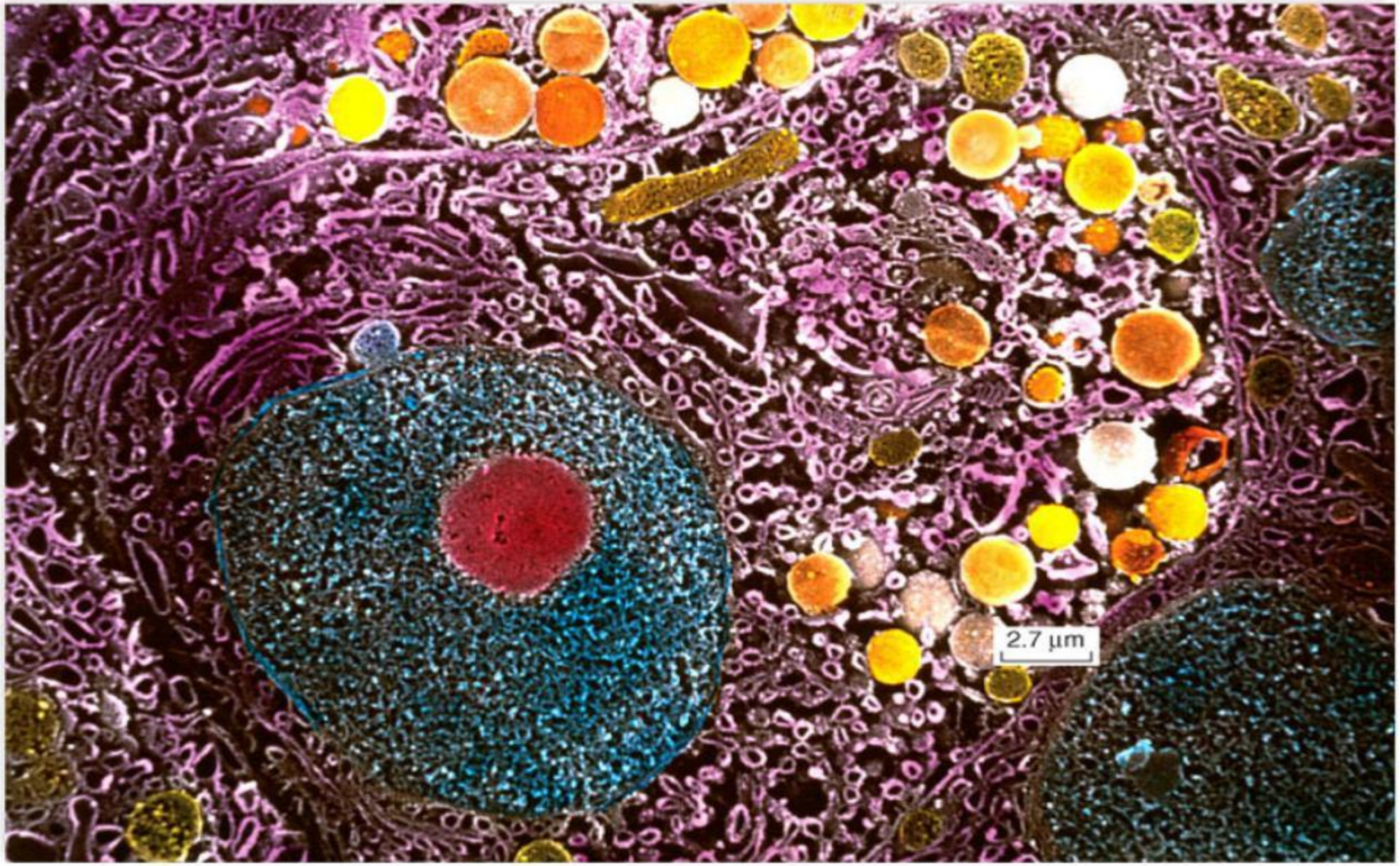
CO 5



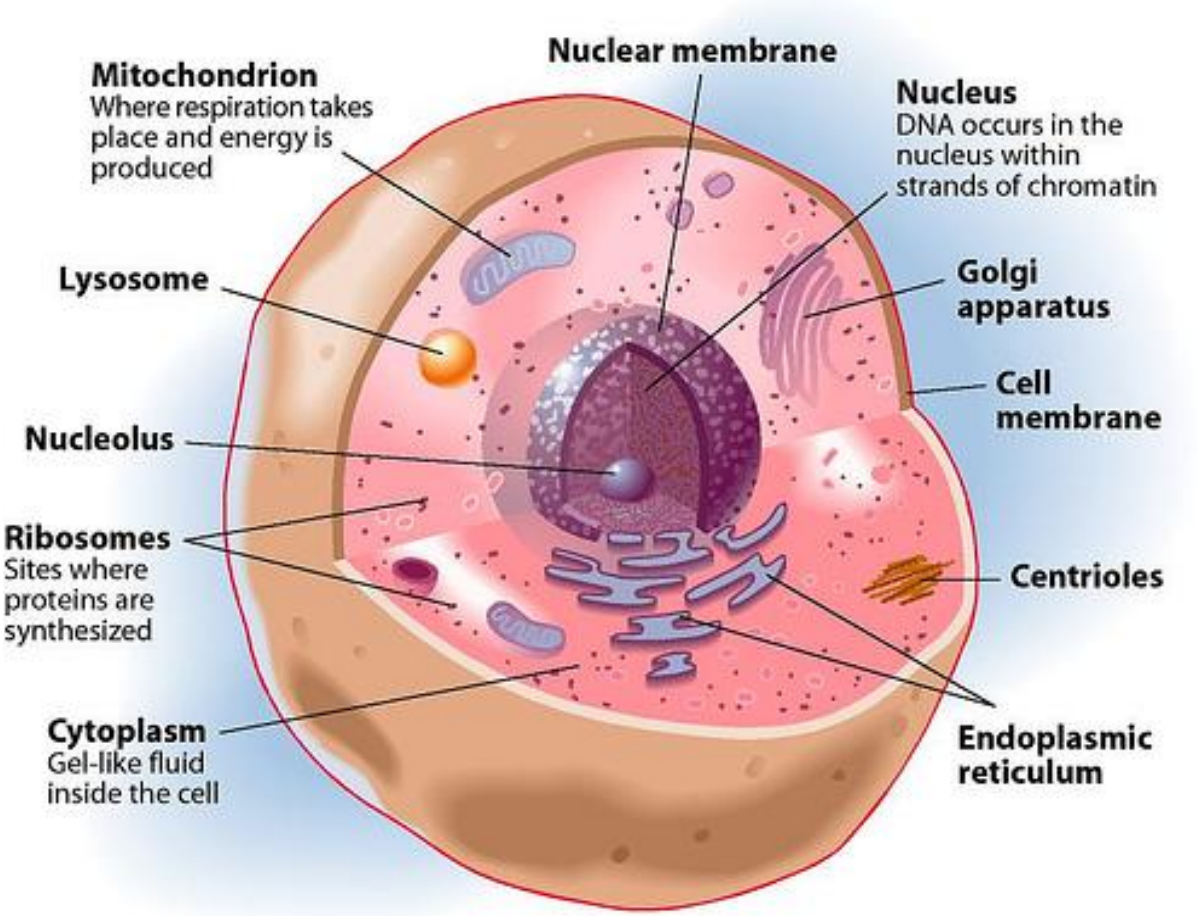
The Cell Membrane
and
Transport

Jobs of the Plasma Membrane:

-Isolate the cytoplasm from the external environment

-Regulate the exchange of substances

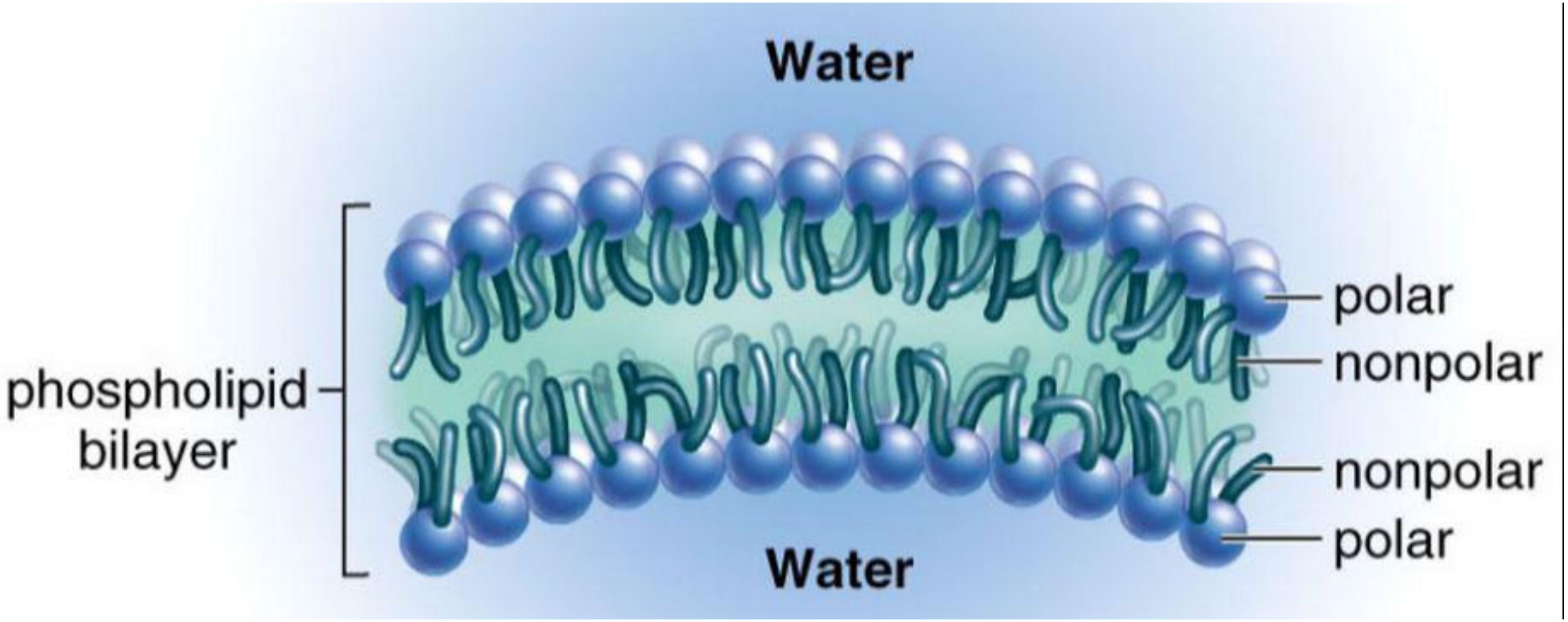
-Communicate with other cells (identification)



The Plasma Membrane (cell membrane)

The membrane is semipermeable (imagine a screen door): some things can get through the barrier, some can not

- S.J. Singer proposed the Fluid Mosaic Model to describe the cell membrane

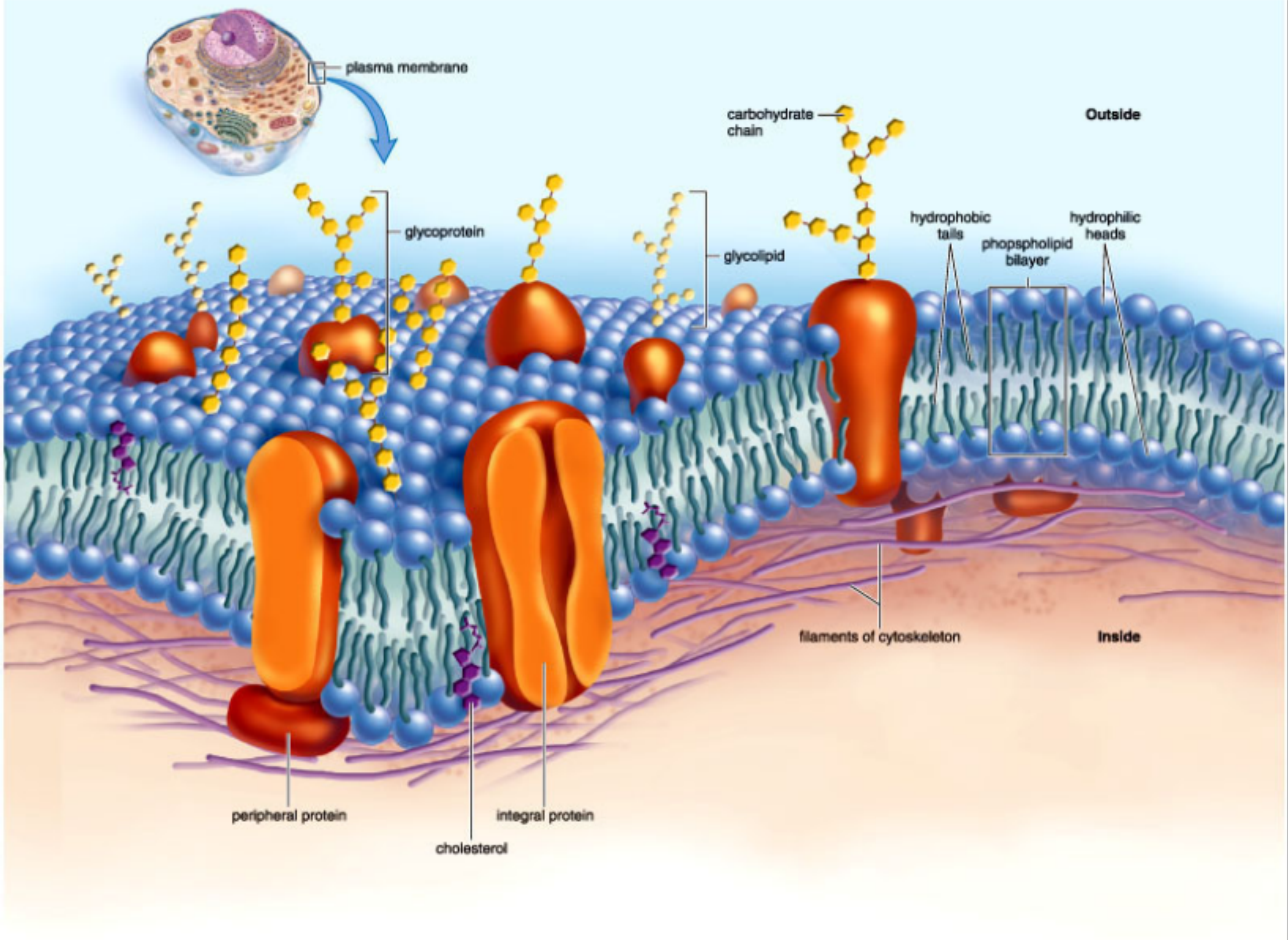


Fluid Mosaic Model

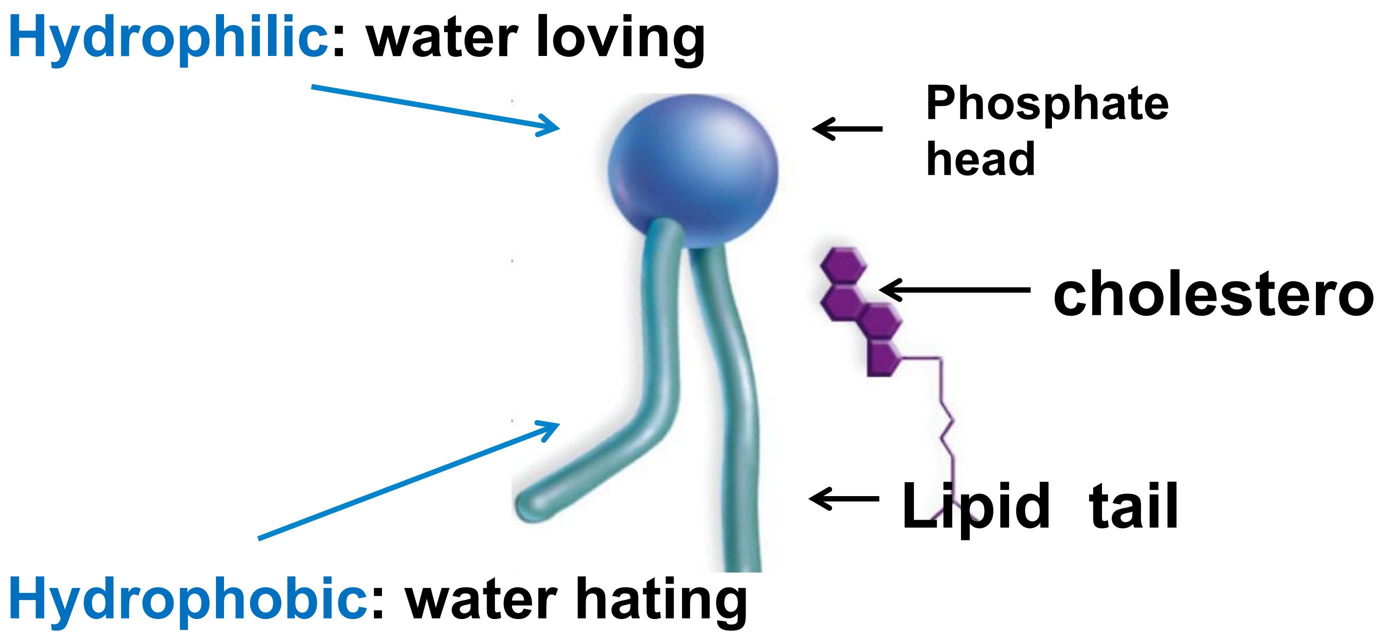
- Th er
  mo e.

