CELL TRANSPORT UNIT

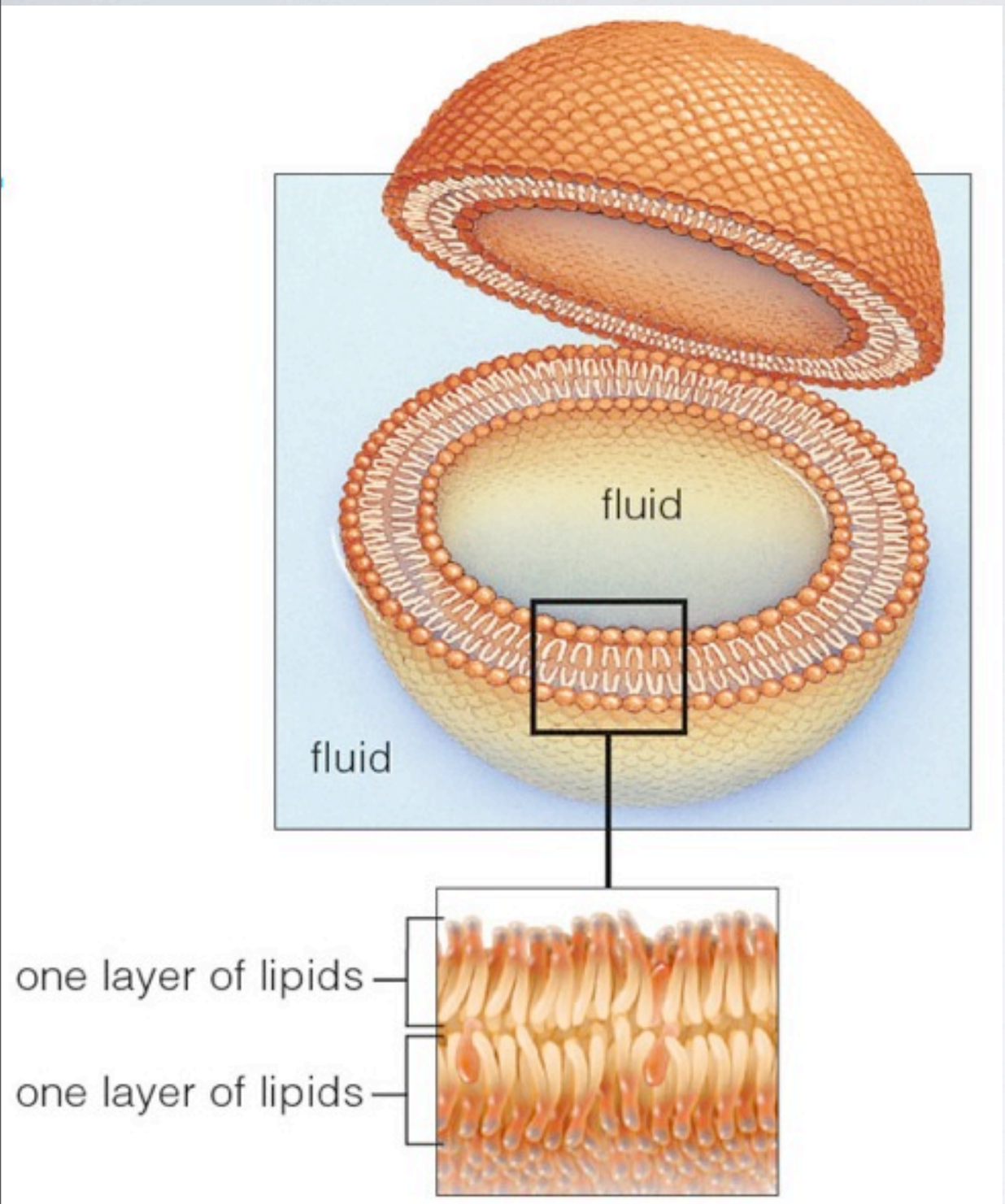
How do materials get in and out of cells?

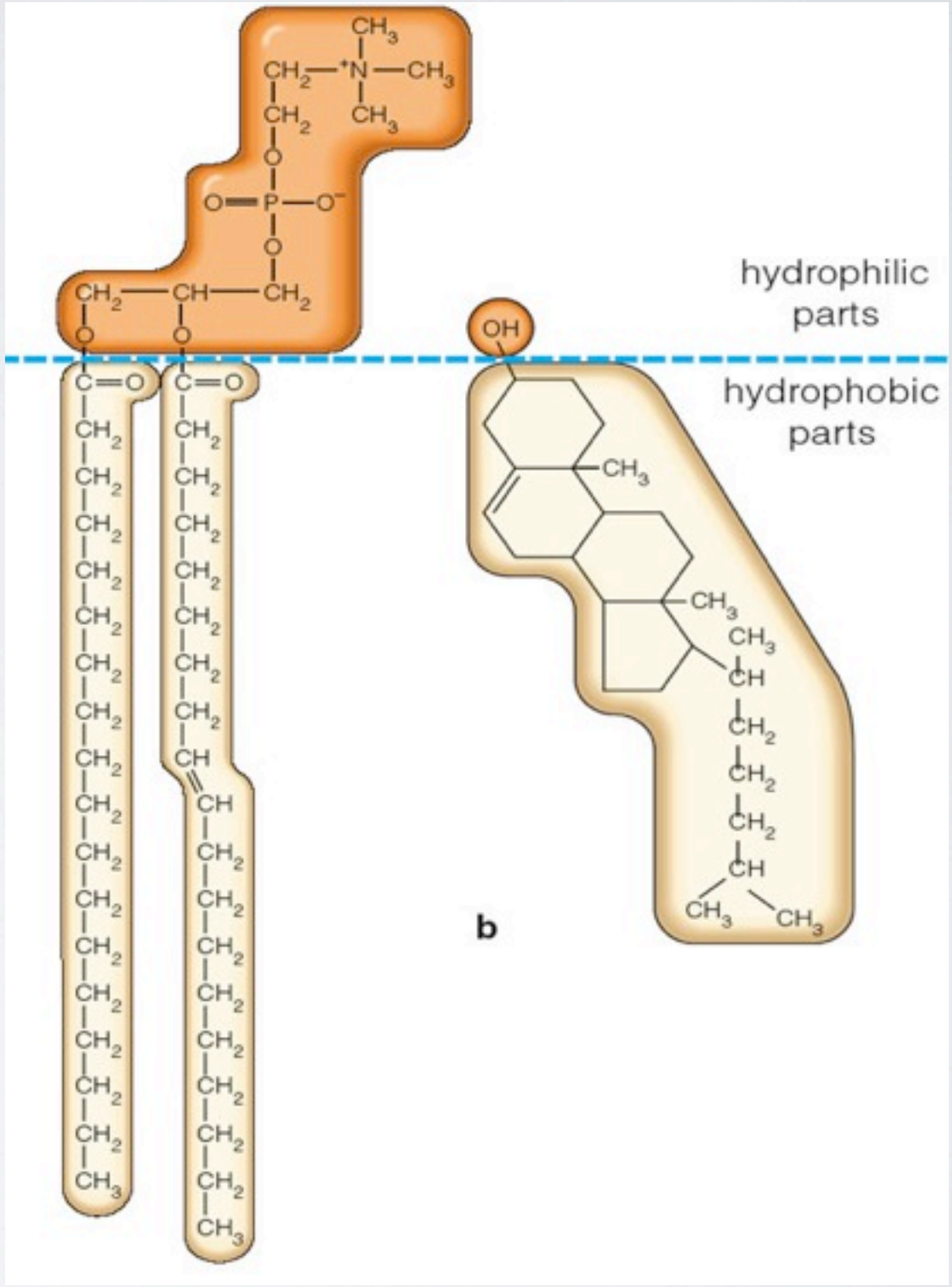
THROUGH CELL/PLASMA/SURFACE MEMBRANE

- Selectively permeable-
- Explained by the FLUID-MOSAIC model- 1972, Singer & Nicolson

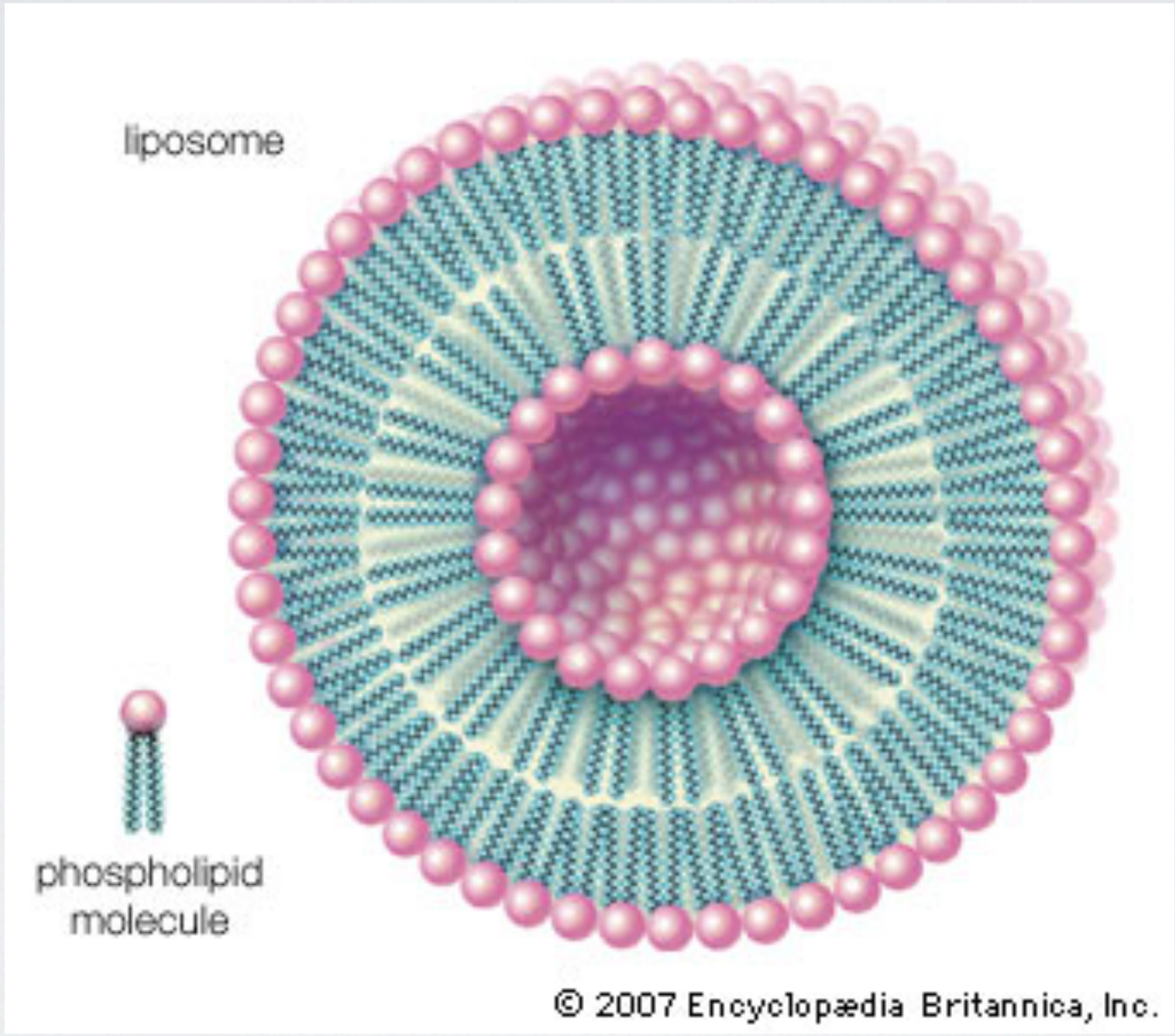
FLUID MOSAIC IS A MODEL OF: BILIPID LAYER OR LIPID BILAYER

