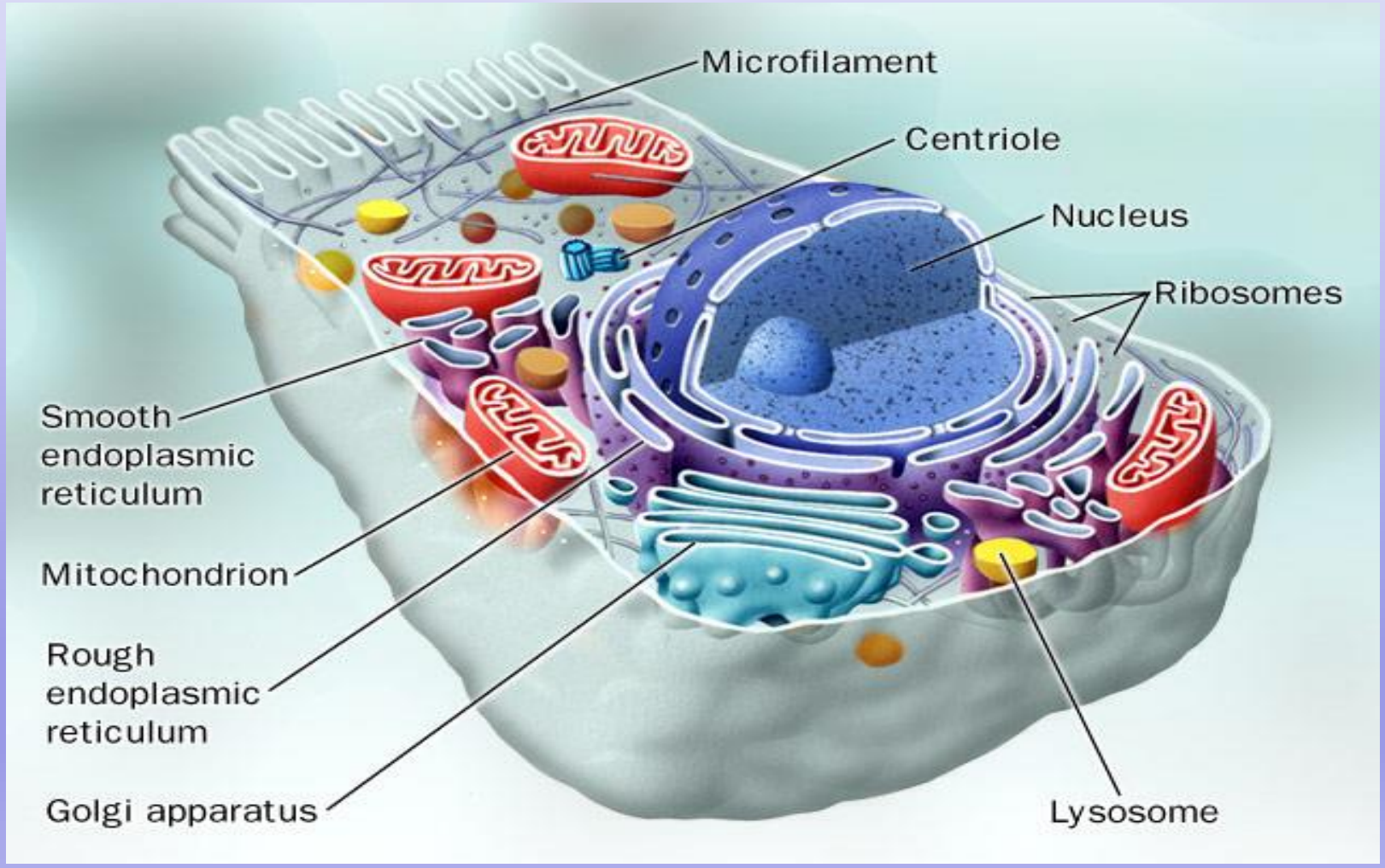
# Go to the "Slide Show" shade above

Click on "Play from Beginning"

# Chapter 4: Introduction to the Cell and Cell Membrane



# Review & Assess What You Know

Every living organism:

-
-
-
-
-
-

Choose the statements below that are **true**. *Check all that apply.*

[ ] Cells are the smallest unit of life.

[ ] Cells are important to the structure and function of living things.

[ ] All organisms are made of multiple cells.

[ ] Cells come in different shapes and sizes.

# Review & Assess What You Know

Every living organism:

- has cells with DNA
- uses energy
- reproduces
- Maintains homeostasis
- responds to the environment
- grows and develops

Choose the statements below that are **true**. *Check all that apply.*

[X] Cells are the smallest unit of life.

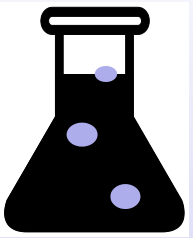
[X] Cells are important to the structure and function of living things.

[ ] ~~All organisms are made of multiple cells.~~

[X] Cells come in different shapes and sizes.

OBJECTIVES

# Lesson Objectives



By the end of this lesson, you should be able to:

- Describe basic structures in all cells and state the cell theory.
- Compare and contrast prokaryotic and eukaryotic cells.
- Describe the anatomy and function of the cell membrane.
- Differentiate between diffusion, osmosis, passive transport, and active transport.
- **Science Practice:** Osmosis in an Egg

WARM-UP

# Identify Cell Structures

Which cell structures are seen in all types of cells? *Check all that apply.*

[ ] membrane bound organelles

[ ] DNA

[ ] cytoplasm

[ ] nucleus

[ ] ribosomes

[ ] cell membrane

Organisms that contain more than one cell with internal membrane-bound structures are known as (Prokaryotes / Eukaryotes).

Organisms that contain only one cell and do not contain a nucleus or internal membrane-bound structures are known as (Prokaryotes / Eukaryotes).

WARM-UP

# Identify Cell Structures

Which cell structures are seen in all types of cells? *Check all that apply.*

[ ] membrane bound organelles

[x] DNA

[x] cytoplasm

[ ] nucleus

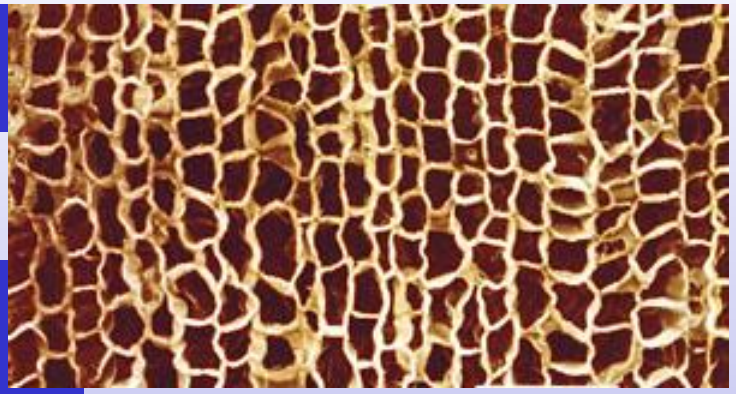
[x] ribosomes

[x] cell membrane

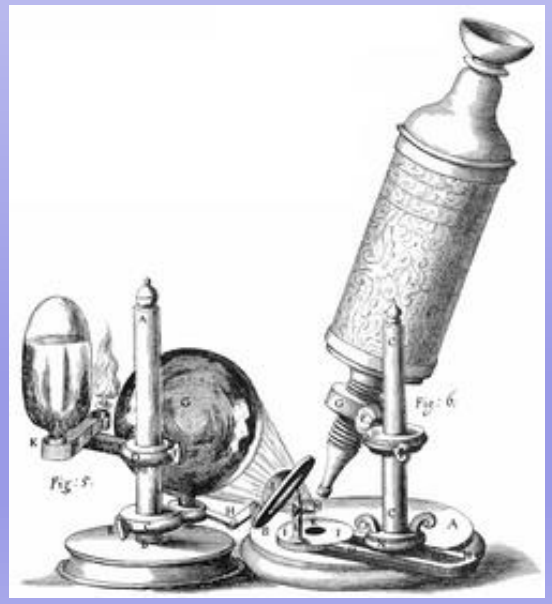
Organisms that contain more than one cell with internal membrane-bound structures are known as Eukaryotes.

Organisms that contain only one cell and do not contain a nucleus or internal membrane-bound structures are known as Prokaryotes.

# First to View Cells



- In 1665, Robert Hooke used a microscope to examine a thin slice of cork (dead plant cell walls).
- What he saw what looked like the small rooms monks used to live in → **Cells.**

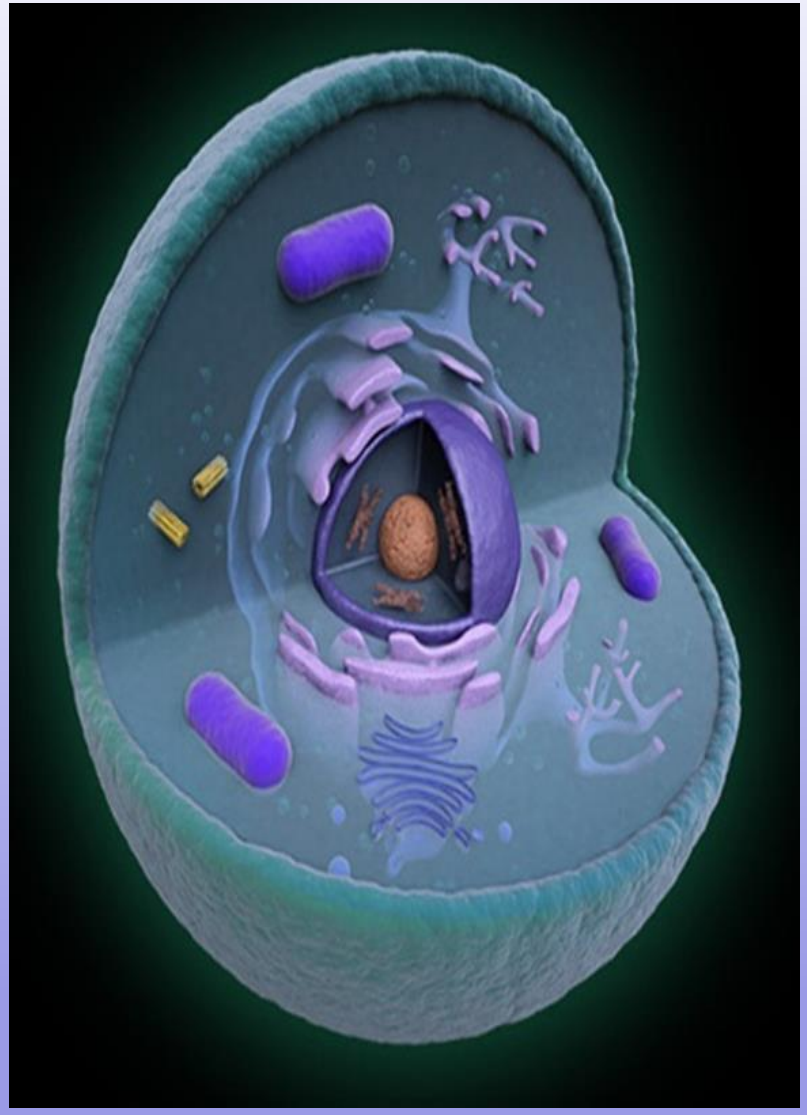


# CELL THEORY

a) All living things are made of **CELLS.**

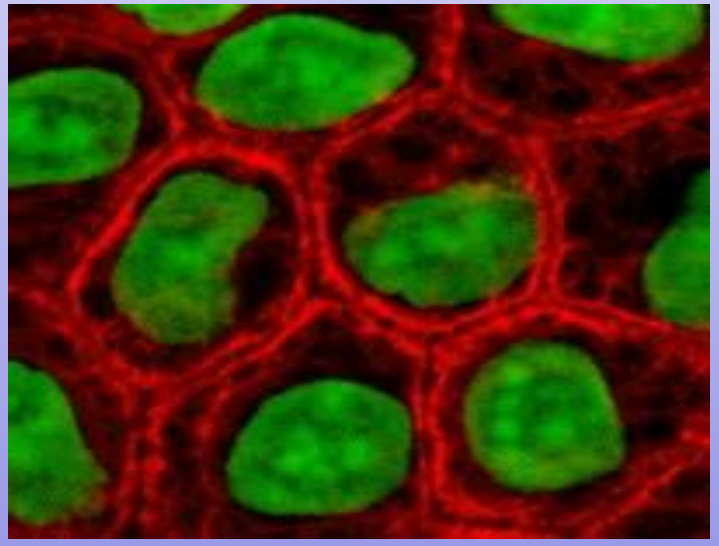
b) Cells are the **basic units of structure and function** for all **Life.**

c) All Cells **are produced from other living cells.**

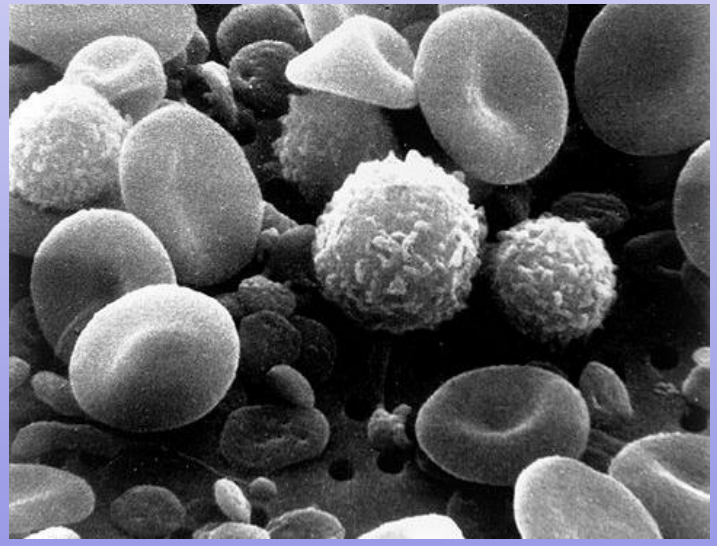


# Cells: The Basic Unit of Life

- A cell is the basic unit of structure and function of all organisms.



- Human skin cells



- Human blood cells

# Cells: The Basic Unit of Life

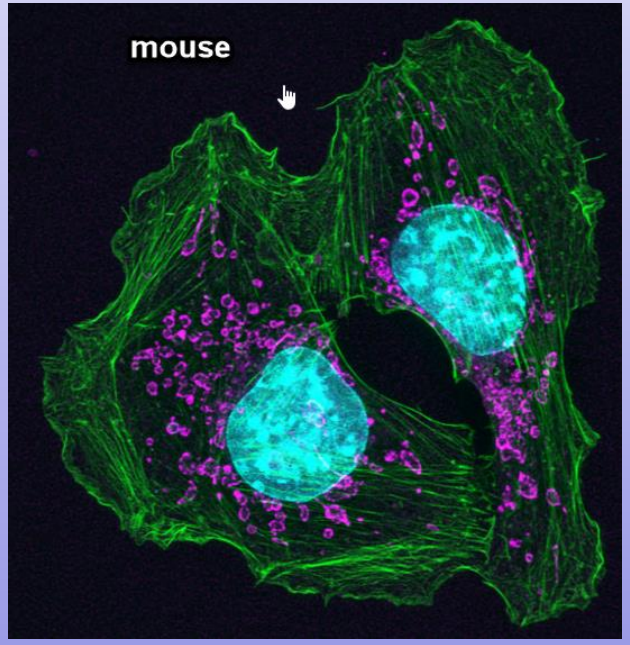
- All organisms are made of cells.

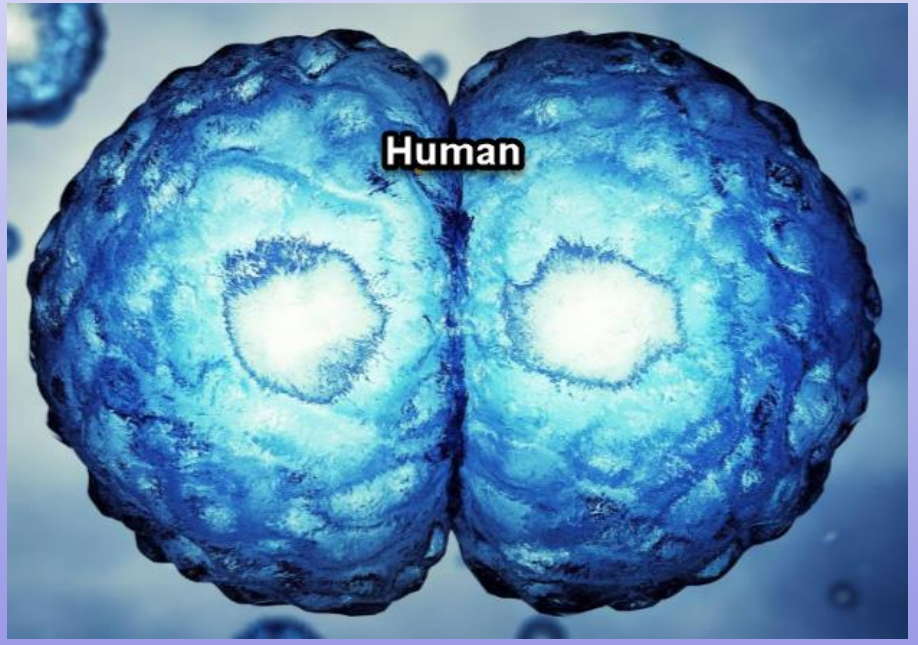
**Unicellular:**
Composed of one cell

**Multicellular:**
Composed of many cells

# Cells: The Basic Unit of Life

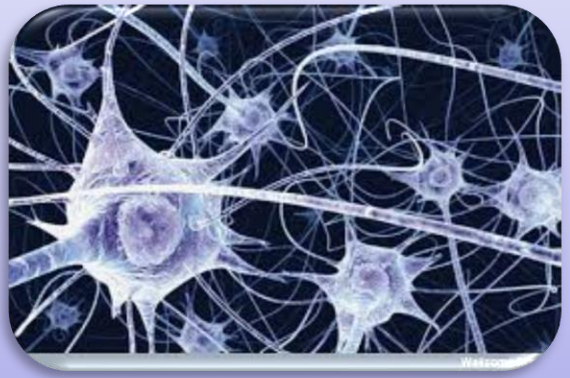
- All cells come from preexisting cells.




One of the **major flaws** of evolution is that ultimately life comes from non-life.

