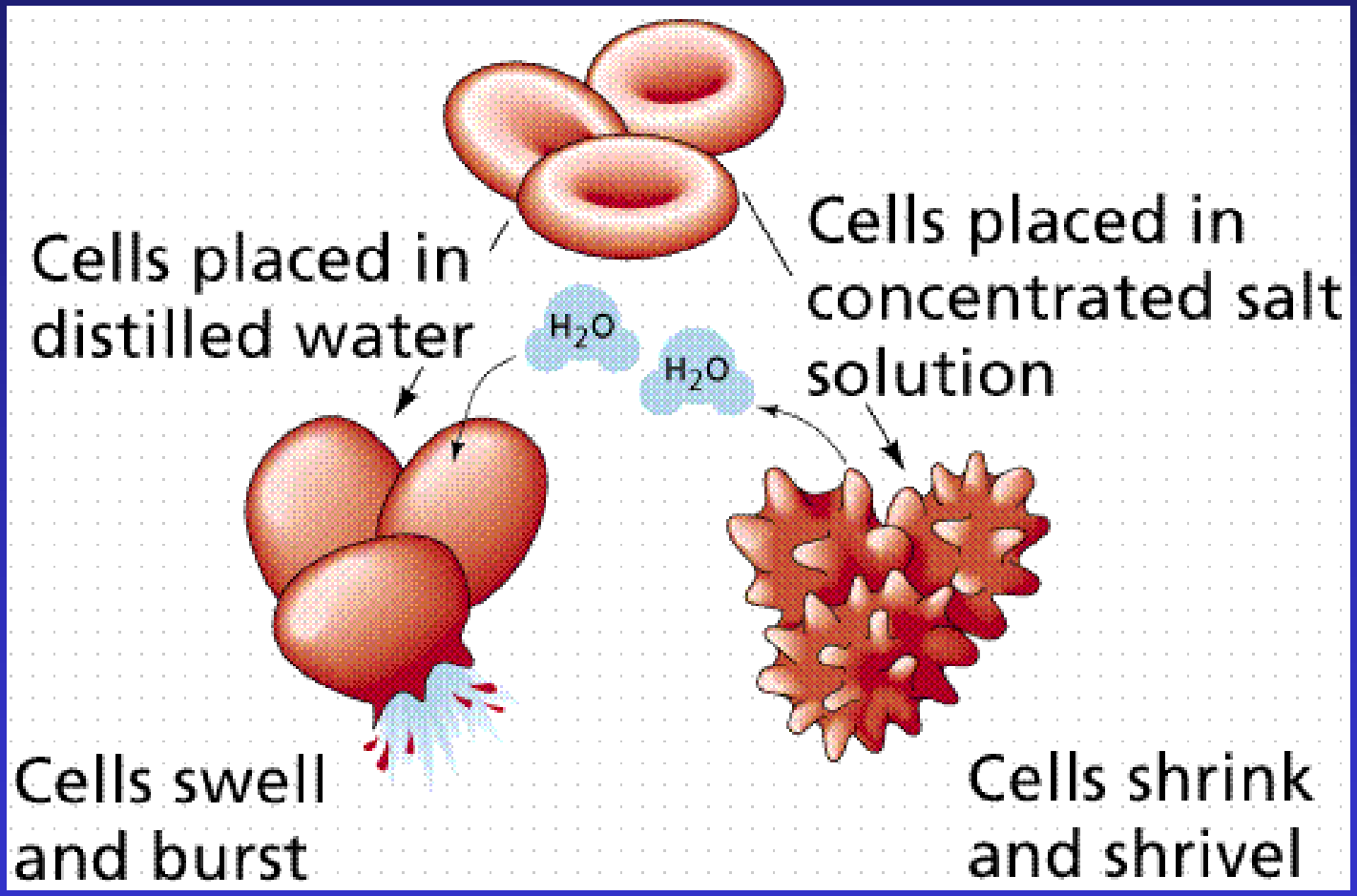
CYTOLYSIS

Hypertonic Solution

↓

PLASMOLYSIS

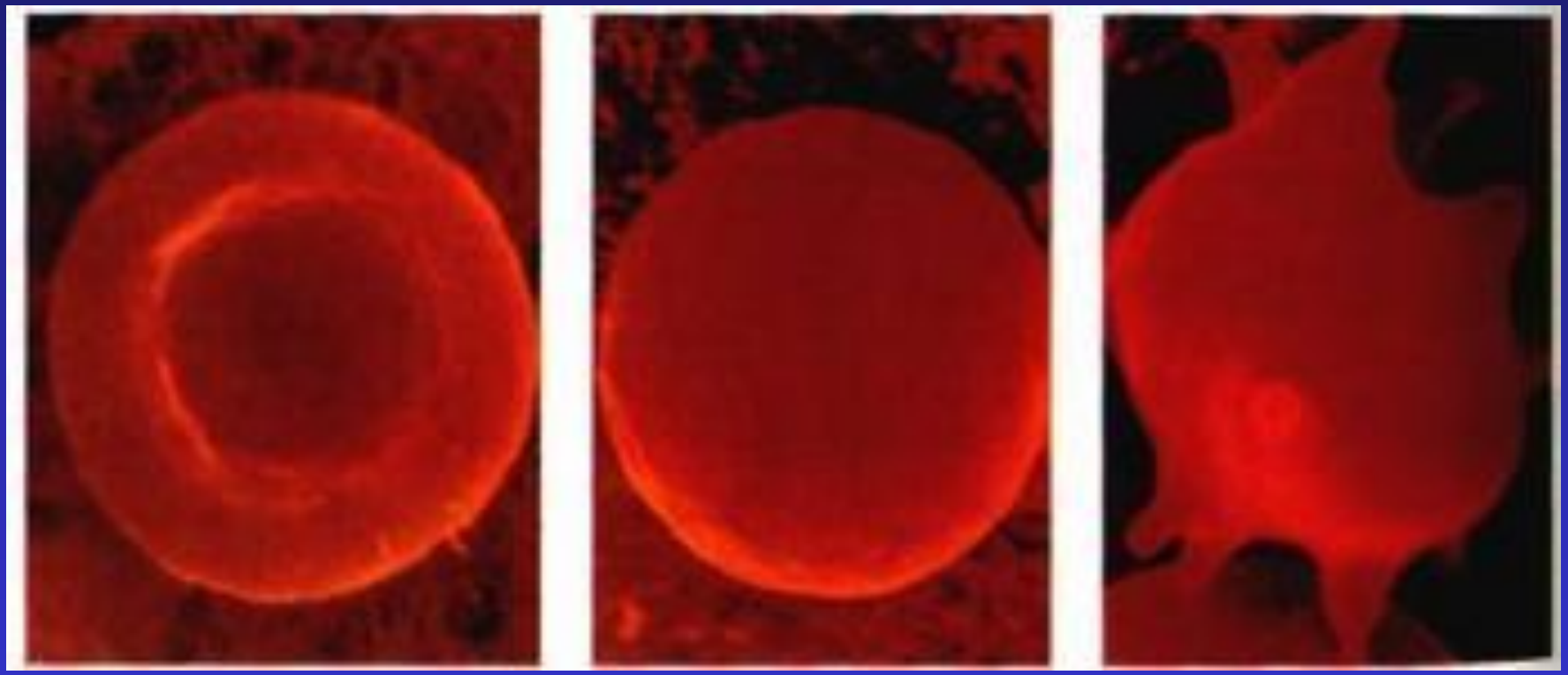
Cytolysis & Plasmolysis



Cytolysis

Plasmolysis

Osmosis in Red Blood Cells

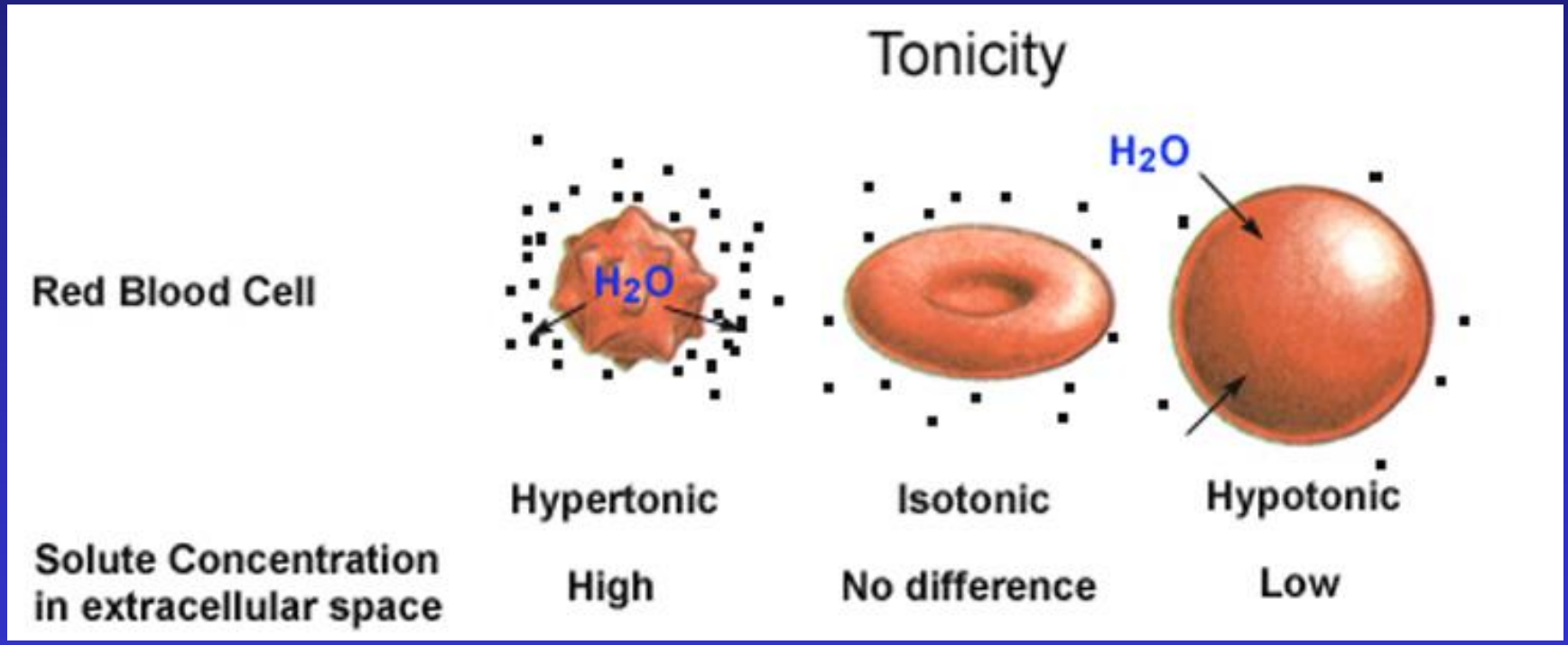


Isotonic

Hypotonic

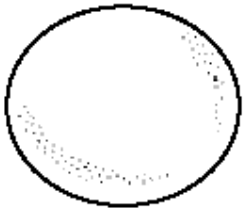
Hypertonic

What Happens to Blood Cells?



STRUCTURES AND FUNCTIONS The drawings below show the appearance of a red blood cell and a plant cell in isotonic, hypotonic, and hypertonic environments. Label each environment in the spaces provided.