- The part ALL membranes have in common


fluid
fluid
one layer of lipids
one layer of lipids

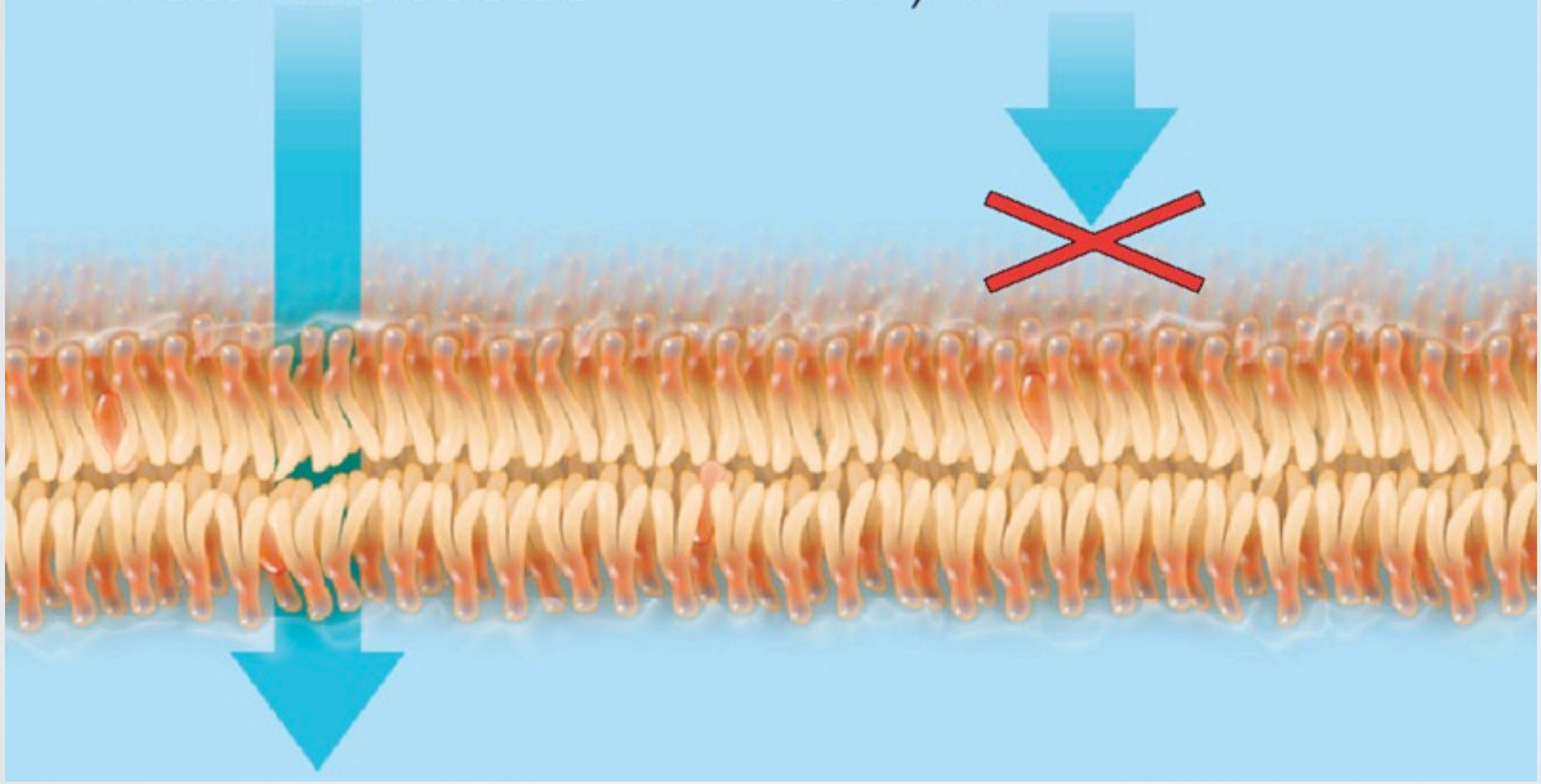

hydrophilic parts
hydrophobic parts
b

LIPID BILAYER ALLOWS FOR SELECT PERMEABILITY.



oxygen, carbon dioxide, and other small, nonpolar molecules; some water molecules

glucose and other large, polar, water-soluble molecules; ions (e.g., H^+, Na^+, K^+, Ca^{++}, Cl^-)