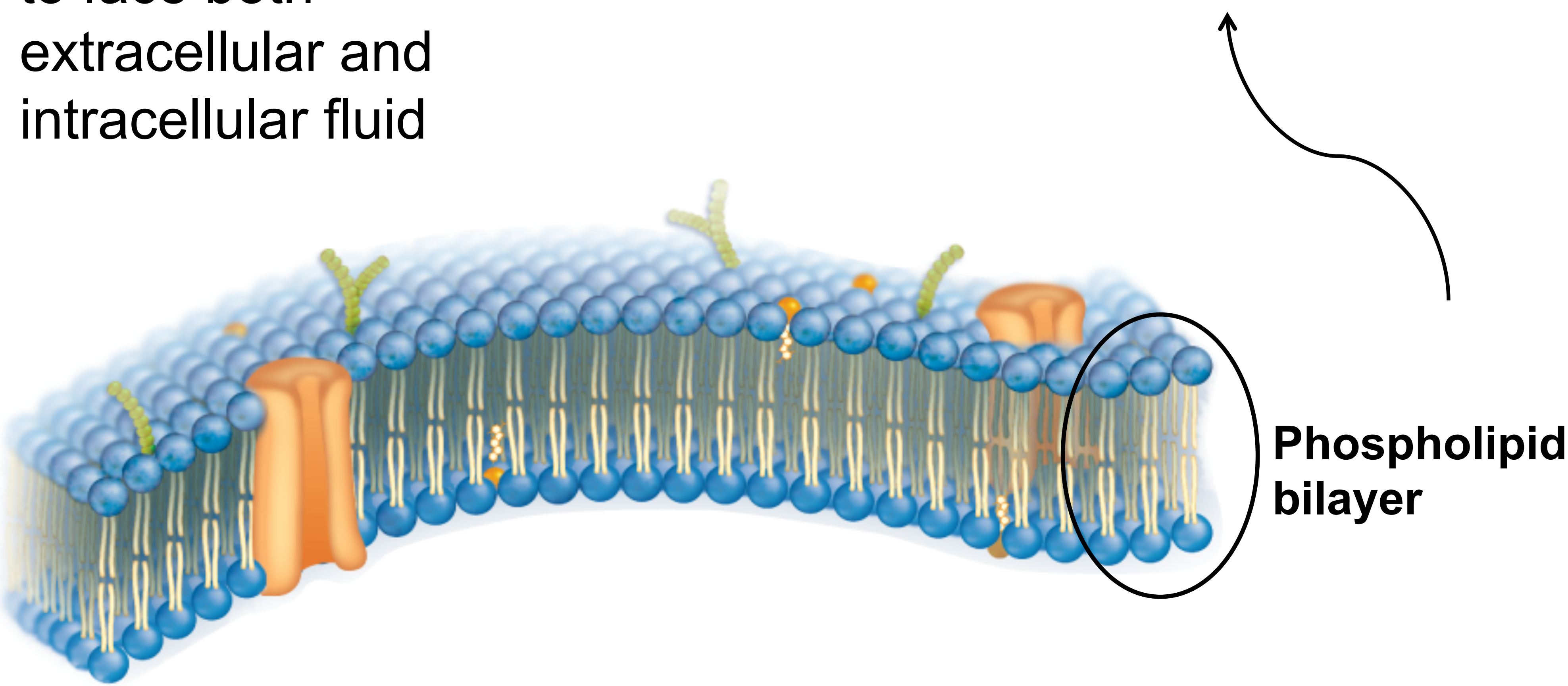
[video]

The plasma membrane is a **phospholipid bilayer:** make of lipid and embedded proteins.



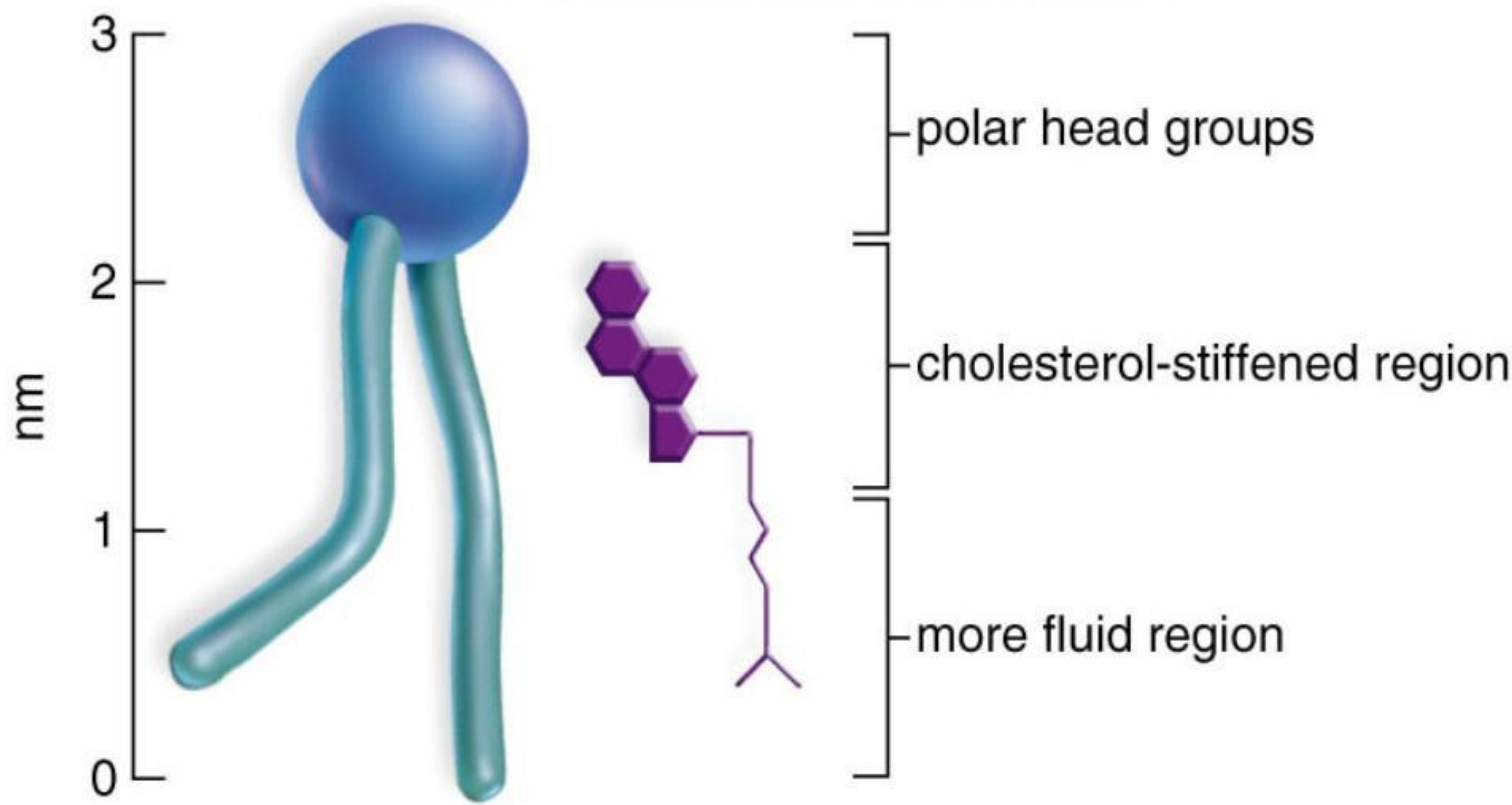
nonpolar tails (hydrophobic) are directed inward, polar heads (hydrophilic) are directed outward to face both extracellular and intracellular fluid

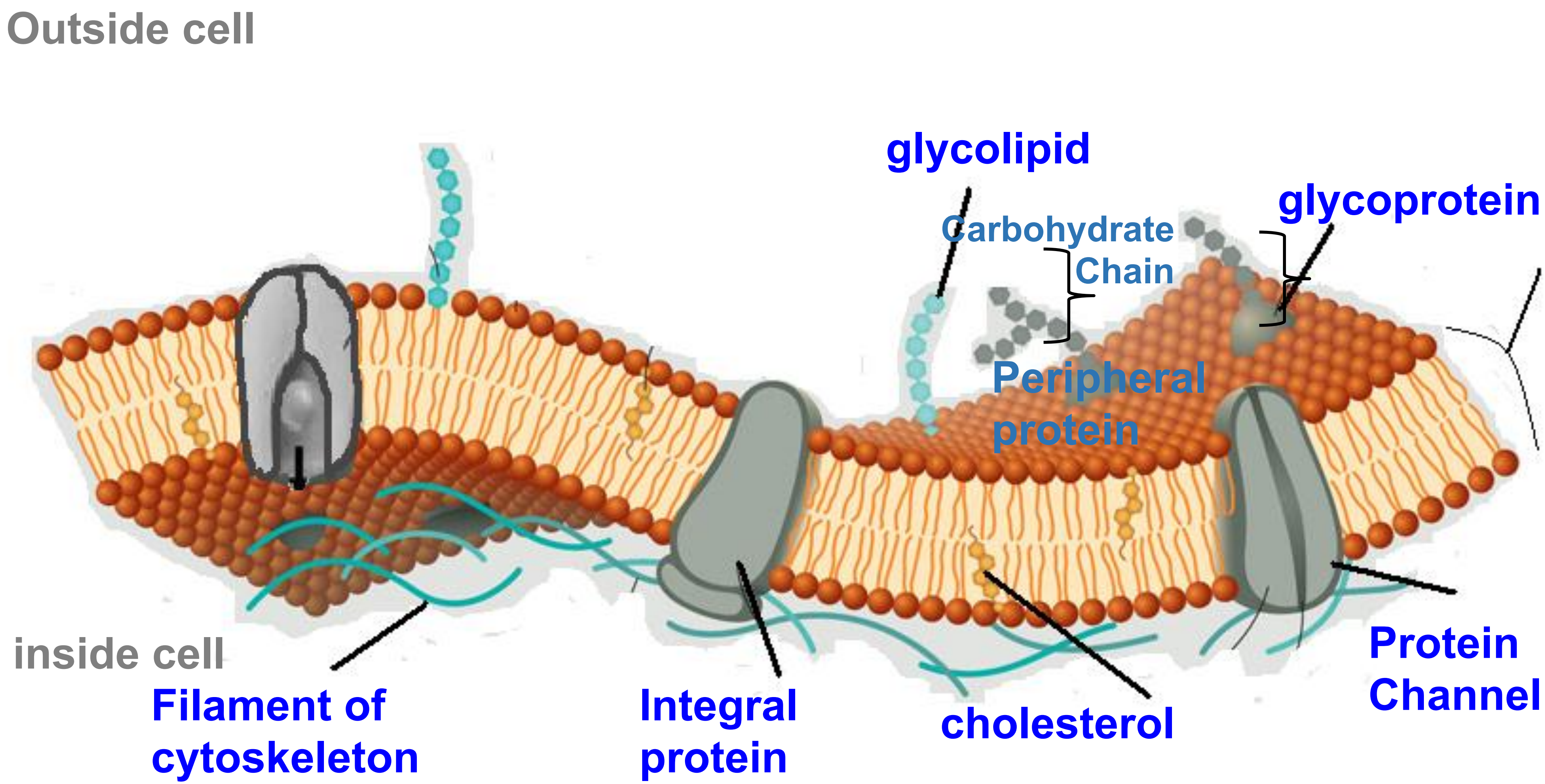




Cholesterol: lipid, affect fluidity of membrane, stiffen and strengthen

- high temps: stiffens to make less fluid
- low temps: helps prevent membrane from freezing

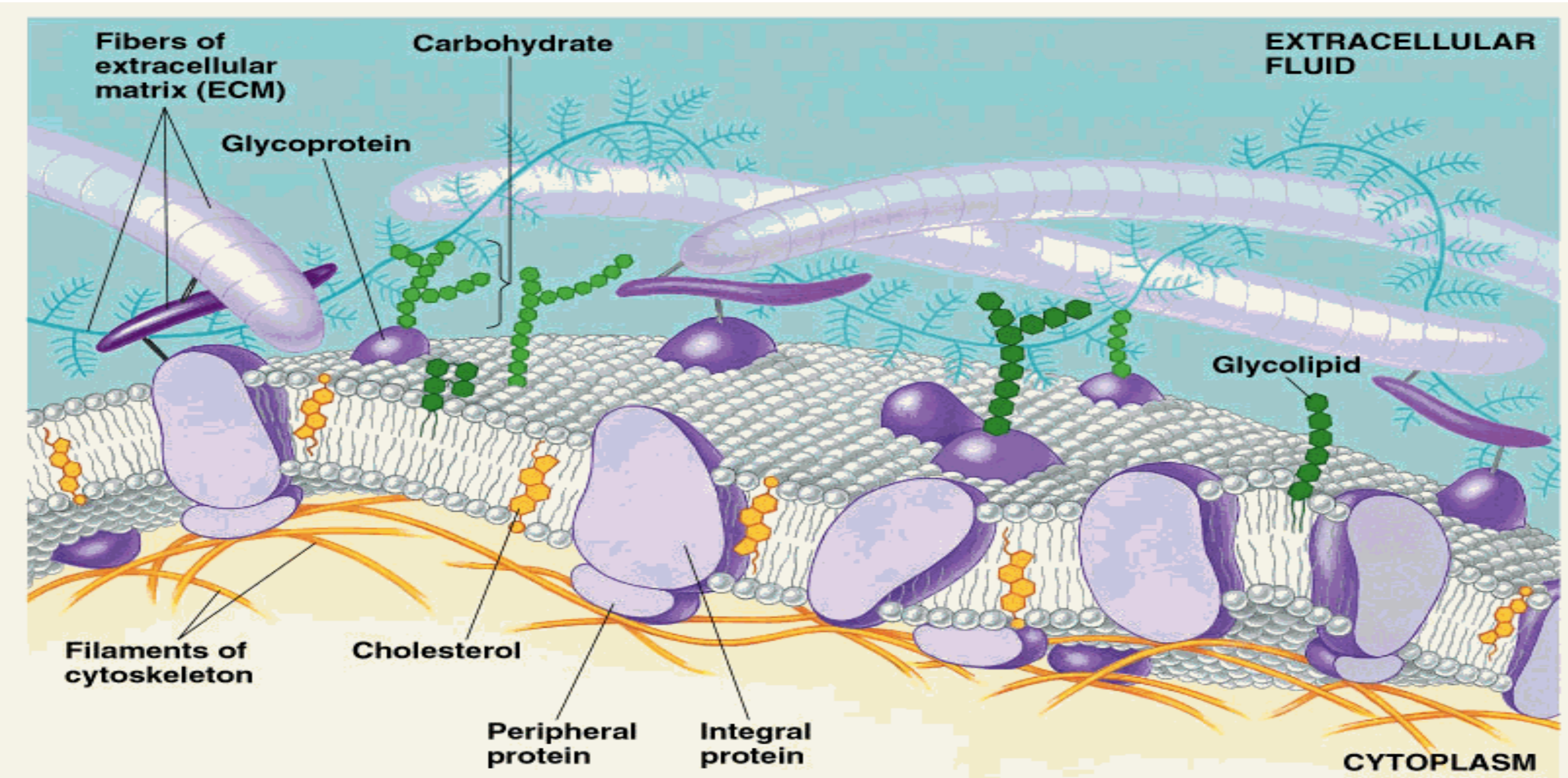




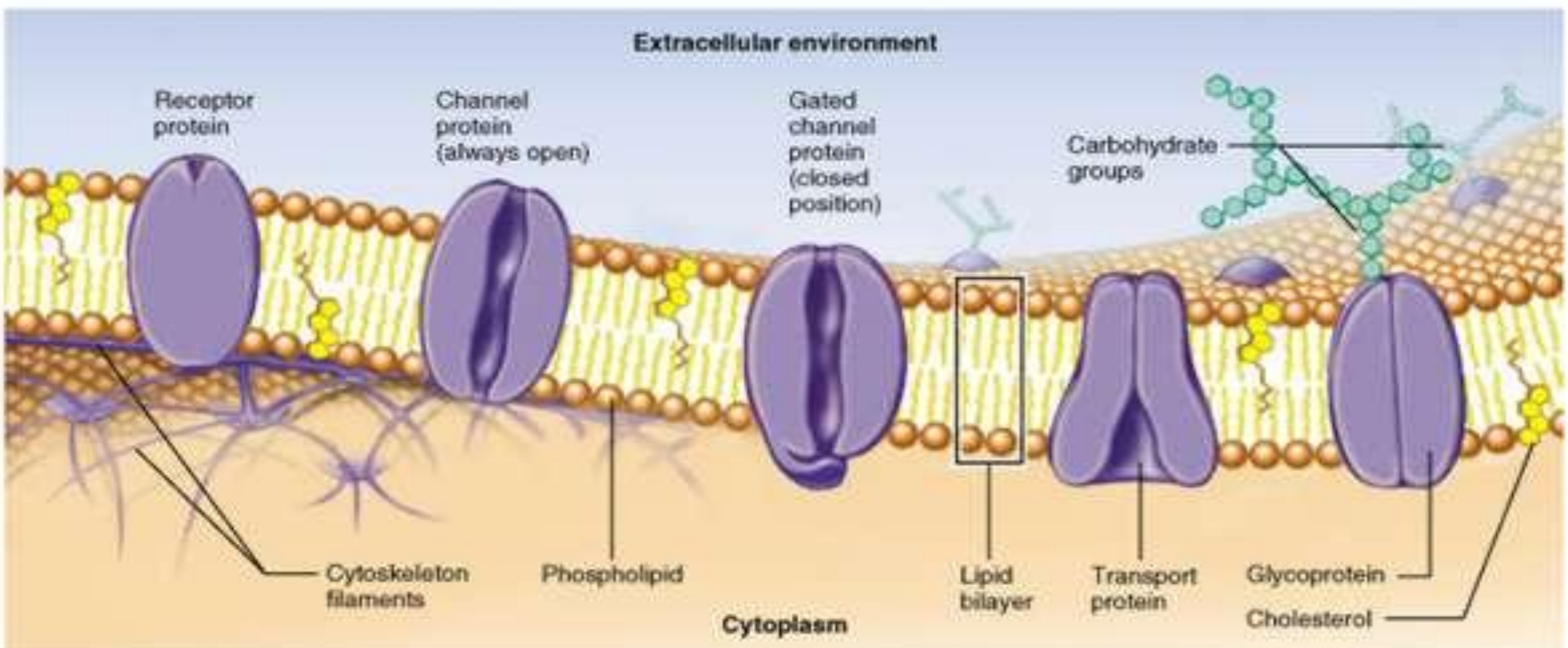
Proteins: form dif channels and structures