# Cells are diverse in shape, size, and function:



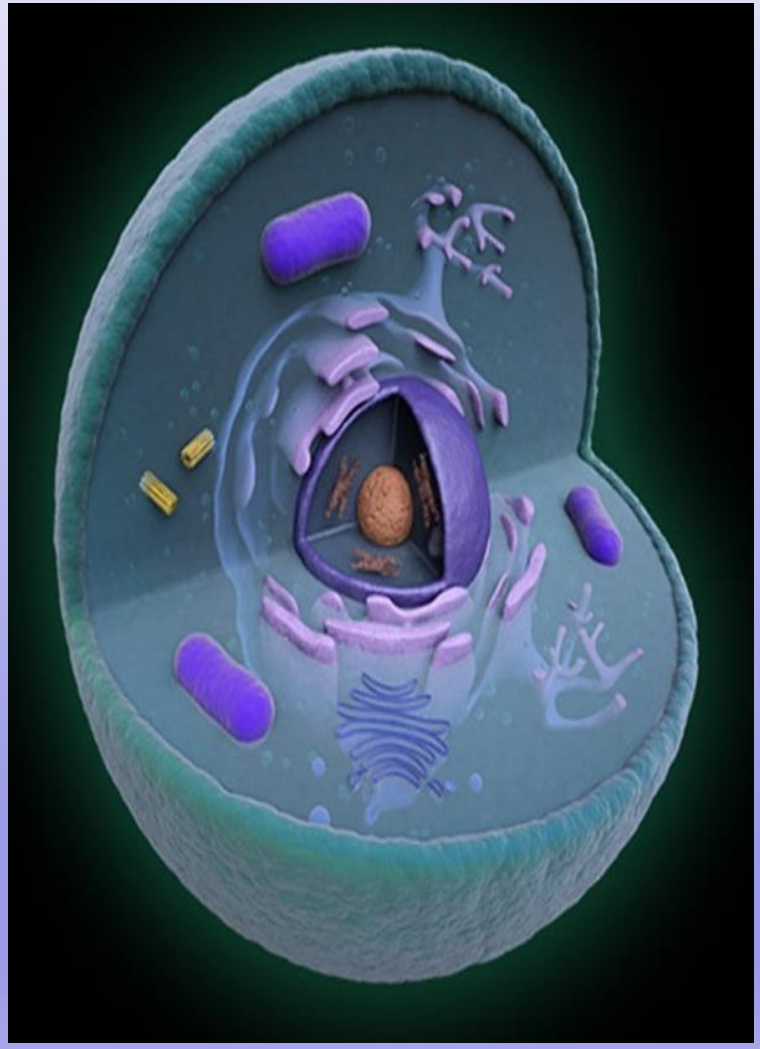
# Number of Cells

Organisms may be:

- **Unicellular** – composed of one cell.
- **Multicellular**- composed of many cells that may organize into tissues, organs, etc.

# Common Features of All Cells

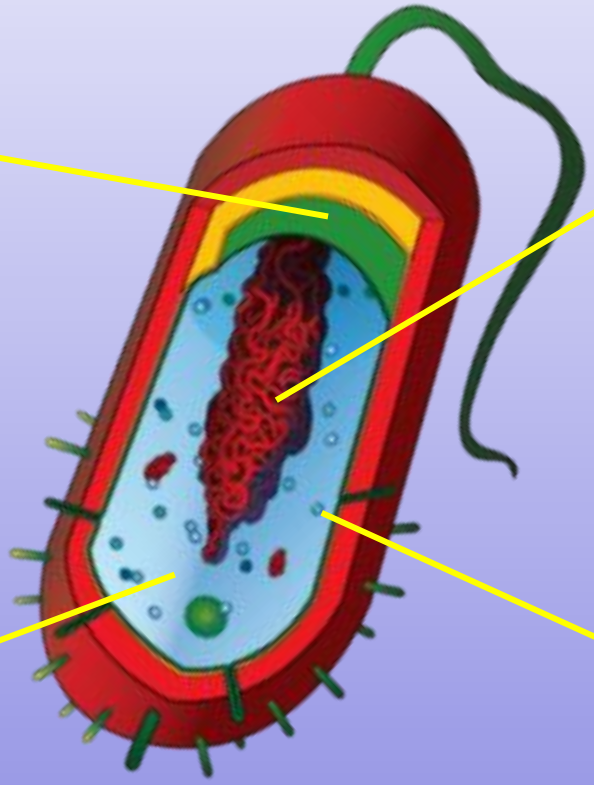
- **Cell Membrane:** Barrier around the cell that protects it from the outside world.
- **Organelles:** Separate units inside of cells which perform certain functions.
- **Contain DNA**



# Common Features of All Cells

## Cell membrane

An organelle that provides a protective layer around the cell and controls what enters and leaves the cell.



## DNA

A nucleic acid that contains the genetic information for heredity in most organisms.

## Cytoplasm

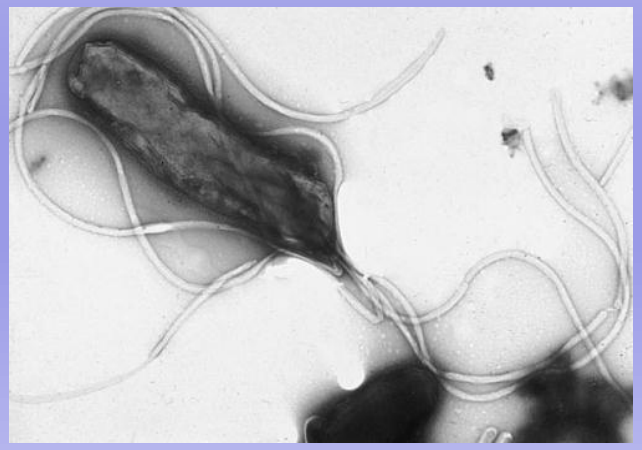
A jelly-like substance that supports and protects organelles in the cell.

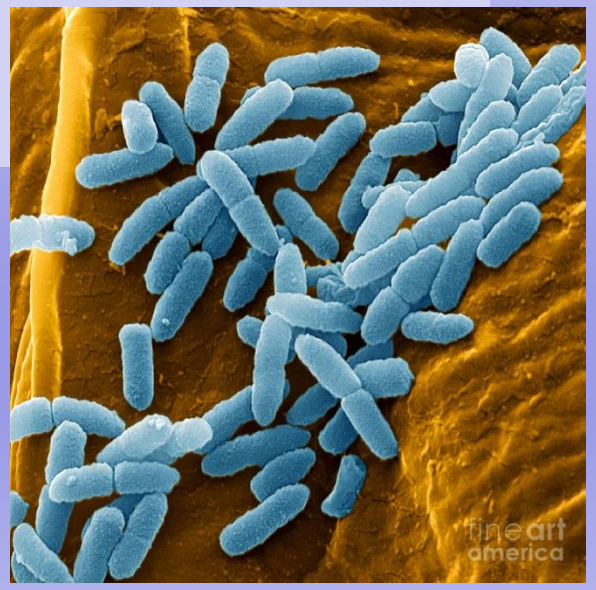
## Ribosomes

Organelles that produce proteins for the cell.

# Prokaryotic Cells

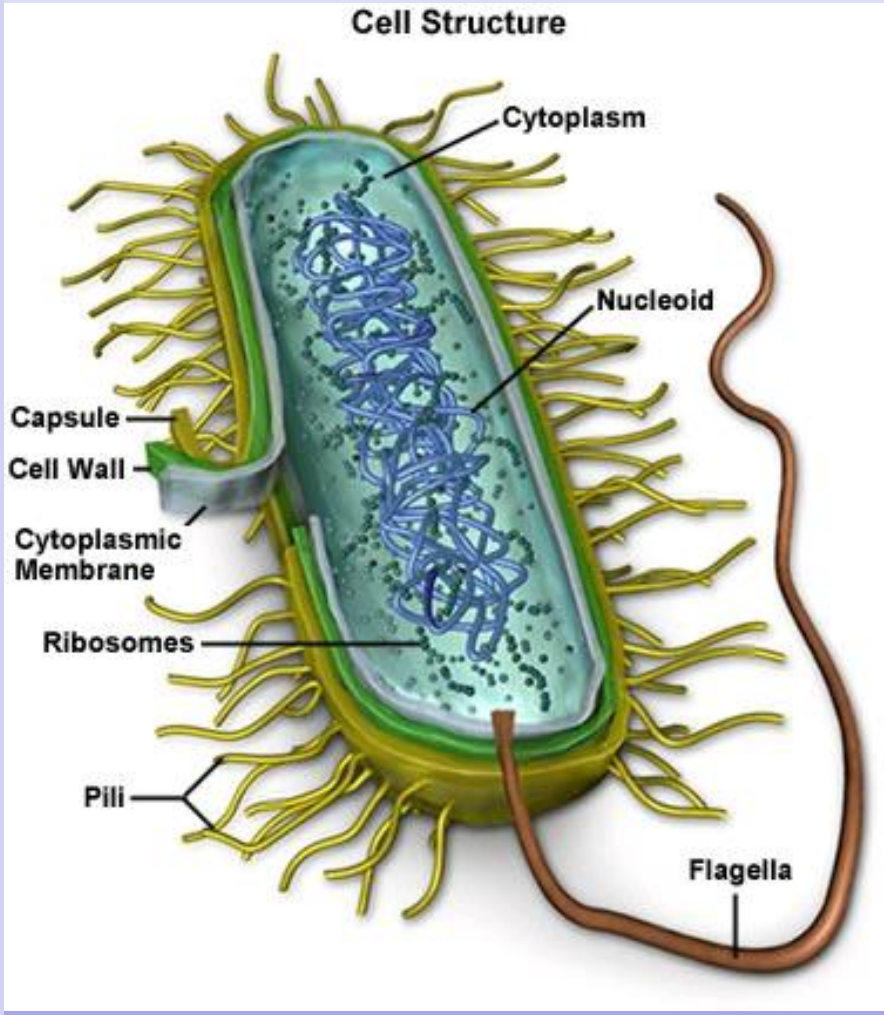
- Cells that lack a nucleus and membrane-bound organelles.
- Includes Eubacteria and Archaebacteria.
- Simplest type of cell.
- Single, circular chromosome.





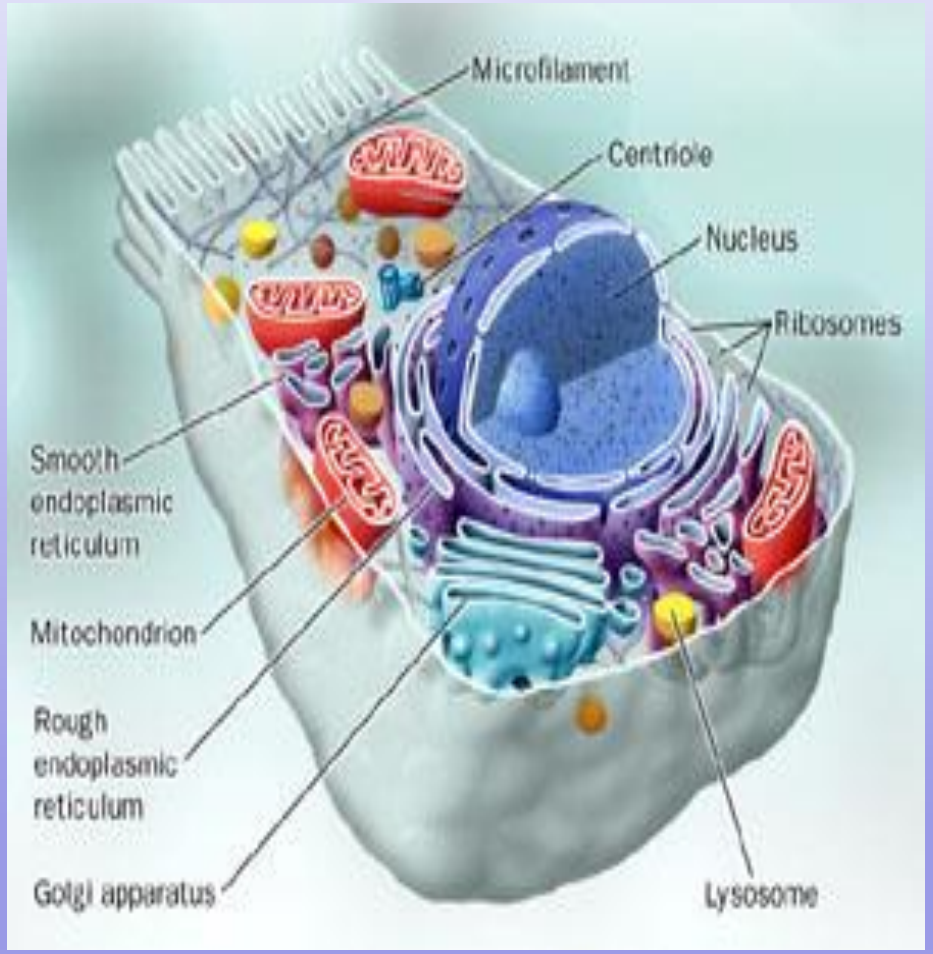
# Prokaryotic Cells

- Nucleoid Region (center) contains the DNA in the cytoplasm.
- Surrounded by Cell Membrane and Cell Wall.
- No membrane-bound organelles.
- Contain Ribosomes in their Cytoplasm to make proteins.

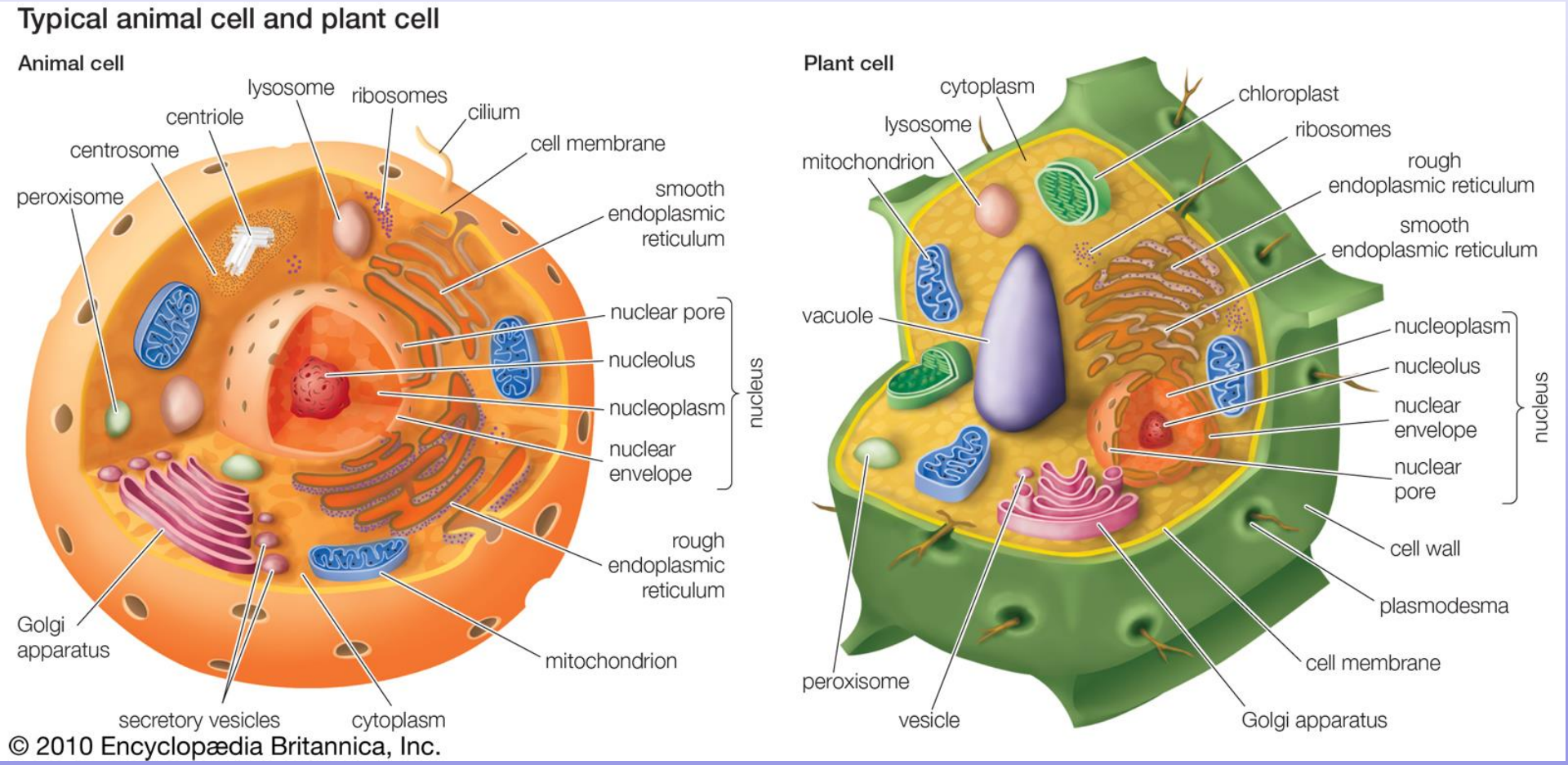


# Eukaryotic Cells

- Cells that HAVE a **nucleus** and membrane-bound + non-membrane bound **organelles.**
- Includes protists, fungi, plants, & animals.
- More complex type of cells.