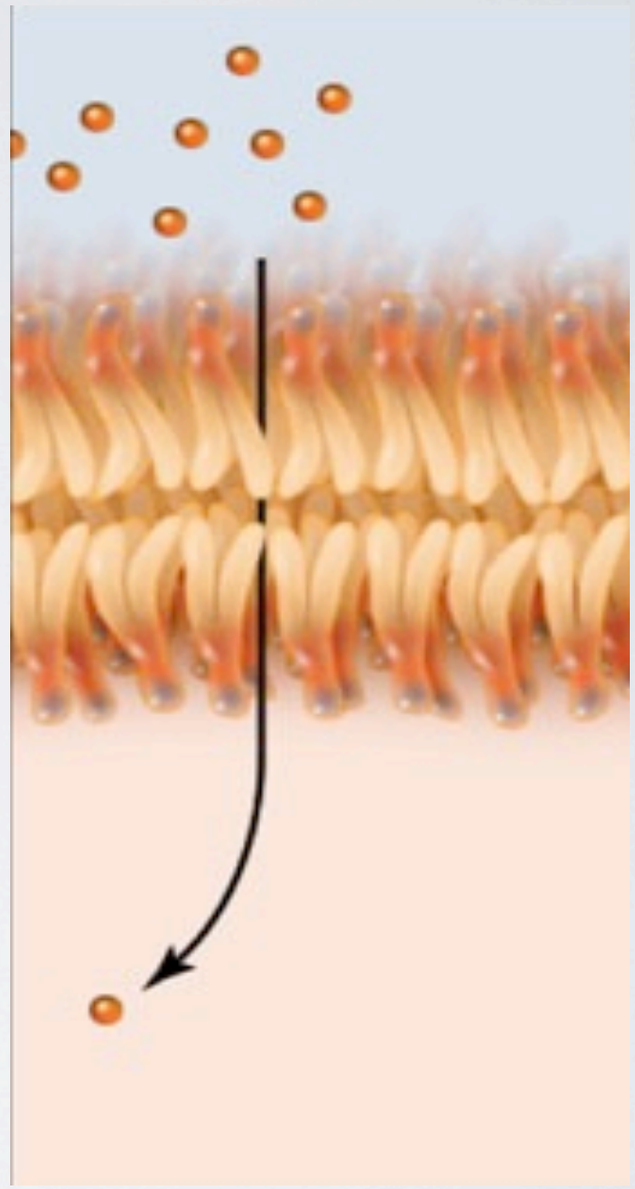


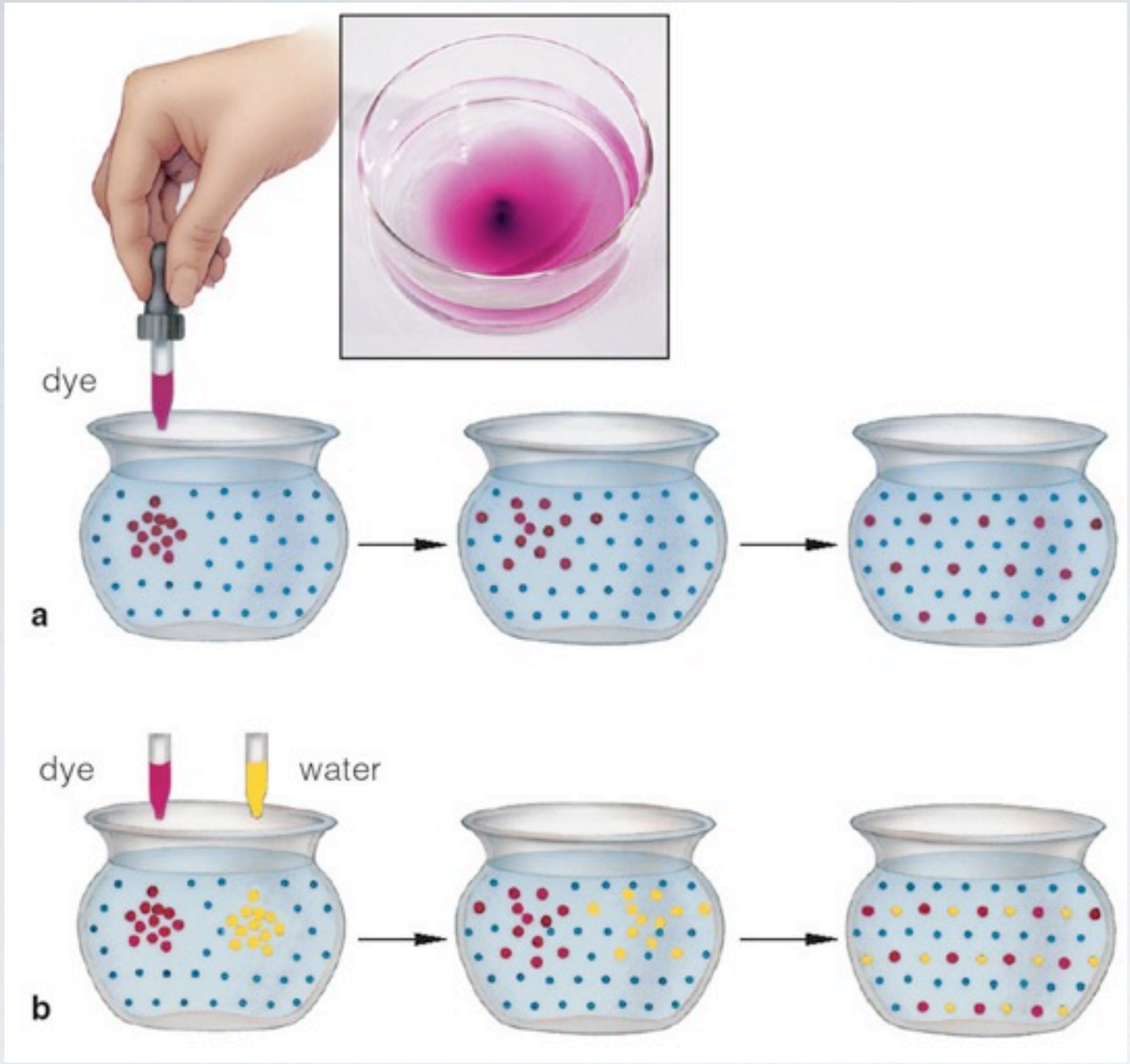
1. SIMPLE DIFFUSION

- Description-

- Accounts for the

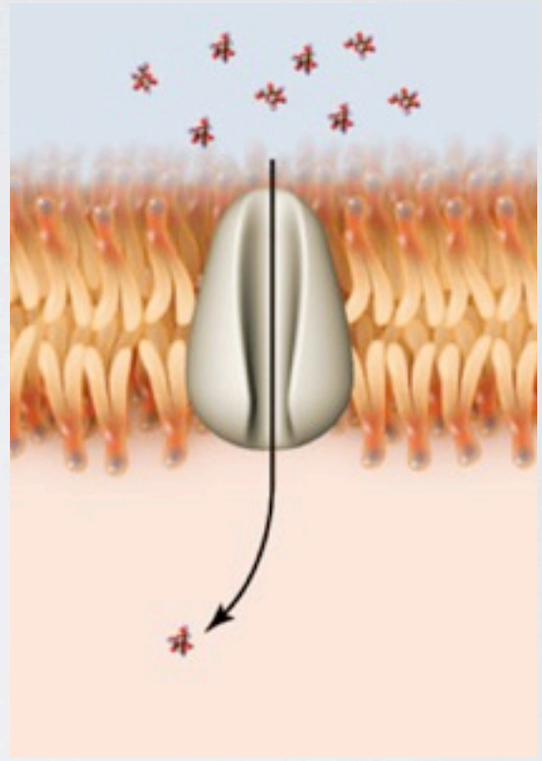
  movement of-




dye
a
dye
water
b

2. FACILITATED DIFFUSION

- Description-



- Accounts for the

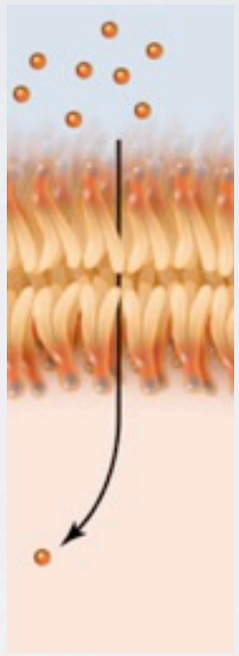
  movement of-

FACILITATED DIFFUSION

- For ions and molecules which cannot freely diffuse through the cell
- Can use channel proteins or gated proteins (also called carrier proteins)
- Facilitated diffusion still goes with concentration gradient
- Facilitated Diffusion Does not use energy.

3. OSMOSIS

- Description-



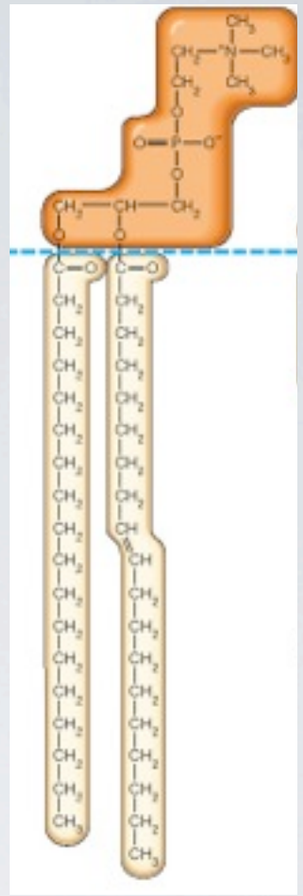
- Accounts for the movement

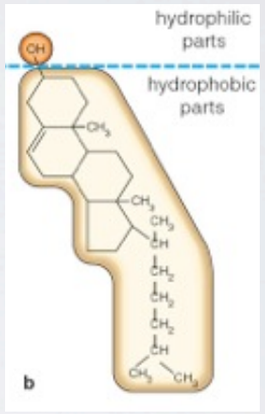
  of-

CELL MEMBRANE TERMS

- **hydrophobic**
- **hydrophilic**
- **saturated phospholipid**
- **unsaturated phospholipid**

Structure	Function
Phospholipid- • hydrophilic head • 2 hydrophobic tails: one saturated, one unsaturated (KINKED!) • 2 layers- tail to tail orientation	• Barrier to large and/or polar and/or charged molecules or ions • FLUID-can change shape, repair itself, and fuse with other membranes
Cholesterol-In animal cells ONLY	Maintains fluidity of membrane



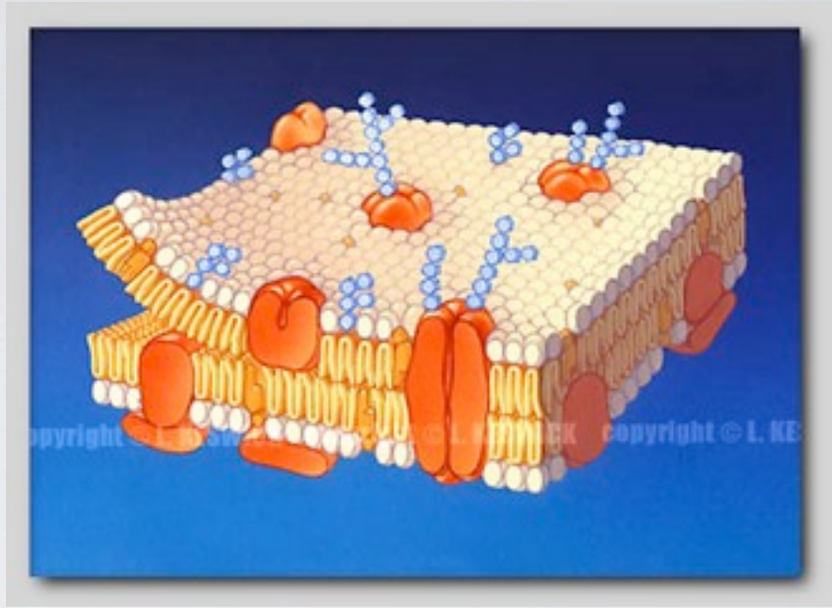


EMBEDDED PROTEINS

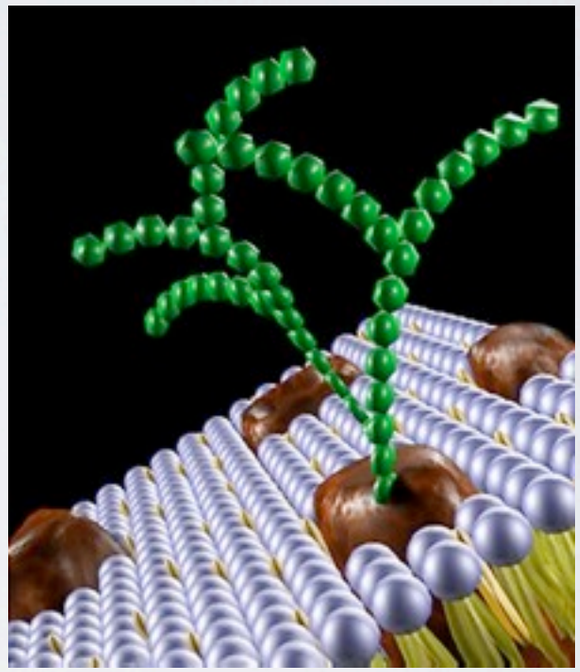
- What differs between all membranes
- Make each membrane UNIQUE
- Creates a MOSAIC