oligosaccharide: chains of carbohydrates- recognition

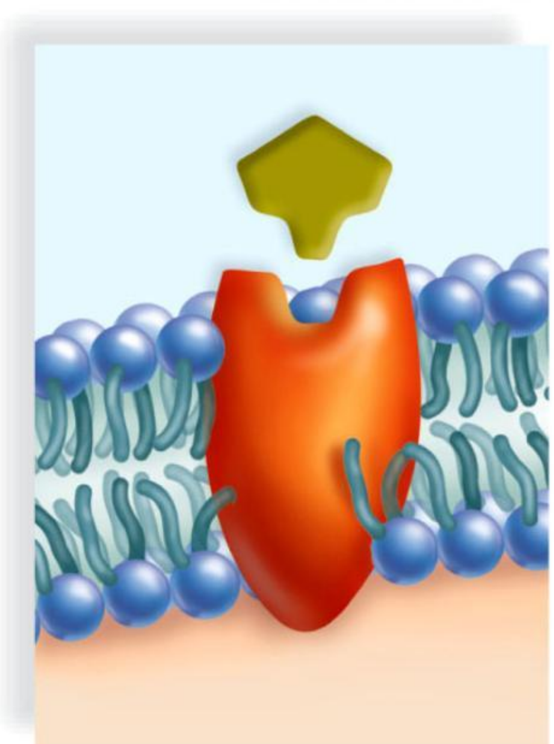
Cholesterol - stiffens and strengthens the membrane.
Glycoproteins - have an attached carbohydrate chain of sugar that projects externally for recognition and communication
Glycolipids - protective and assist in various functions.



Channel Proteins - form small openings for molecules to diffuse through
Transport Proteins - regulate movement of substances across membrane
Carrier Proteins- binding site on protein surface "grabs" certain molecules and pulls them into the cell
Gated Channels - similar to carrier proteins, not always "open"

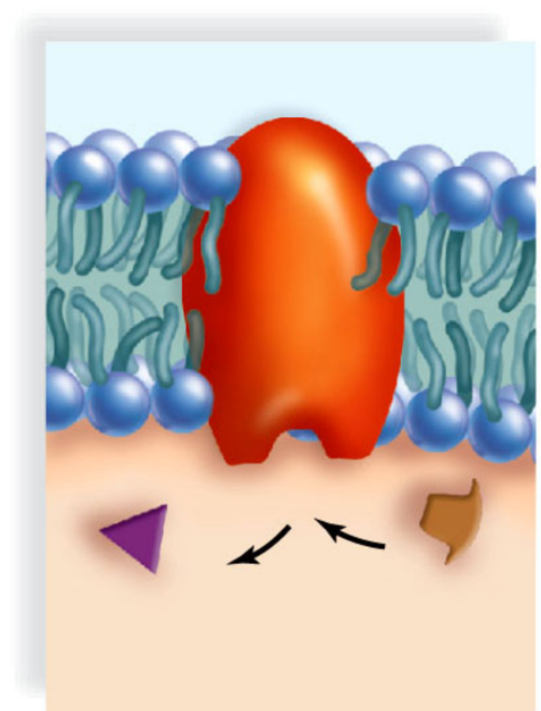


Receptor Proteins - molecular triggers that set off cell responses (such as release of hormones or opening of channel proteins), binding site
Recognition Proteins - ID tags, to identify cells to the body's immune system
Enzymatic Proteins – carry out specific reactions



Receptor Protein
Is shaped in such a way that a specific molecule can bind to it. Pygmies are short, not because they do not produce enough growth hormone, but because their plasma membrane growth hormone receptors are faulty and cannot interact with growth hormone.

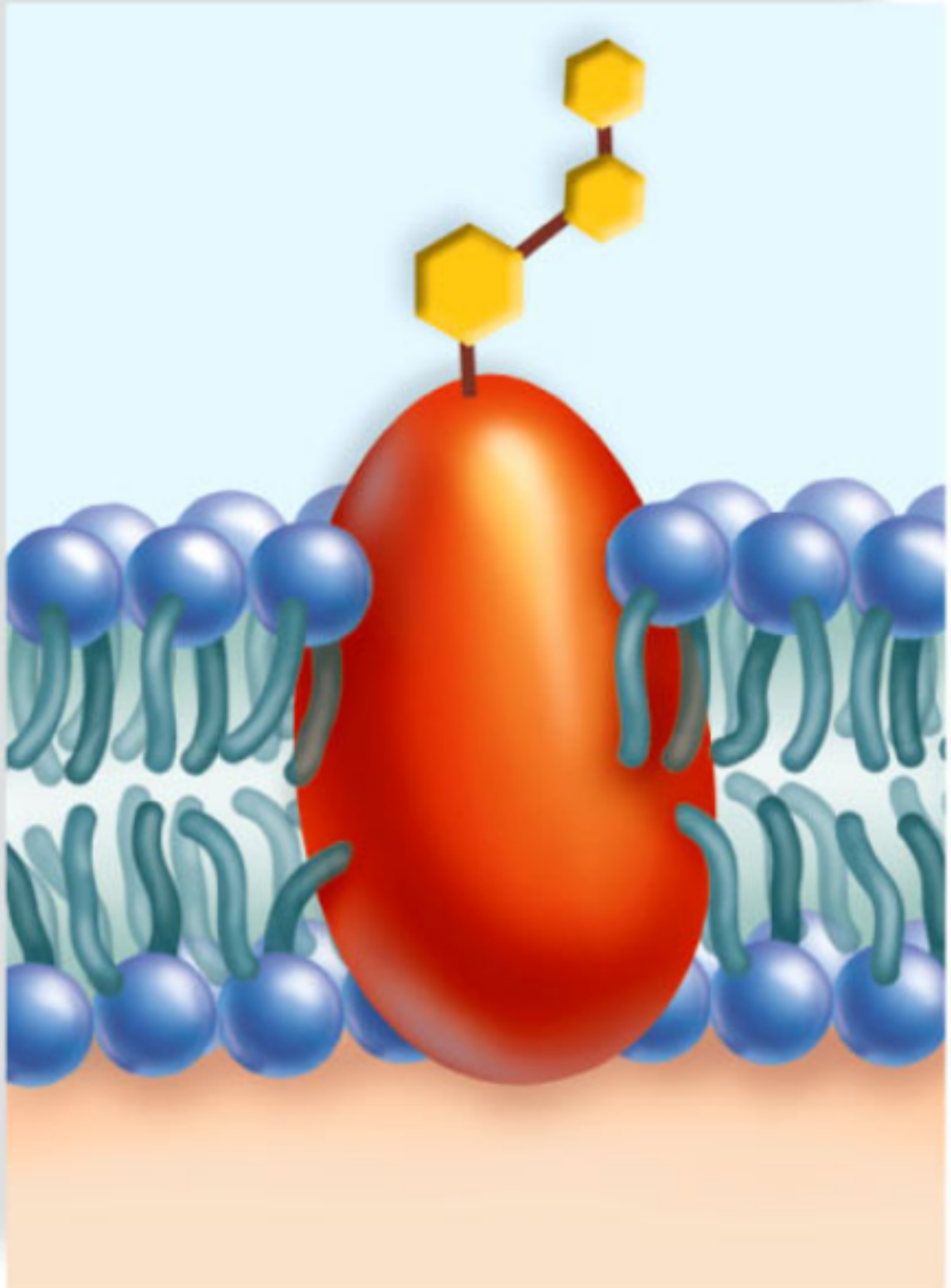
d.



Enzymatic Protein
Catalyzes a specific reaction. The membrane protein, adenylate cyclase, is involved in ATP metabolism. Cholera bacteria release a toxin that interferes with the proper functioning of adenylate cyclase; sodium ions and water leave intestinal cells, and the individual may die from severe diarrhea.

e.

Figure 5.4c



c.

Cell Recognition Protein

The MHC (major histocompatibility complex) glycoproteins are different for each person, so organ transplants are difficult to achieve. Cells with foreign MHC glycoproteins are attacked by white blood cells responsible for immunity.

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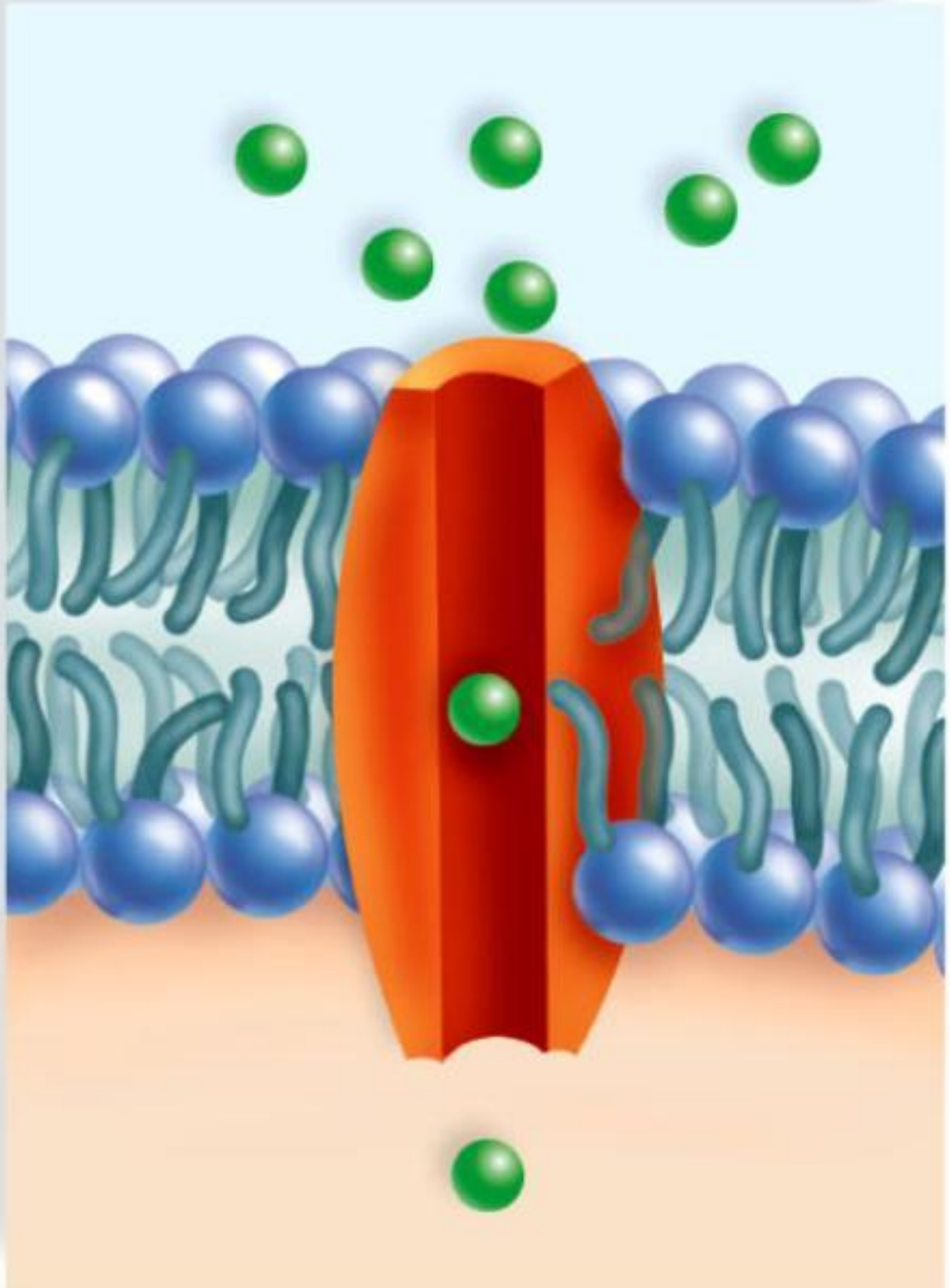
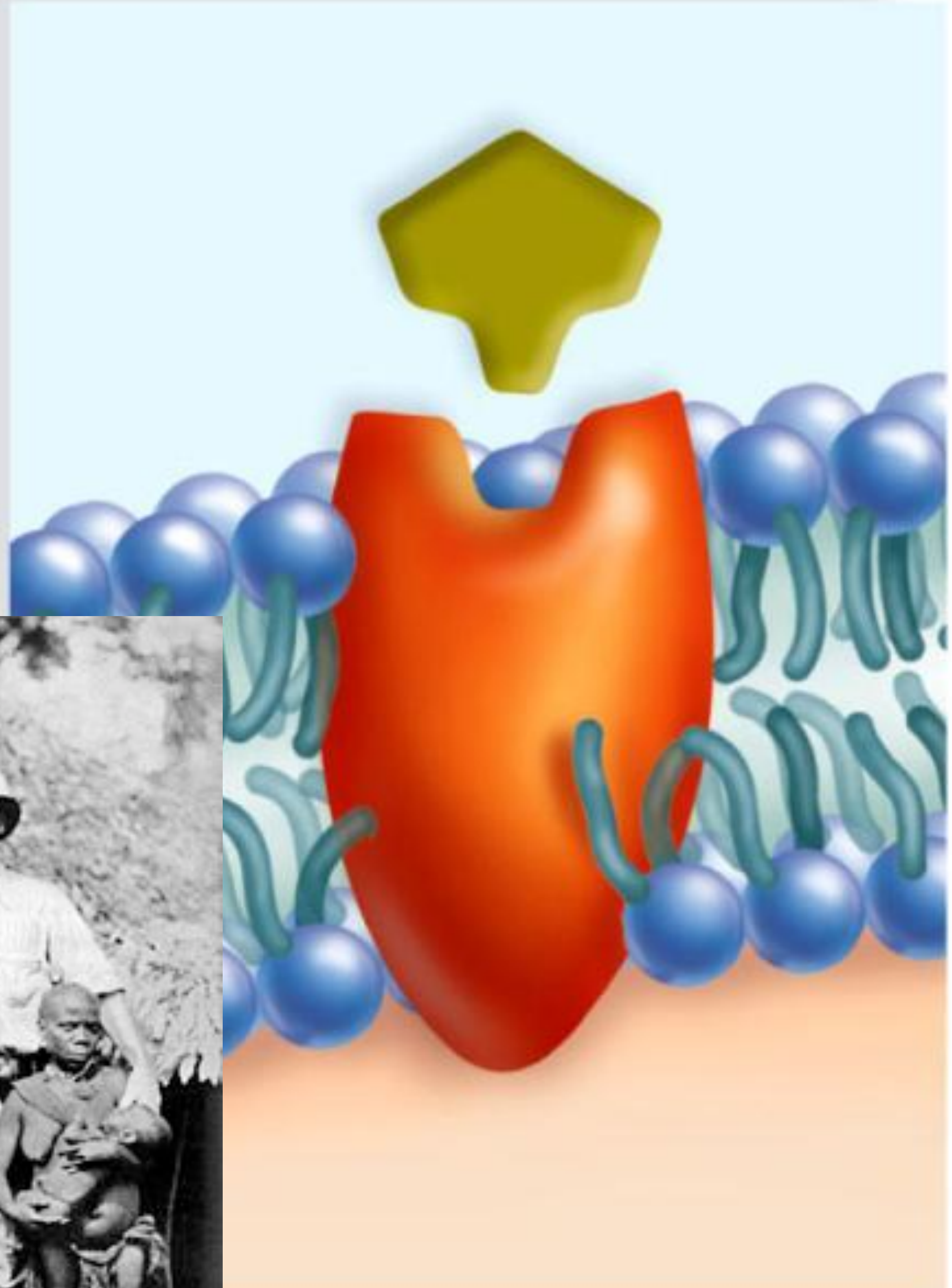
Figure 5.4a



a.