# Two Main Types of Eukaryotic Cells




**Animal Cell**
(No Cell Walls)

**Plant Cell**

# Summary of the Difference Between Eukaryotic and Prokaryotic Cells

QUICK CHECK

| Feature | Prokaryote | Eukaryote |
|---|---|---|
| **Cell (Plasma) Membrane** | ? | ? |
| **Nucleus** | ? | ? |
| **Nuclear Material** | ? | ? |
| **Organelles (with or without membranes)** | ? | ? |
| **Cell Wall** | ? | Animals – ?<br>Plants - ? |
| **Cytoplasm** | ? | ? |



Figure 4.7.2

# Summary of the Difference Between Eukaryotic and Prokaryotic Cells

QUICK CHECK

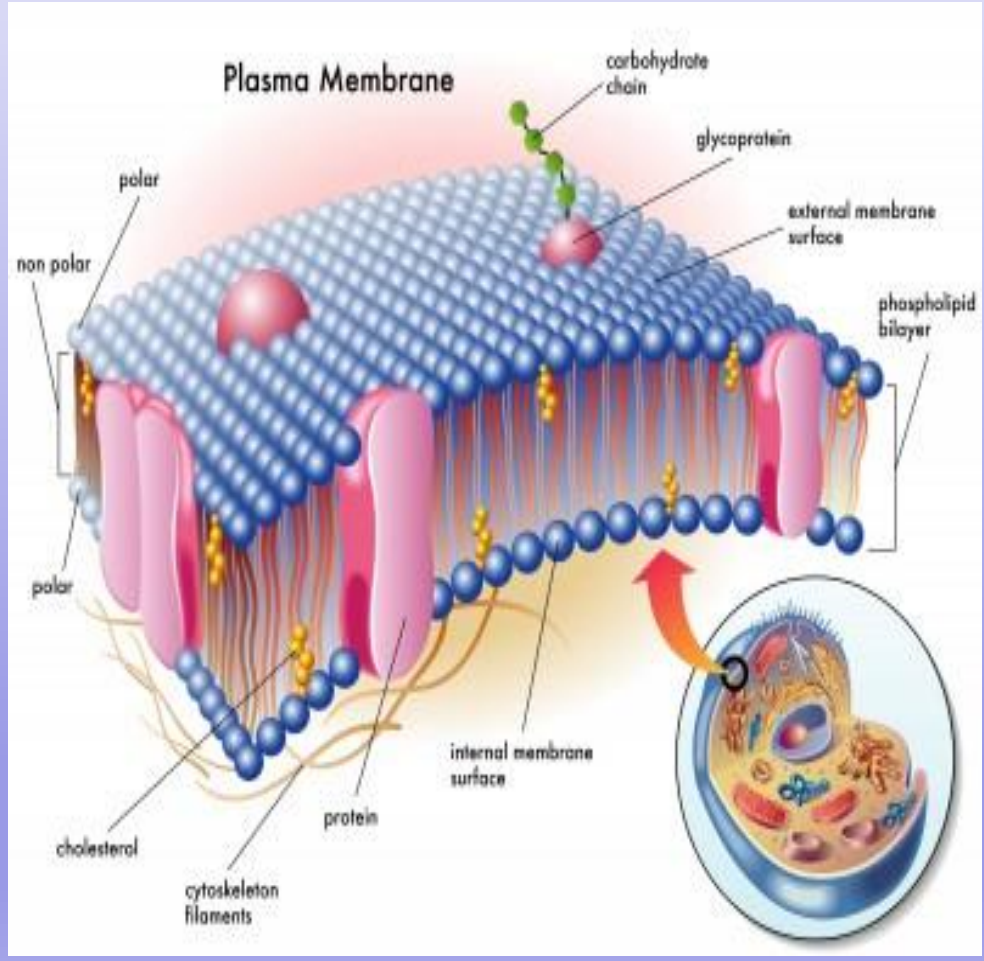
| Feature | Prokaryote | Eukaryote |
|---|---|---|
| **Cell (Plasma) Membrane** | Yes; All | Yes; All |
| **Nucleus** | No | Yes; All |
| **Nuclear Material** | Not a true nucleus; DNA free-floating in **Nucleoid Area** of the cytoplasm | Inside membrane-bound **Nucleus**; In the form of **Chromosomes** |
| **Organelles** | No membrane-bound organelles<br>Only non-membrane bound (e.g. Ribosomes) | Complex organelles with and without membranes |
| **Cell Wall** | Yes, some | Animals – No<br>Plants - Yes |
| **Cytoplasm** | Yes | Yes |



Figure 4.7.2

# Cell Membrane

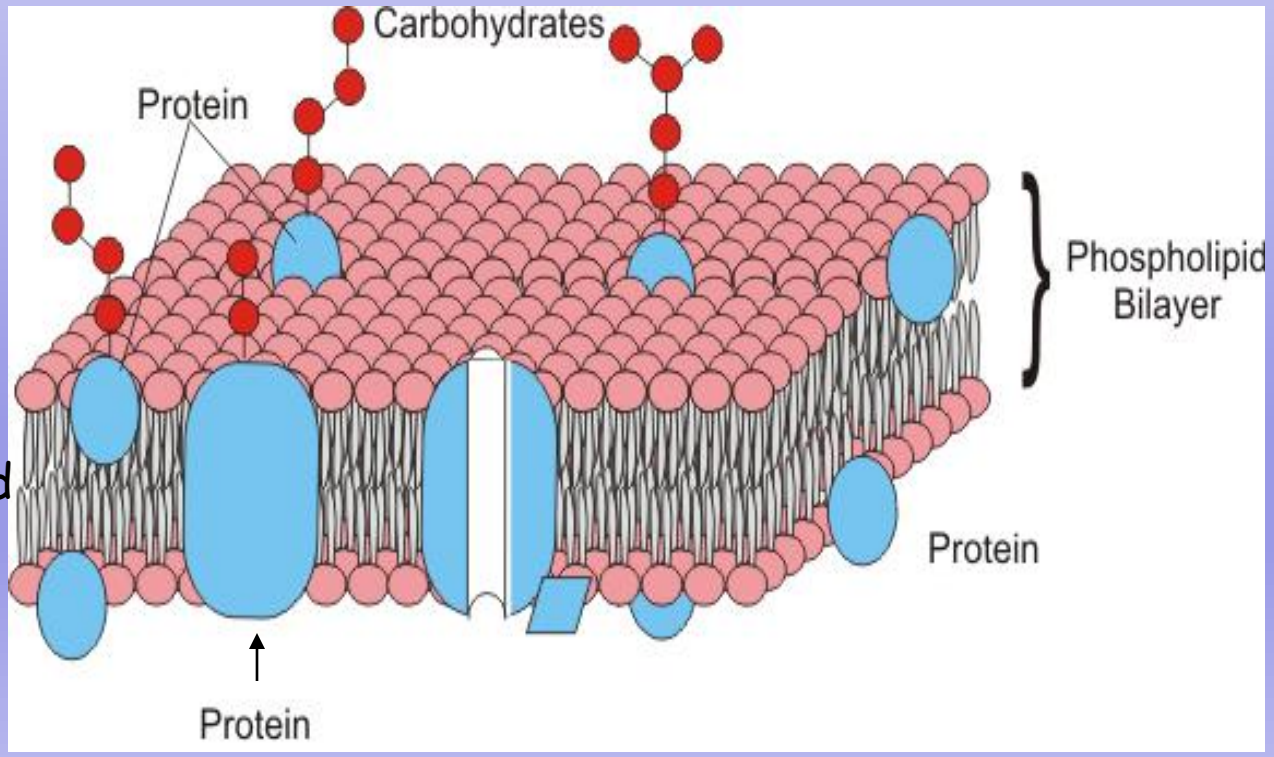
- Made up mostly of lipids and proteins.
- Outer boundary of the cell.
- Regulates which molecules can get in and out of the cell (selectively permeable).
- Helps with Cell to Cell recognition.



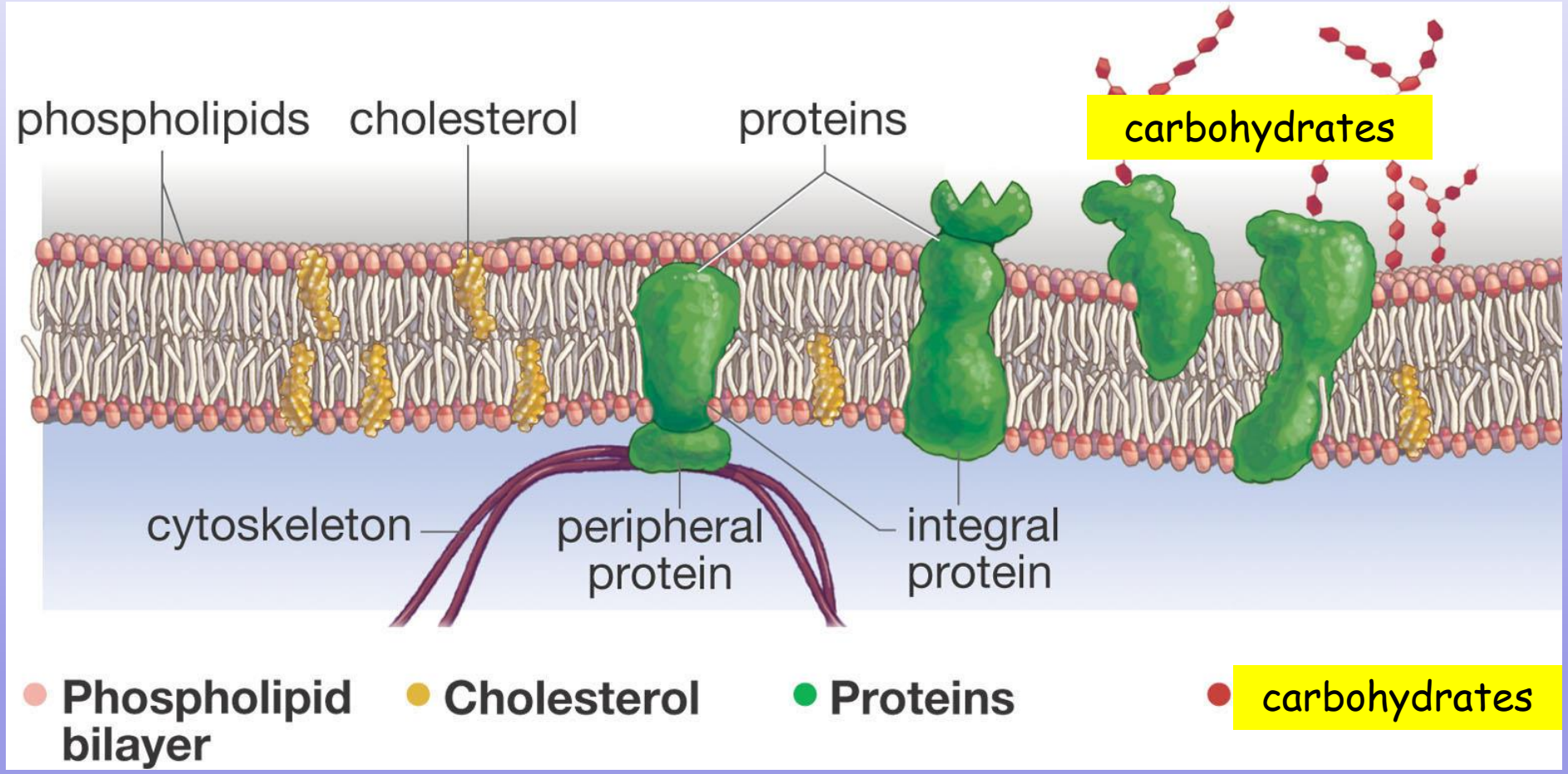
# Cell Membrane

Main Components:

- Double Layer of Phospholipids
- Proteins
- Carbohydrates
- Cholesterol

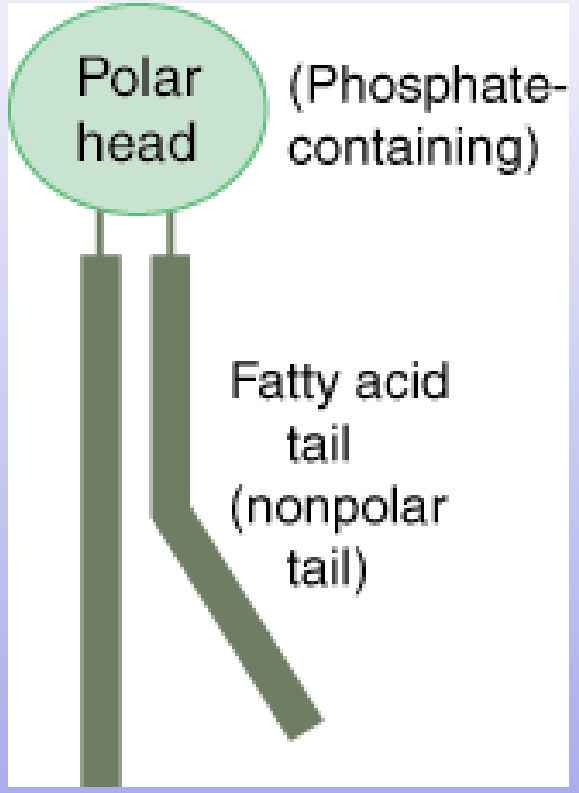


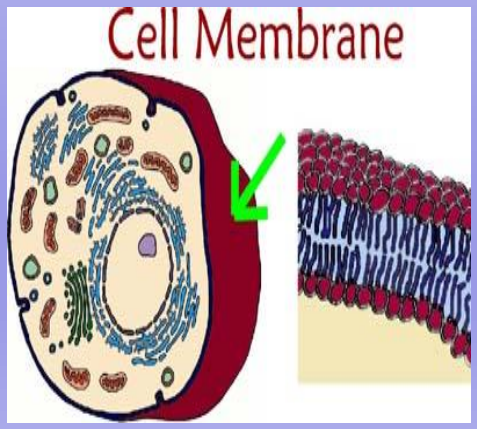
# Membrane Components



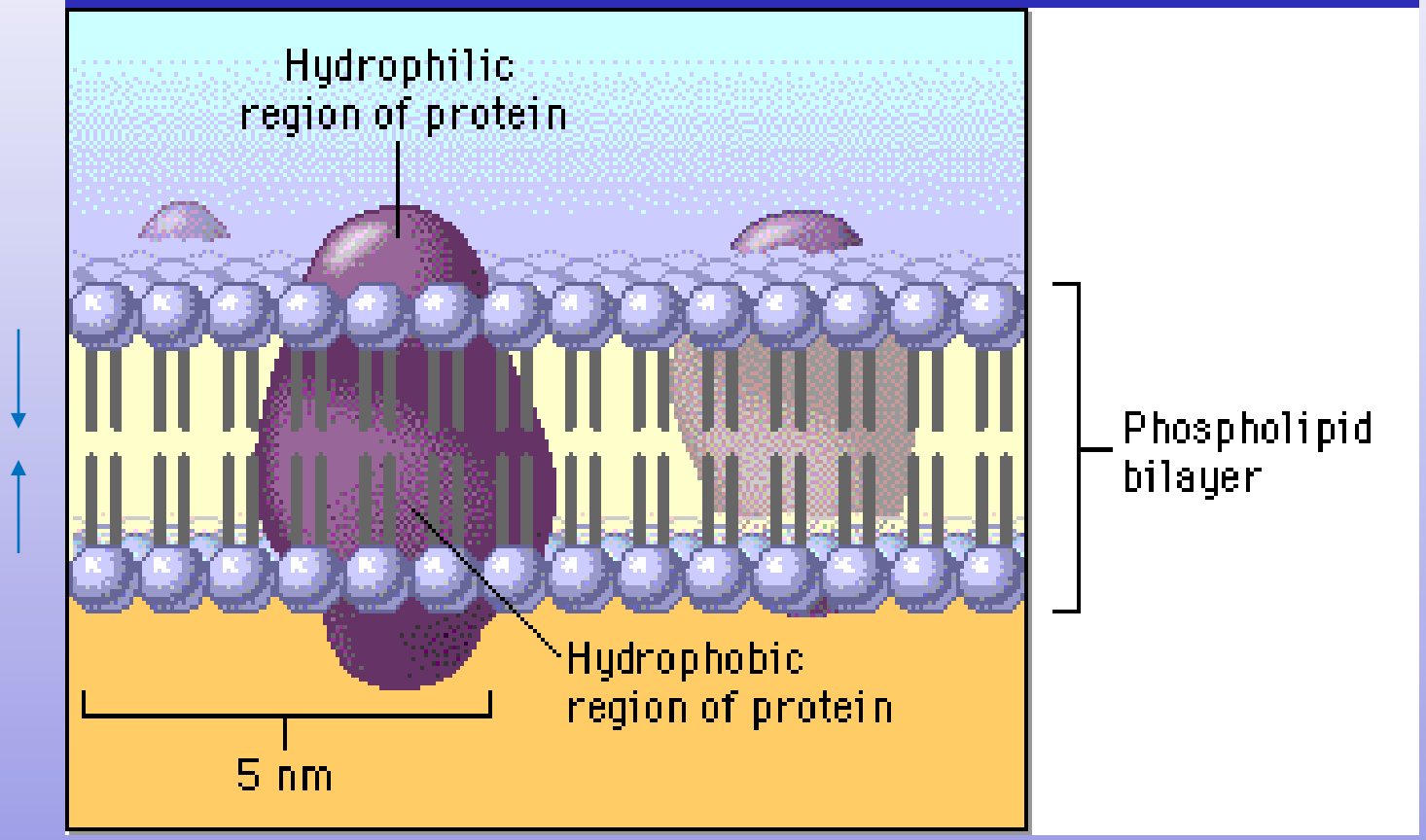
# Phospholipids

- Heads contain glycerol and phosphate and are hydrophilic (attract water).
- Tails are made of fatty acids and are hydrophobic (repel water).
- Make up a bilayer where tails point inward toward each other.
- This makes the membrane **"Selective"** in what crosses it.