STRUCTURE

- Integral-



- Peripheral-

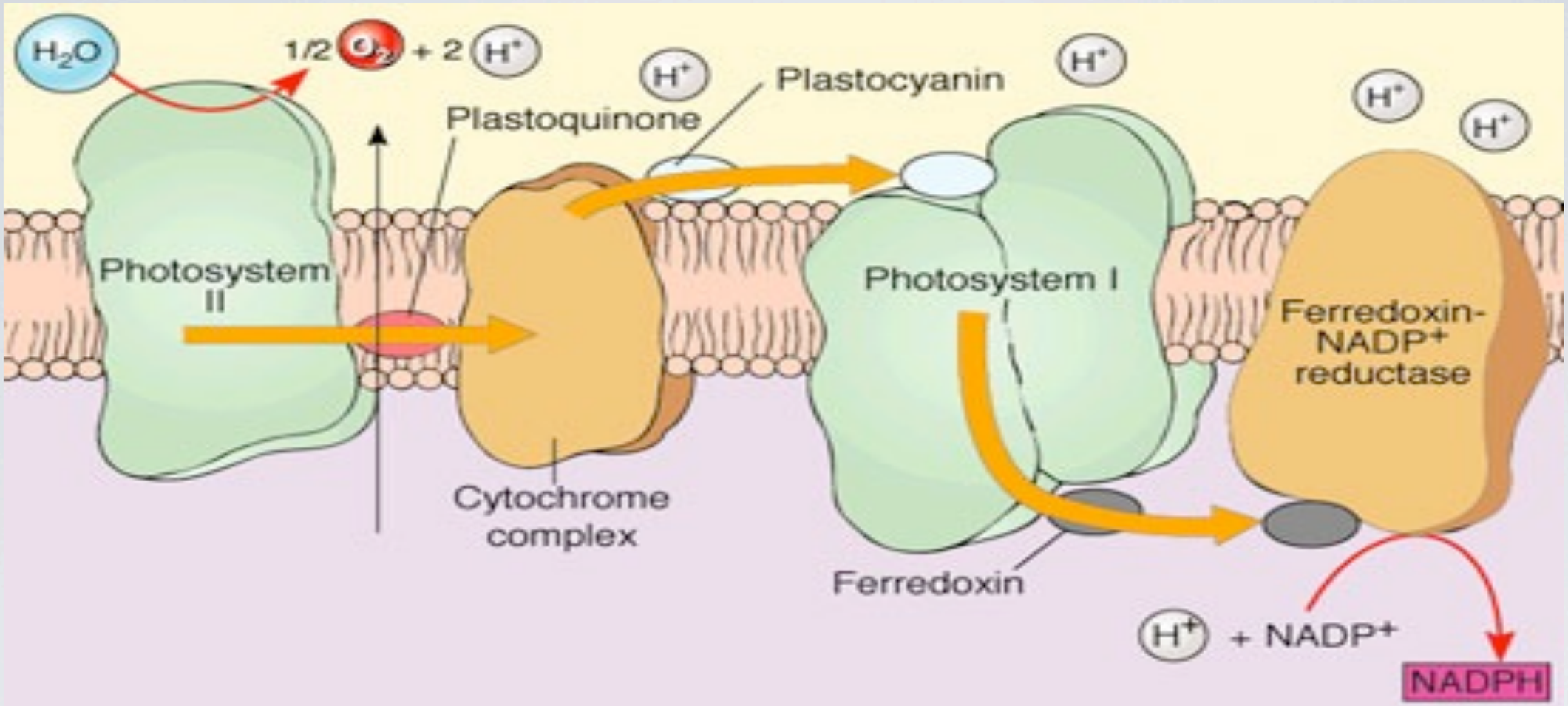


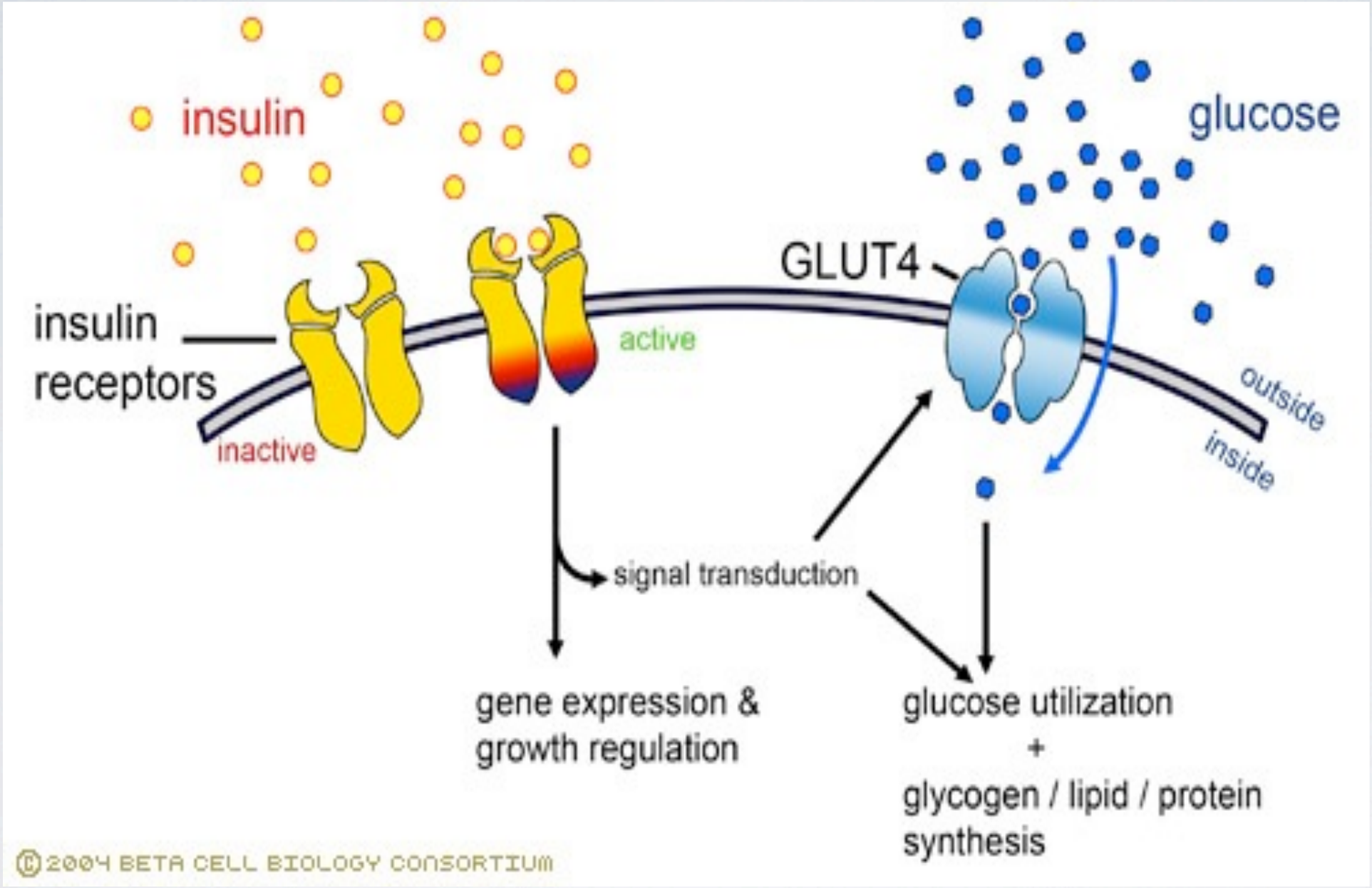
- Glycoprotein-

  (can be integral or peripheral)

2. FUNCTIONS

- Transport channels
- Enzymes
- Electron carriers
- Hormone binding sites (receptors)
- Antigen binding sites (receptors)


H_2O
1/2 O_2 + 2 H^+
H^+
Plastocyanin
Plastoquinone
H^+
H^+
H^+
Photosystem II
Photosystem I
Ferredoxin-NADP+ reductase
Cytochrome complex
Ferredoxin
H^+ + $NADP^+$
NADPH


insulin
glucose
GLUT4
insulin
receptors
active
inactive
outside
inside
signal transduction
gene expression &
growth regulation
glucose utilization
+
glycogen / lipid / protein
synthesis
©2004 BETA CELL BIOLOGY CONSORTIUM

MECHANISMS REQUIRING NO ENERGY

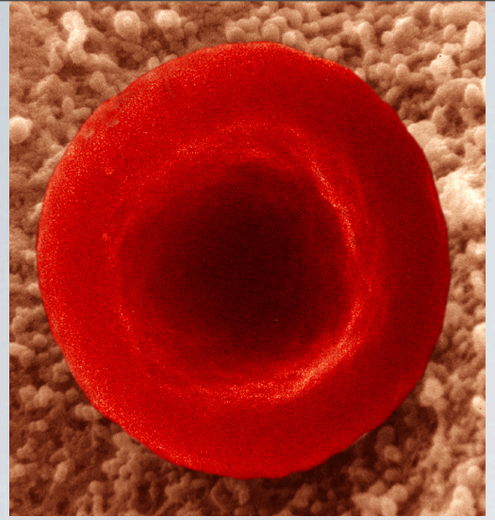
- [high] ➔[low]
- Towards equilibrium
- The rate at which substances move by these processes explains why cells are ***microscopic***- we'll return to this idea later.
- Includes DIFFUSION AND OSMOSIS