RED BLOOD CELL

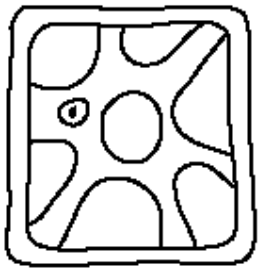


a **hypotonic**

b **hypertonic**

c **isotonic**

PLANT CELL



d **hypertonic**

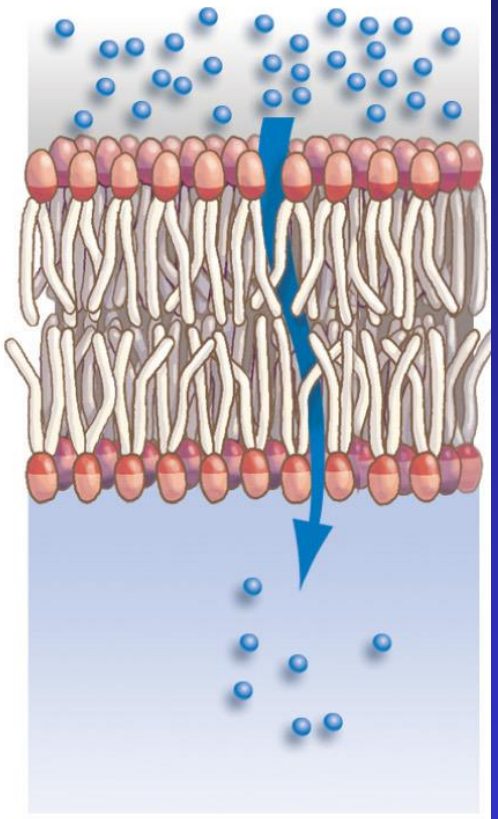
e **isotonic**

f **hypotonic**

Three Forms of Transport Across the Membrane

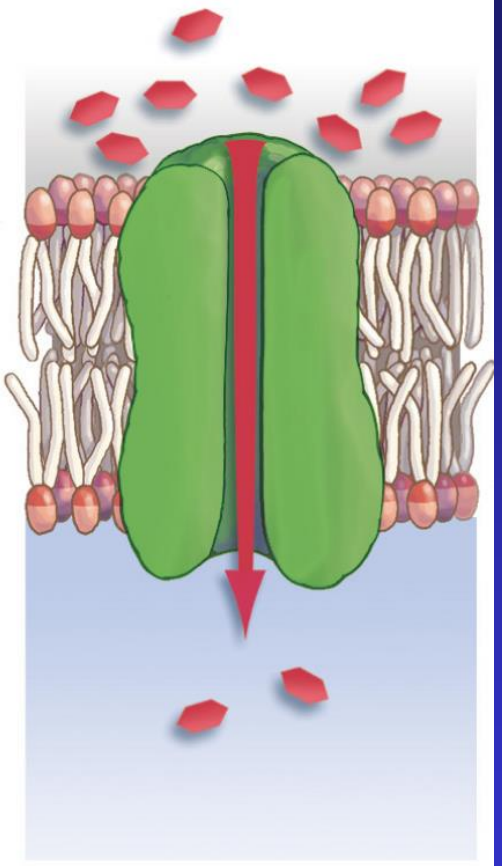
Passive transport

simple diffusion



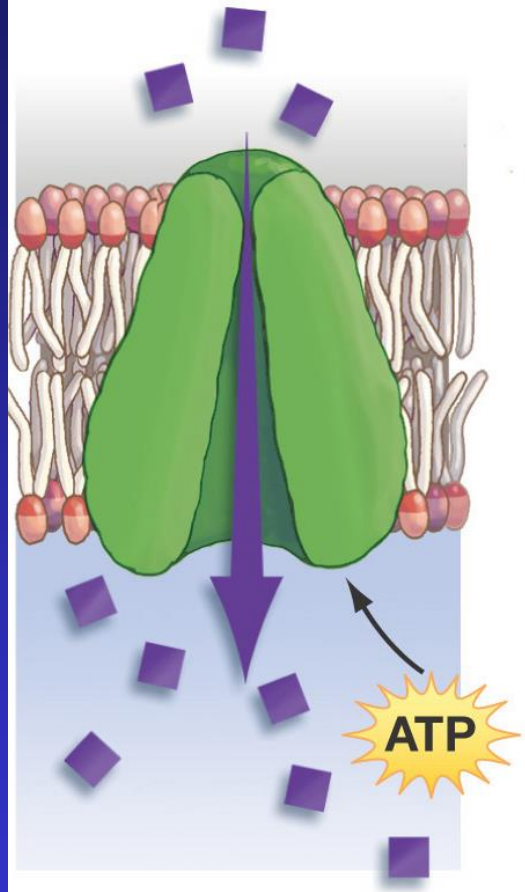
Materials move down their concentration gradient through the phospholipid bilayer.

facilitated diffusion

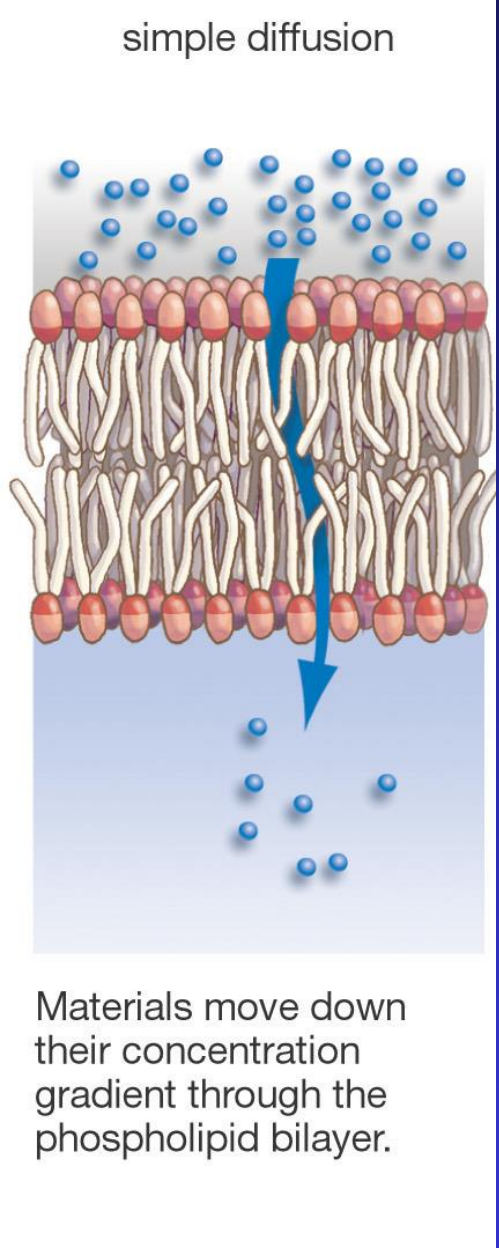


The passage of materials is aided both by a concentration gradient and by a transport protein.

Active transport



Molecules again move through a transport protein, but now energy must be expended to move them against their concentration gradient.

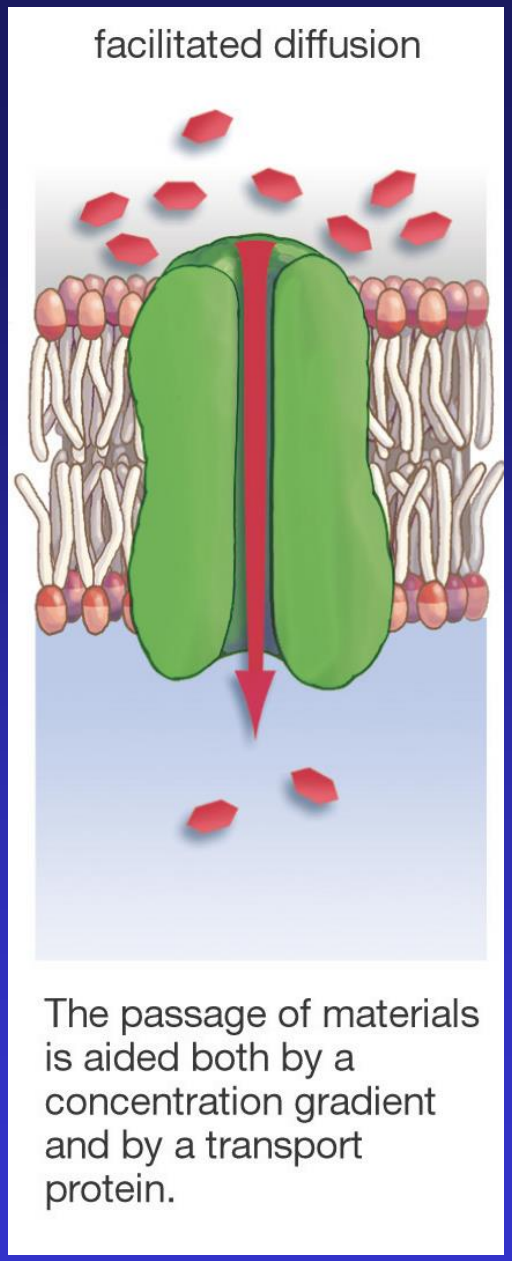


Materials move down their concentration gradient through the phospholipid bilayer.

Passive Transport

Simple Diffusion

- Doesn't require energy
- Moves high to low concentration
- Example: Oxygen or water diffusing into a cell and carbon dioxide diffusing out.



The passage of materials is aided both by a concentration gradient and by a transport protein.