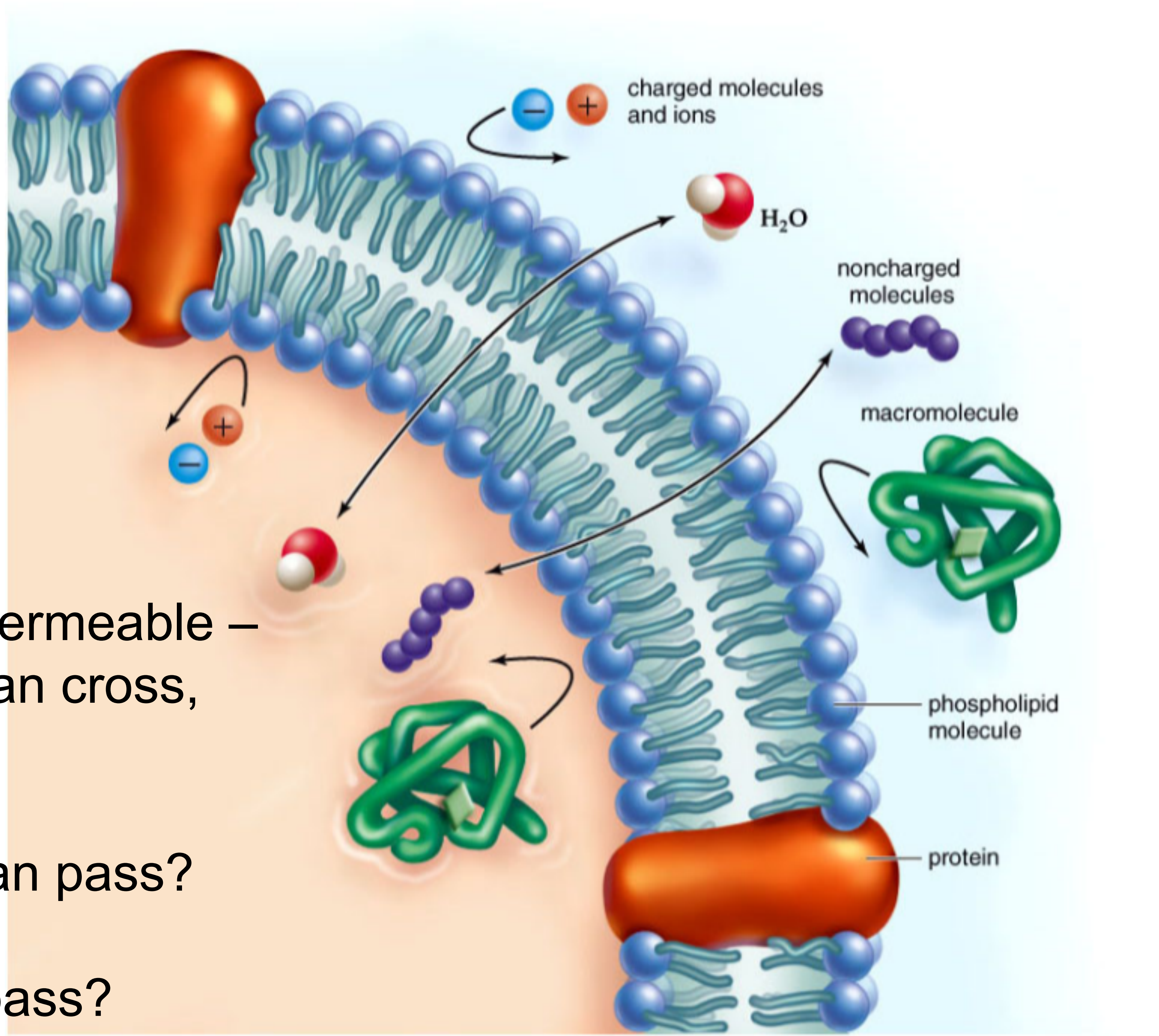
Channel Protein
Allows a particular molecule or ion to cross the plasma membrane freely. Cystic fibrosis, an inherited disorder, is caused by a faulty chloride (Cl^{-}) channel; a thick mucus collects in airways and in pancreatic and liver ducts.

Figure 5.4d



Receptor Protein
Is shaped in such a way that a specific molecule can bind to it. Pygmies are short, not because they do not produce enough growth hormone, but because their plasma membrane growth hormone receptors are faulty and cannot interact with growth hormone.

Membrane Permeability Transport Across Membrane



*Selectively or Differentially permeable – some things can cross, not others

What things can pass?

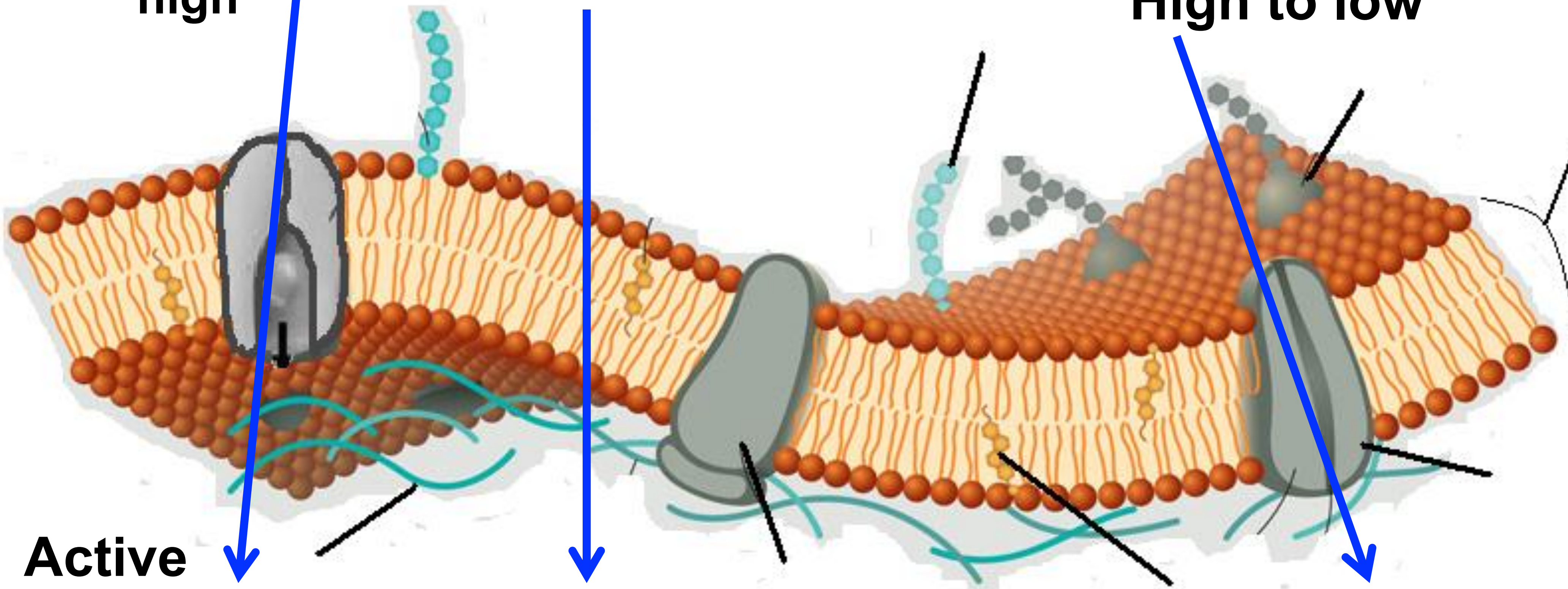
What cannot pass?

Plasma Membrane

Noncharged, small particles, CO_2 & O_2, water

Low to high

High to low



Active Transport
need energy

Passive Diffusion
H_2O = Osmosis

Facilitated Diffusion

Remember lipids are nonpolar

Concentration Gradient: difference in the amount of particles in a space

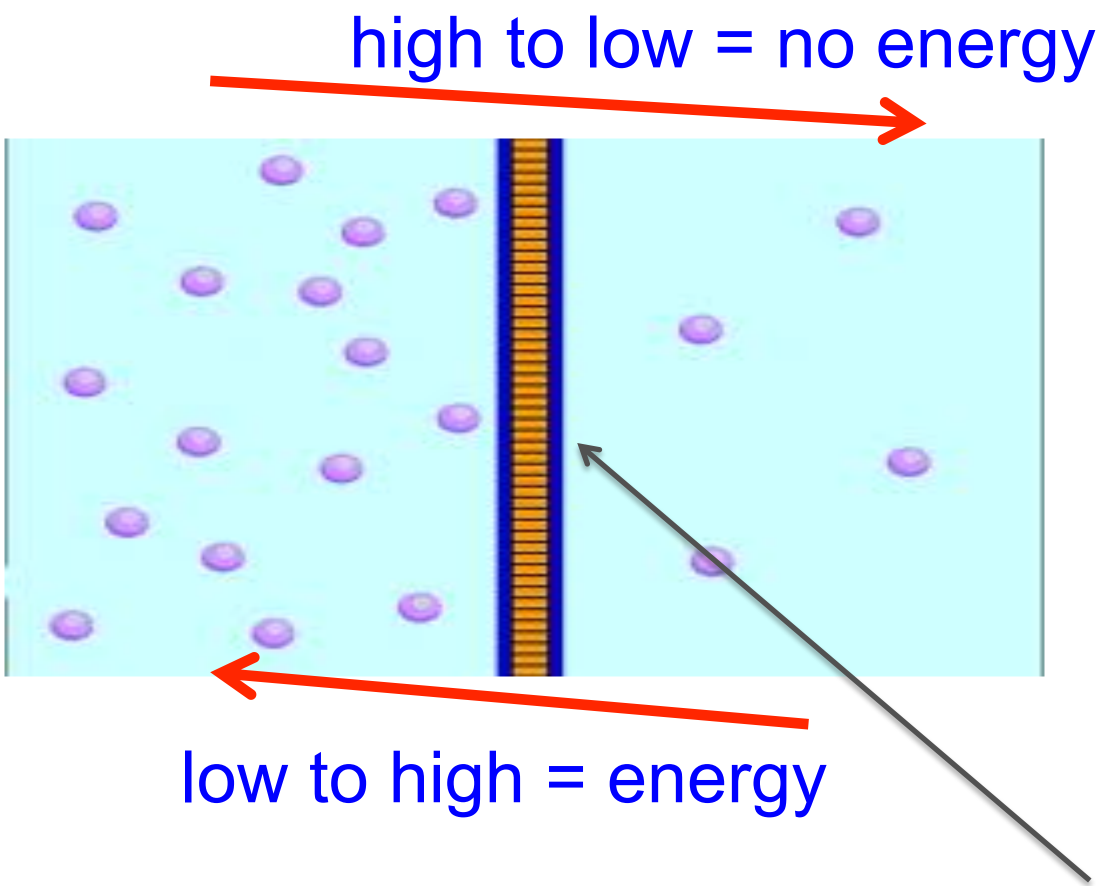
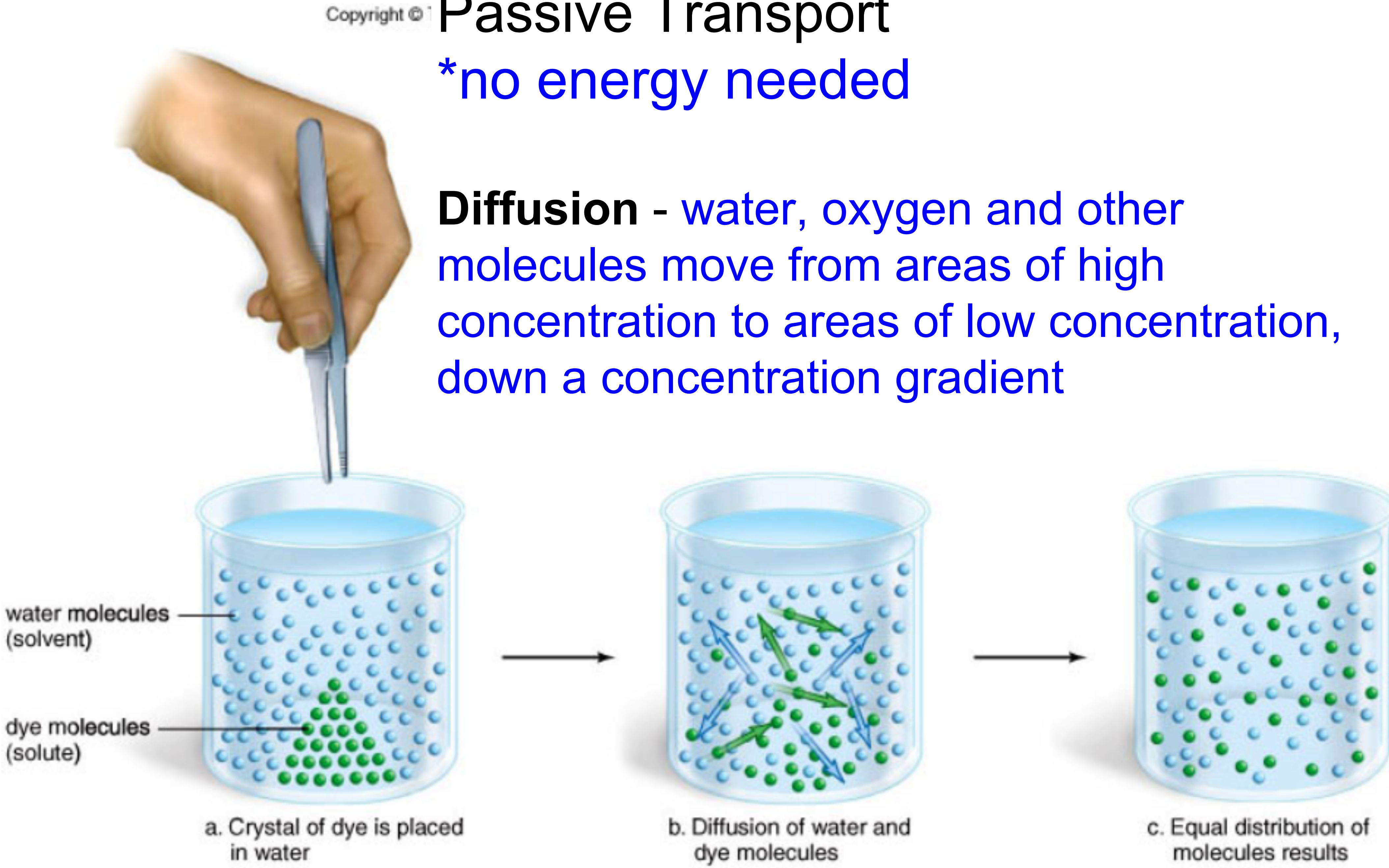


Figure 5.6

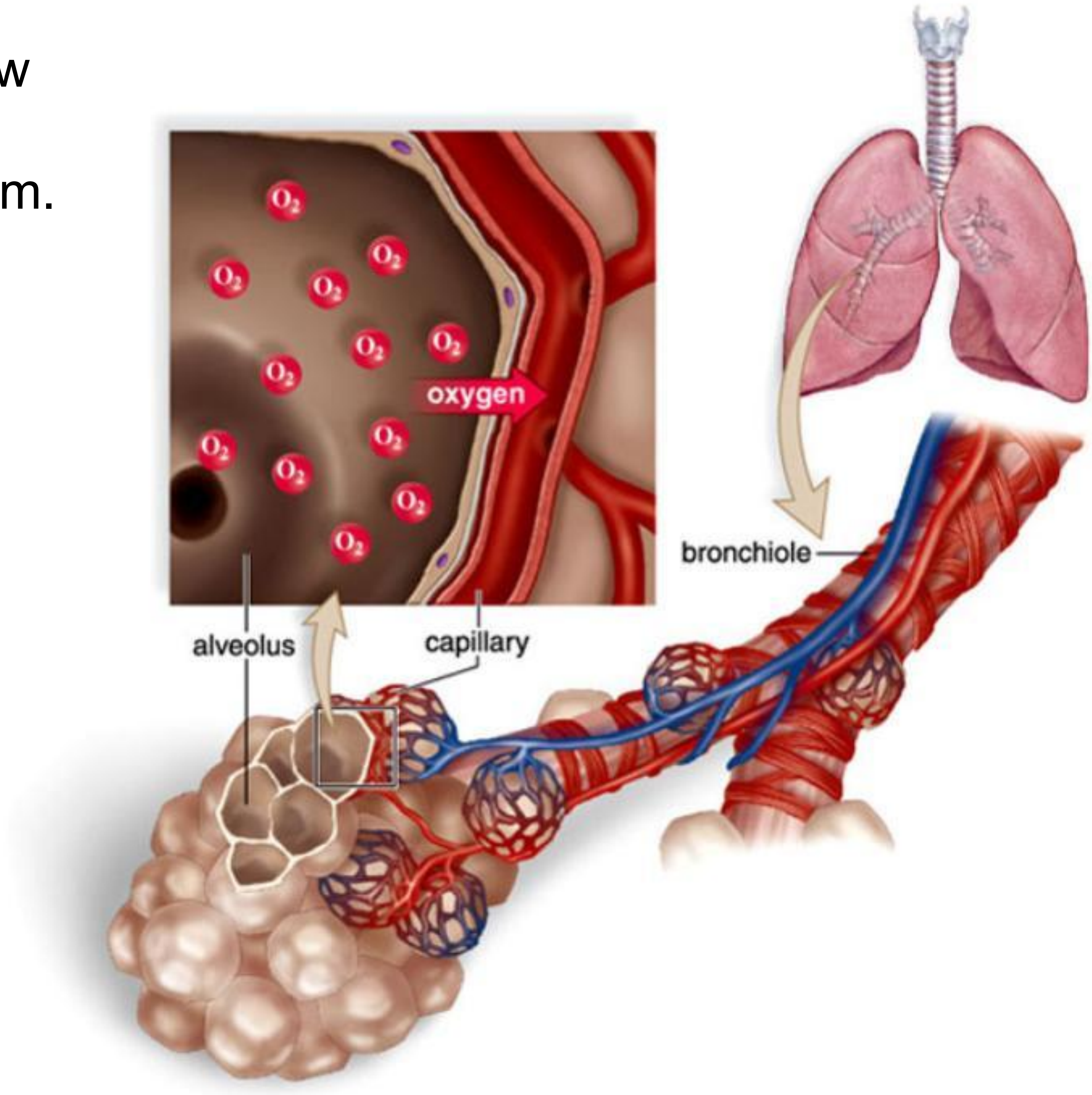
Passive Transport

*no energy needed

Diffusion - water, oxygen and other molecules move from areas of high concentration to areas of low concentration, down a concentration gradient



Diffusion is how oxygen enters our bloodstream.