# Fluid Mosaic Model

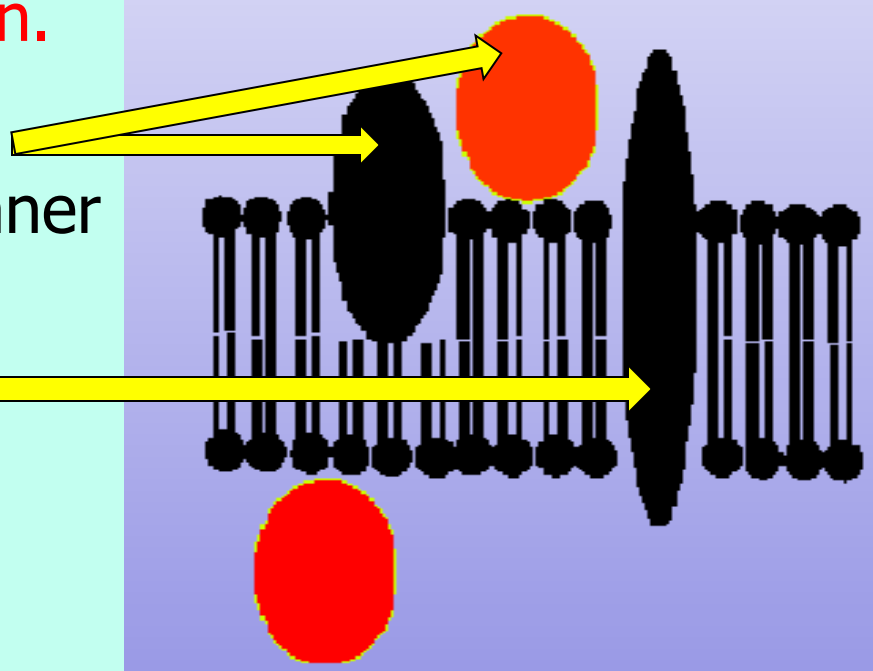



**FLUID** because individual phospholipids and proteins can move side-to-side within the layer, like a liquid.

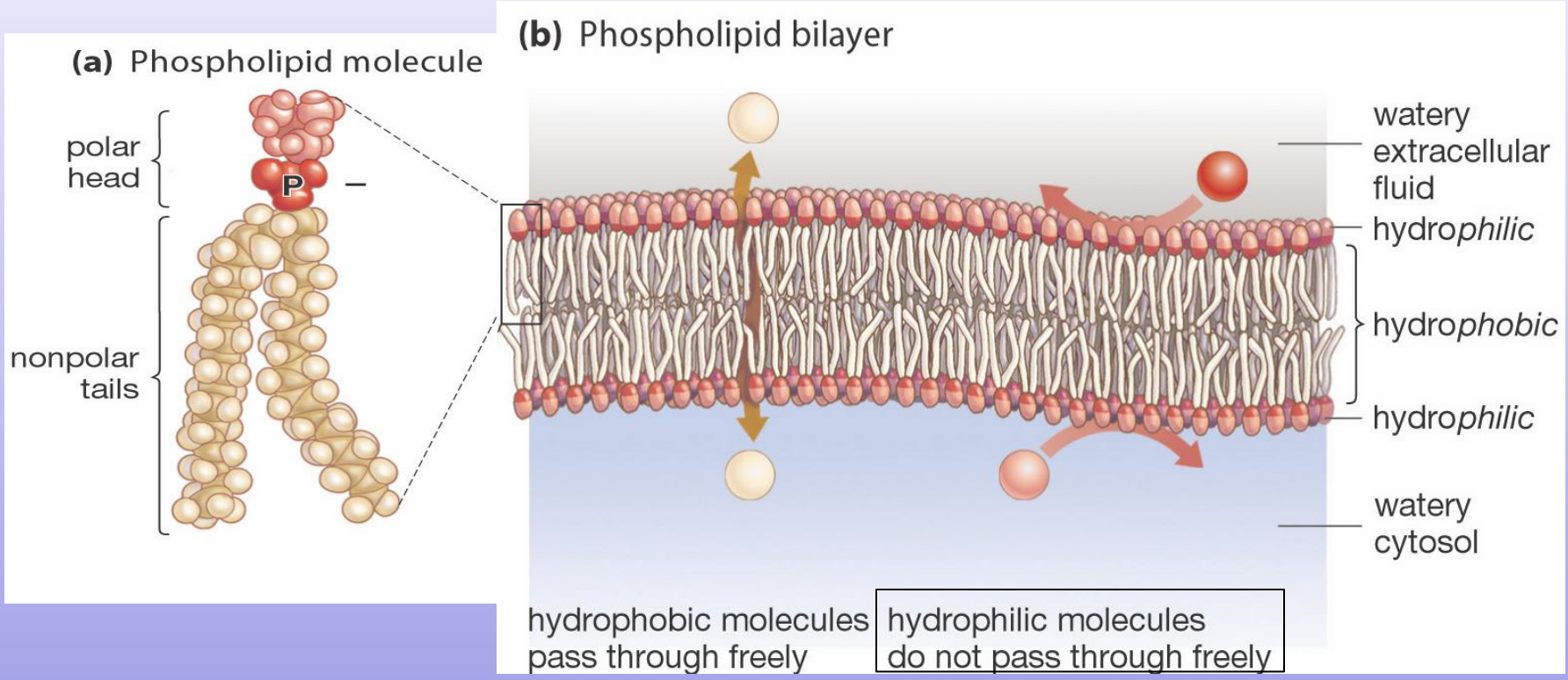
**MOSAIC** because of the pattern produced by the scattered protein molecules when the membrane is viewed from above.

# Cell Membrane Proteins

- Proteins help move large molecules in and out of the cell or aid in cell recognition.
- **Peripheral proteins** are attached on the surface (inner or outer).
- **Integral proteins** are embedded completely through the membrane.
  - Function as channel to regulate movement of substances in and out of the cell.



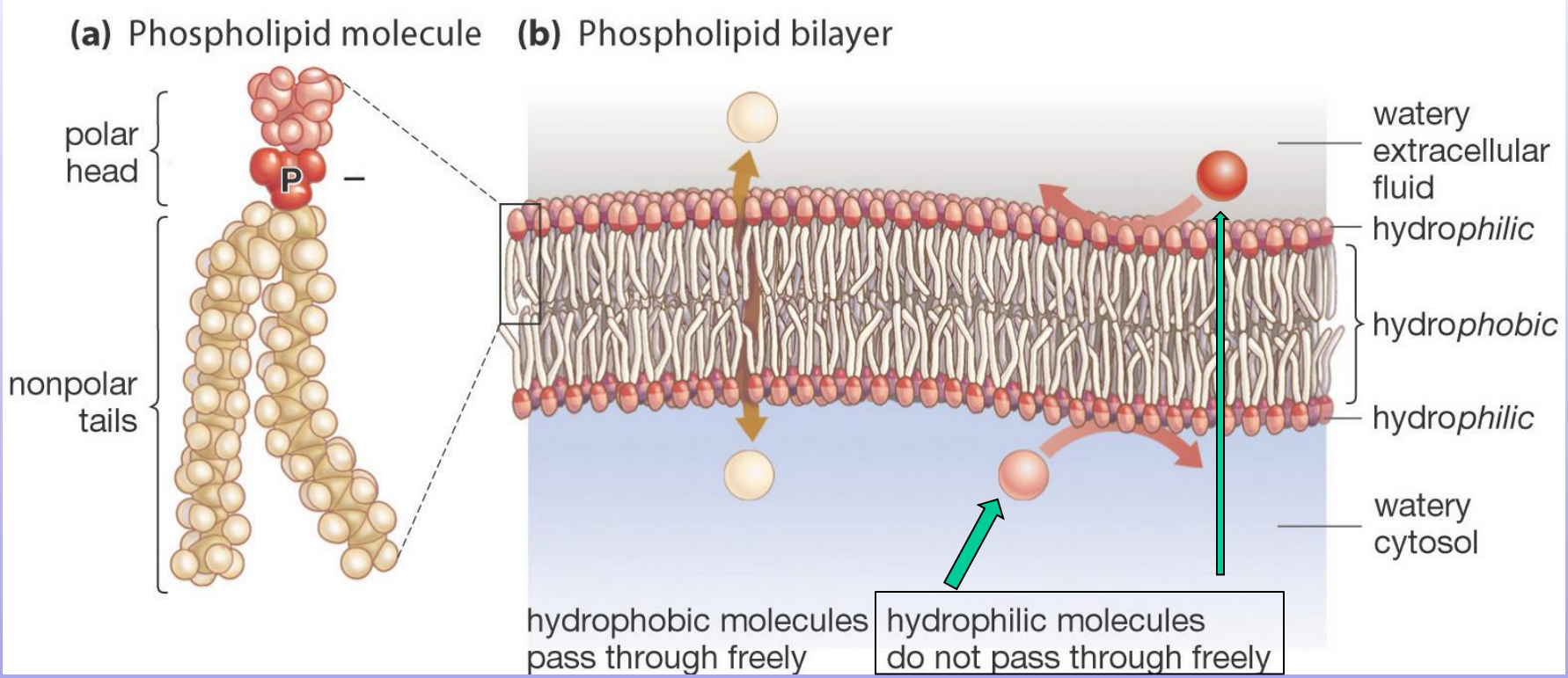
# Semipermeable Membrane




In general, small, non-charged, hydrophobic molecules that are soluble in lipids can pass through the cell membrane easily.

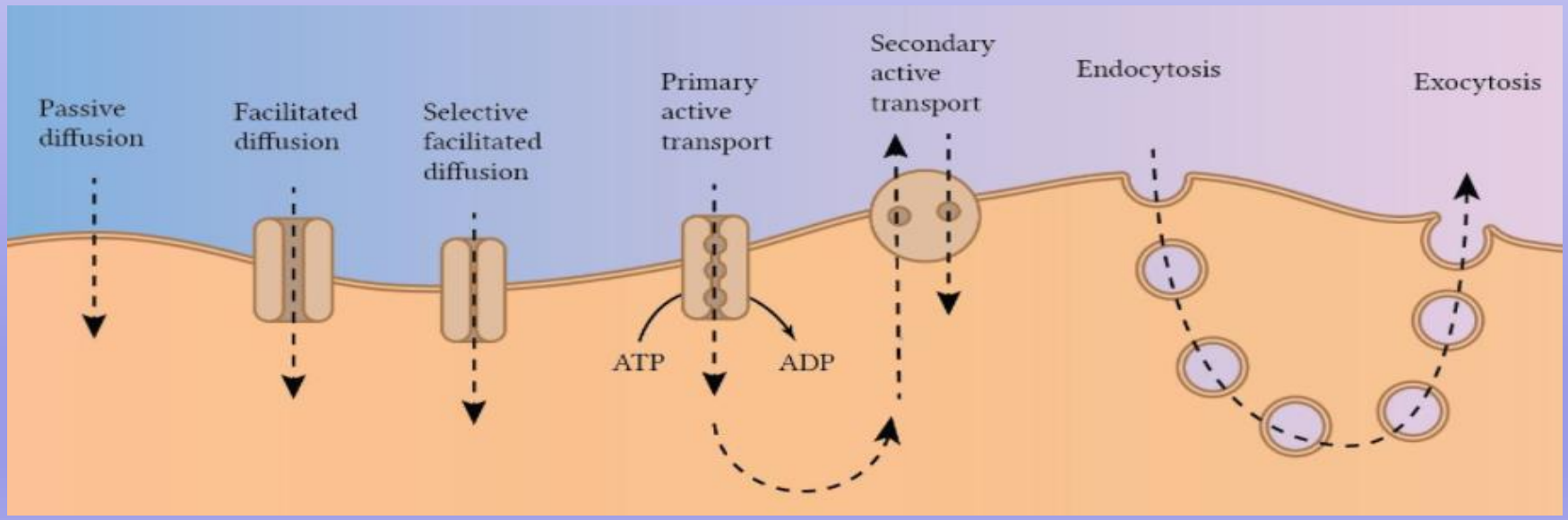
E.g. $O_2$, $CO_2$, Alcohol

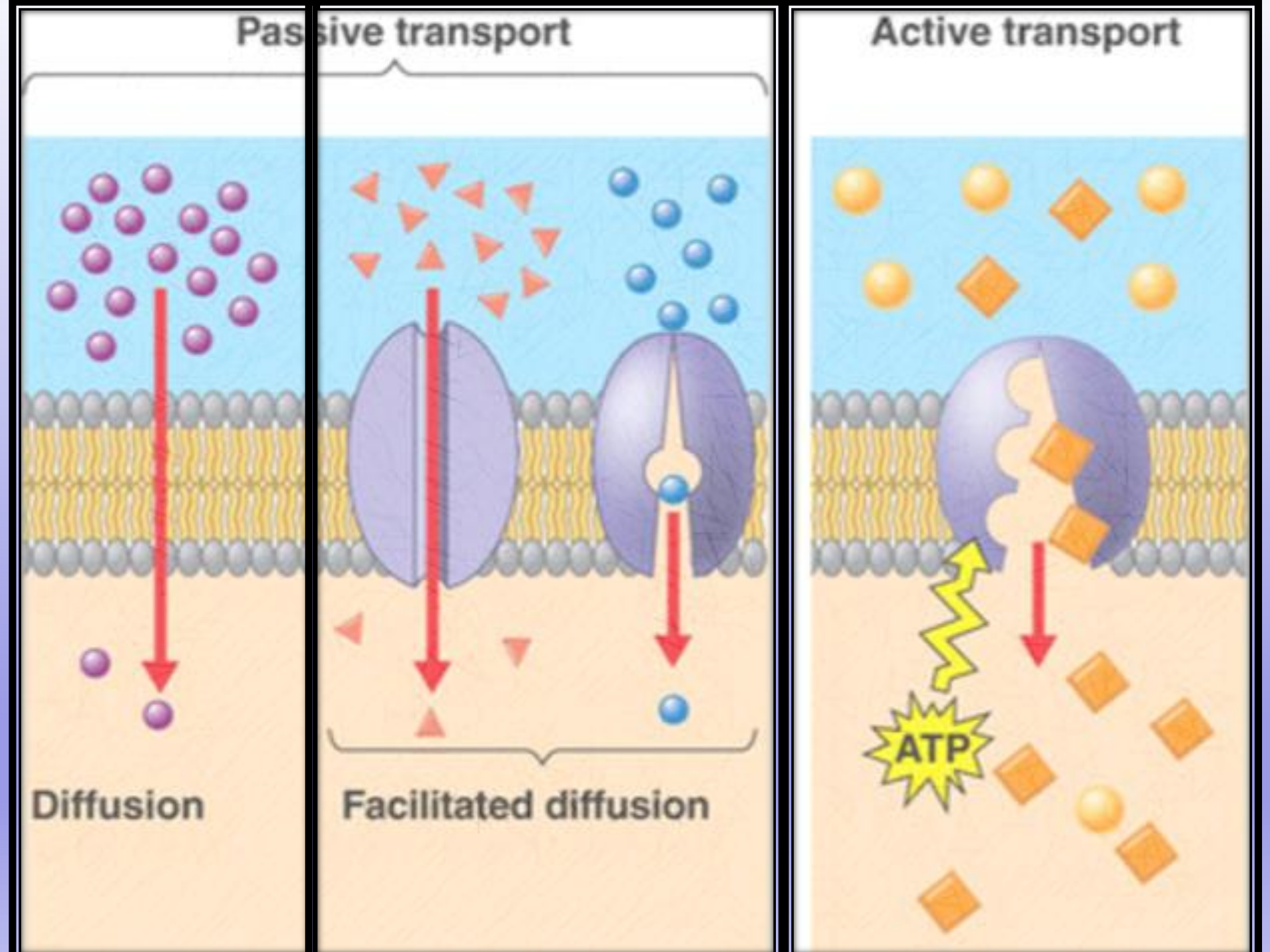
# Semipermeable Membrane

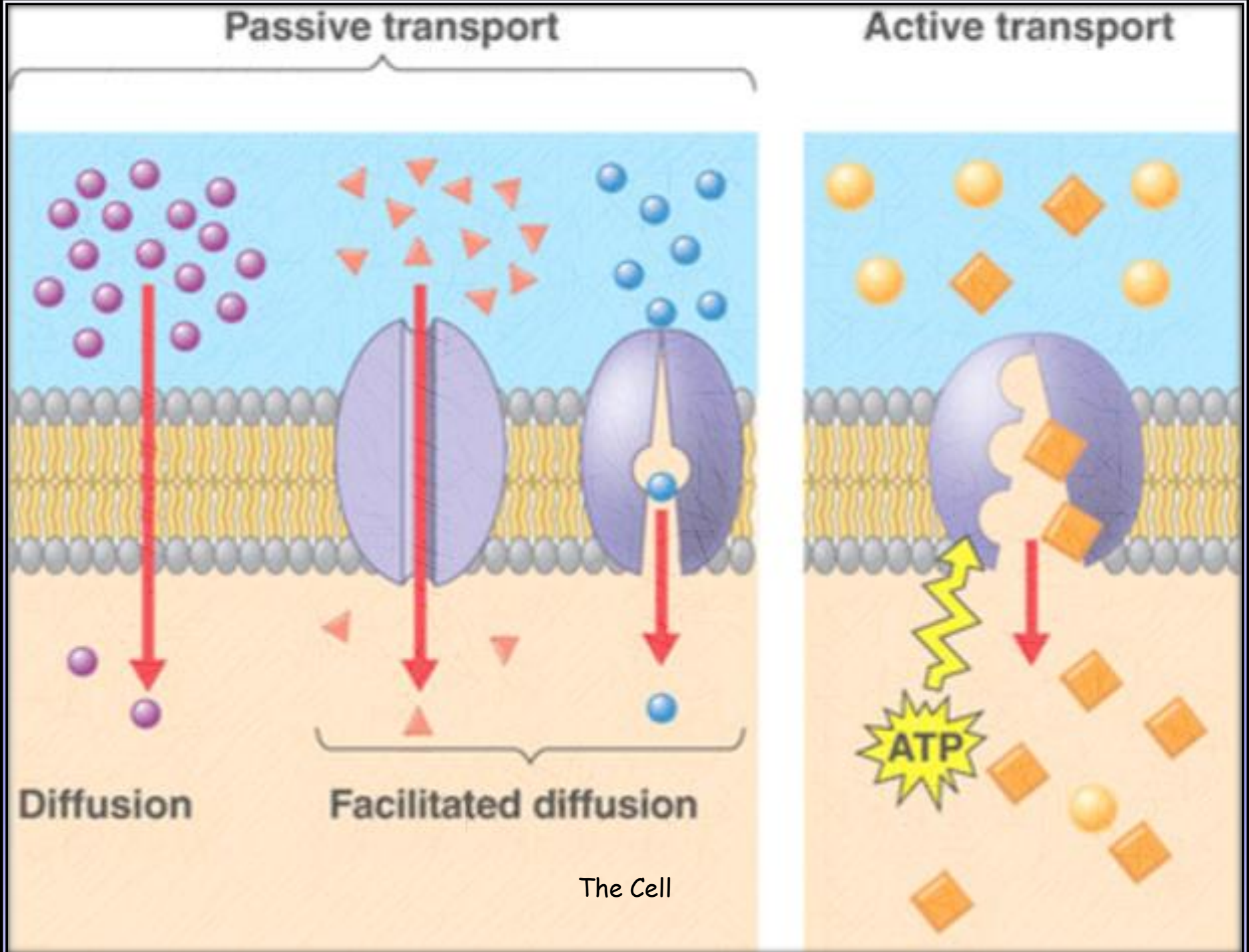



- Ions, hydrophilic, and polar molecules such as glucose and proteins (amino acids) do not move through the membrane on their own.