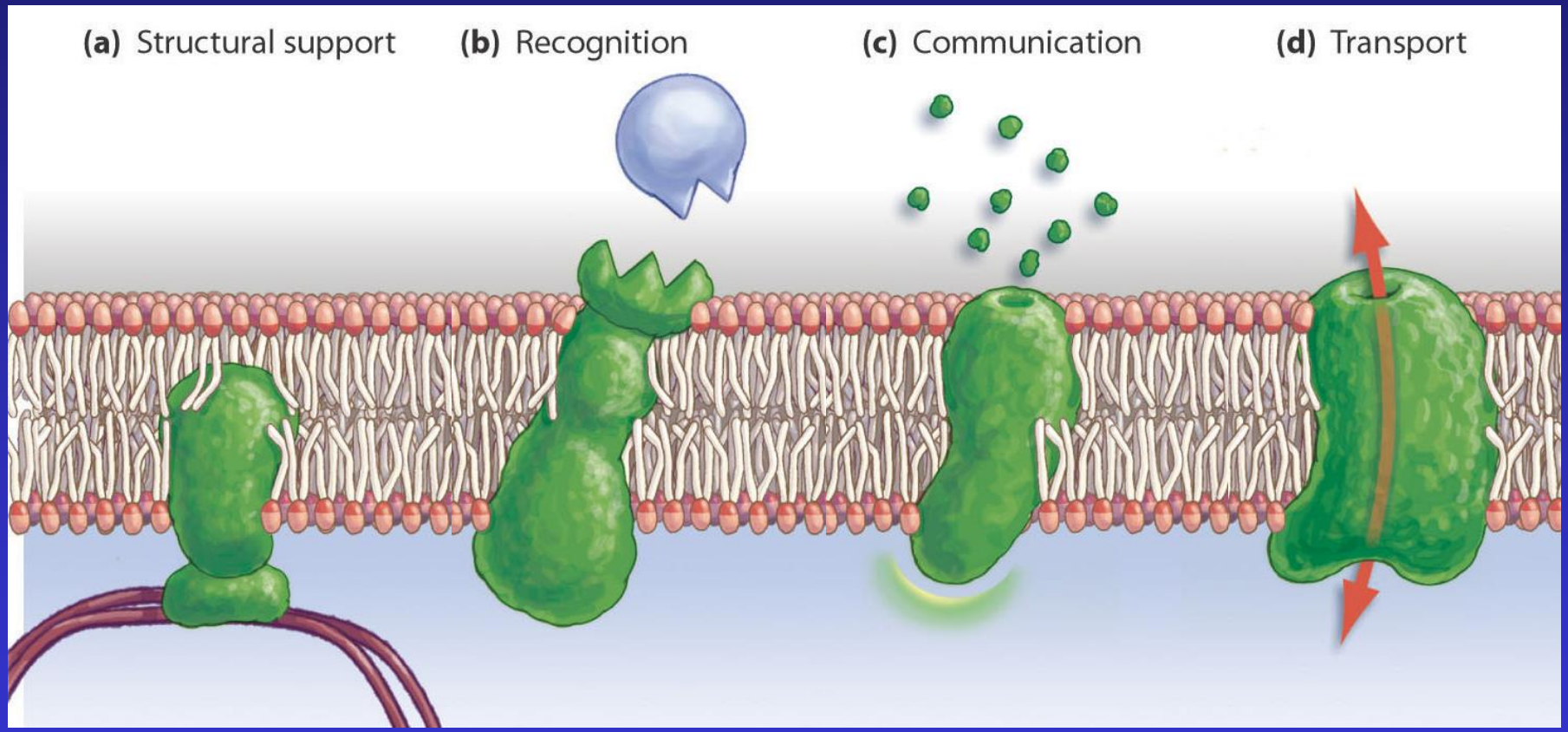
Passive Transport

Facilitated diffusion

- Doesn't require energy
- Uses transport proteins to move high to low concentration

Examples: Glucose or amino acids moving from blood into a cell.

Proteins Are Critical to Membrane Function

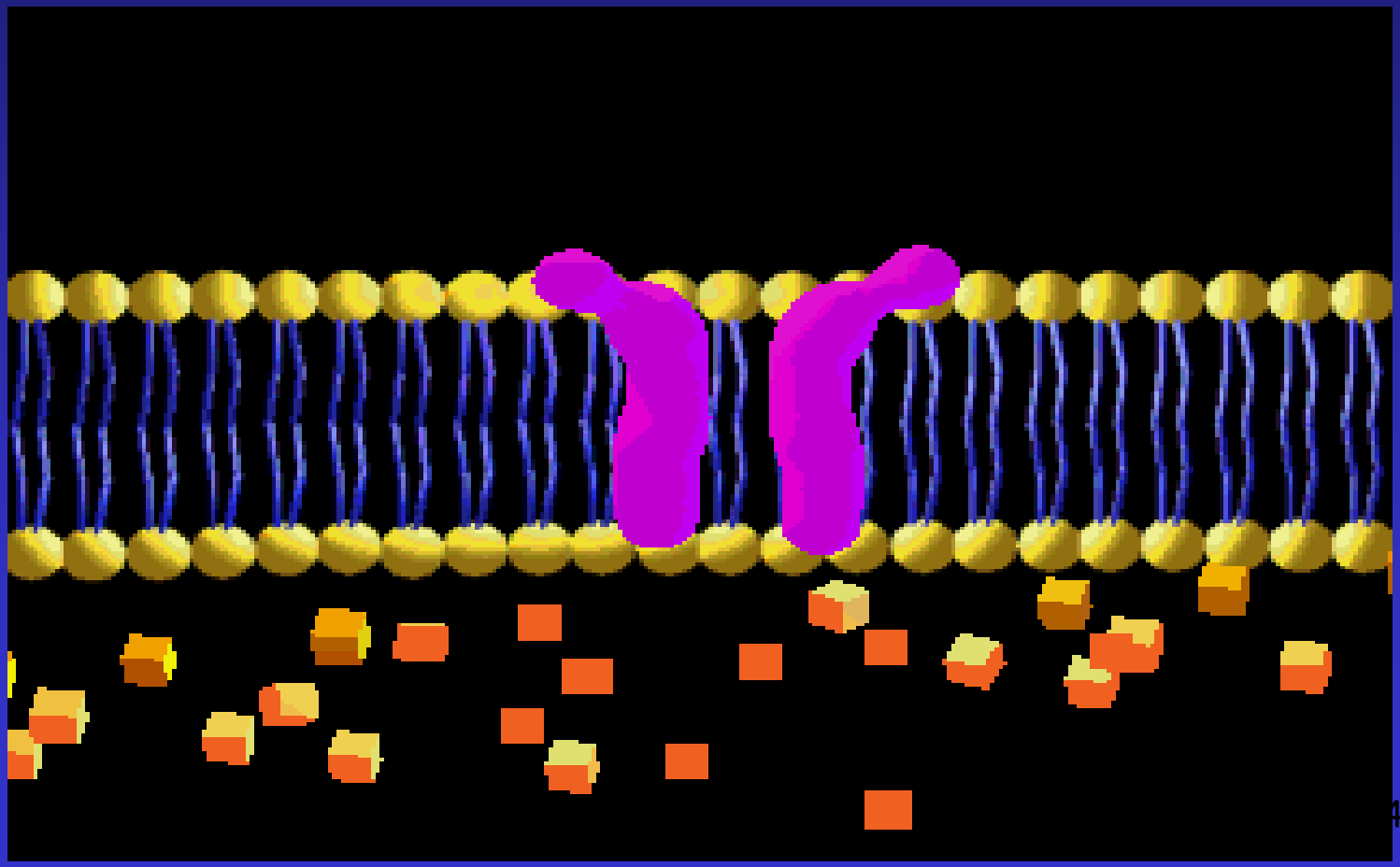


Types of Transport Proteins

- Channel proteins are embedded in the cell membrane & have a pore for materials to cross
- Carrier proteins can change shape to move material from one side of the membrane to the other

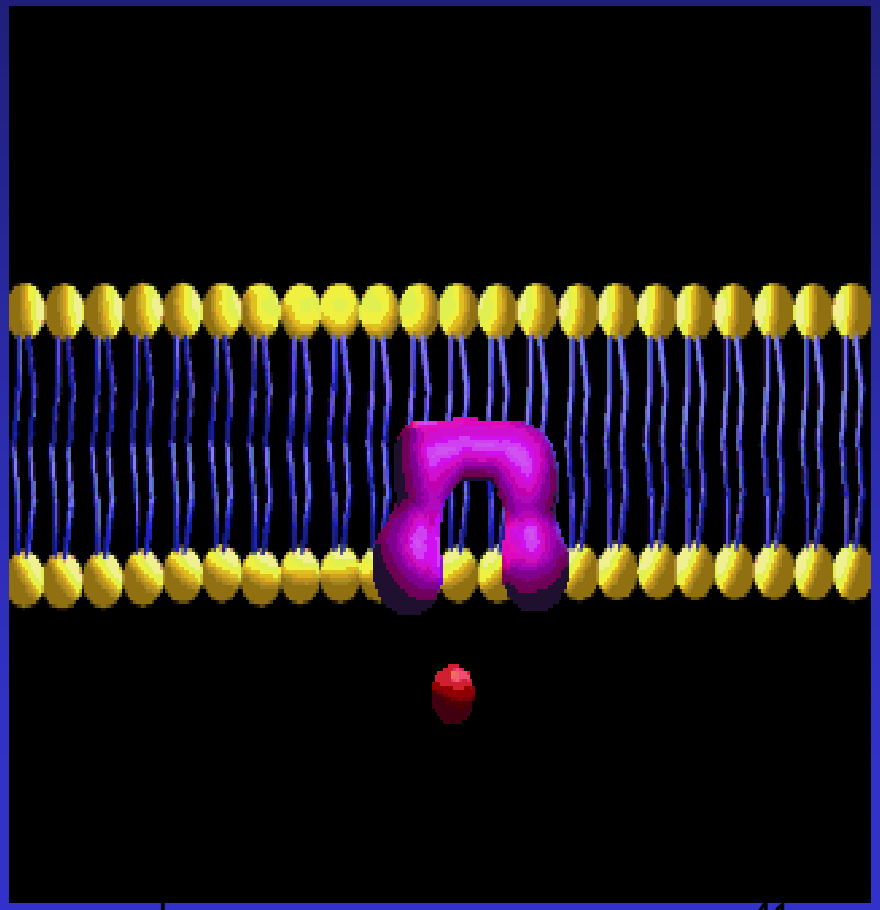
Facilitated Diffusion

Molecules will randomly move through the pores in Channel Proteins.