SOLUTIONS

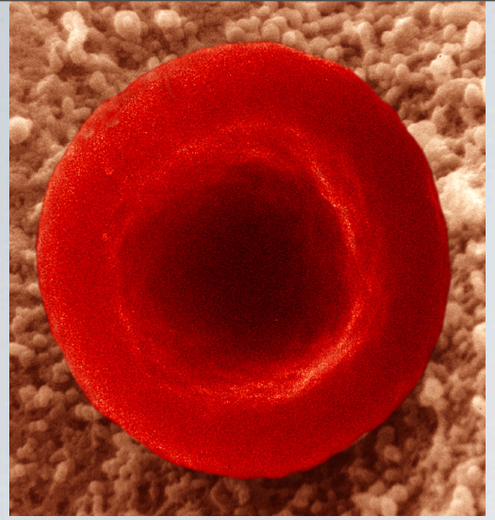
- Hypertonic-

- Hypotonic-

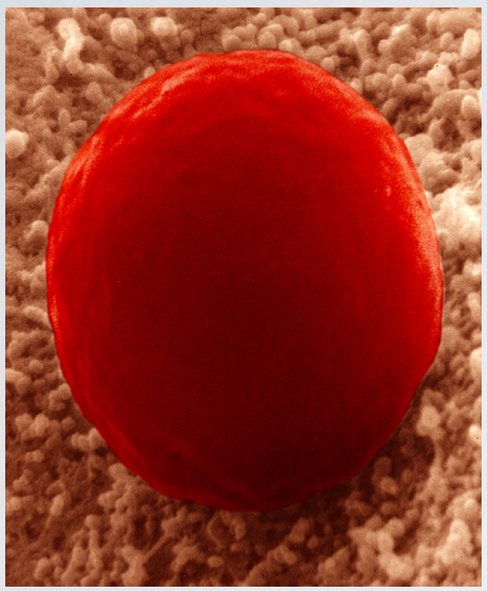
- Isotonic-



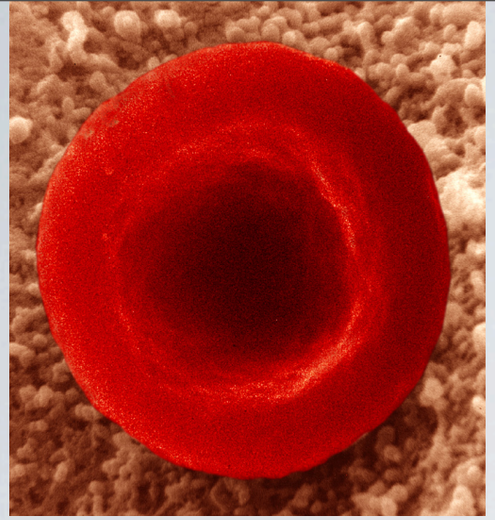
Normal looking RBC (red blood cell).



Normal looking RBC (red blood cell).



RBC in a hypertonic or hypotonic solution?



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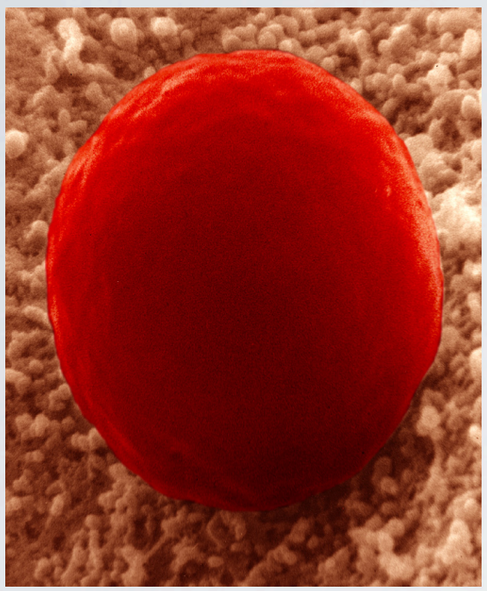
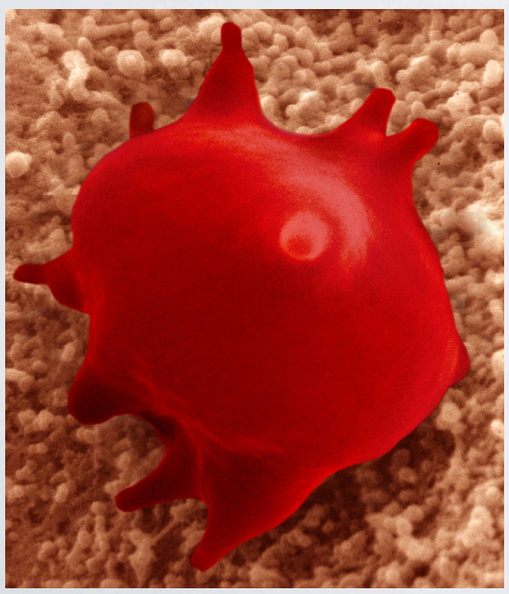


RBC in a hypertonic or hypotonic solution?



RBC in a hypertonic or hypotonic solution ?

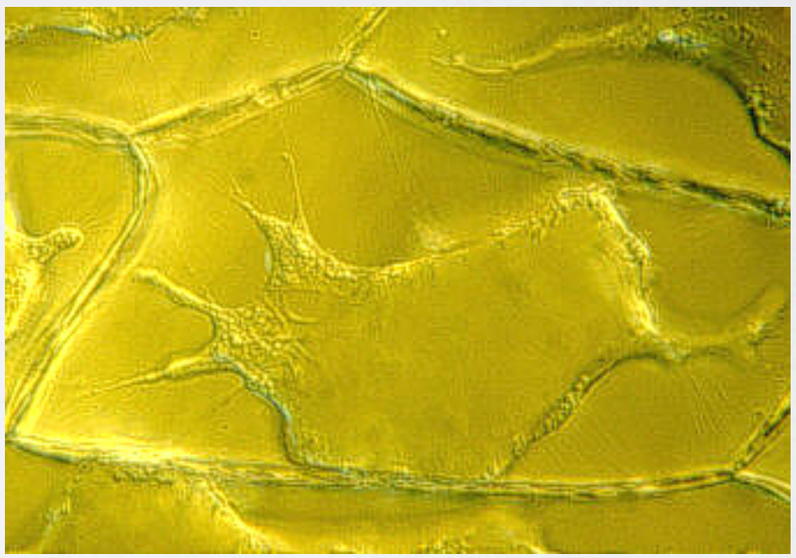
Normal plant cells

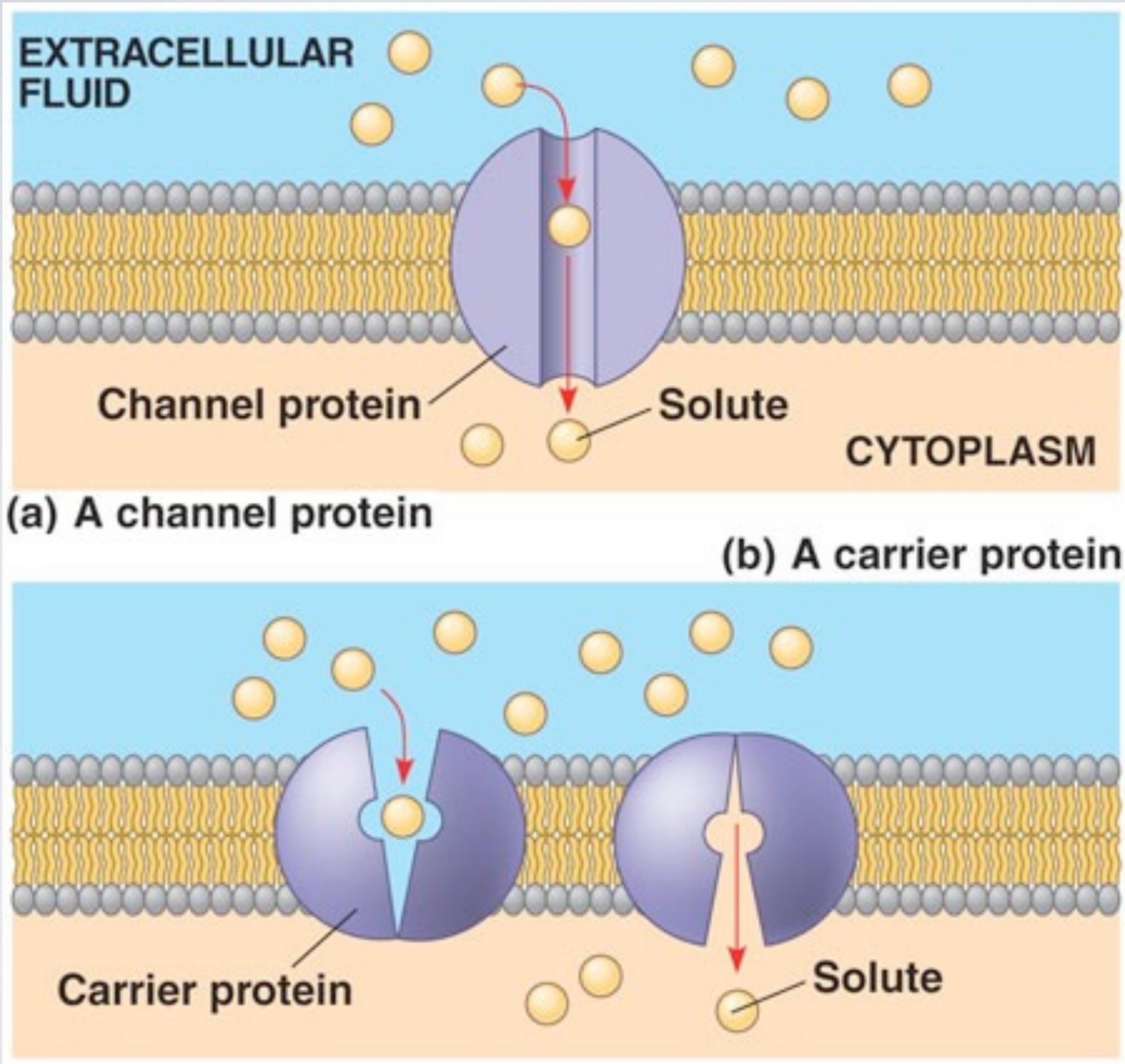
What do you predict will happen if watered with a hypertonic solution?

Normal plant cells

What do you predict will happen if watered with a hypertonic solution?