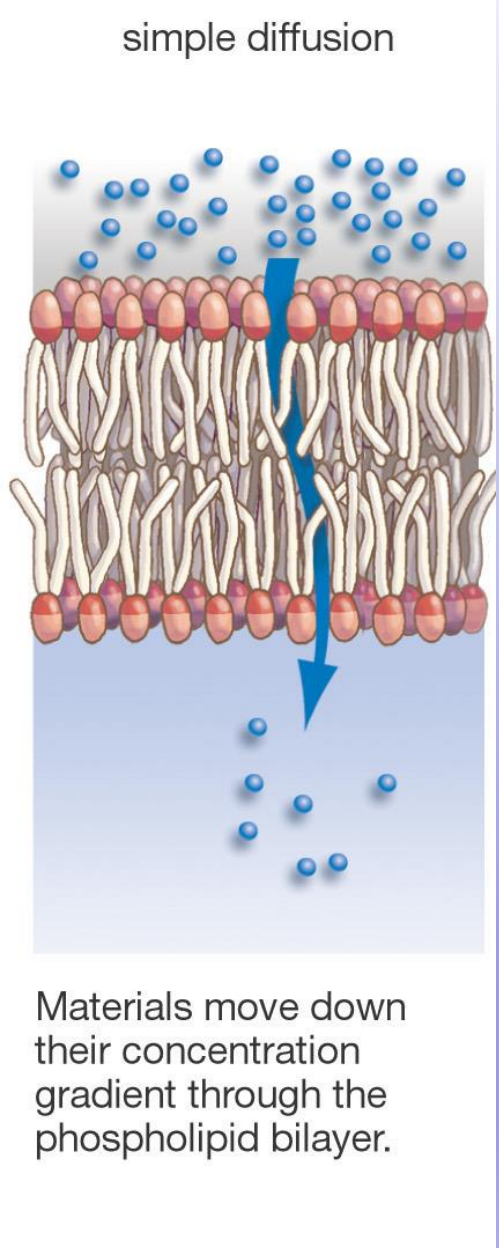
# Types of Transport Across Cell Membranes




Passive transport
Active transport
Diffusion
Facilitated diffusion
ATP


Passive transport
Active transport
Diffusion
Facilitated diffusion
ATP

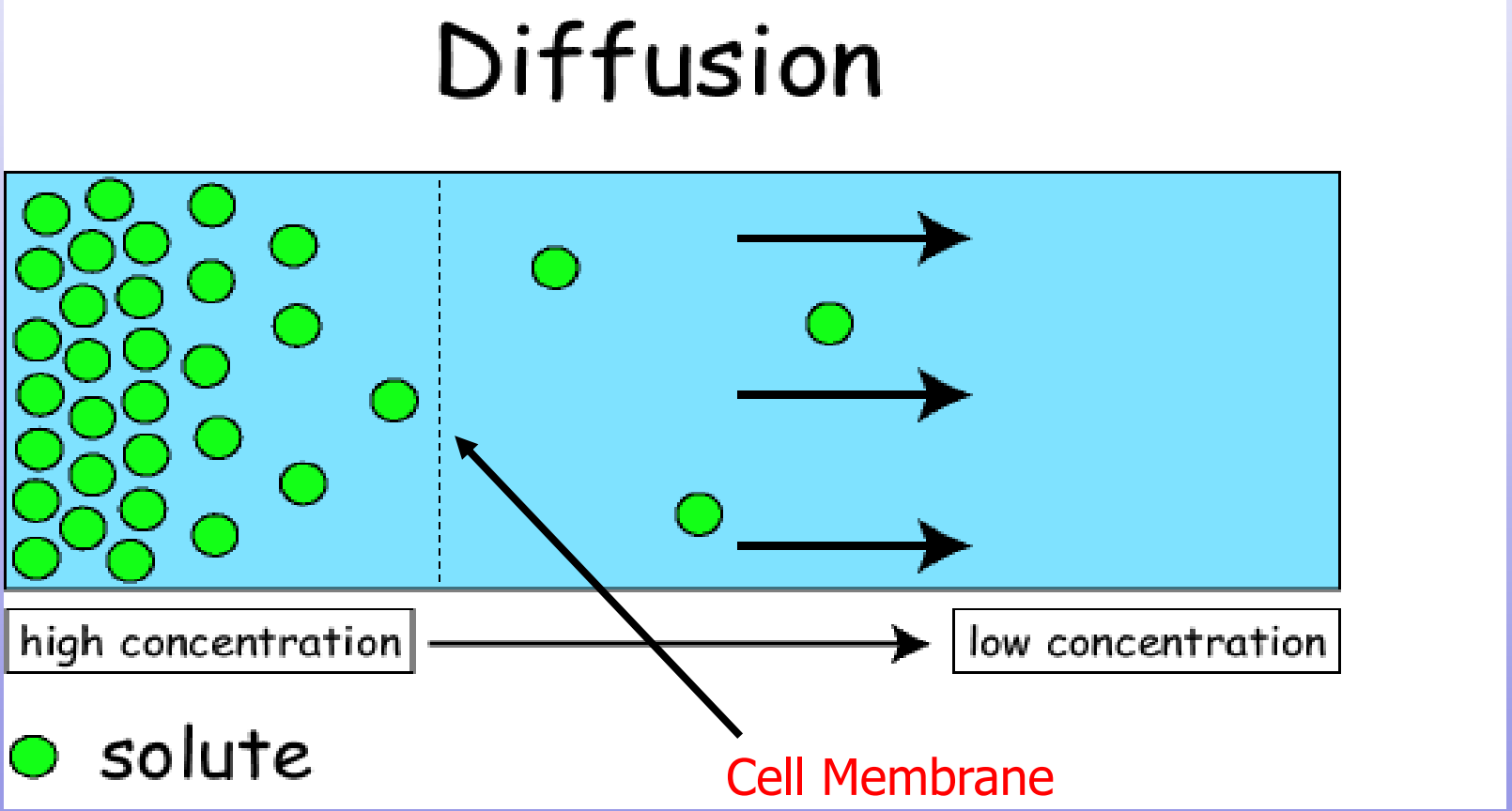
# Passive Transport: Simple Diffusion




Materials move down their concentration gradient through the phospholipid bilayer.

- Does not require energy.
- Moves from high to low concentration.
  - "Down" a concentration gradient
- Example: Oxygen diffusing into a cell.

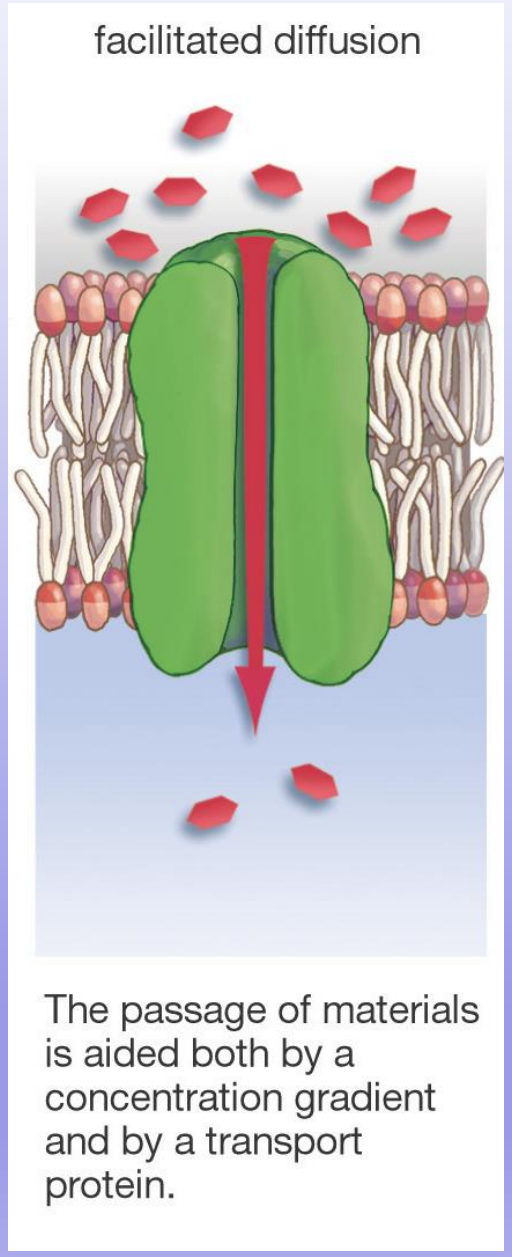
# Diffusion through a Membrane




**Solute moves DOWN the concentration gradient from HIGH to LOW.**

**E.g.: Oxygen**

**How Diffusion Works (1:29)**
**http://somup.com/c3eir7Tv0j**




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

# Passive Transport: Facilitated Diffusion

- Does not require energy.
- Uses transport proteins to move high to low concentration.

E.g.: Glucose moving from blood into a cell.

**How facilitated diffusion works**
**http://somup.com/c3eir8Tv0z (1:17)**

# Passive Transport: Osmosis

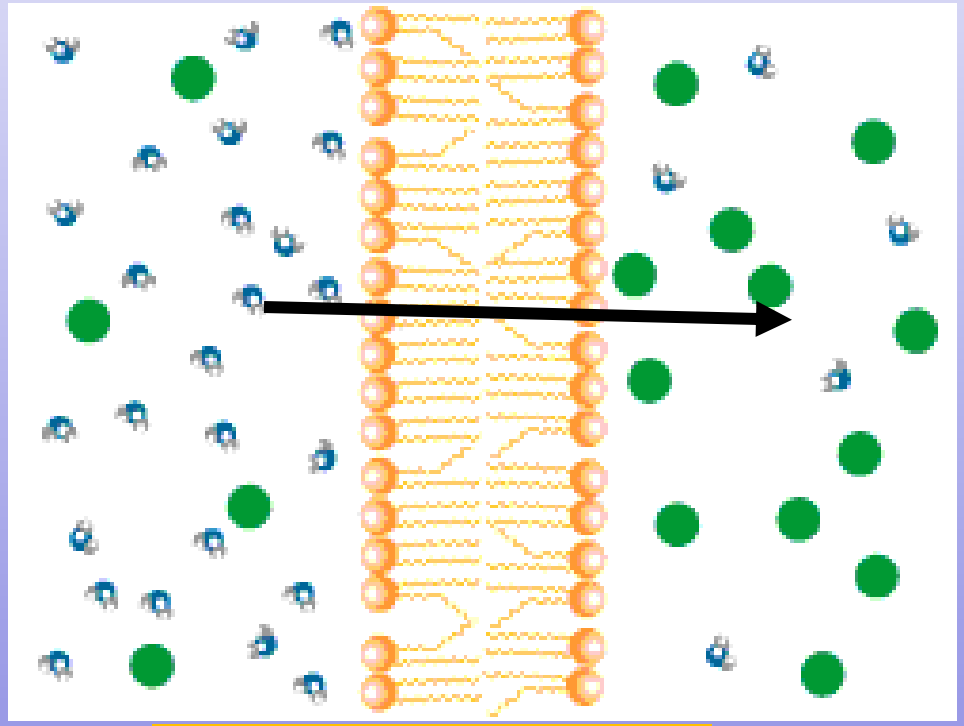
- Diffusion of **WATER** across a semipermeable membrane.
- Membrane permeable only to water.
- Flows from HIGH water potential or concentration (LOW solute concentration) to LOW water potential or concentration (HIGH solute concentration).
- Passive Transport (No energy required).

**TONICITY** → the relative concentration of **SOLUTE** (particles) OUTSIDE the cell compared with the inside of the cell.