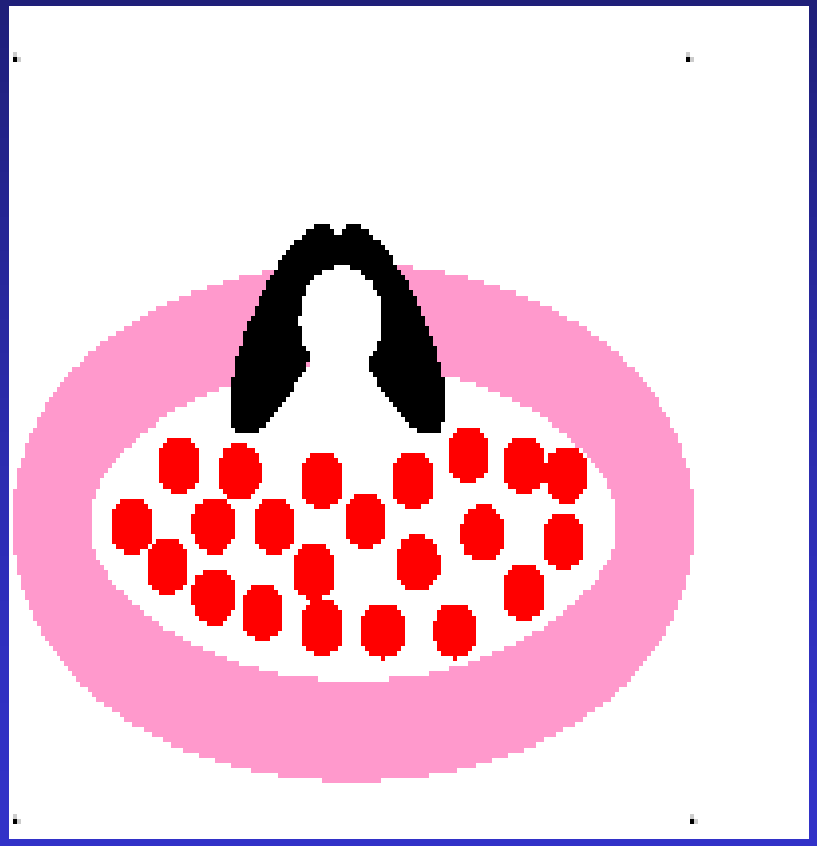
Facilitated Diffusion

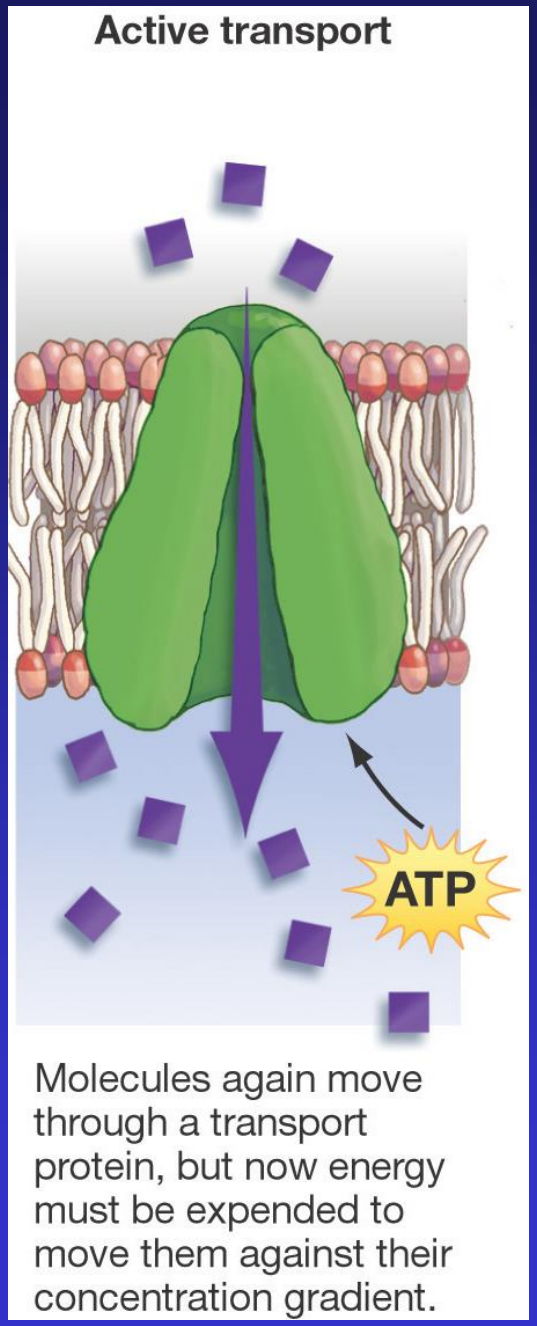
- Some Carrier proteins do not extend through the membrane.
- They bond and drag molecules through the lipid bilayer and release them on the opposite side.



Carrier Proteins

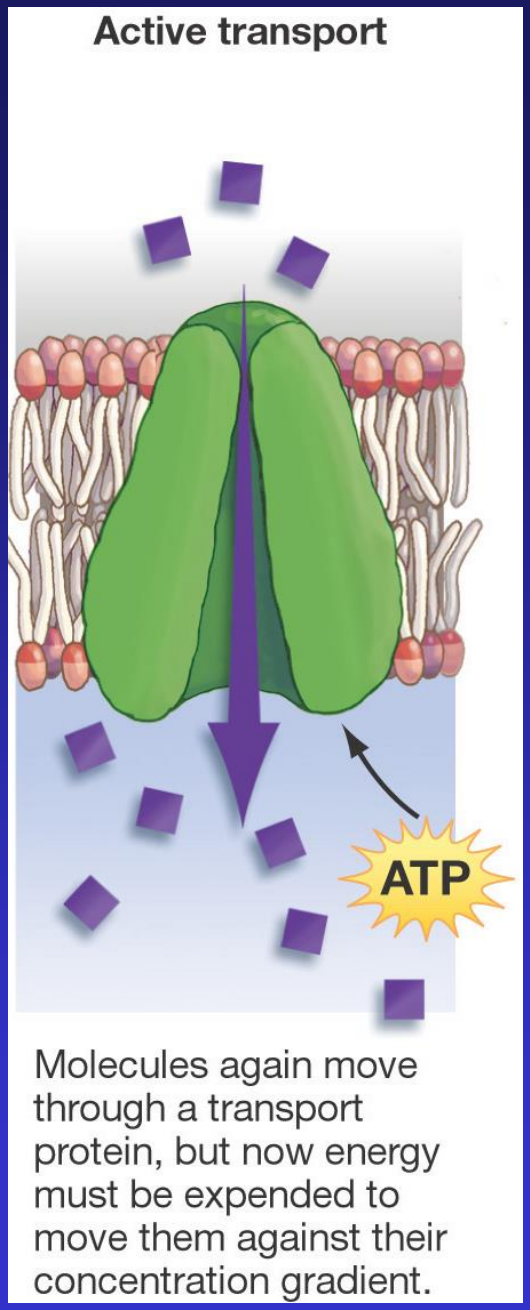
- Other carrier proteins change shape to move materials across the cell membrane





Active Transport

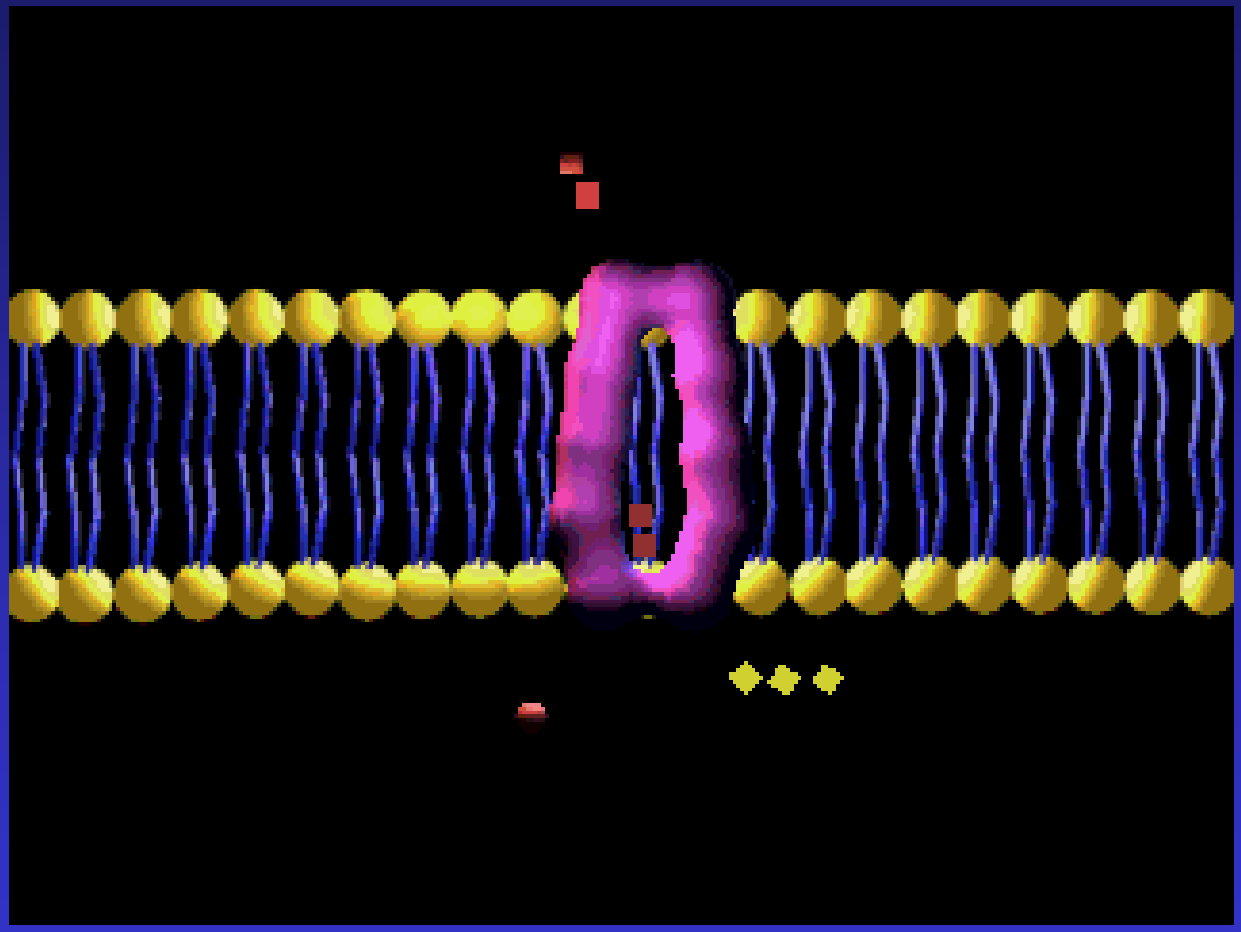
- Requires energy or ATP
- Moves materials from LOW to HIGH concentration
- AGAINST concentration gradient



Active transport

- Examples: Pumping Na^+ (sodium ions) out and K^+ (potassium ions) in against strong concentration gradients.
- Called Na+-K+ Pump

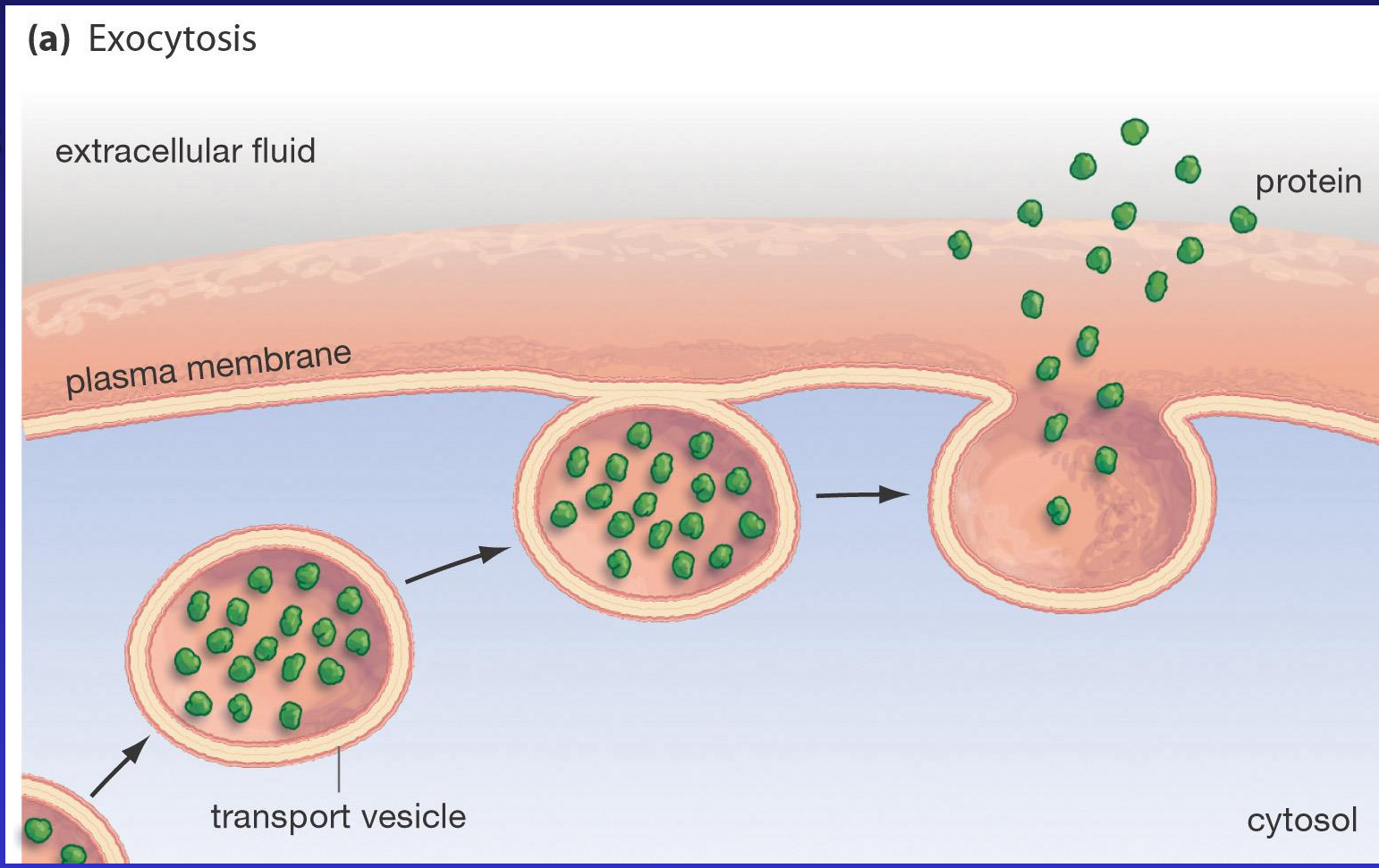
Sodium-Potassium Pump



3 Na+ pumped in for every 2 K+ pumped out; creates a membrane potential

Moving the "Big Stuff"