Normal plant cells




EXTRACELLULAR FLUID
Channel protein
Solute
CYTOPLASM
(a) A channel protein
(b) A carrier protein
Carrier protein
Solute

TRANSPORT METHODS REQUIRING ENERGY

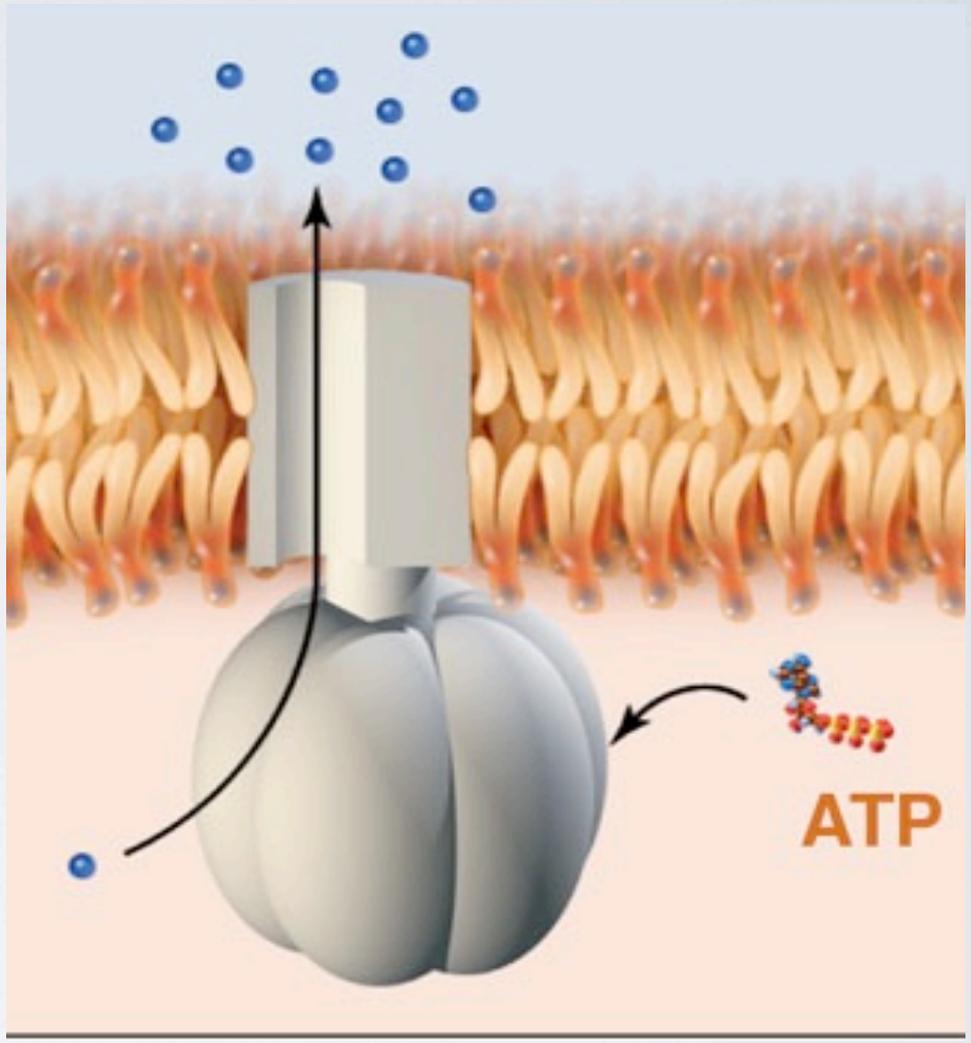
1. ACTIVE TRANSPORT

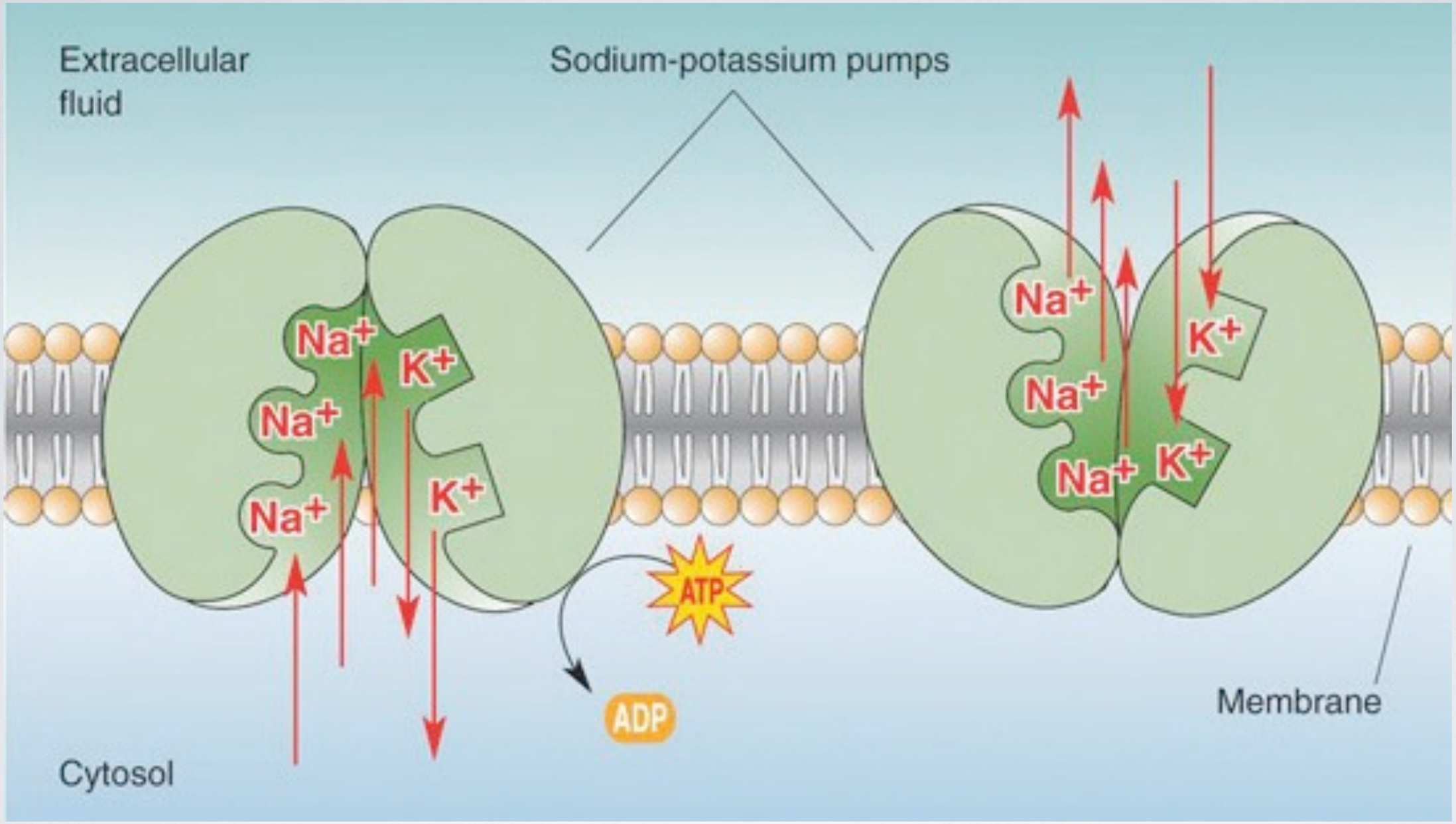
- Description-