# Diffusion of $H_2O$ Across A Membrane

High $H_2O$ potential or concentration

Low Solute concentration

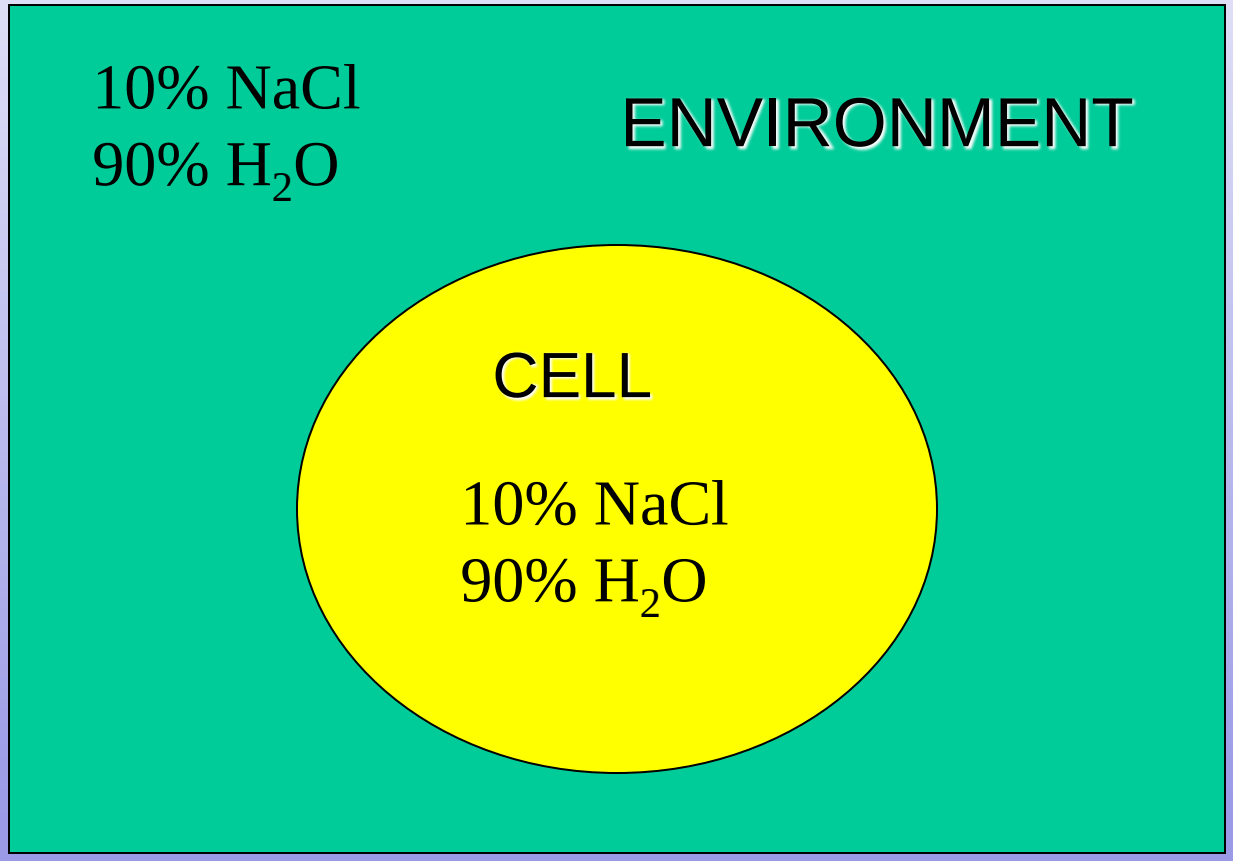


Low $H_2O$ potential or concentration

High Solute concentration

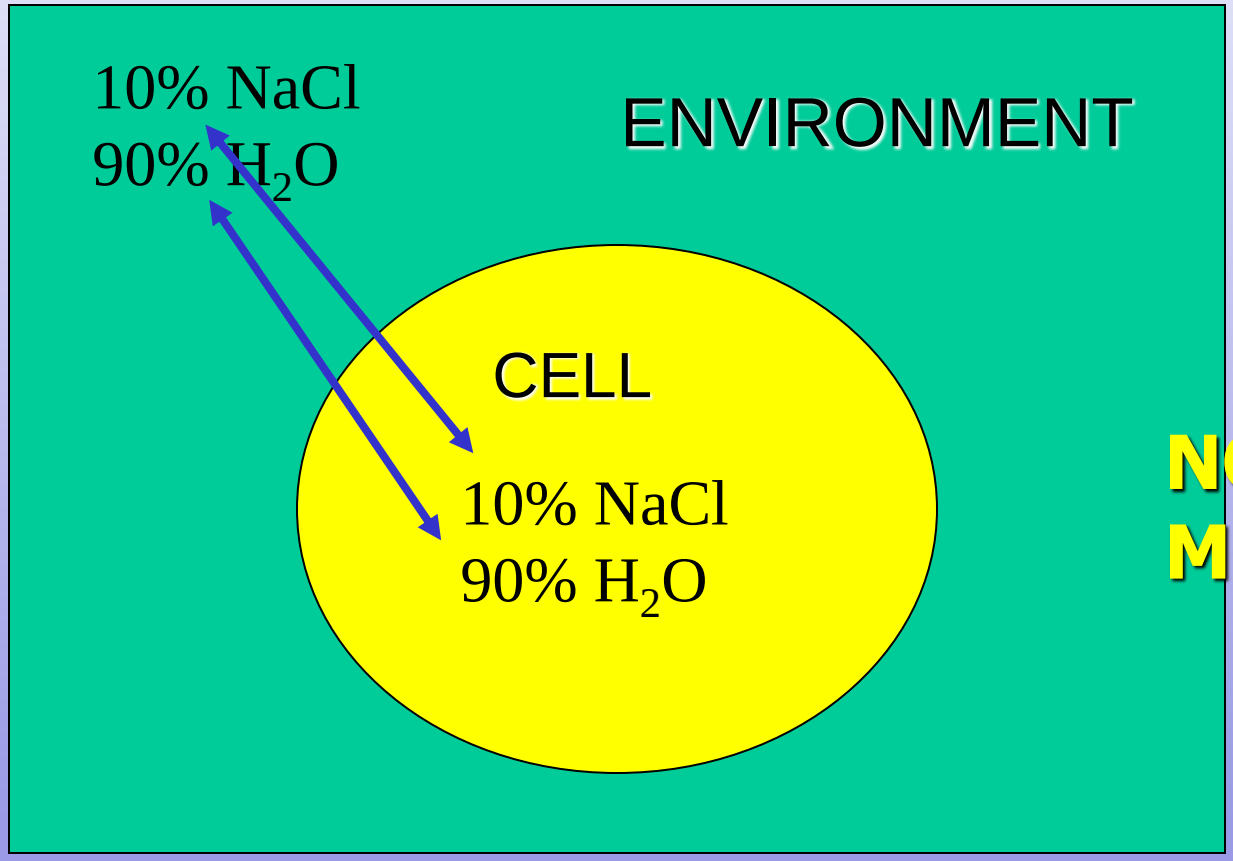
● = solute

# Animal Cell in Isotonic Solution




**What is the direction of water movement?**

# Animal Cell in Isotonic Solution

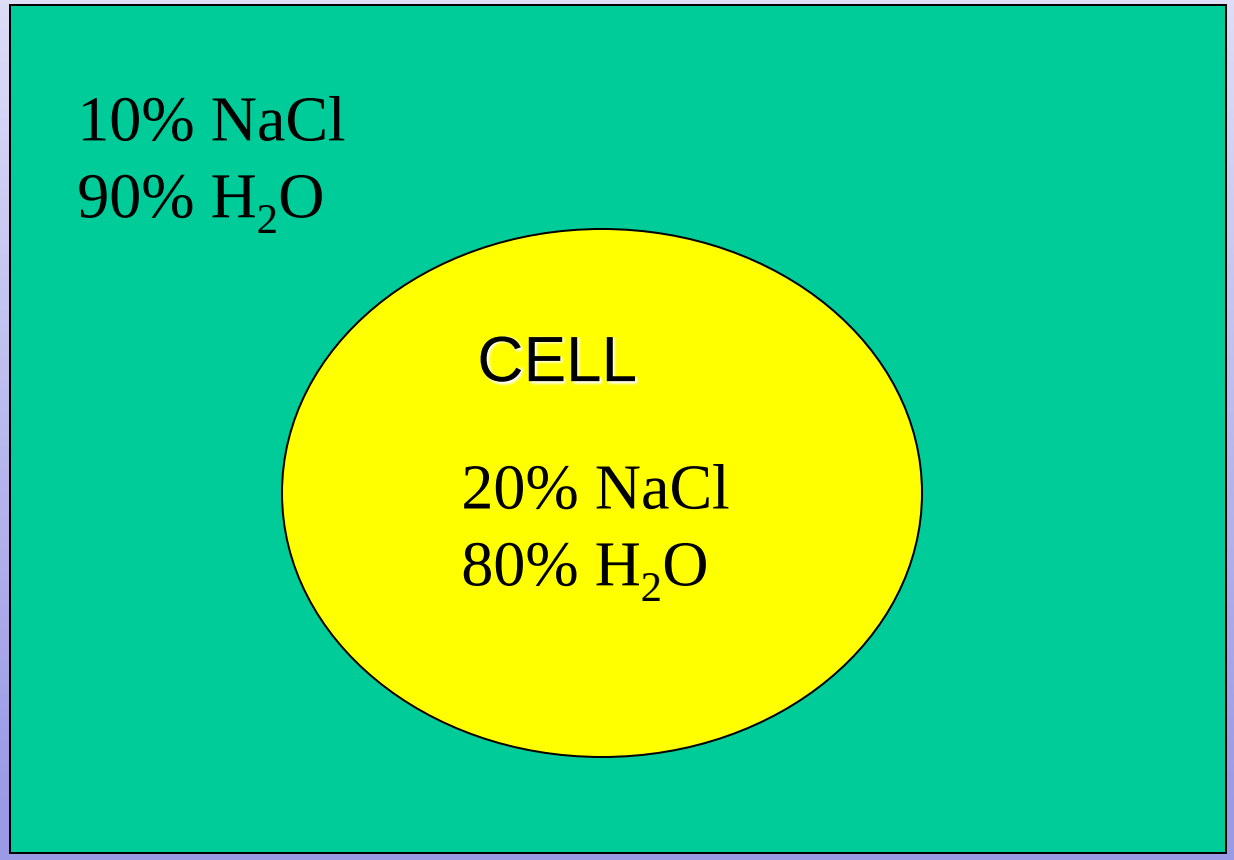



**NO NET MOVEMENT**

**What is the direction of water movement?**

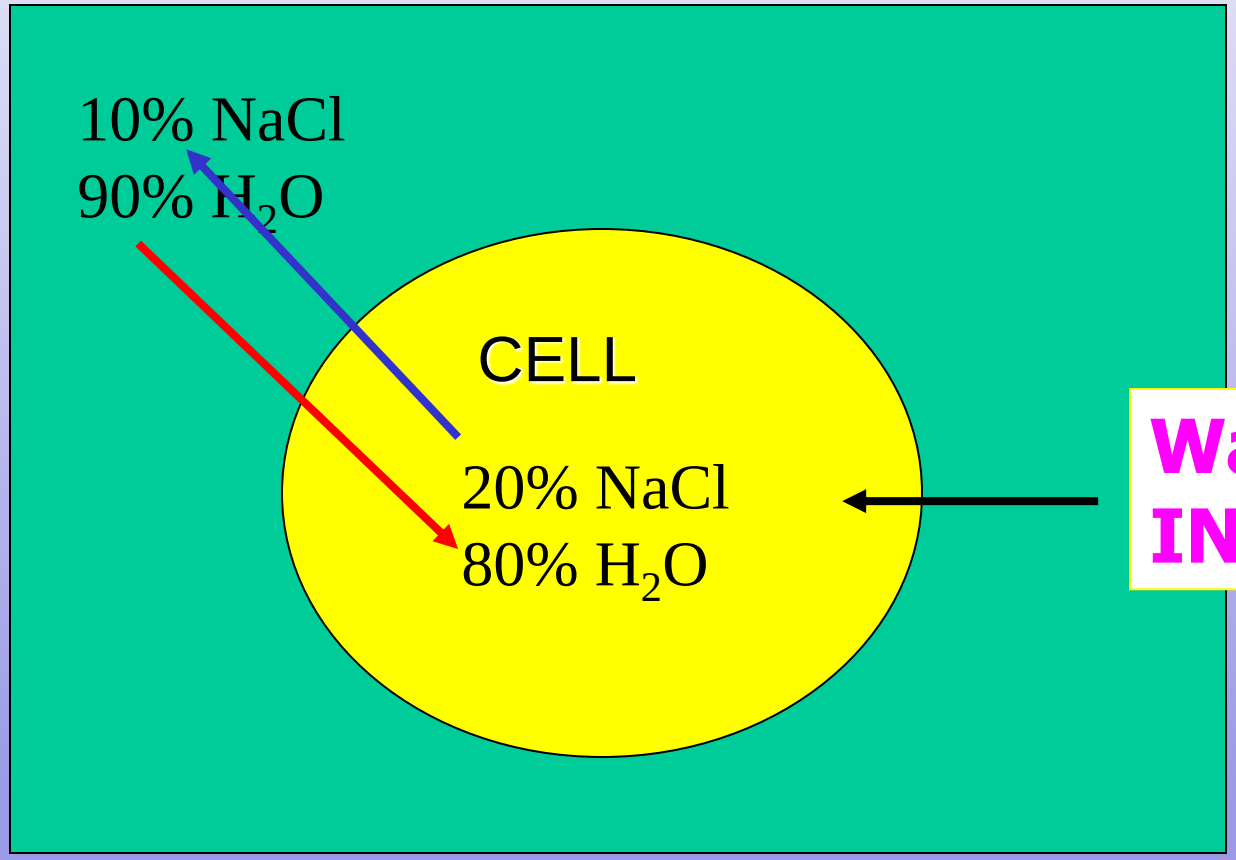
**The Cell is at equilibrium ("iso-")**

# Animal Cell in Hypotonic Solution




**What is the direction of water movement?**

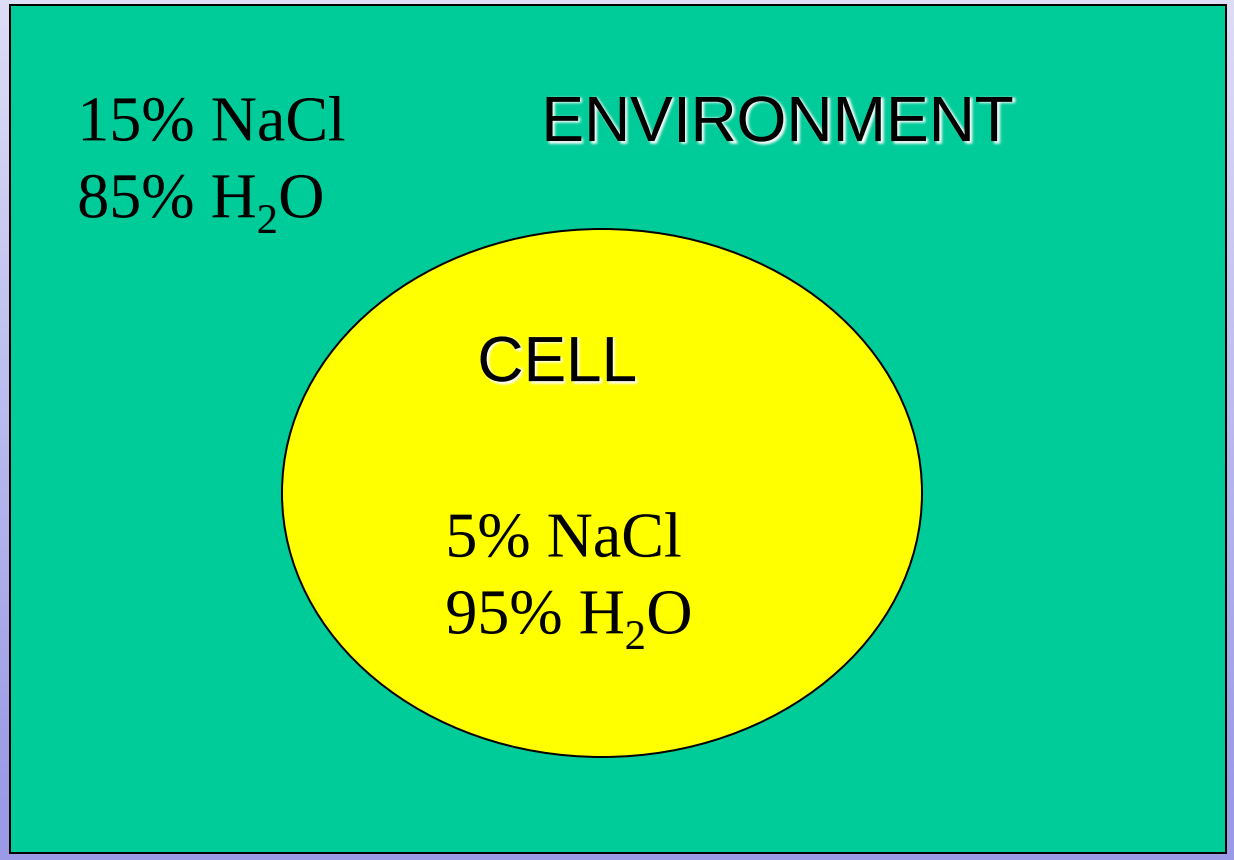
# Animal Cell in Hypotonic Solution




**What is the direction of water movement?**

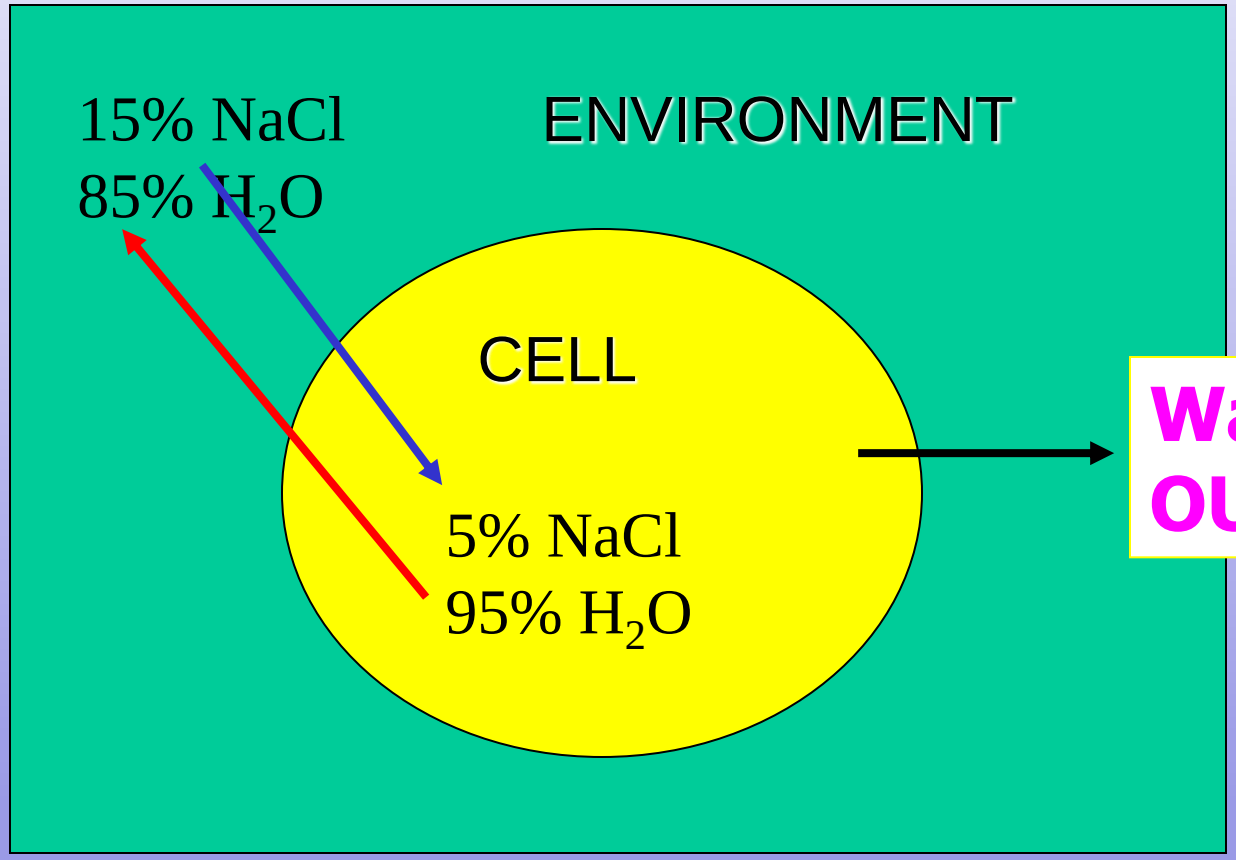
**"hypo-" means LOWER solute OUTSIDE the cell; *more water inside the cell.***