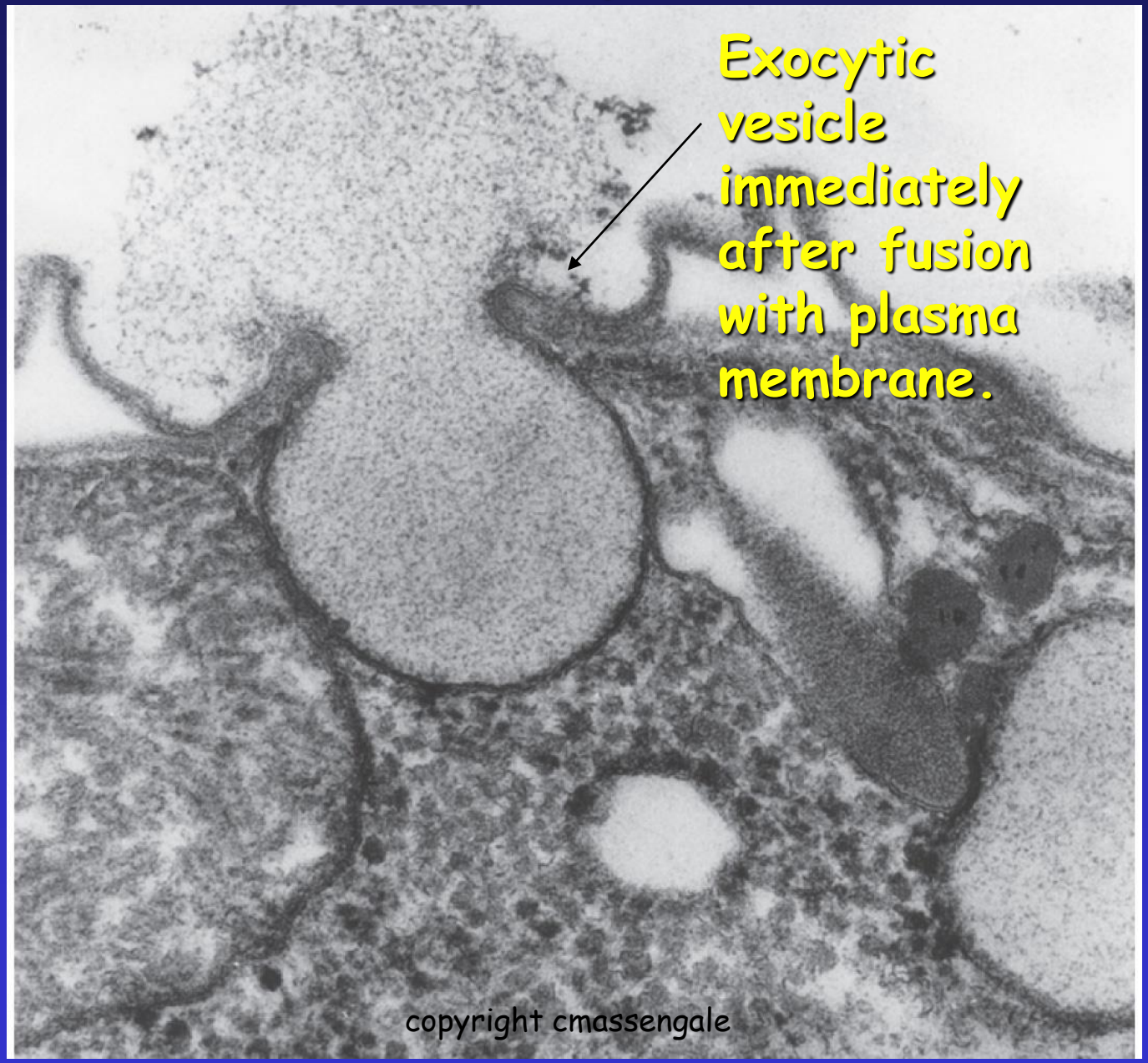
Exocytosis - moving things out.



Molecules are **moved out** of the cell by **vesicles** that **fuse** with the plasma membrane.

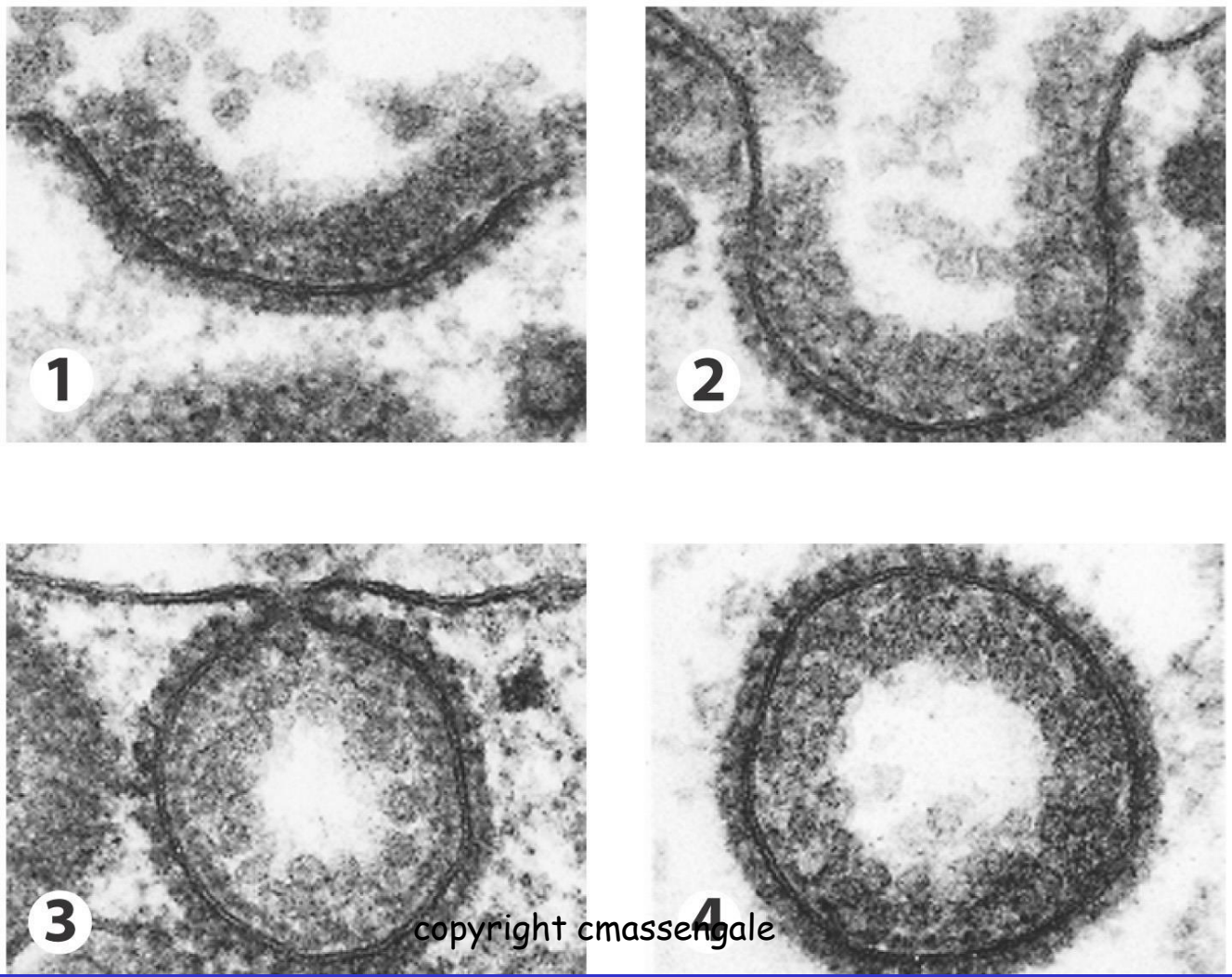
This is how many **hormones** are secreted and how **nerve cells** communicate with one another.

Exocytosis

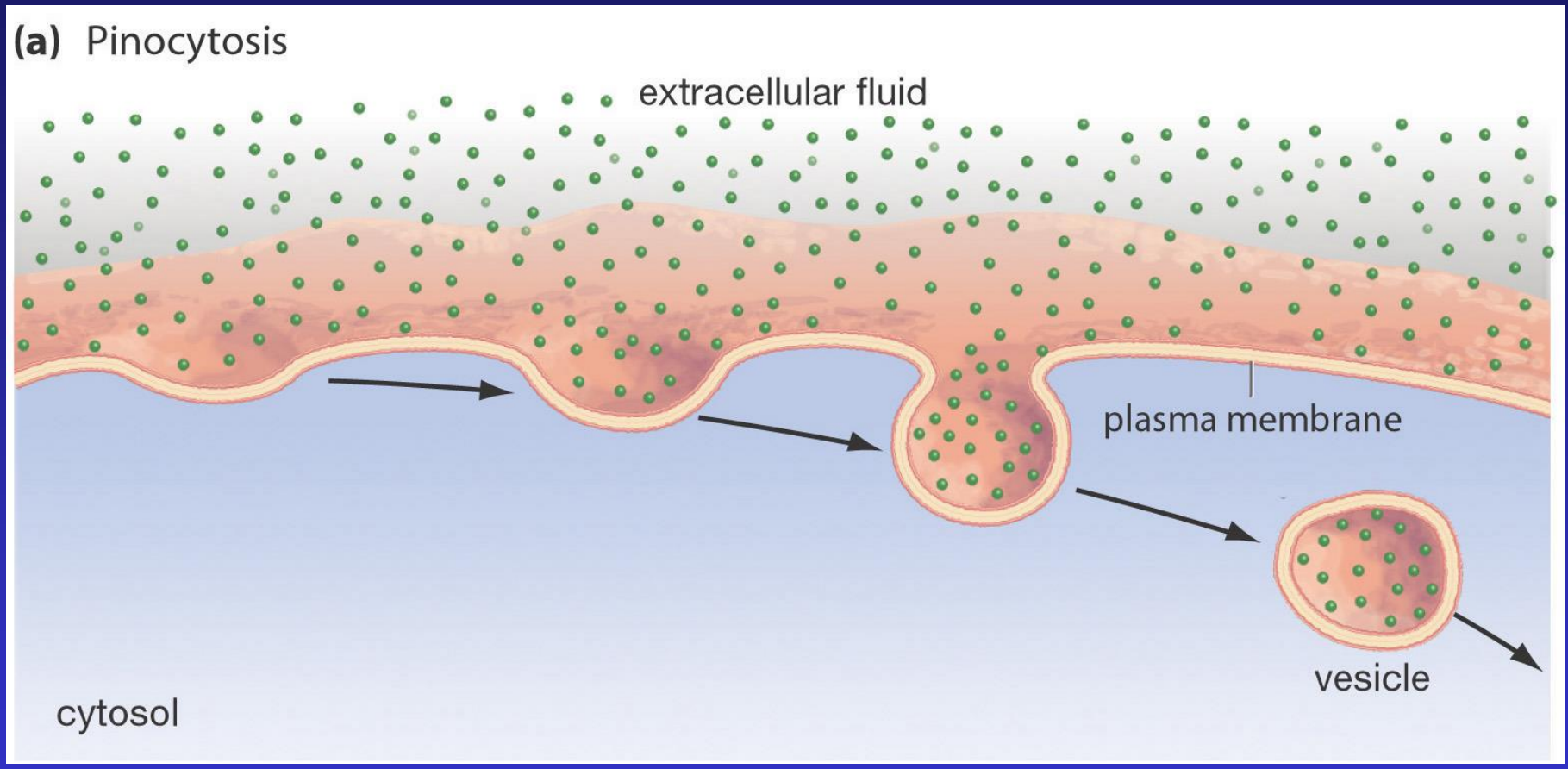

Exocytic vesicle immediately after fusion with plasma membrane.
copyright cmassengale