OSMOSIS

Osmosis - diffusion of water.

Osmosis affects the turgidity of cells, different solution can affect the cells internal water amounts

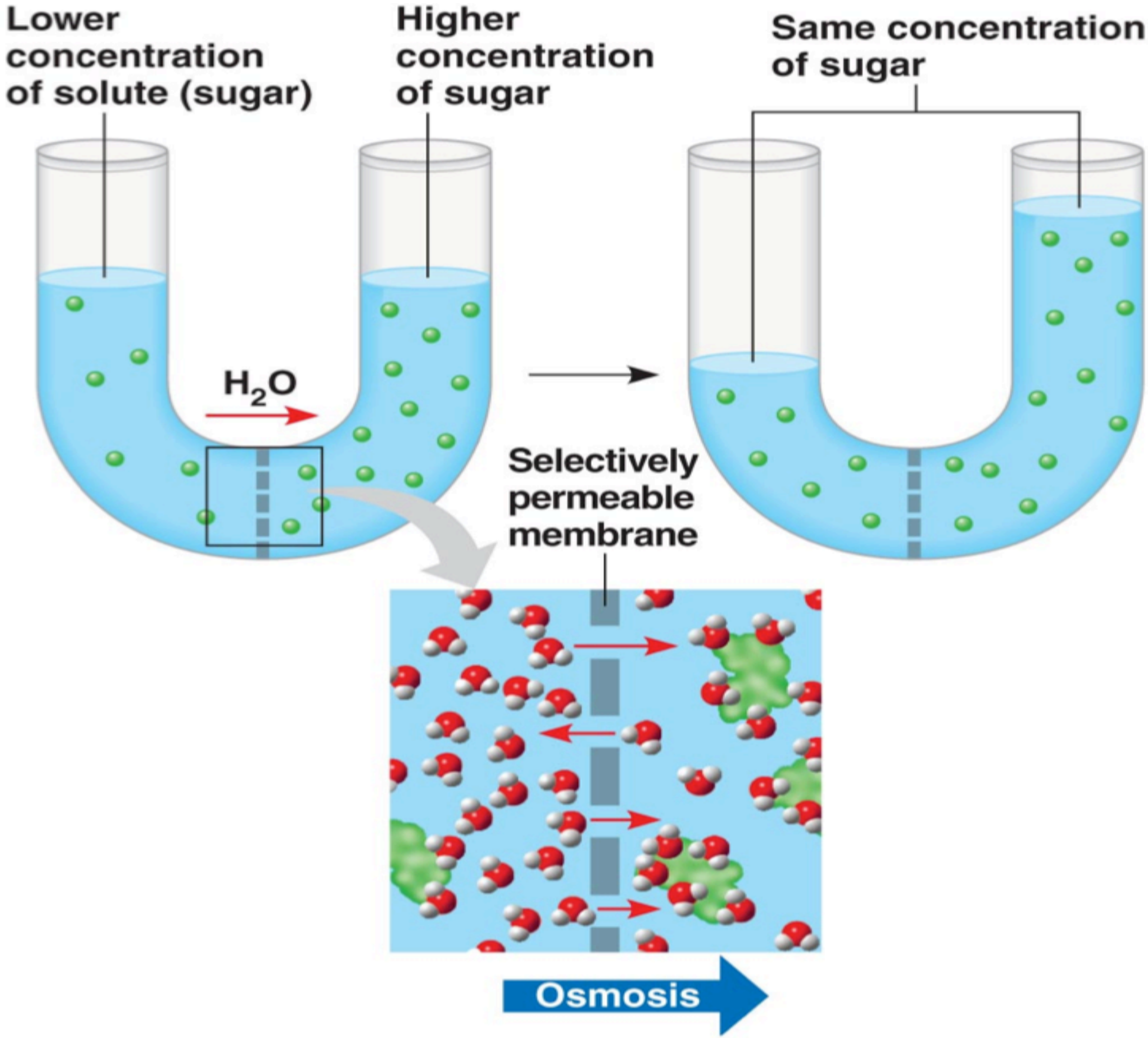
Contractile Vacuoles are found in freshwater microorganisms - they pump out excess water

Turgor pressure occurs in plants cells as their central vacuoles fill with water.

Water Potential: predicts which way water diffuses through plant tissues

$$\Psi = \Psi_P + \Psi_S$$

Water potential



$\psi = \psi_P + \psi_S$

Water Potential = Pressure Potential + Solute Potential

*if open air, pressure potential = 0, so water potential is equal to the solute potential:

$(\psi_S) = -\ iCRT$,

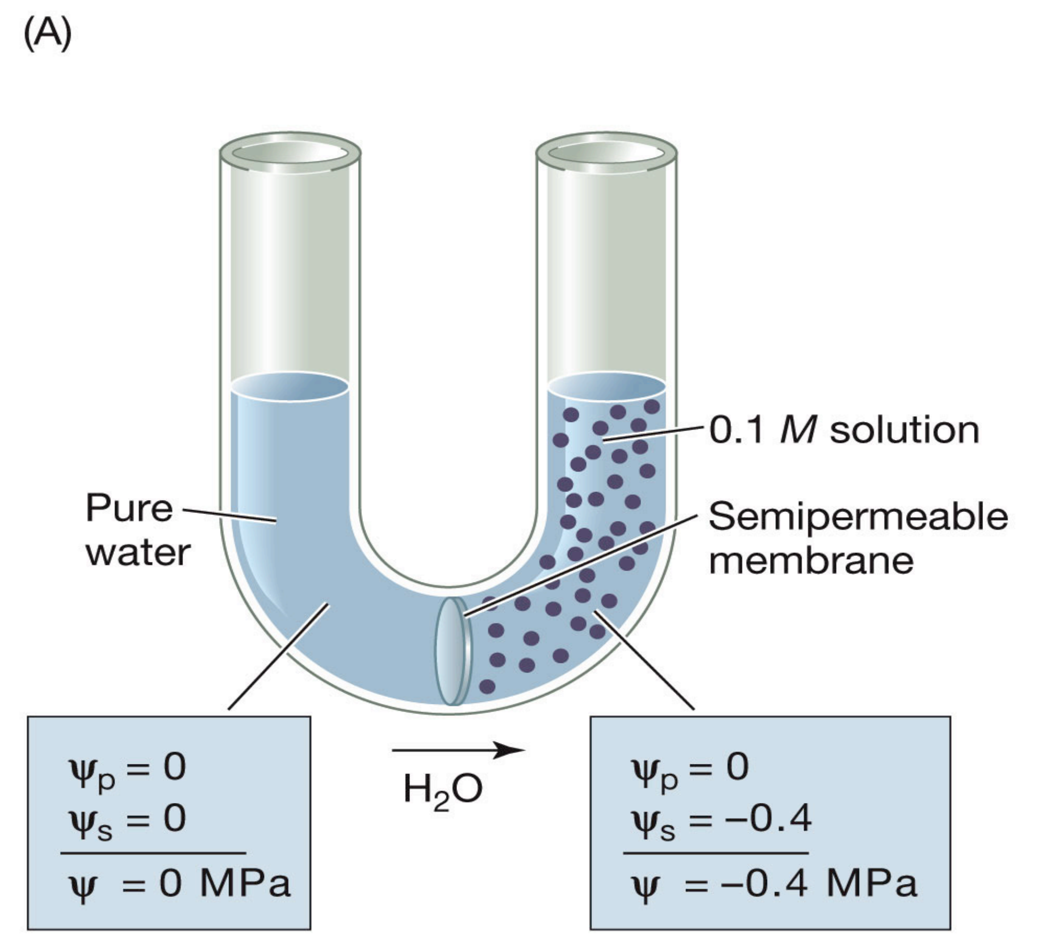
I = ionization constant,

C = molar concentration,

R = the pressure constant

(R = 0.0831 liter bars/mole-K)

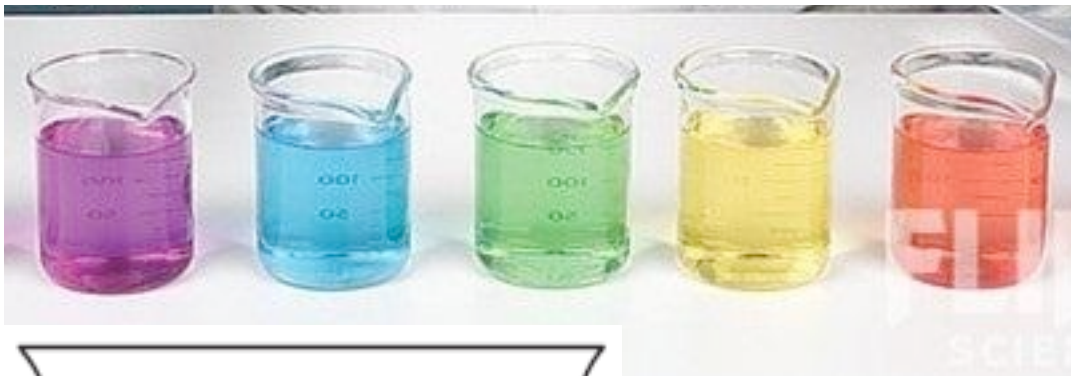
T = temperature in K (273 + C°).

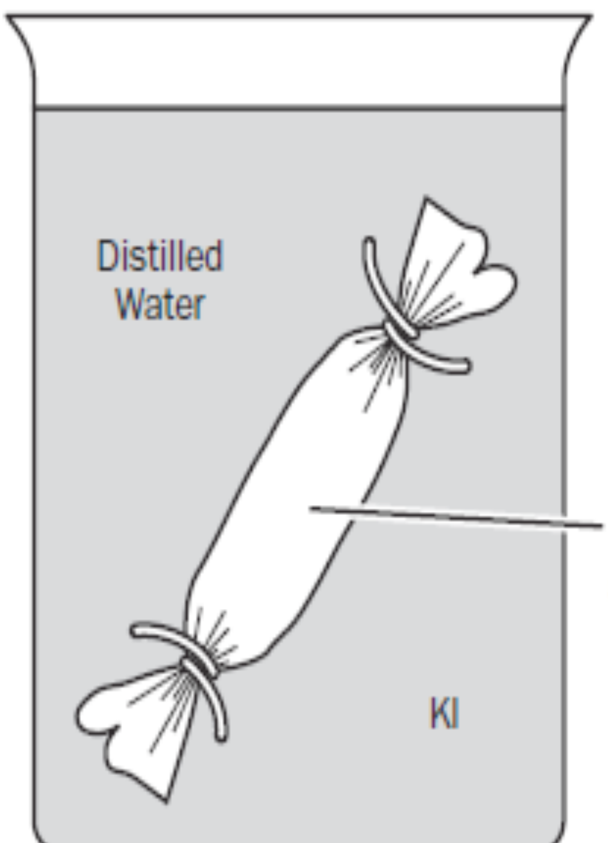


ɜ 35.2 (Part 1)

Ionization constant: is a given:
(1.0 for sucrose, 2.0 for NaCl, 3.0 for $CaCl_2$)

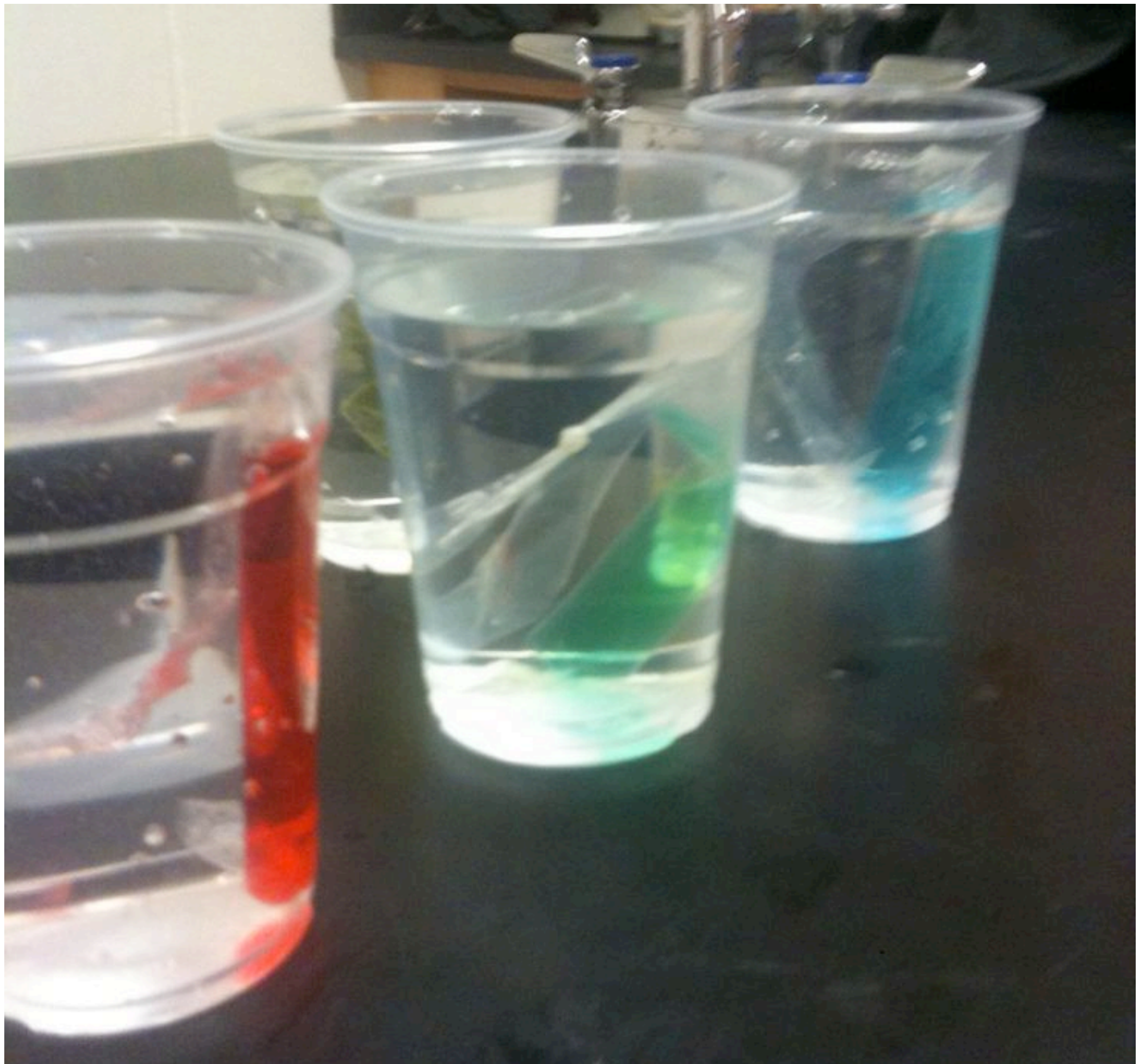
Lab investigation: what is the water potential of the unknown solutions?





Dialysis tubing (represent semi-permeable membrane) with unknown sugar solution

Lab unknown solutions: .2, .4, .6, .8 and 1.0 molar solution used



Each dialysis tube gets filled with a different unknown solution, and then placed in distilled water. The percent change in mass will be calculated for each.

- What should be used as a control?
- How do you know which is what solution in the end?

Example calculation

0.6M sucrose in open beaker, what is the water potential at 21C?

$\boldsymbol{\psi = \psi_P + \psi_S}$

Y_p= 0 because open beaker

So Y= Y_s –iCRT

= -(1) (.6mol/l) (.0831 l bar/ molK) (294K)

= -14.6 bars

A simple rule to remember is:

SALT SUCKS

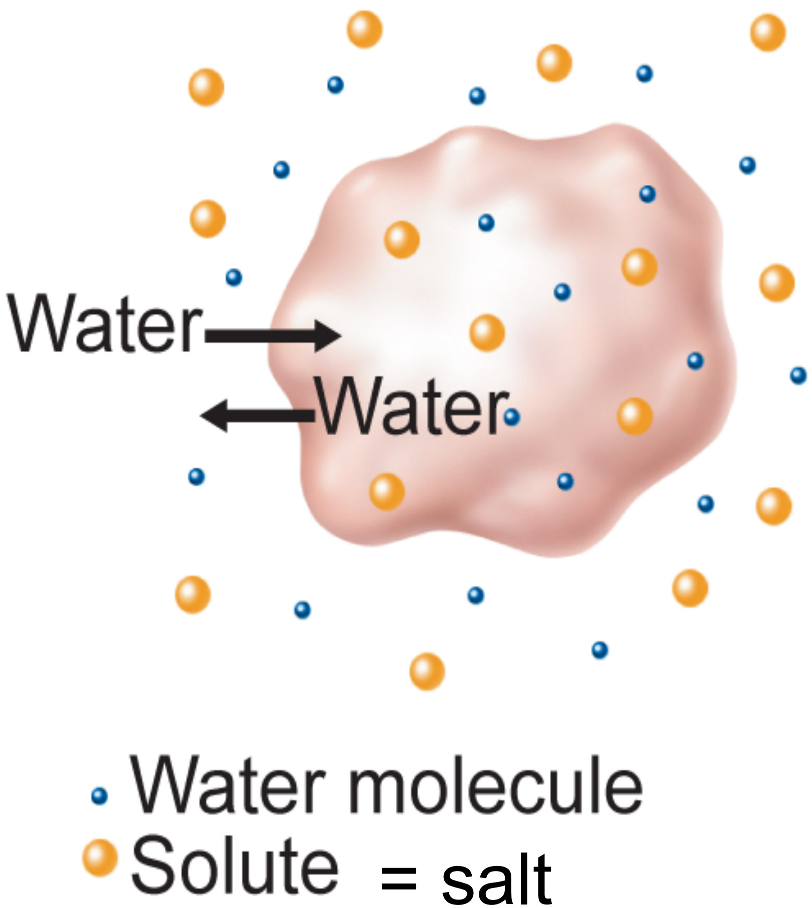
Salt = solute water = solvent

When salt is concentrated it will draw the water in its direction.