# Animal Cell in Hypertonic Solution




**What is the direction of water movement?**

# Animal Cell in Hypertonic Solution



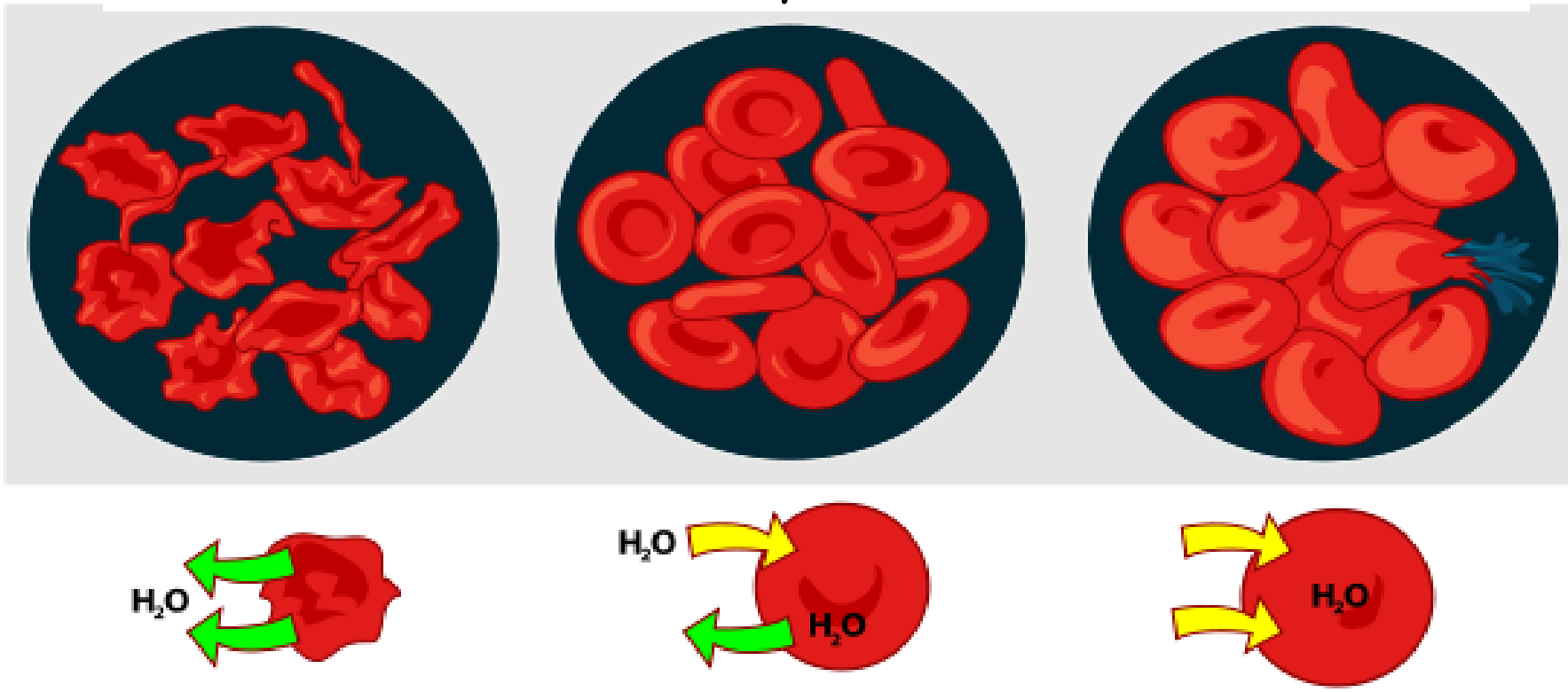

**What is the direction of water movement?**

**"hyper-" means HIGHER solute OUTSIDE the cell;** ***lower water inside the cell.***

# Describe the diffusion of $H_2O$ across the Membrane

QUICK CHECK

Give the tonicity of each situation



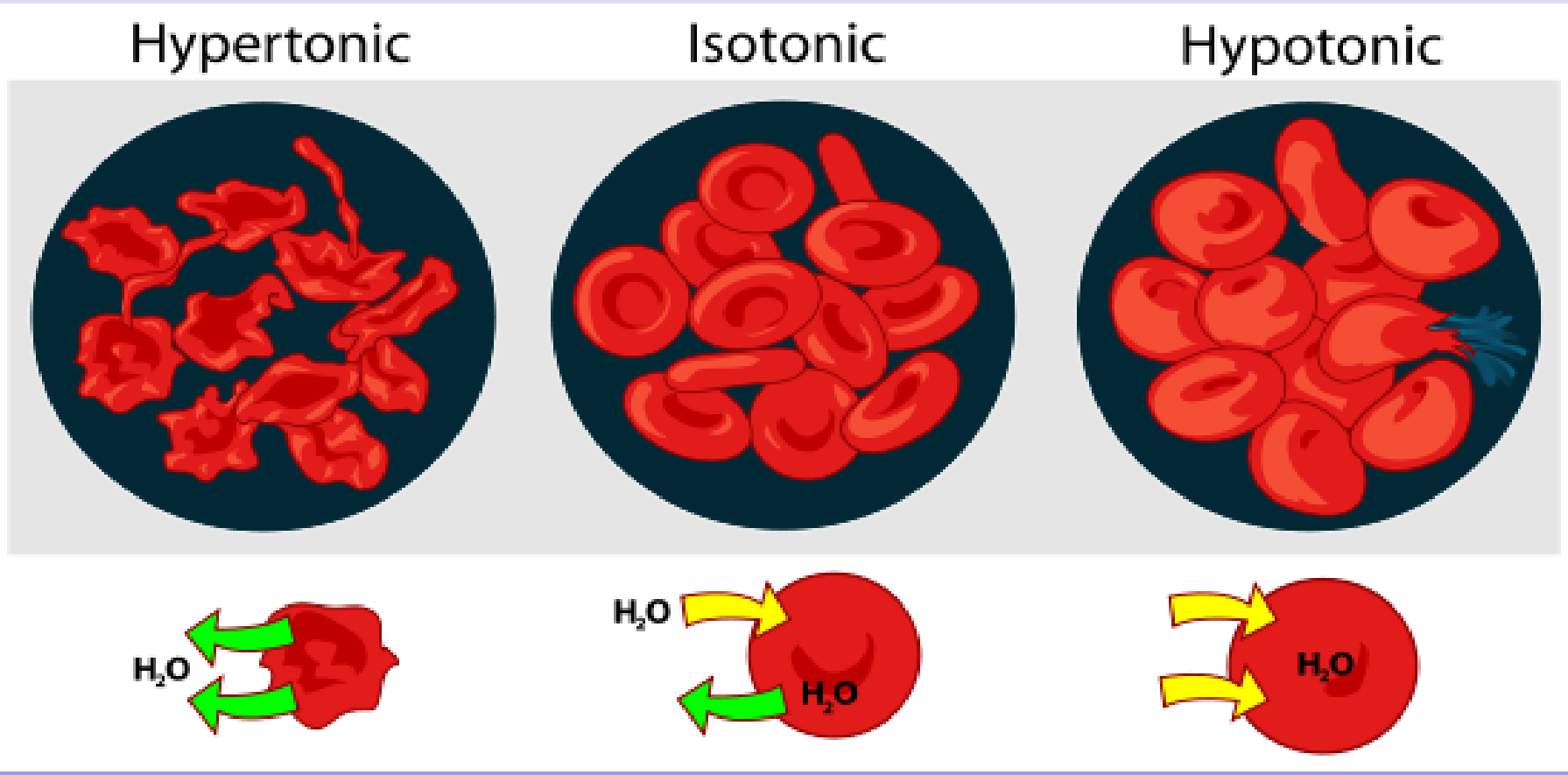

? $H_2O$ potential or concentration ? Solute concentration

? $H_2O$ potential or concentration ? Solute concentration

? $H_2O$ potential or concentration ? Solute concentration

# Describe the diffusion of $H_2O$ across the Membrane

QUICK CHECK

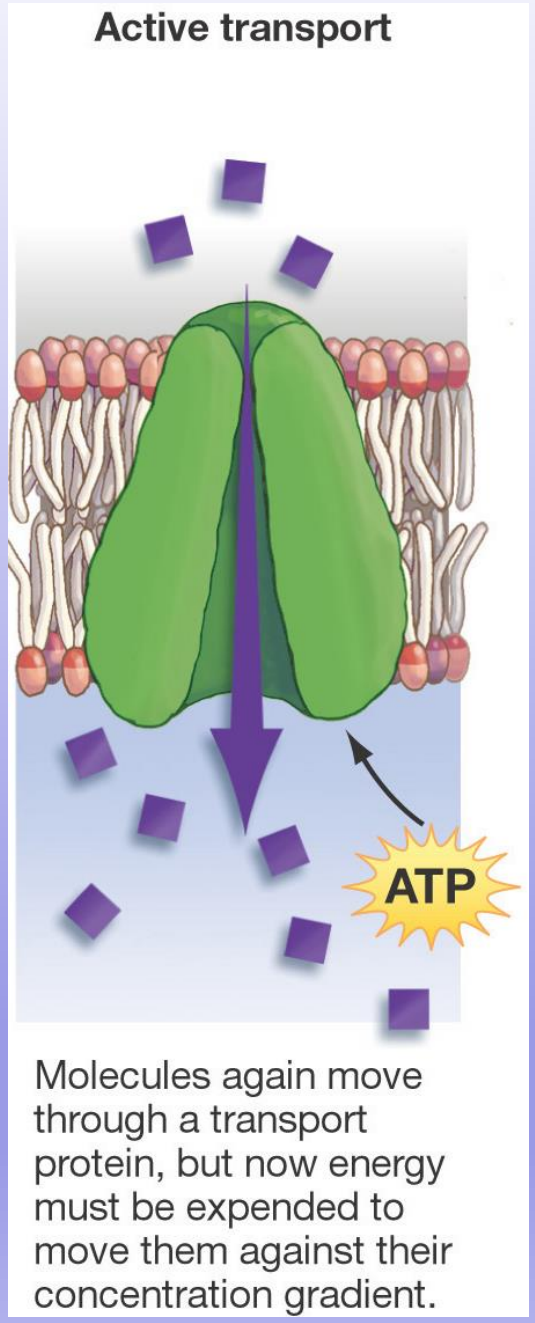



LOW $H_2O$ potential or concentration HIGH Solute concentration OUTSIDE cell

EQUAL $H_2O$ potential or concentration EQUAL Solute concentration OUTSIDE cell

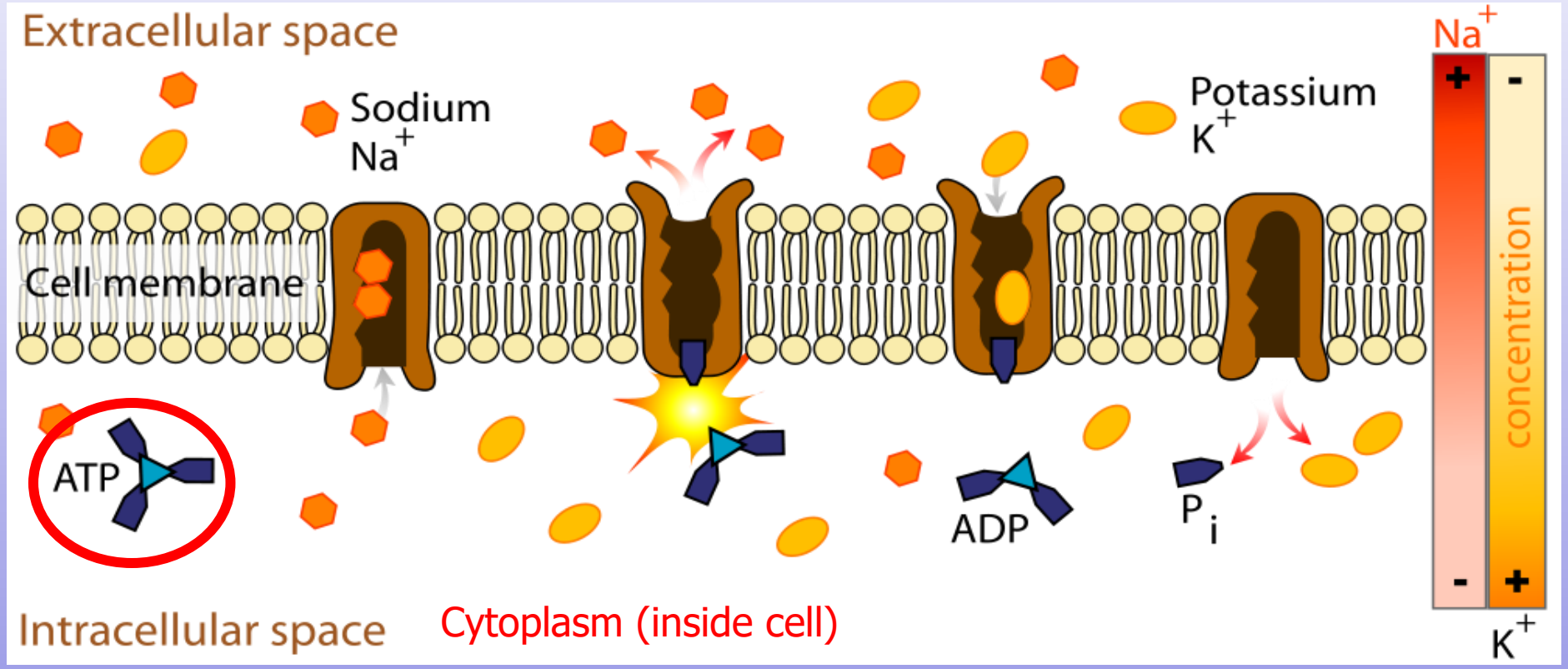
HIGH $H_2O$ potential or concentration LOW Solute concentration OUTSIDE cell

# Active Transport




- Requires energy or ATP.
- Requires a Protein Carrier.
- Moves materials from LOW to HIGH concentration.
- Flows AGAINST the concentration gradient.

# Active Transport



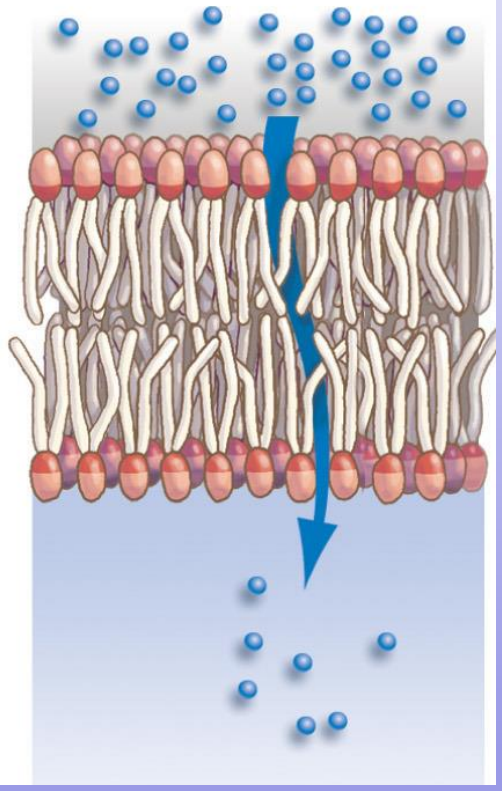

In cells, the use of energy (ATP) by the cell to move particles AGAINST the concentration gradient from an area of LOW concentration to an area HIGH concentration.

# Three Forms of Transport Across the Membrane

QUICK CHECK

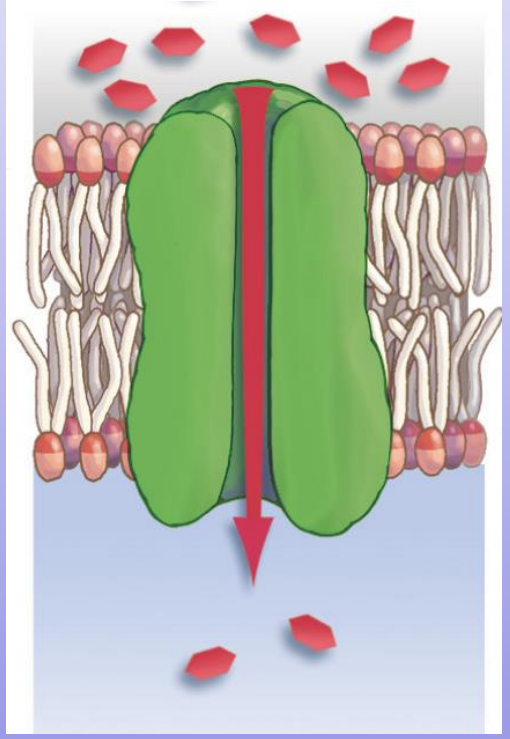
## Give the type of transport in each cell?

Give the type of diffusion

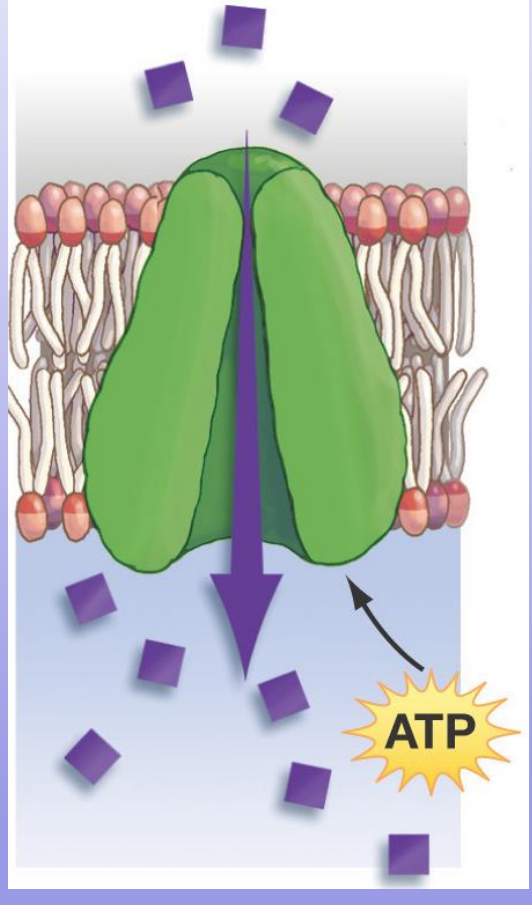


Materials move down their concentration gradient through the _____ _____.

Give the type of diffusion



Materials move down their concentration gradient aided by a transport _____.



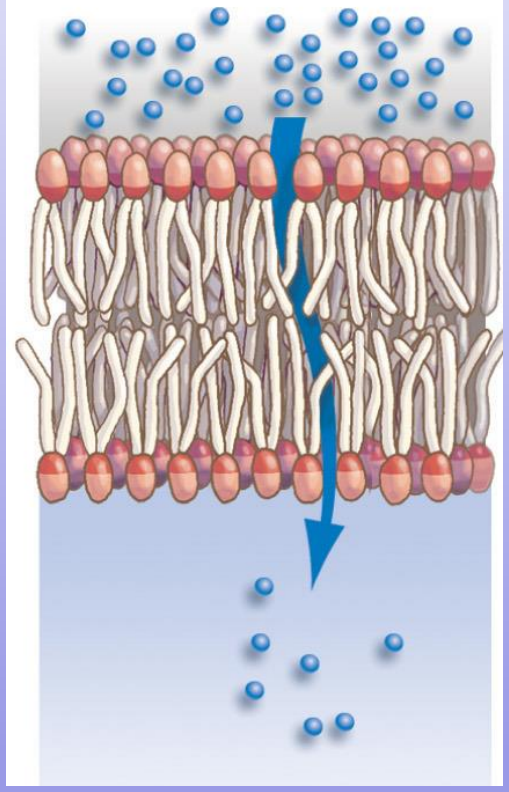

Molecules move through a transport protein _____ the concentration gradient, requiring _____.

# Three Forms of Transport Across the Membrane

QUICK CHECK

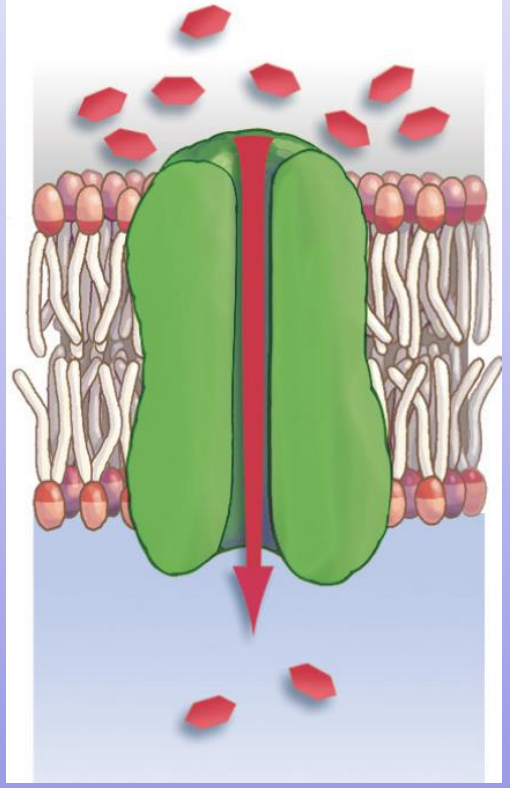
## Passive transport

simple diffusion



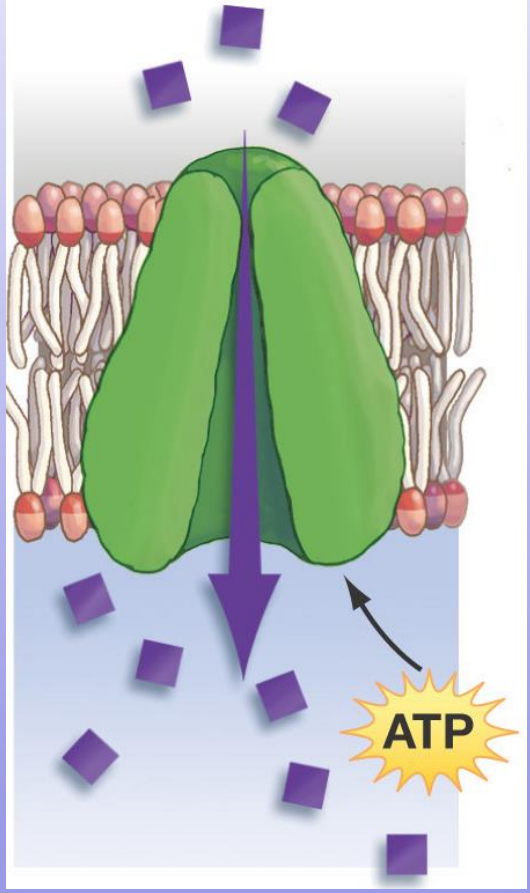
Materials move down their concentration gradient through the phospholipid bilayer.

facilitated diffusion



Materials move down their concentration gradient aided by a transport protein.

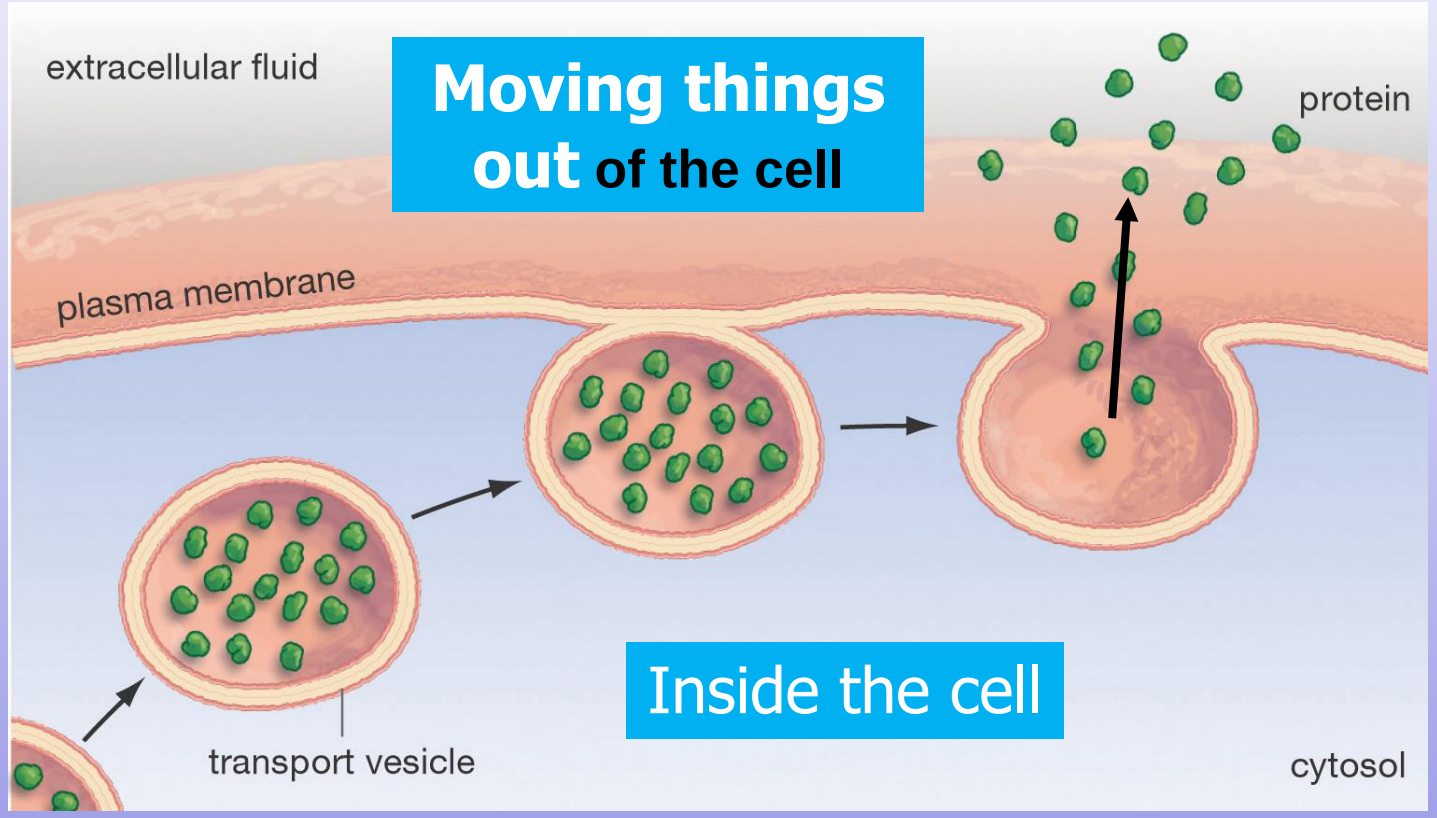
## Active transport




Molecules move through a transport protein AGAINST the concentration gradient, requiring ENERGY.