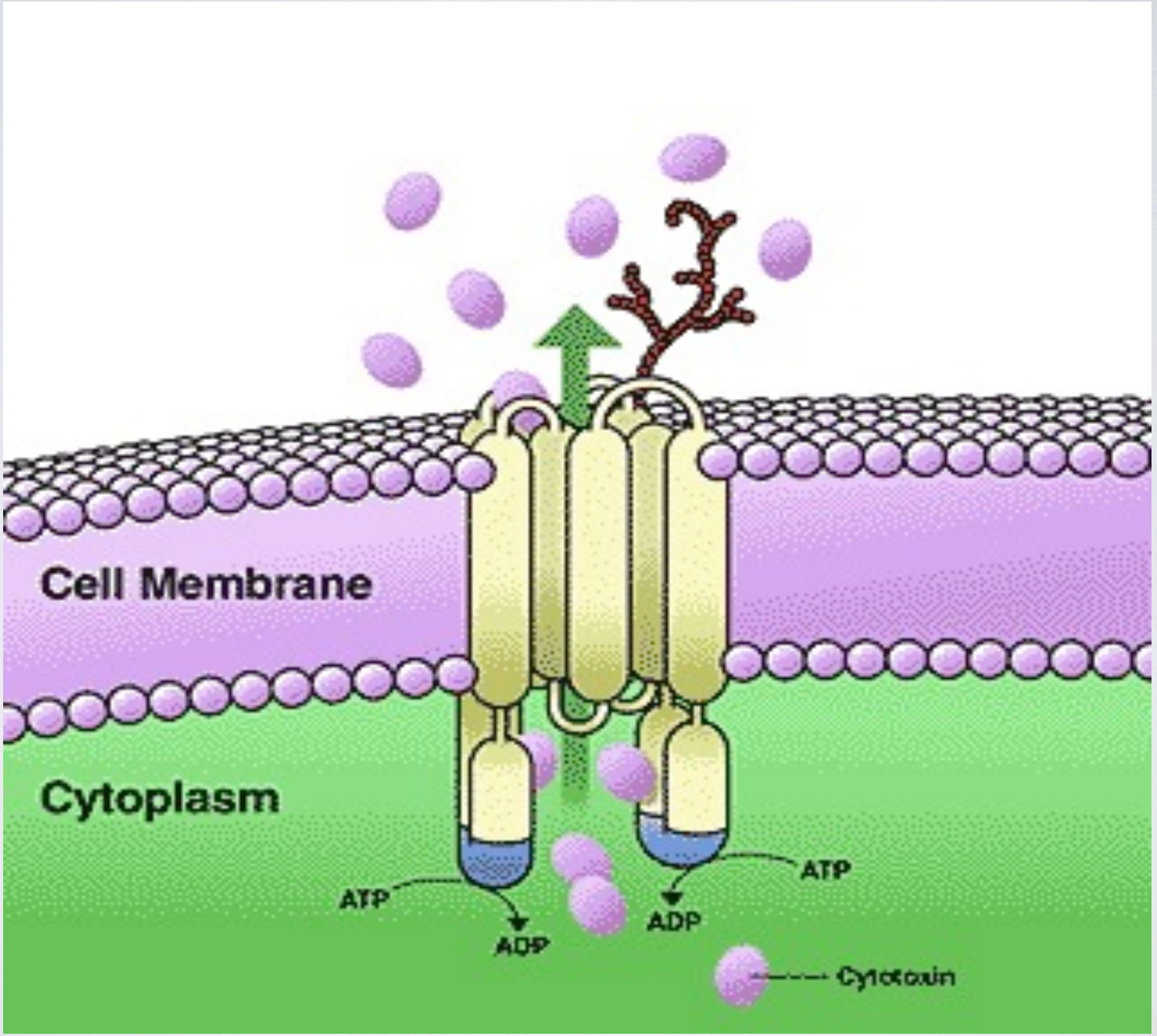
- Accounts for the

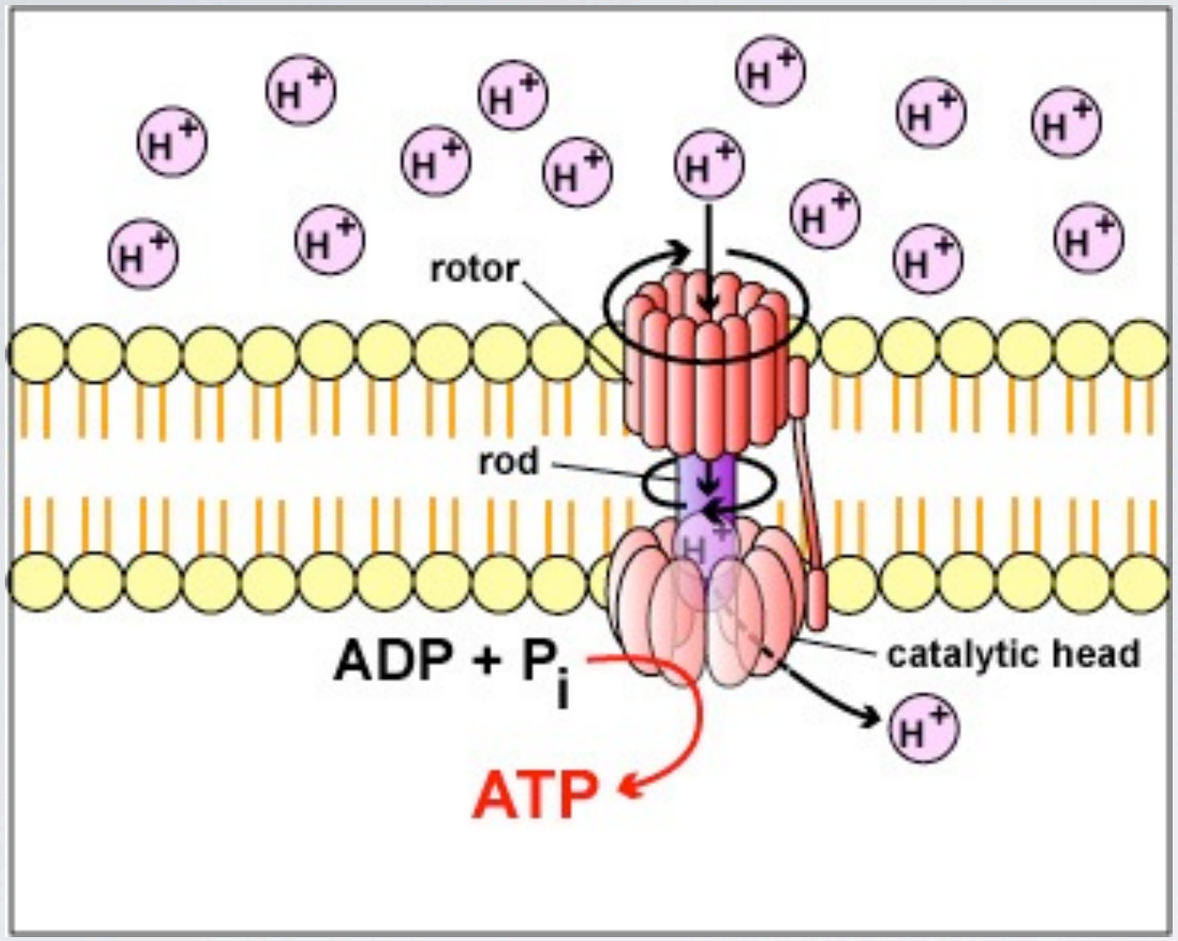
  movement of-

- Examples of cell use-

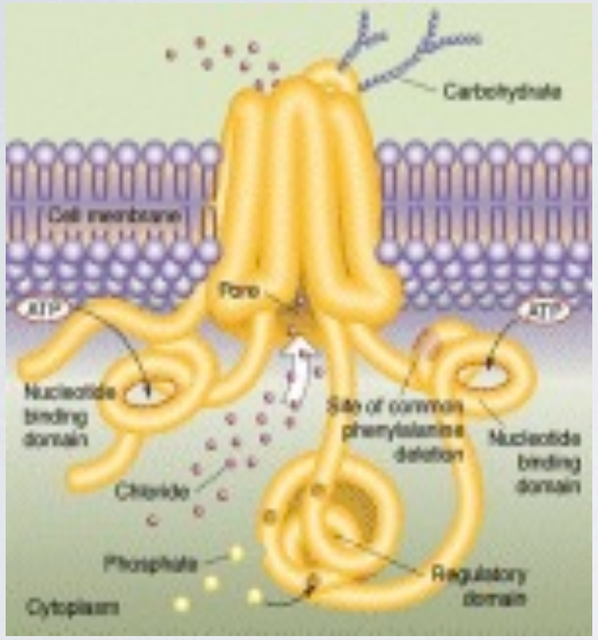



Extracellular fluid
Sodium-potassium pumps
Na+
K+
Na+
Na+
K+
ATP
ADP
Na+
K+
Na+
Na+
K+
Membrane
Cytosol