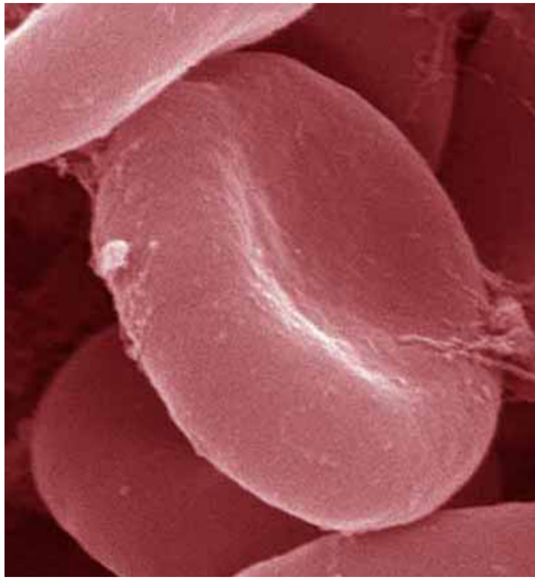
This is also why you get thirsty after eating something salty.

Isotonic Solution = equal solute concentration inside and out

- Water and dissolved substances diffuse into and out of the cell at the same rate



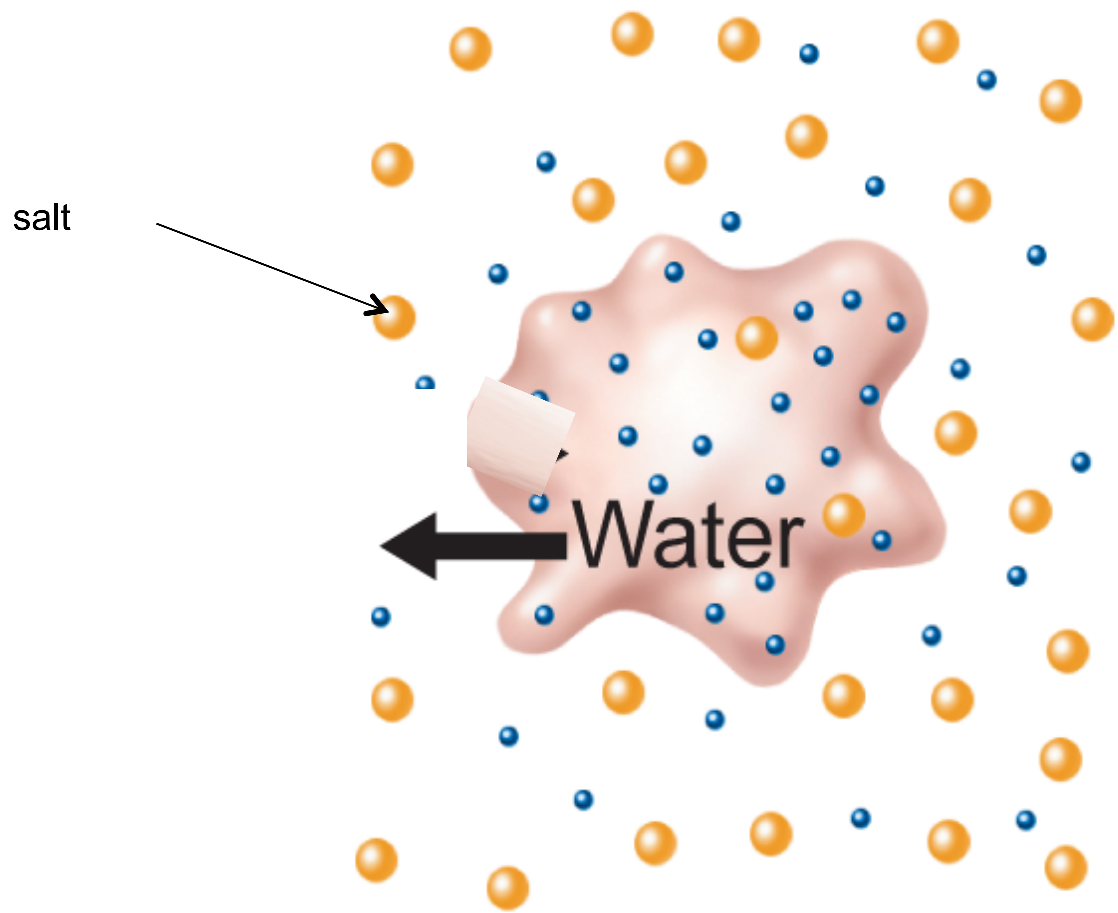
= salt

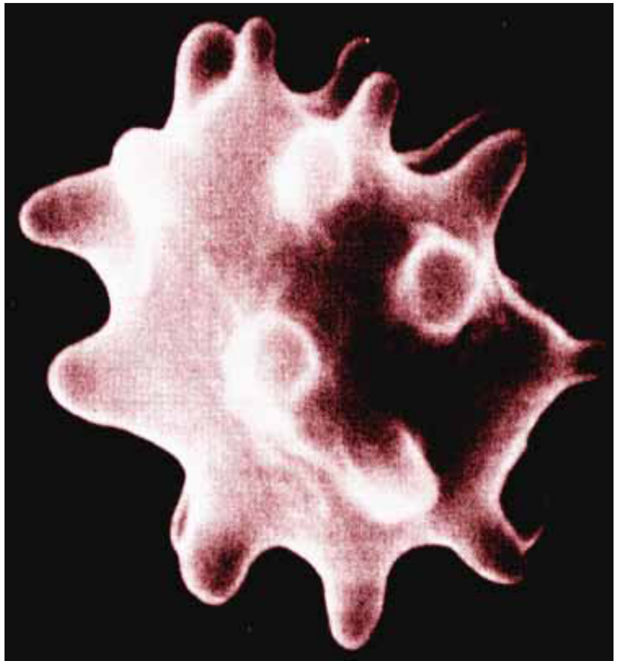


Hypertonic Solution

Hyper= more

- Solute concentration is **higher outside** the cell.
- Water diffuses **out** of the cell. Cell **shrinks**





Hypotonic Solution = hippo Hypo= less (under)

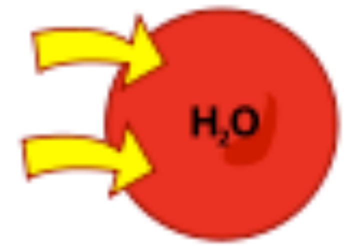
- Solute concentration **lower outside** the cell (is **higher inside** the cell).
- Water diffuses <u>into</u> the cell, <u>cell swells</u>

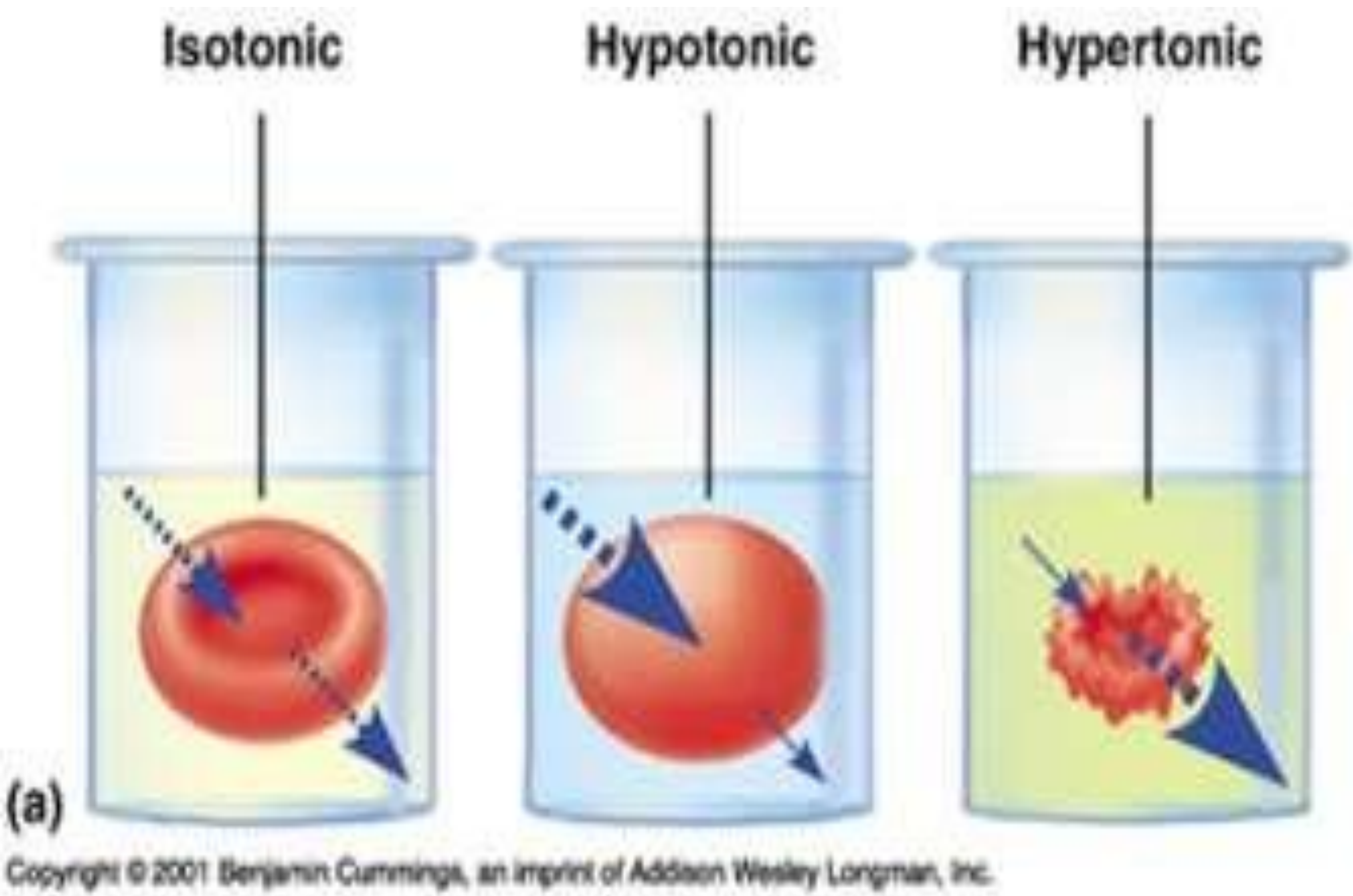
salt

Isotonic - no net movement

Hypertonic - water moves out of the cell, cell shrinks

Hypotonic - water moves into the cell, cell could burst





1. What is the difference in a solute and solvent?

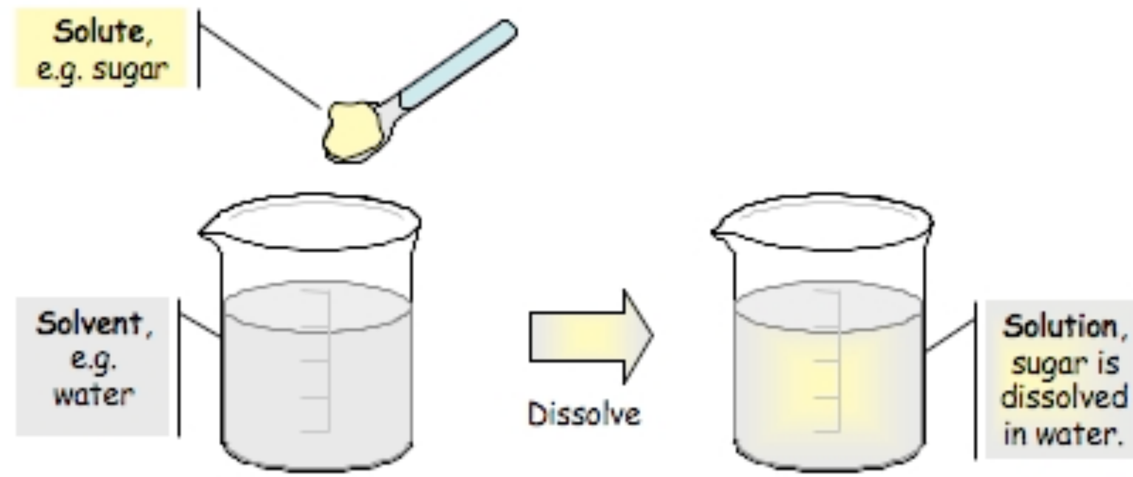
Draw a picture of a cell in a

2. Hypertonic
3. Hypotonic
4. Isotonic solution

Include arrows showing water flow

A simple rule to remember is:

SALT SUCKS



Salt = solute water = solvent

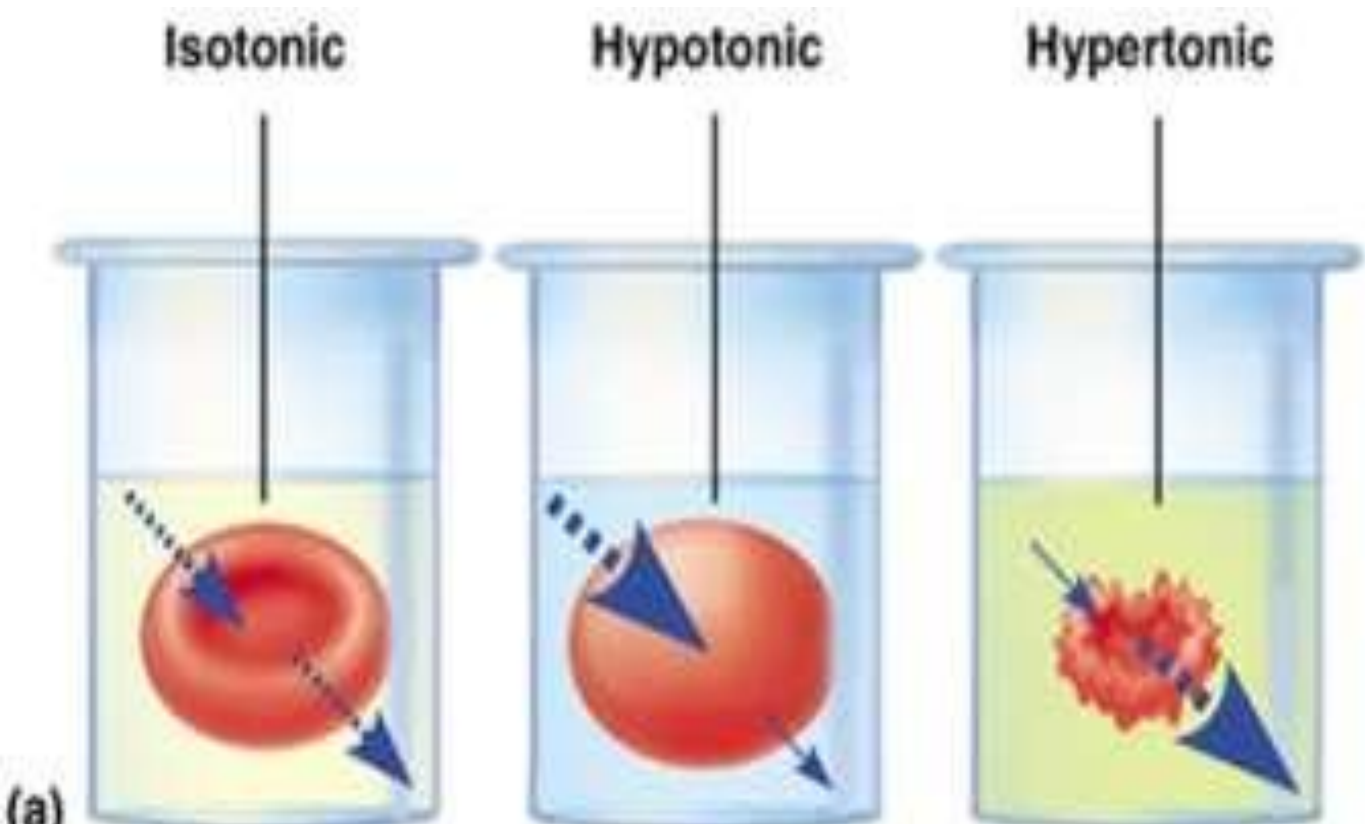
When salt is concentrated it will draw the water in its direction.

This is also why you get thirsty after eating something salty.