# EXOCYTOSIS

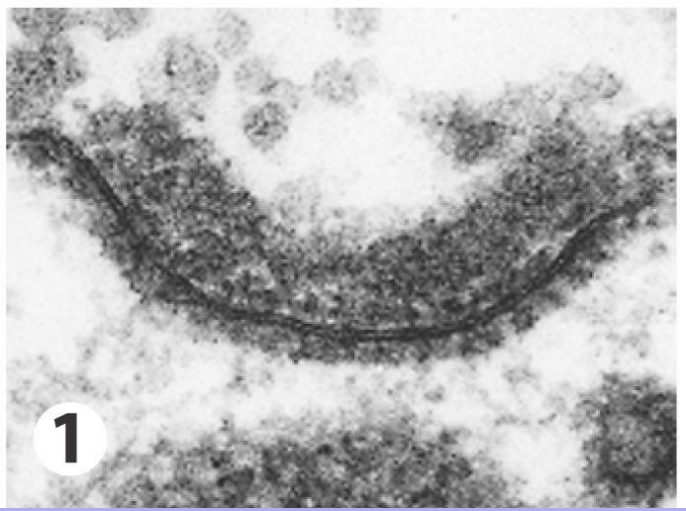
## Moving the "Big Stuff"

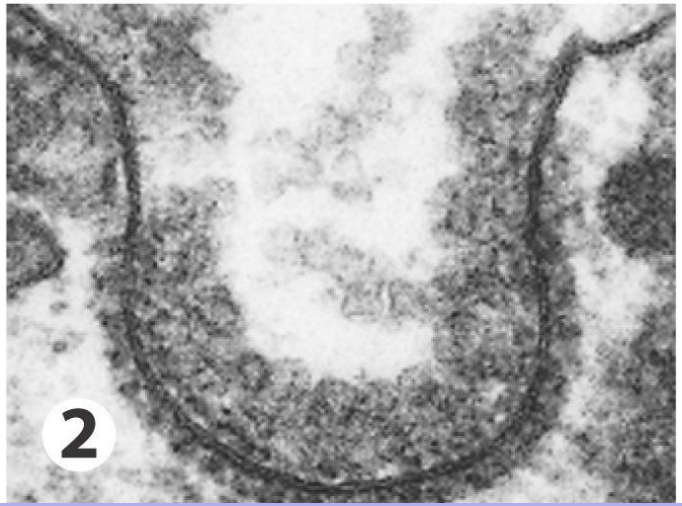


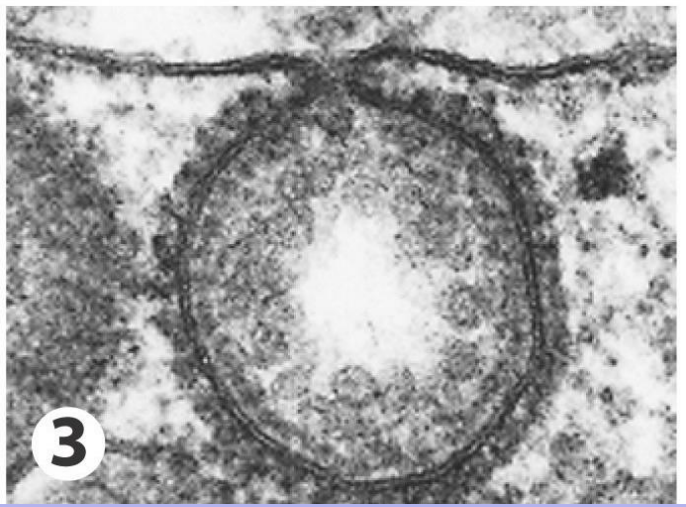

- Molecules are moved out of the cell by vesicles that fuse with the plasma membrane.
- This is how many hormones are secreted and how nerve cells communicate with one another through neurotransmitters.

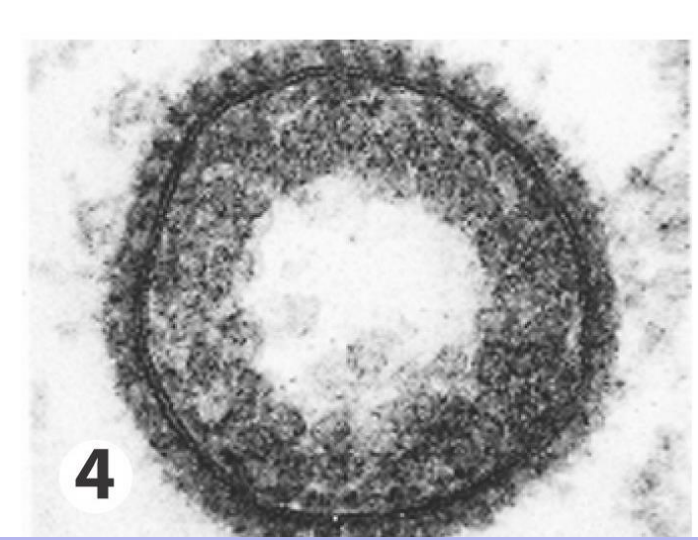
# Moving the "Big Stuff"

Molecules move INTO the cell by ENDOCYTOSIS.

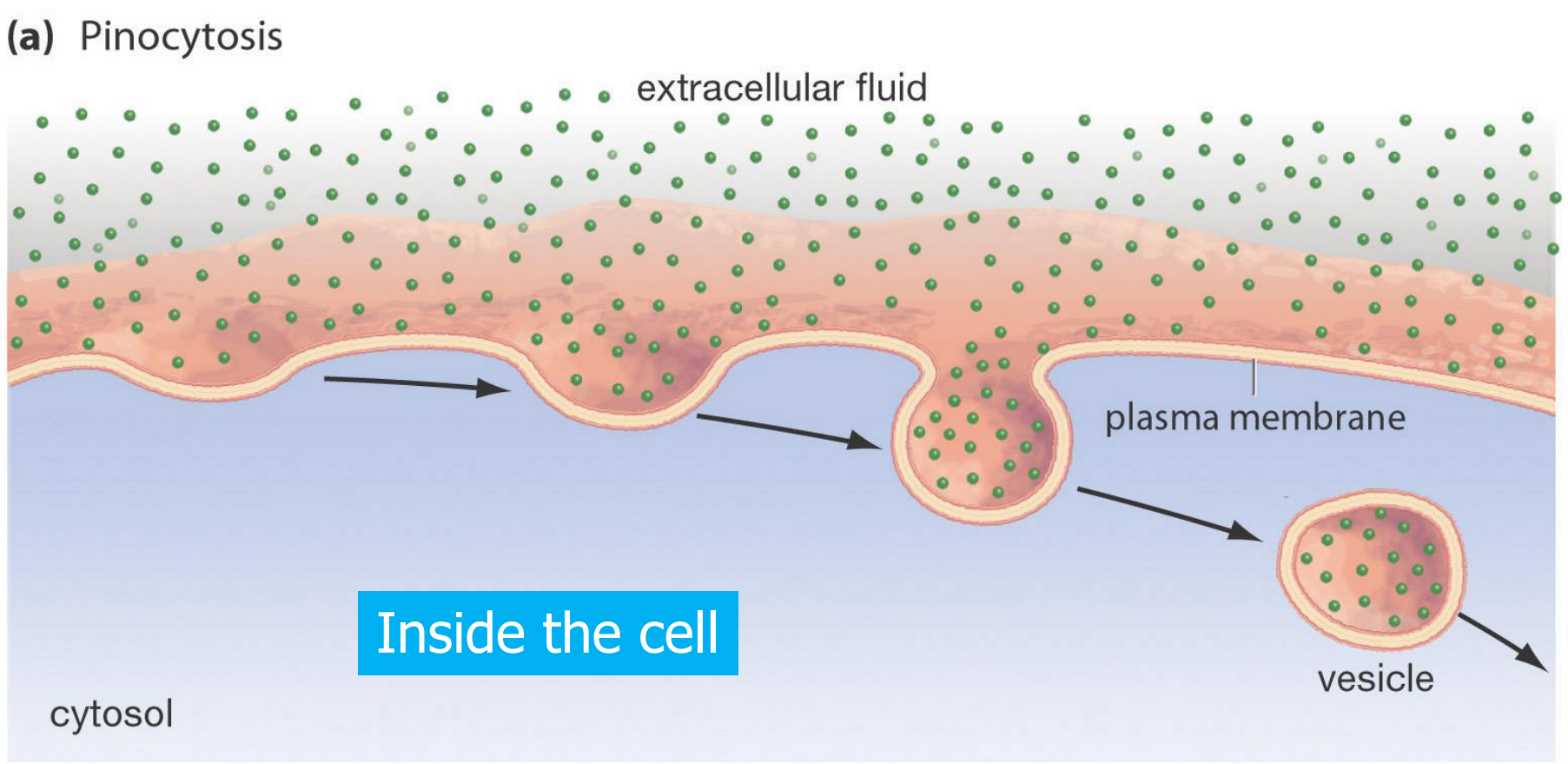


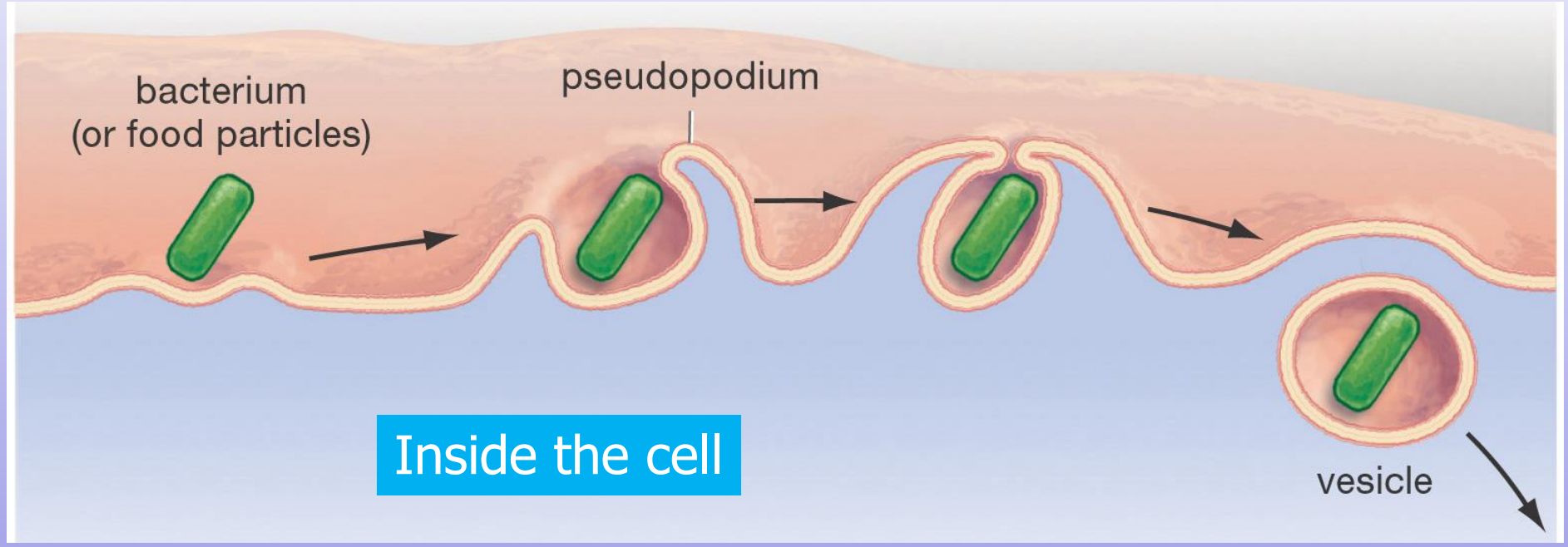



# Endocytosis: Pinocytosis



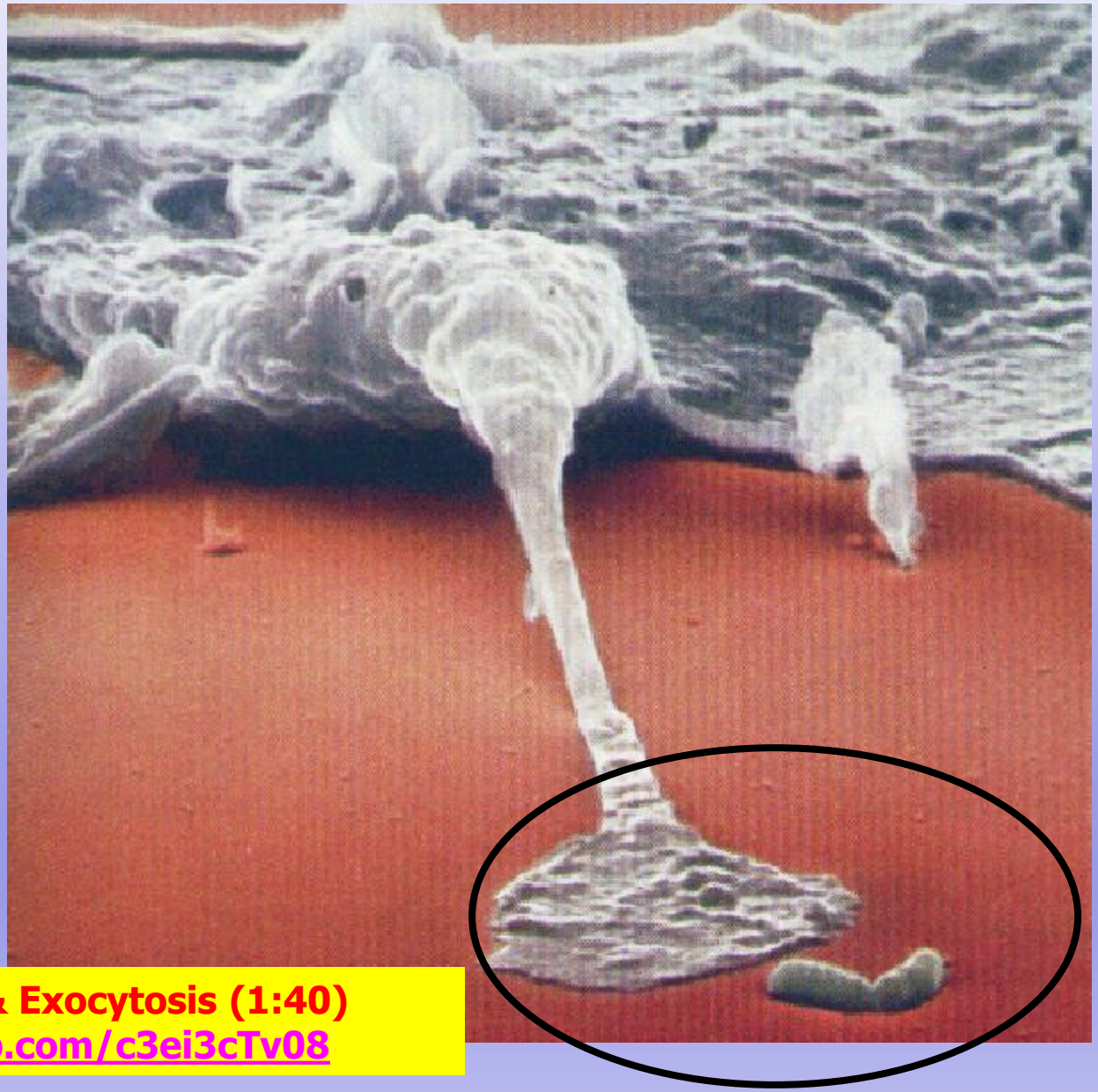

Cell moves large quantities of fluid (or SMALLER particles) INTO the cell.

# Endocytosis – Phagocytosis




Used to engulf large particles such as food, bacteria, etc. into vesicles and bring into cell.

# Phagocytosis About to Occur



**Endocytosis & Exocytosis (1:40)**
**http://somup.com/c3ei3cTv08**

# Summary of Transport Mechanisms

QUICK CHECK

| General Mode of Transport | Examples | Energy Required | Movement |
|---|---|---|---|
| **?** | • D_____<br>• F_____ Diffusion<br>• O_____ | ? | Down Concentration _____ |
| **?** | • Membrane Pumps | ? | _____ Concentration Gradient |
| **Cytosis** | • Leave cell ?<br>• Small/fluid ?<br>• Large ? | ? | Down or Against Concentration Gradient |

# Summary of Transport Mechanisms

QUICK CHECK

| General Mode of Transport | Examples | Energy Required | Movement |
|---|---|---|---|
| **Passive** | • Diffusion<br>• Facilitated Diffusion<br>• Osmosis | No | Down Concentration Gradient |
| **Active** | • Membrane Pumps | Yes | Against Concentration Gradient |
| **Cytosis** | • Exocytosis<br>• Pinocytosis<br>• Phagocytosis | Yes | Down or Against Concentration Gradient |