Cell Membrane
Cytoplasm
ATP
ADP
ATP
ADP
Cytotoxin


H+
rotor
rod
catalytic head
ADP + Pi
ATP

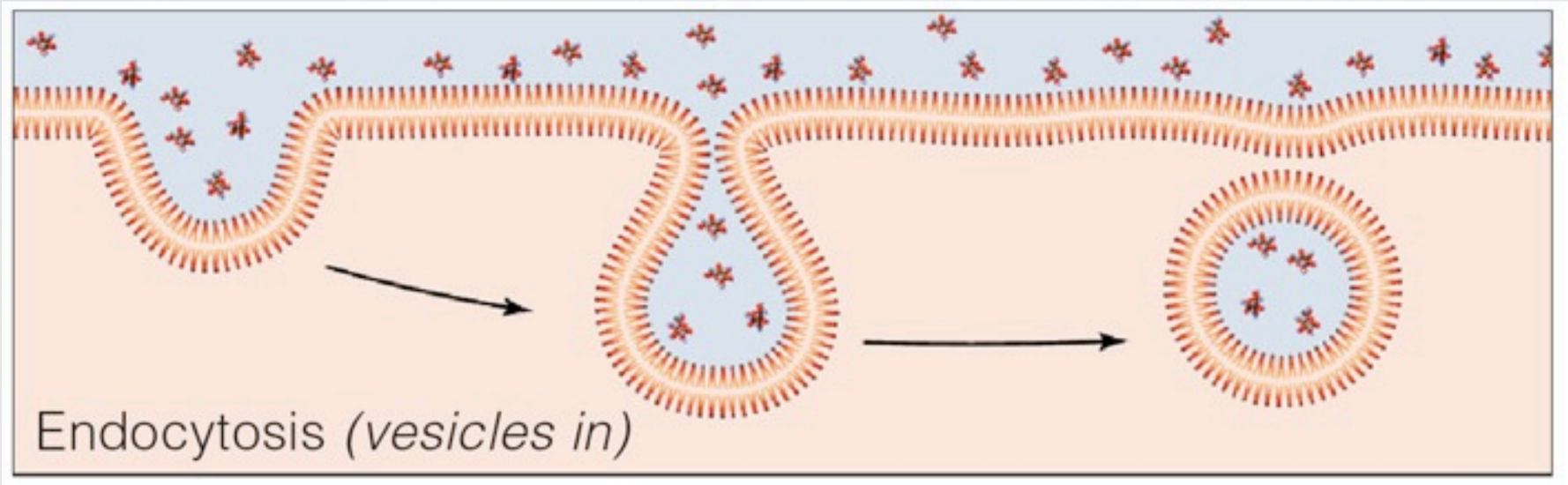
Cystic fibrosis



2. ENDOCYTOSIS

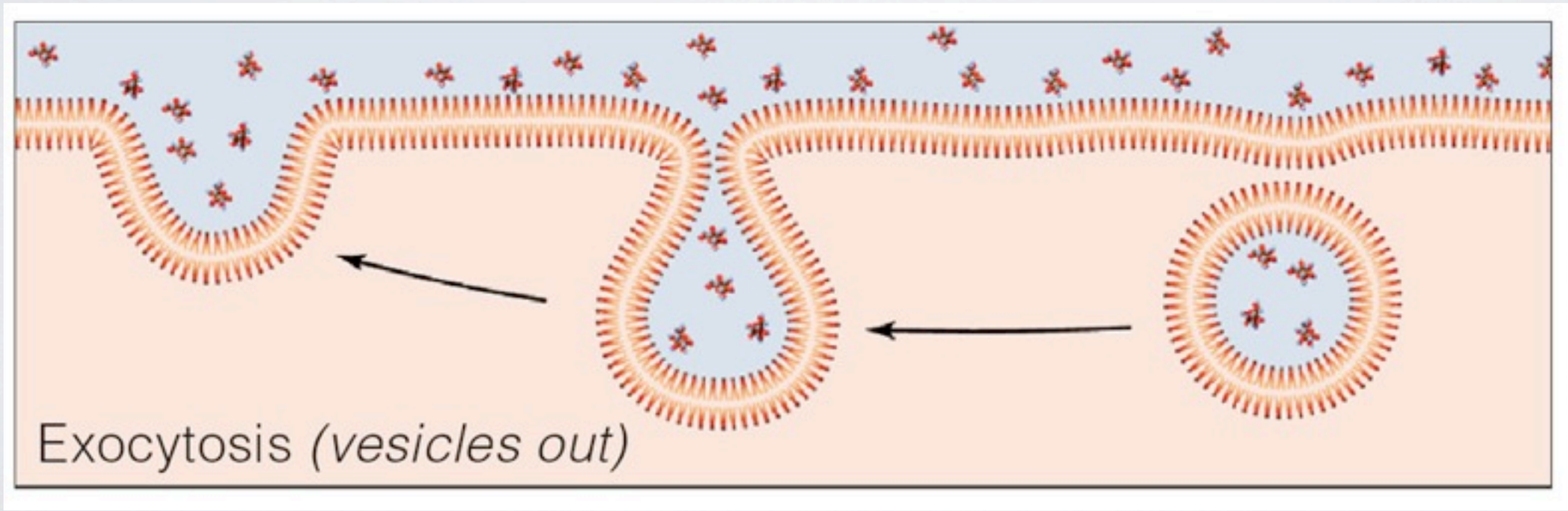
- Description-

- Examples of cell use-



3. EXOCYTOSIS

- Description-
- Accounts for the movement of-

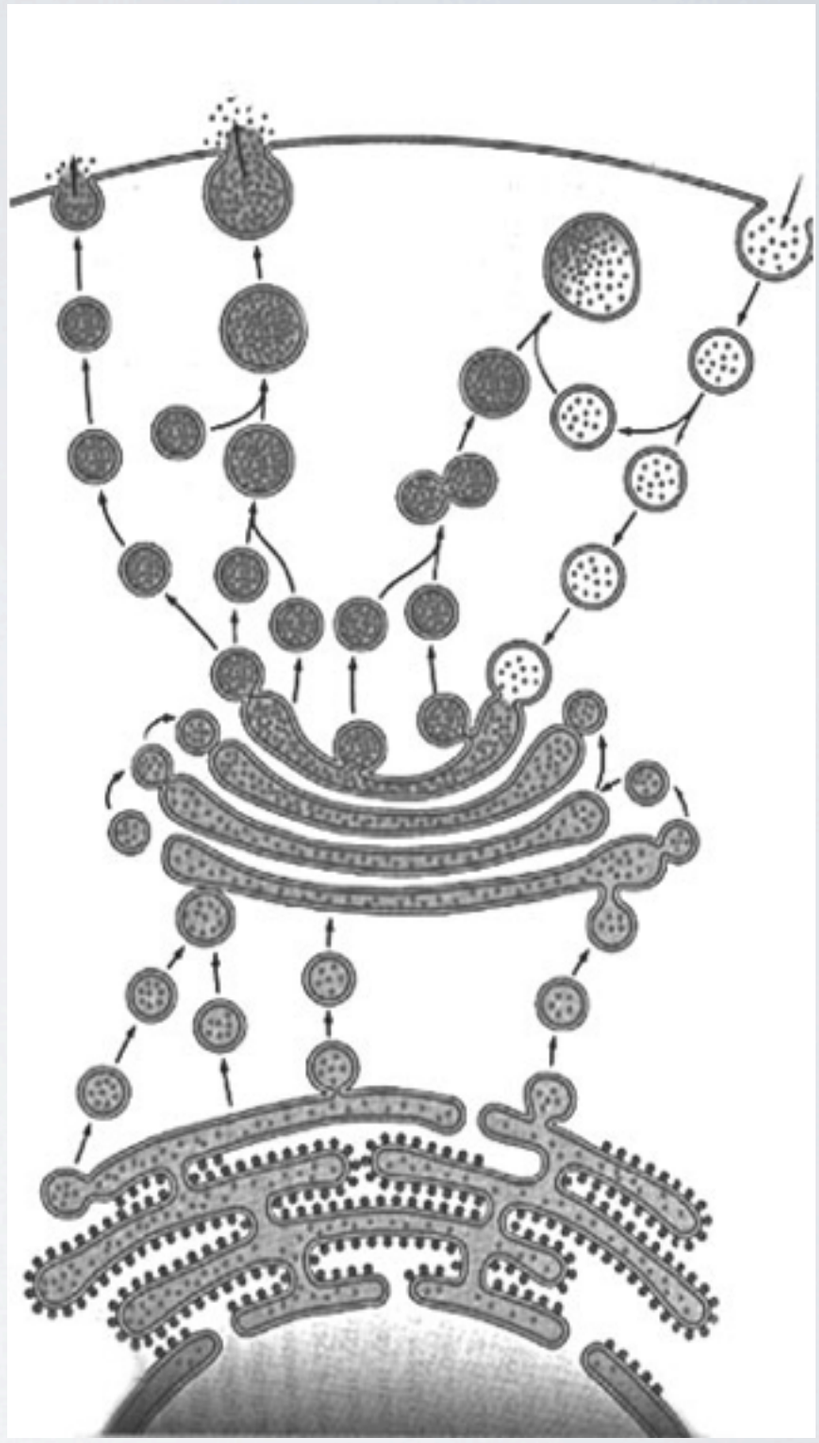


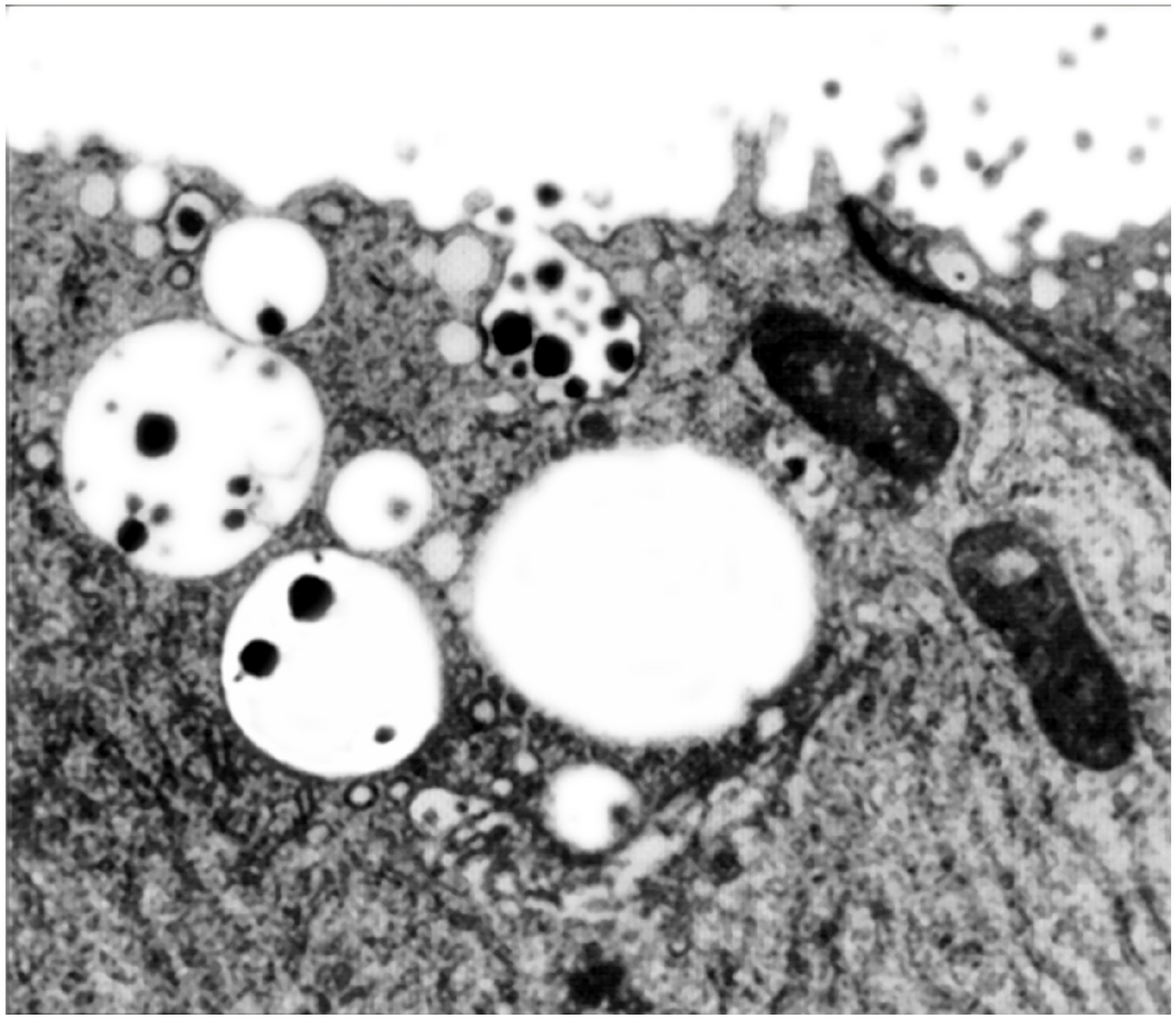
B. ENERGY REQUIRED

- [low]➔[high]
- Very large molecules
- Very large quantities of molecules

RECYCLING:

ENDOCYTOSIS AND EXOCYTOSIS ARE CONSTANTLY CYCLING CELL MEMBRANE





Credit: © Dr. Don Fawcett/Visuals Unlimited

350787

Exocytosis of the protein components of milk by a mammary gland cell. Exocytosis is the process by which cellular material is discharged from a cell. TEM.

⊙ How Surface Area to Volume Ratio Limits Cell Size

1. A cell is a metabolic compartment where a multitude of chemical reactions occur.

2. The number of reactions increase as the volume of metabolic volume within a cell increases. (The larger the volume the larger the number of reactions)

3.All raw materials necessary for metabolism can enter the cell only through its cell membrane.

4.The greater the surface area the larger the amount of raw materials that can enter at only one time.

5.Each unit of volume requires a specific amount of surface area to supply its metabolism with raw materials. The amount of surface area available to each unit of volume varies with the size of a cell.

6. As a cell grows its SA/V decreases.

7. At some point in its growth its SA/V becomes so small that its surface area is too mall to supply its raw materials to its volume. At this point the cell cannot get larger.

Cube A 1 cm each side	Cube B 2 cm each side
Surface area?	Surface area?
Volume?	Volume?
Ratio?	Ratio?

Most Animal cells require a minimum surface area:volume of **600:1**.

Most Plant cells require a minimum surface area:volume of **60:1**.