Isotonic - no net movement

Hypertonic - water moves out of the cell, cell shrinks

Hypotonic - water moves into the cell, cell could burst



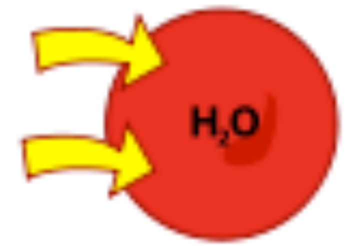
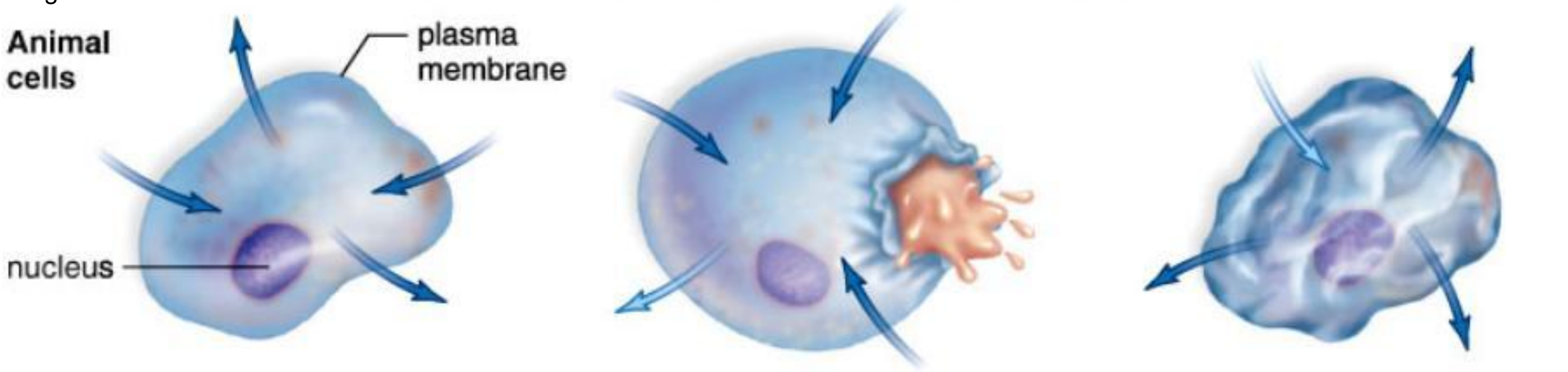


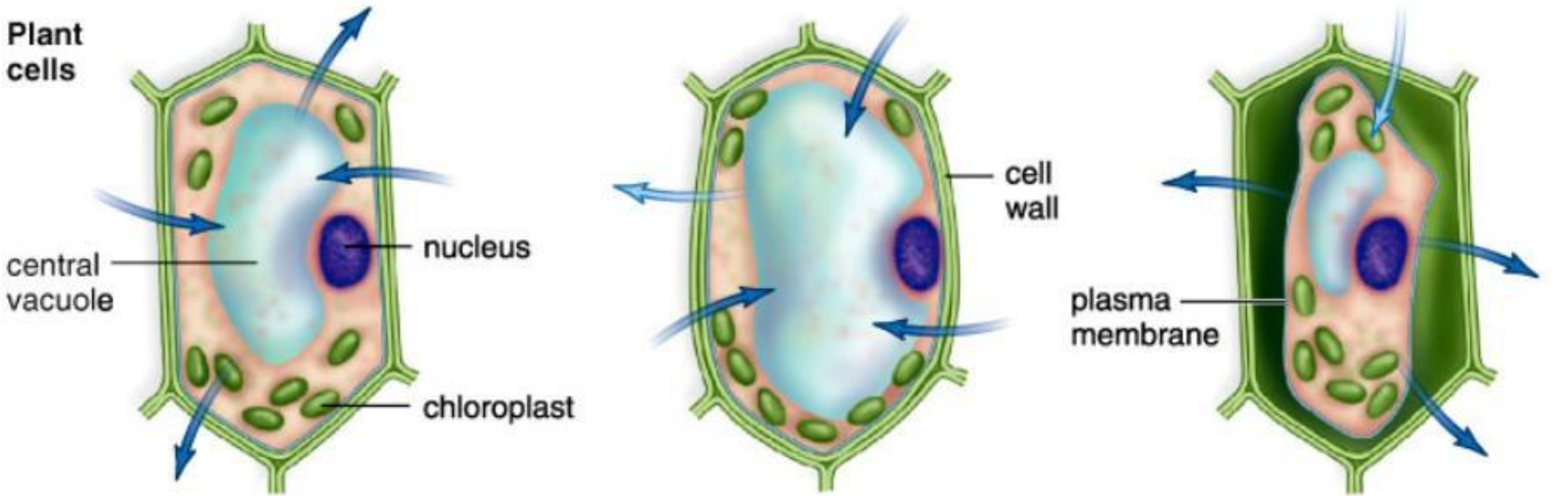
Figure 5.9



In an isotonic solution, there is no net movement of water.

In a hypotonic solution, water enters the cell, which may burst (lysis).

In a hypertonic solution, water leaves the cell, which shrivels (crenation).

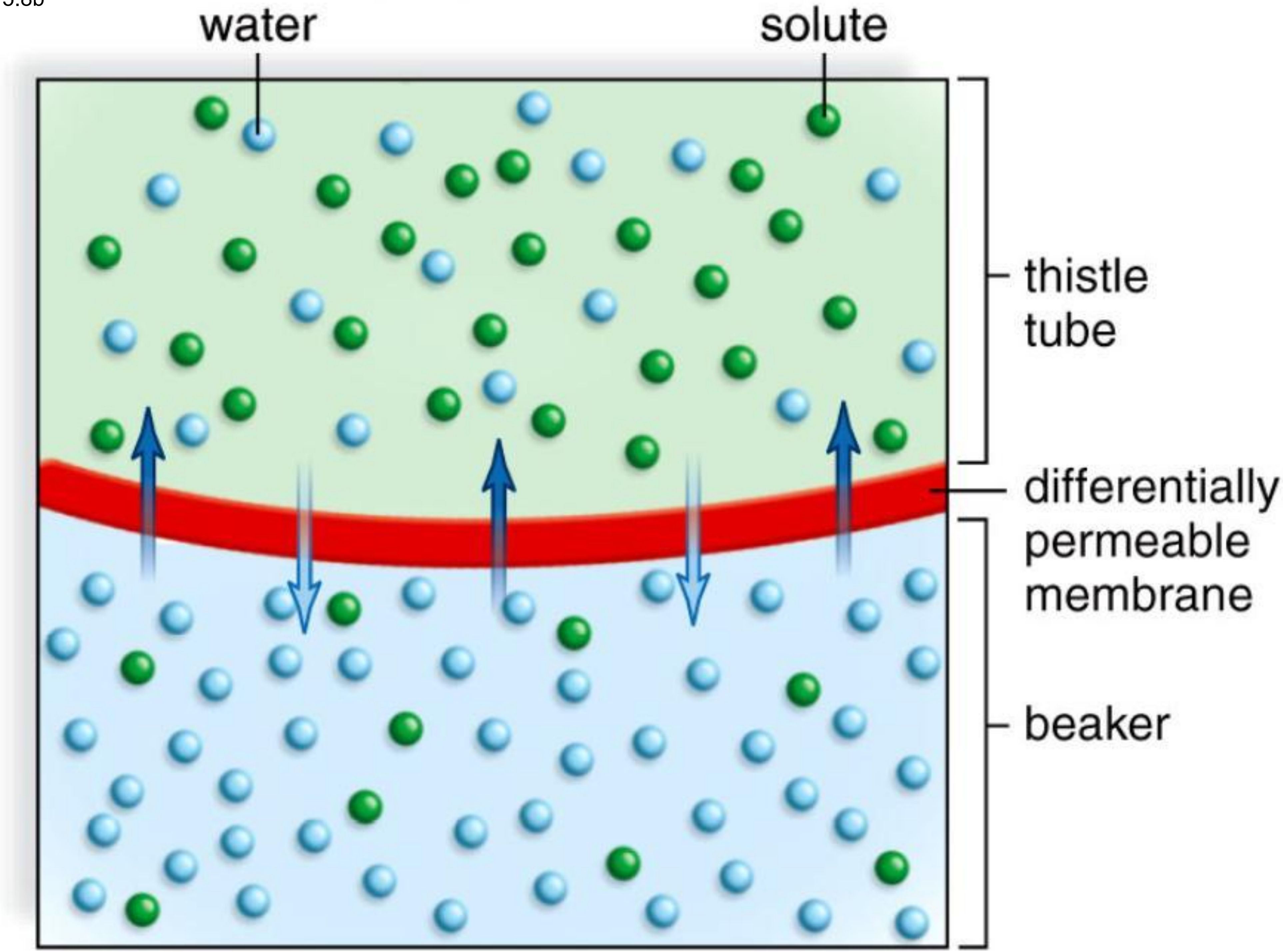


In an isotonic solution, there is no net movement of water.

In a hypotonic solution, vacuoles fill with water, turgor pressure develops, and chloroplasts are seen next to the cell wall.

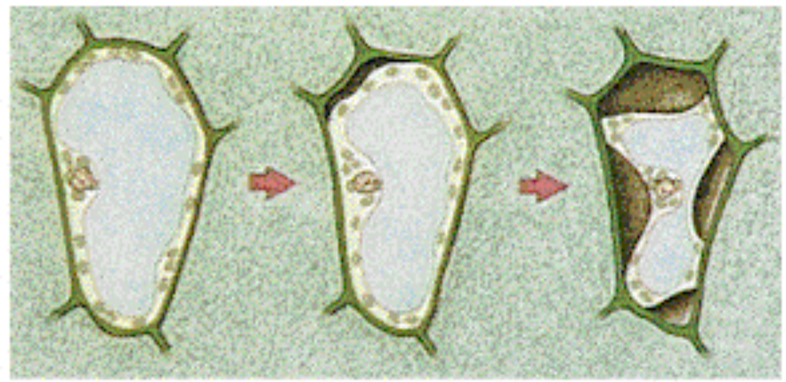
In a hypertonic solution, vacuoles lose water, the cytoplasm shrinks (plasmolysis), and chloroplasts are seen in the center of the cell.

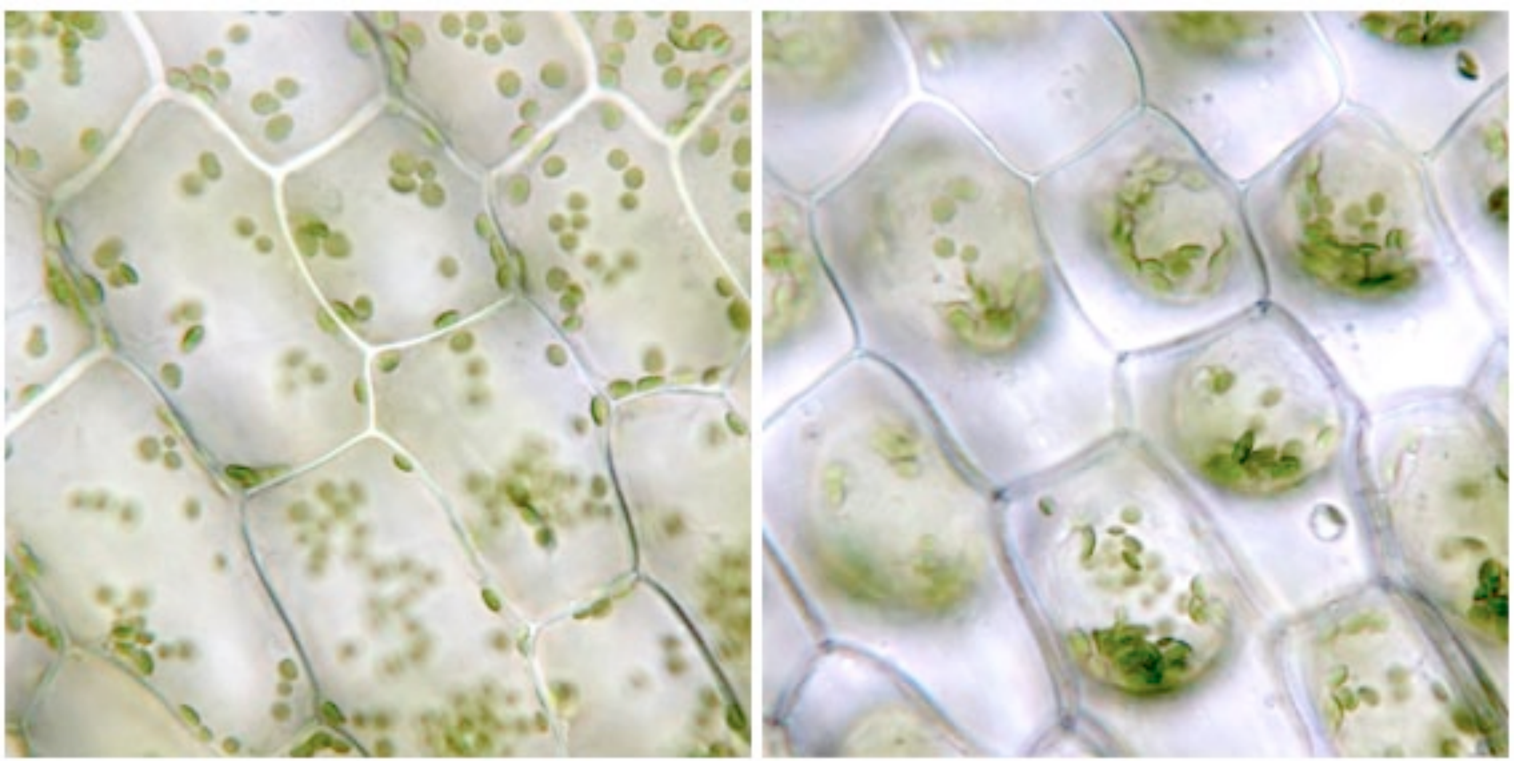
Figure 5.8b


water
solute
thistle tube
differentially permeable membrane
beaker

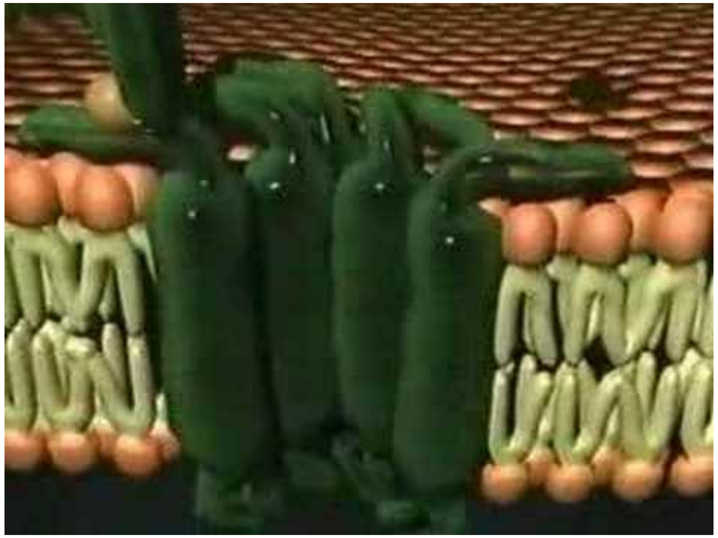
b.

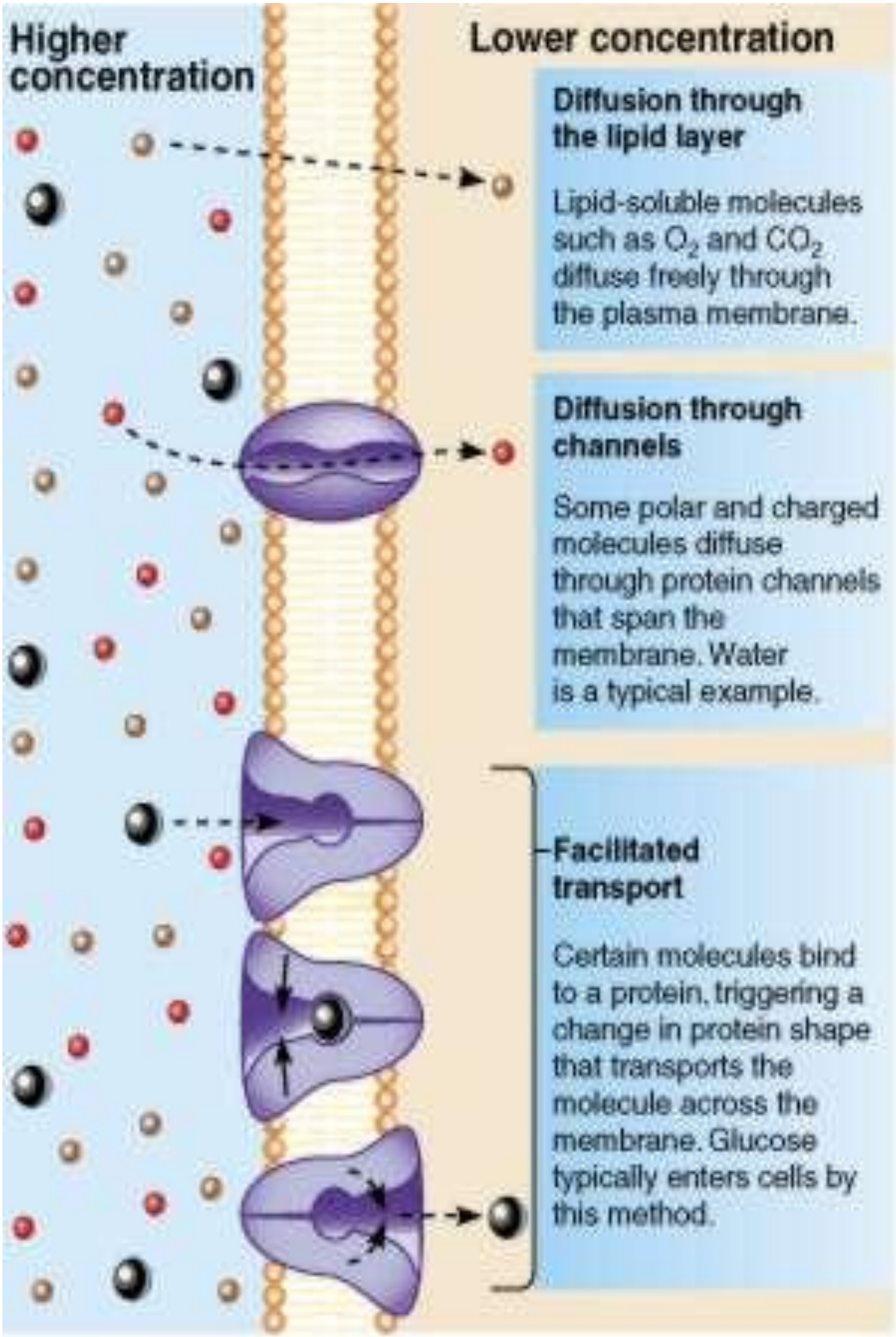
Plasmolysis: in plant cells where the cytoplasm pulls away from the cell wall due to the loss of water through osmosis