Moving the "Big Stuff"

Large molecules move materials into the cell by one of three forms of endocytosis.



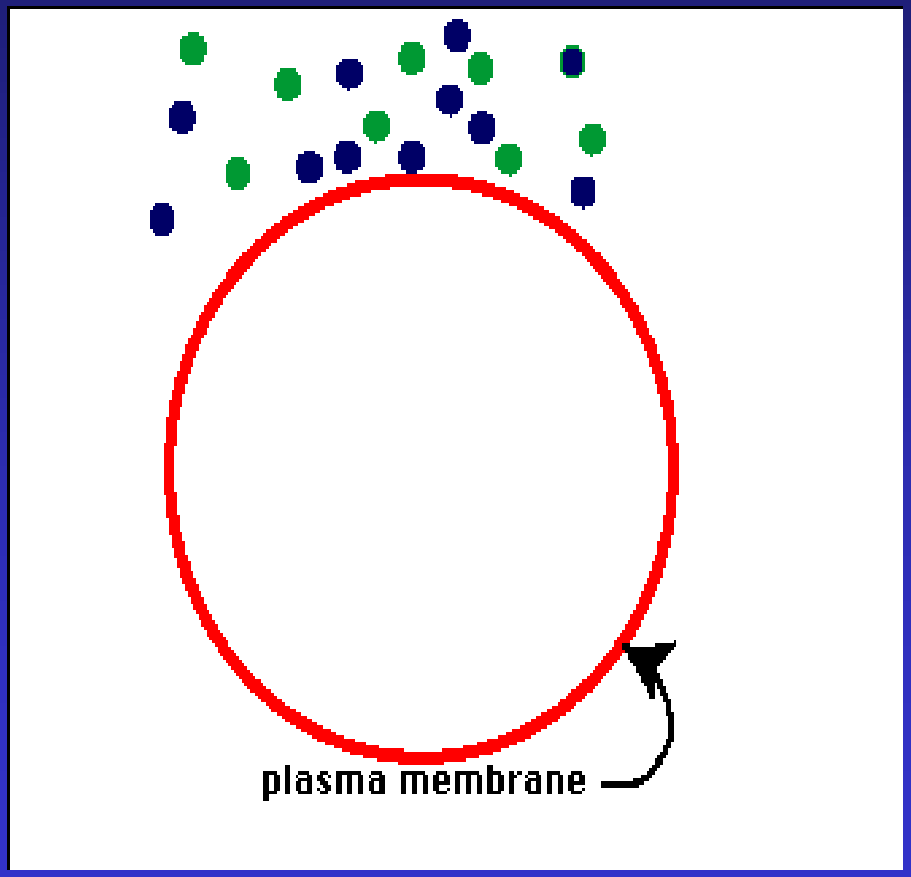
Pinocytosis



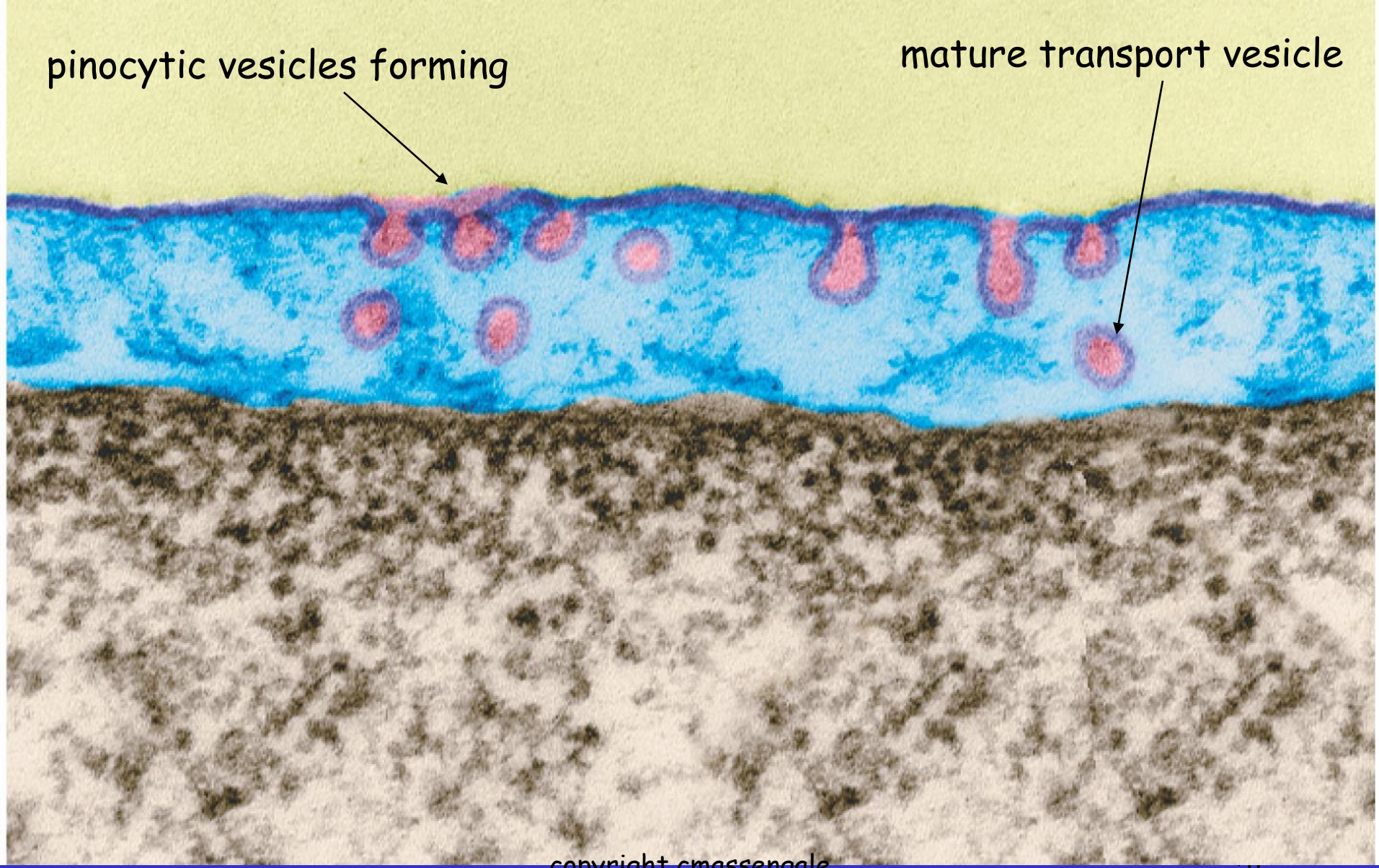
Most **common** form of endocytosis.
Takes in **dissolved** molecules as a vesicle.

Pinocytosis

- Cell forms an invagination
- Materials dissolve in water to be brought into cell
- Called "Cell Drinking"

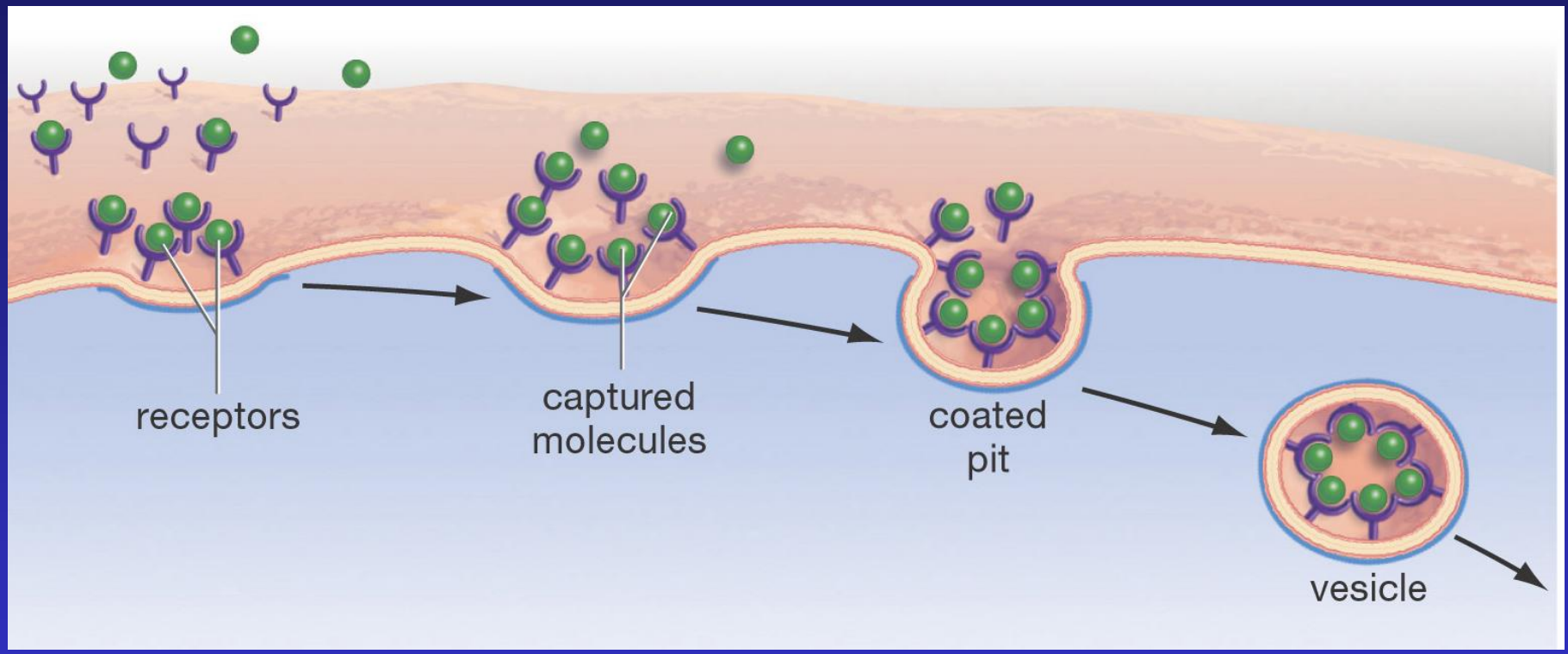


Example of Pinocytosis



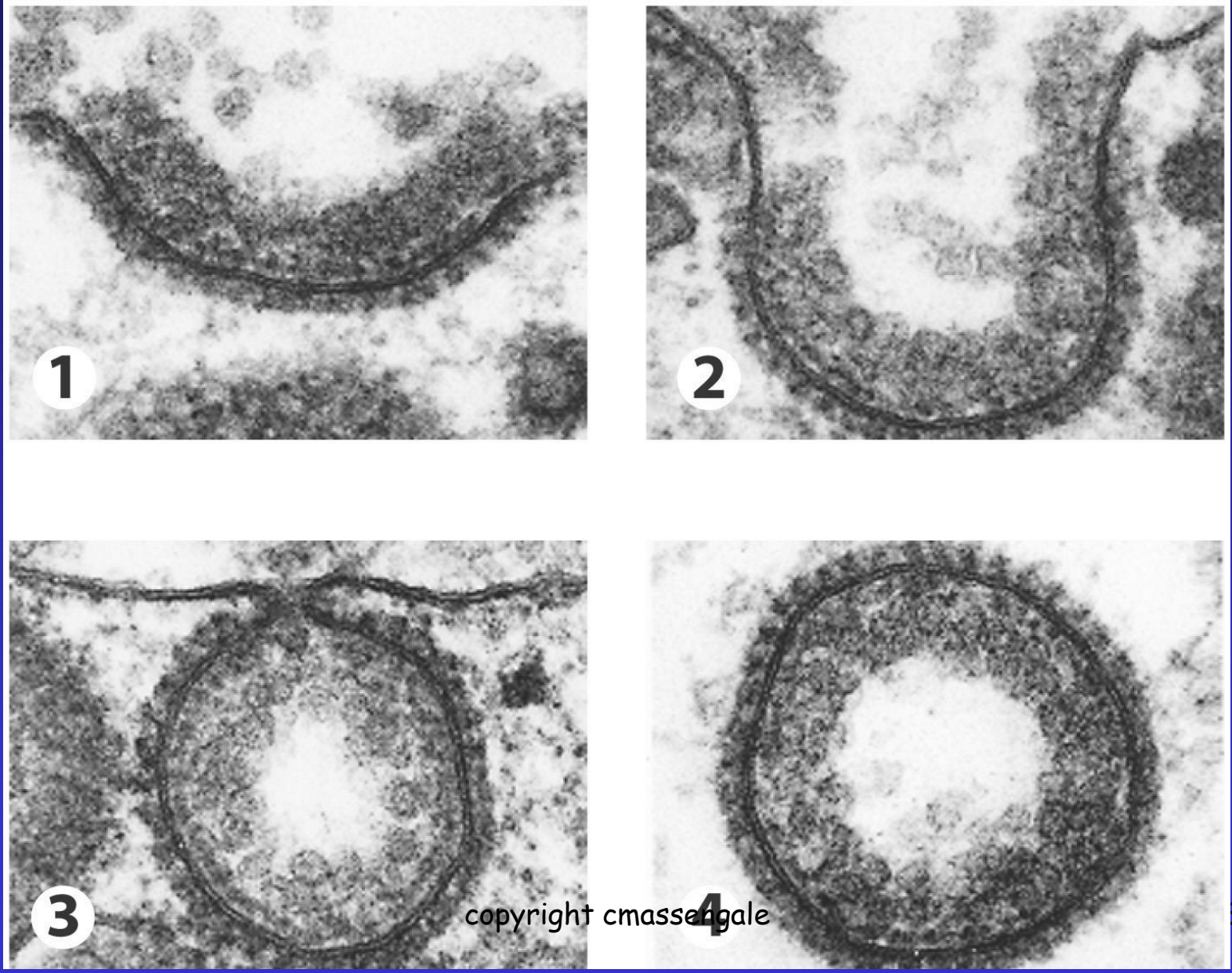
Transport across a capillary cell (blue).

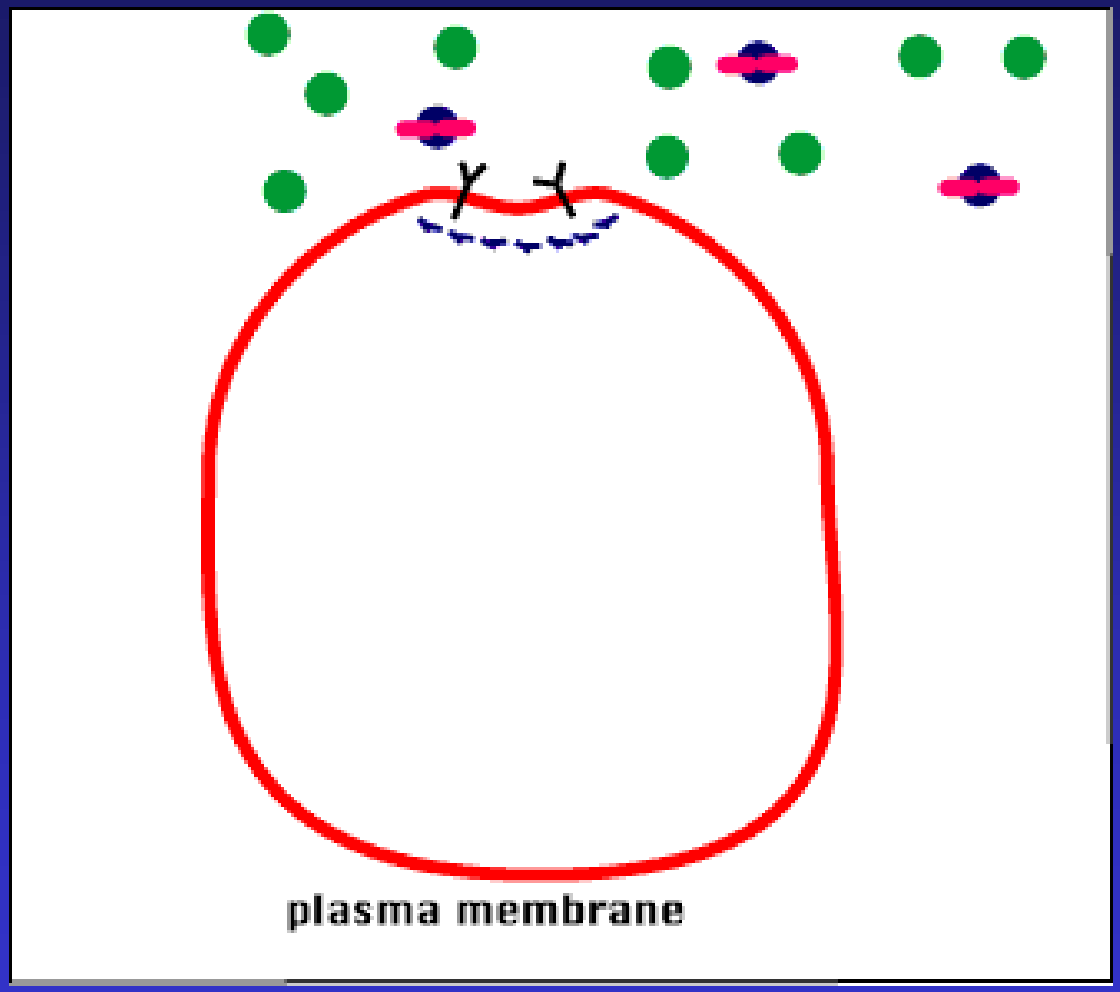
Receptor-Mediated Endocytosis



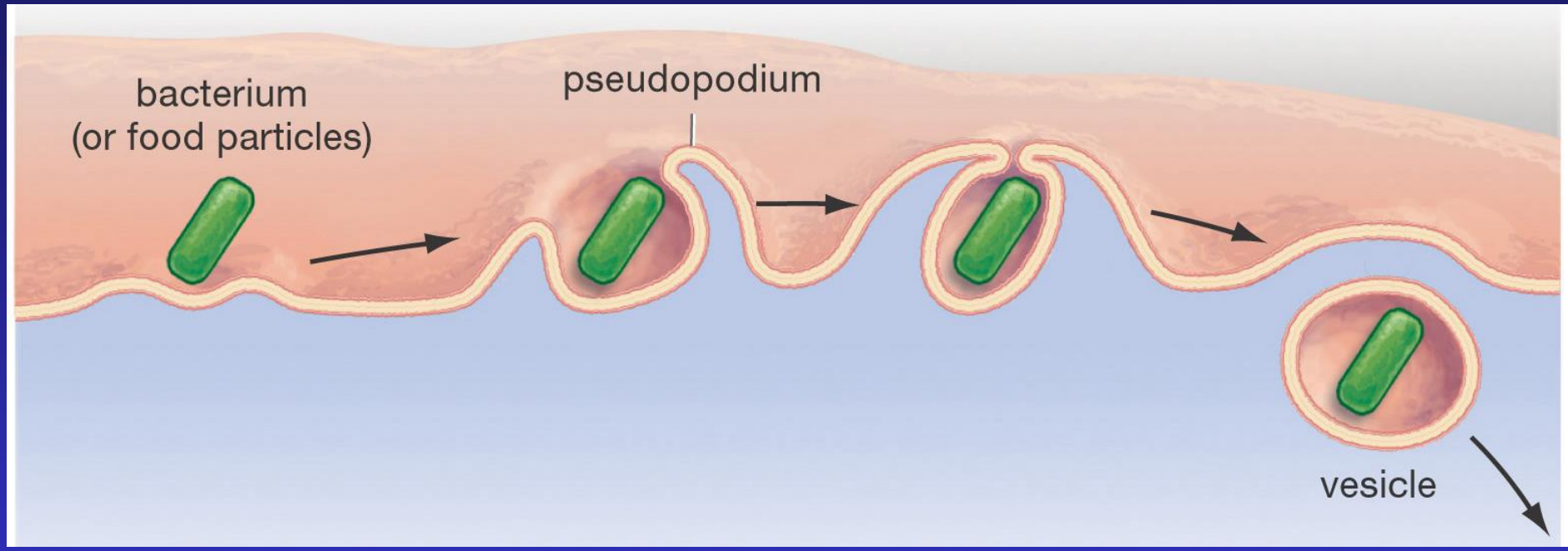
Some integral proteins have receptors on their surface to recognize & take in hormones, cholesterol, etc.

Receptor-Mediated Endocytosis



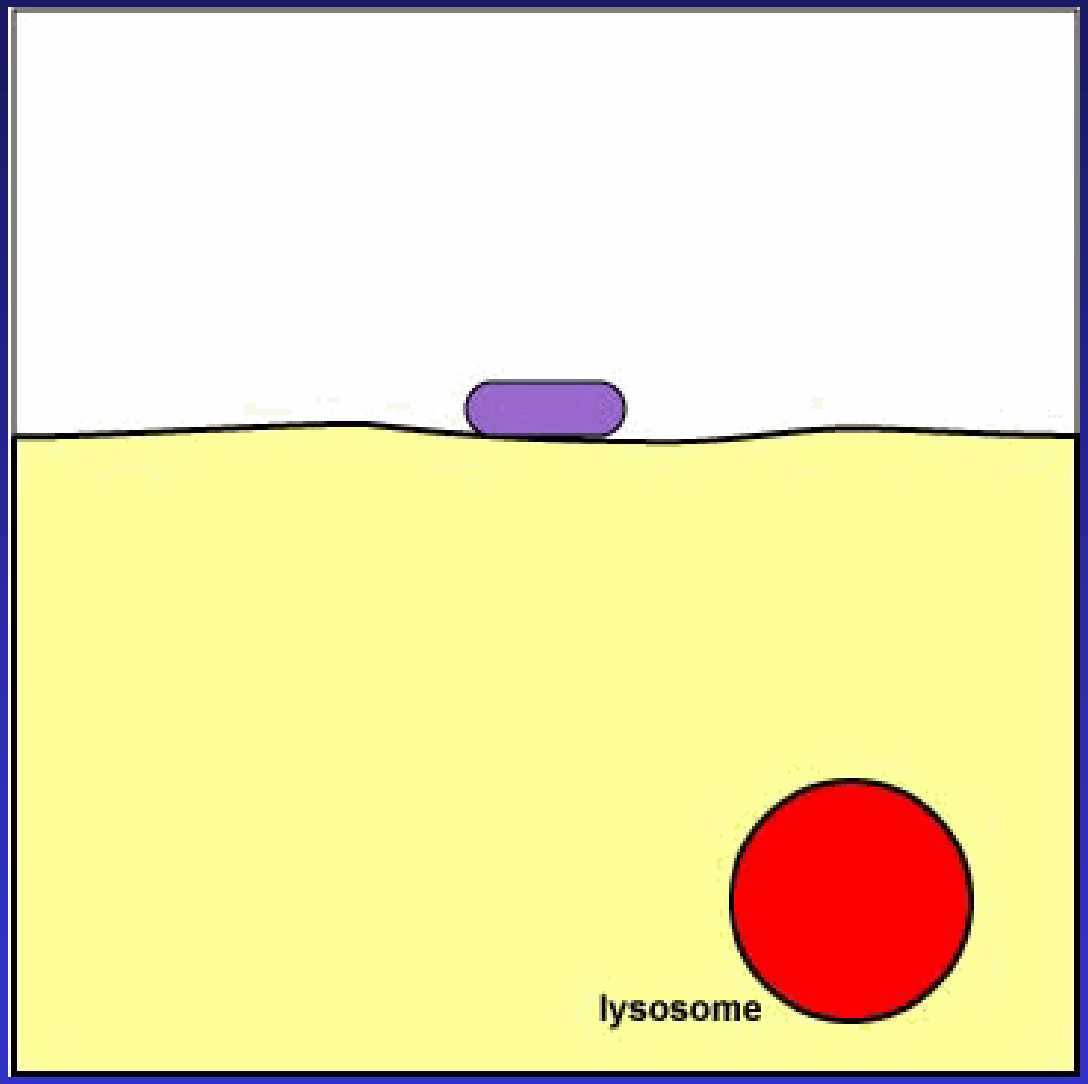


Endocytosis – Phagocytosis

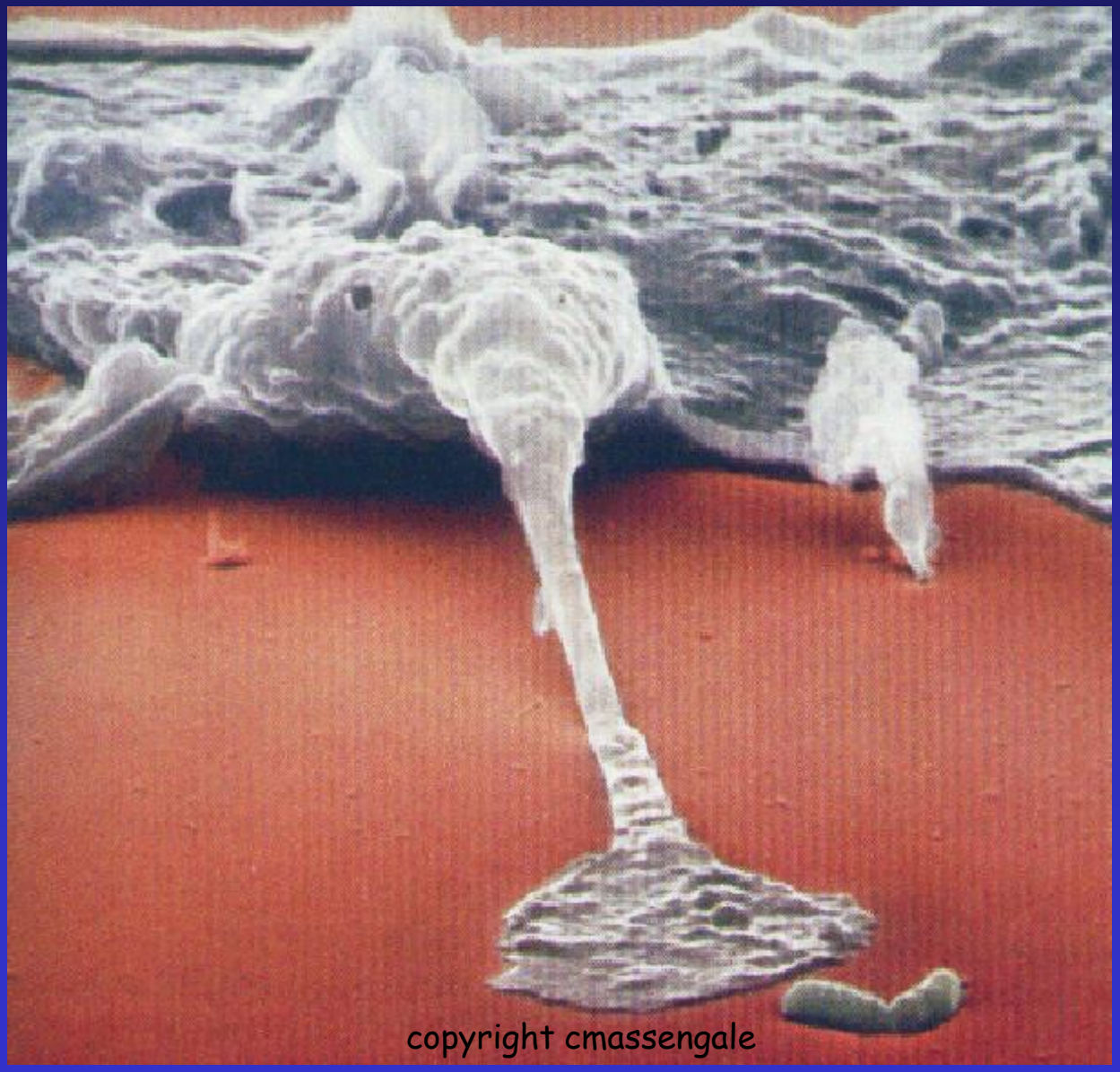


Used to **engulf large particles** such as food, **bacteria**, etc. into vesicles

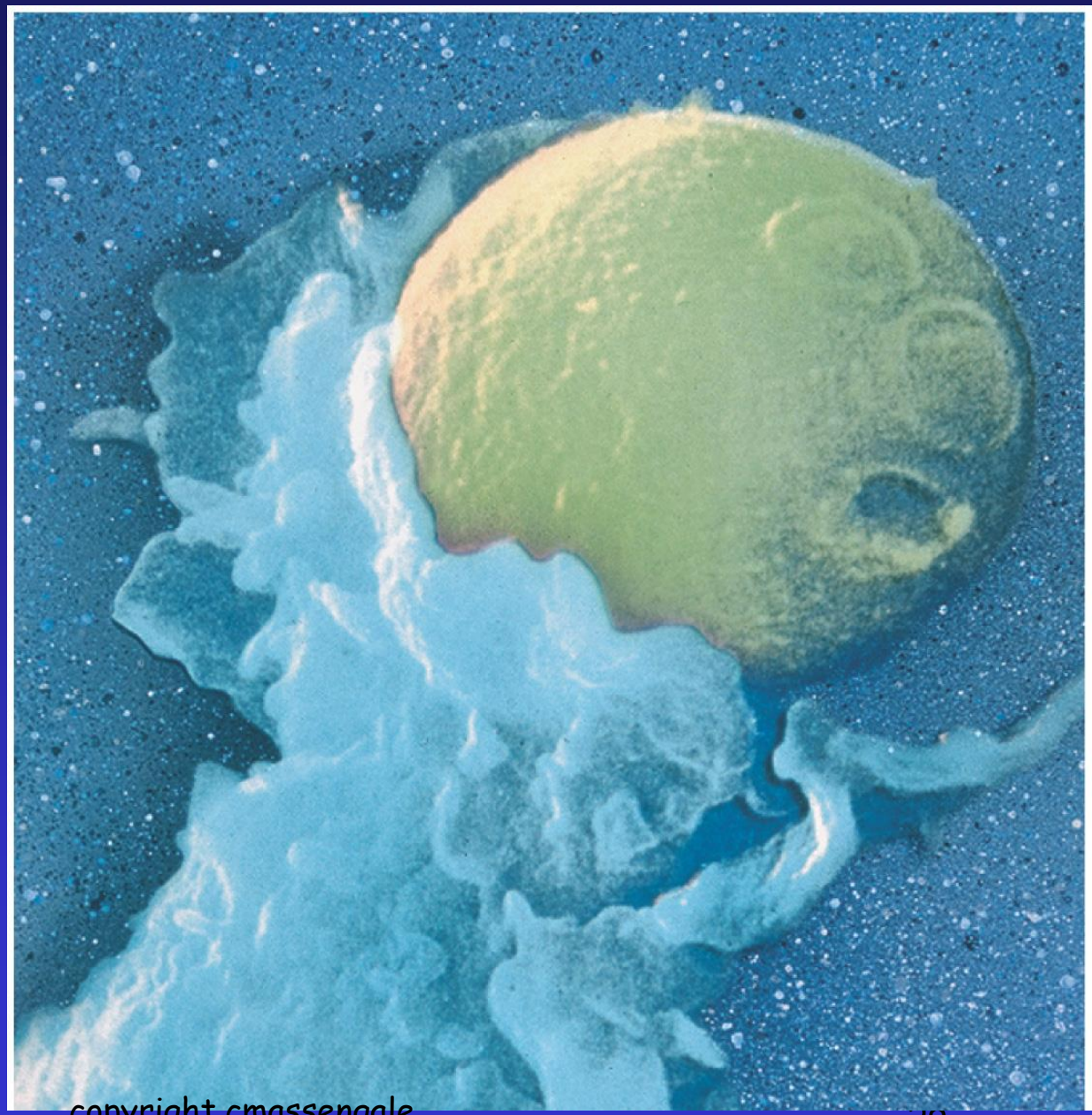
Called **"Cell Eating"**



Phagocytosis About to Occur



Phagocytosis - Capture of a **Yeast** Cell (yellow) by Membrane Extensions of an **Immune System Cell** (blue)



Exocytosis

The opposite of endocytosis is exocytosis. **Large molecules** that are manufactured in the cell are **released** through the cell membrane.