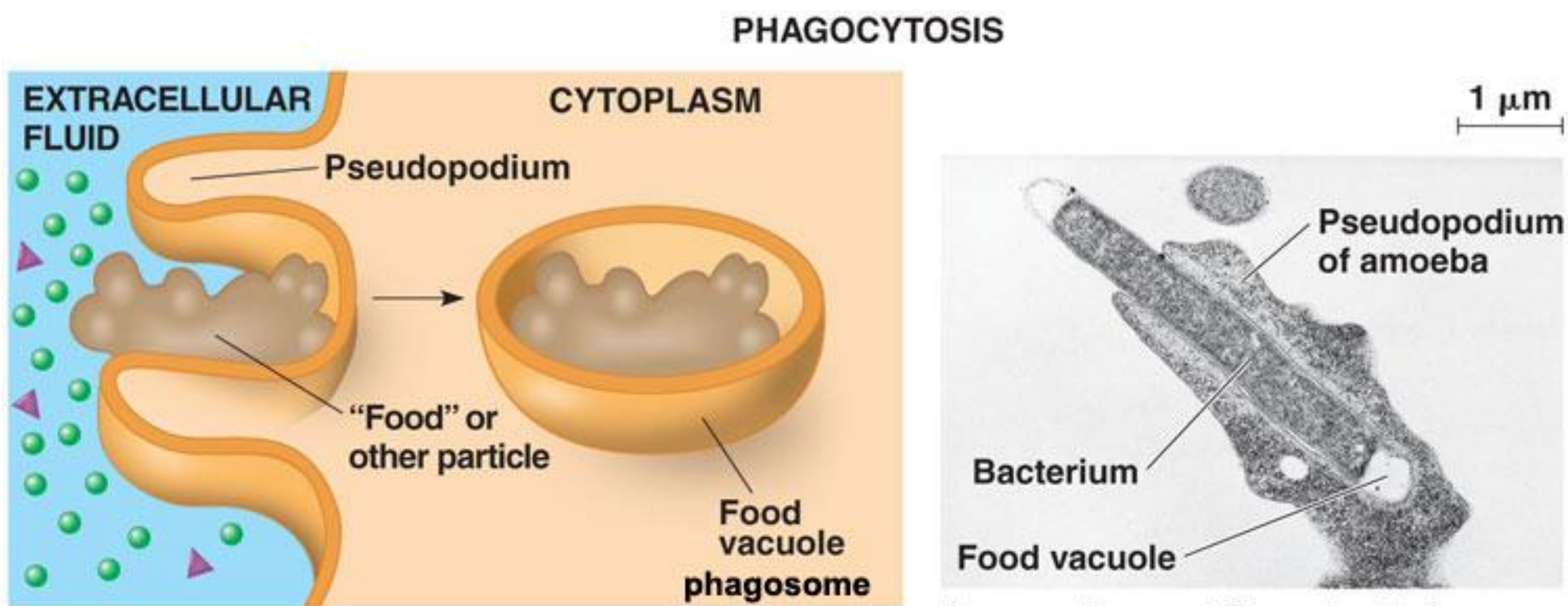
Facilitated Transport (Diffusion) - diffusion that is assisted by proteins (channel or carrier proteins)





Active Transport: move molecules against the concentration gradient *uses energy

- involves moving molecules "uphill" against the concentration gradient, which requires energy



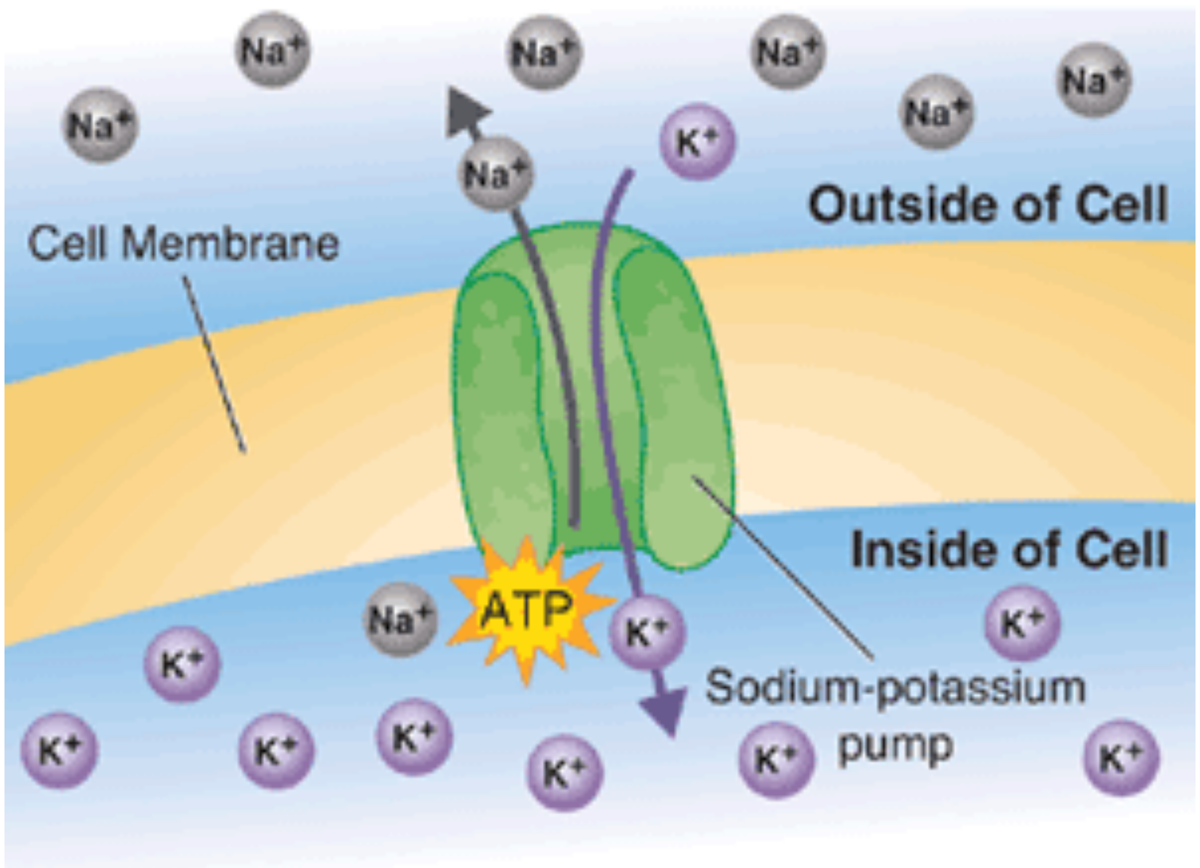
An amoeba engulfing a bacterium via phagocytosis (TEM)

file://localhost/Users/sarahdavisson/Dropbox/LACHSA/AP bio/ch 4, 5/ppt/Membrane Transport Animation (LEGENDADO) copy.mp4 energy

Na^+/K^+ ATPase pump

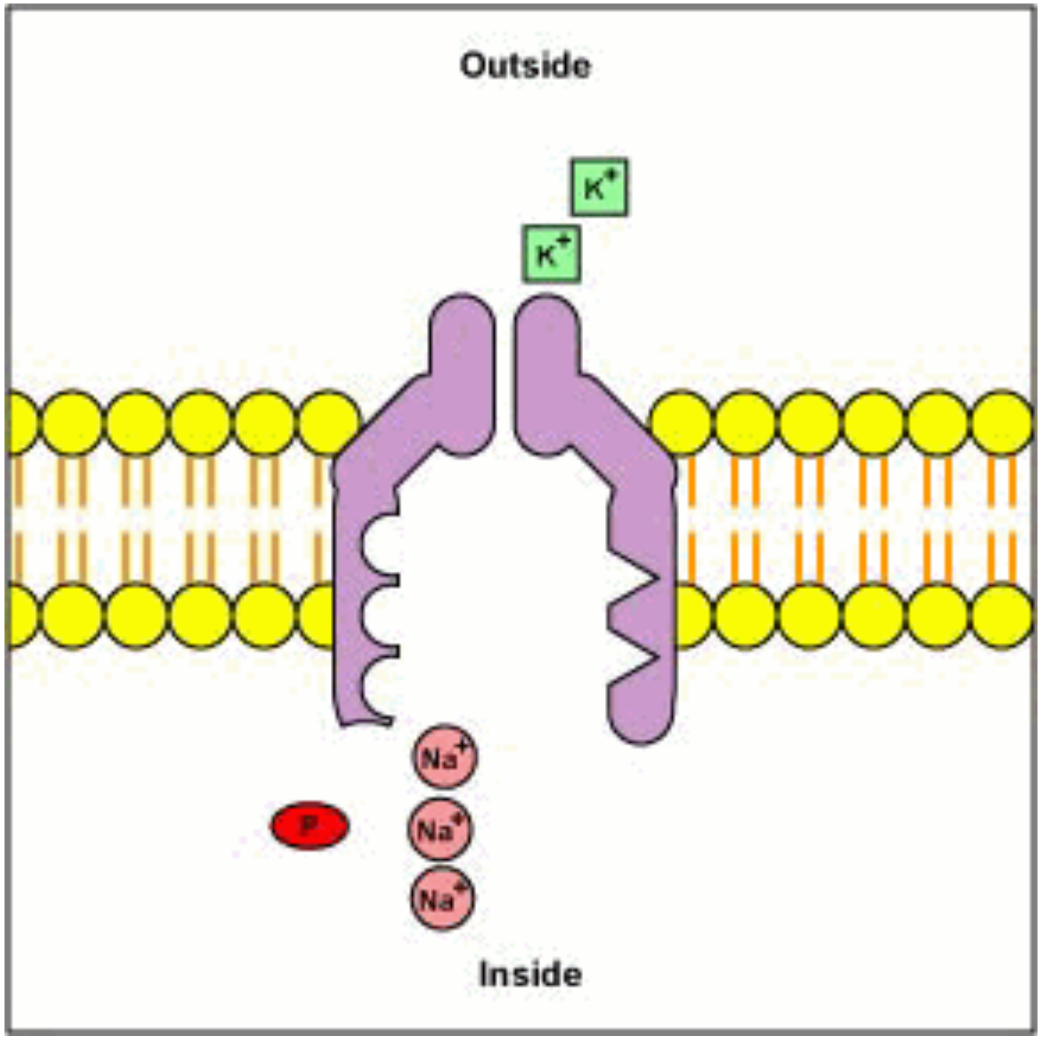
sodium potassium

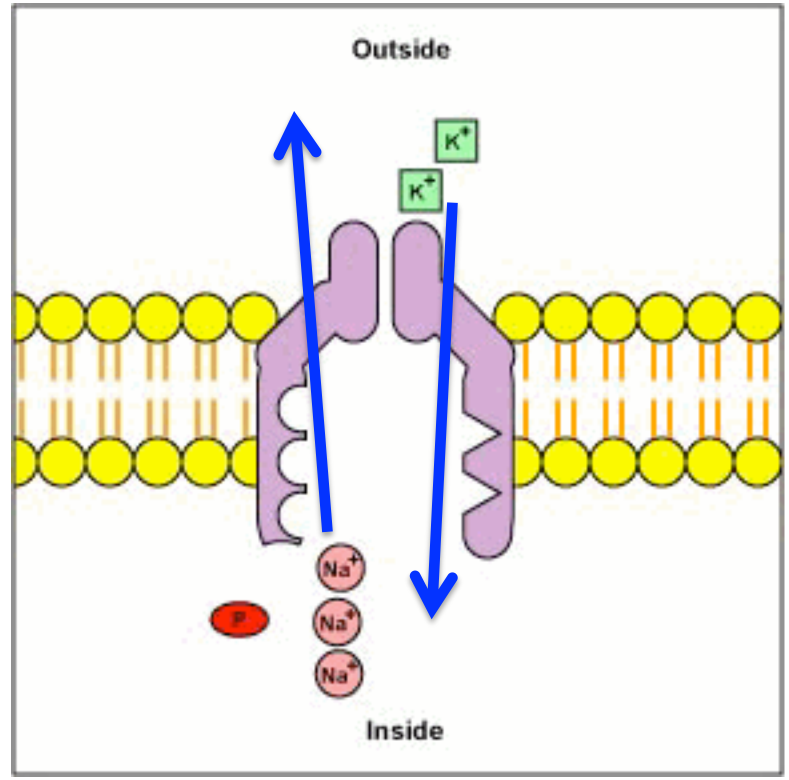
- Pumps 3 Na^+ ions out of the cell and 2 K^+ ions into the cell, *against the concentration gradient*



A huge amount of energy in our bodies is used to power this pump and prevent sodium from building up within our cells.

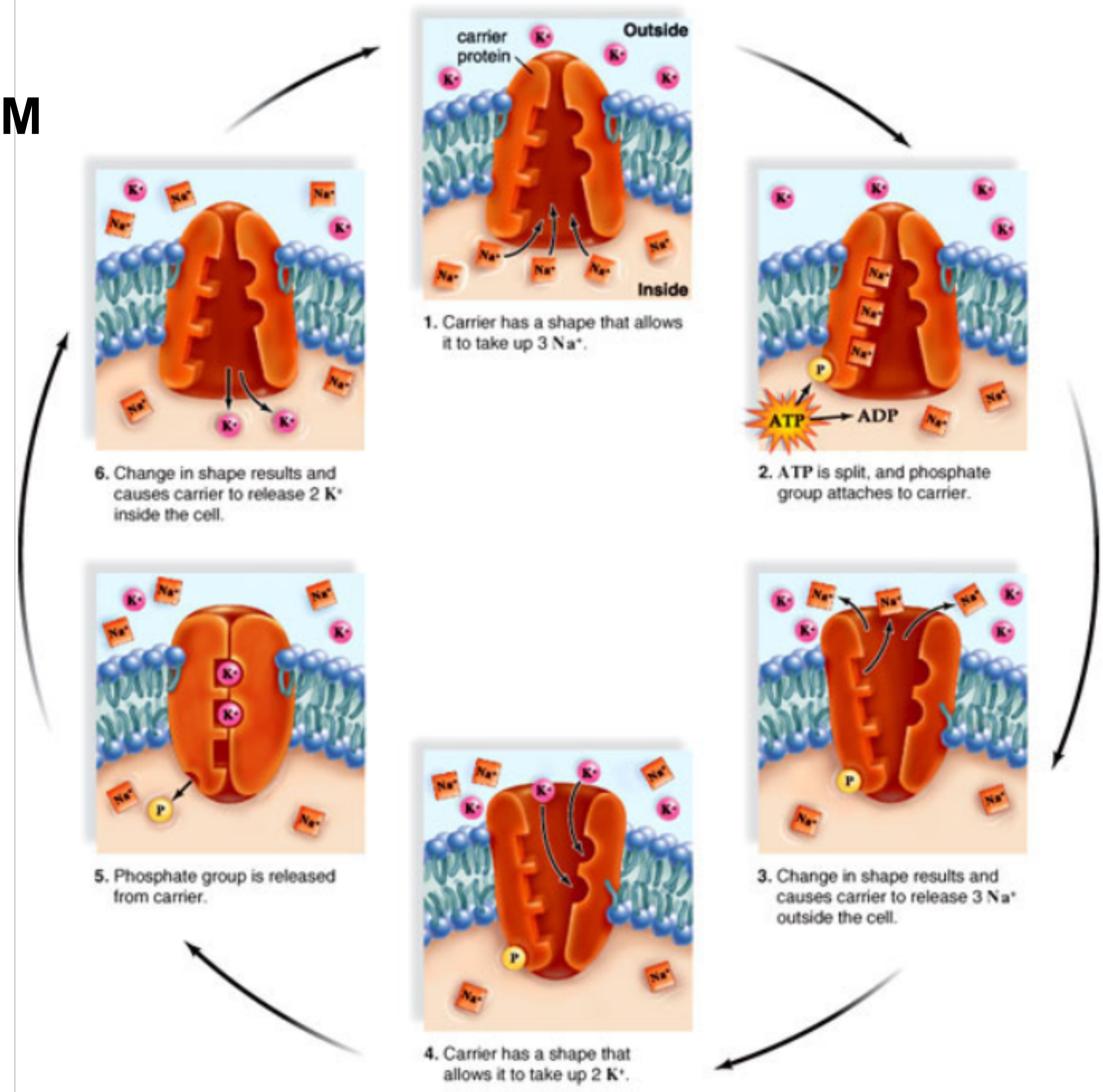
What would happen if you had too much sodium in your cells?



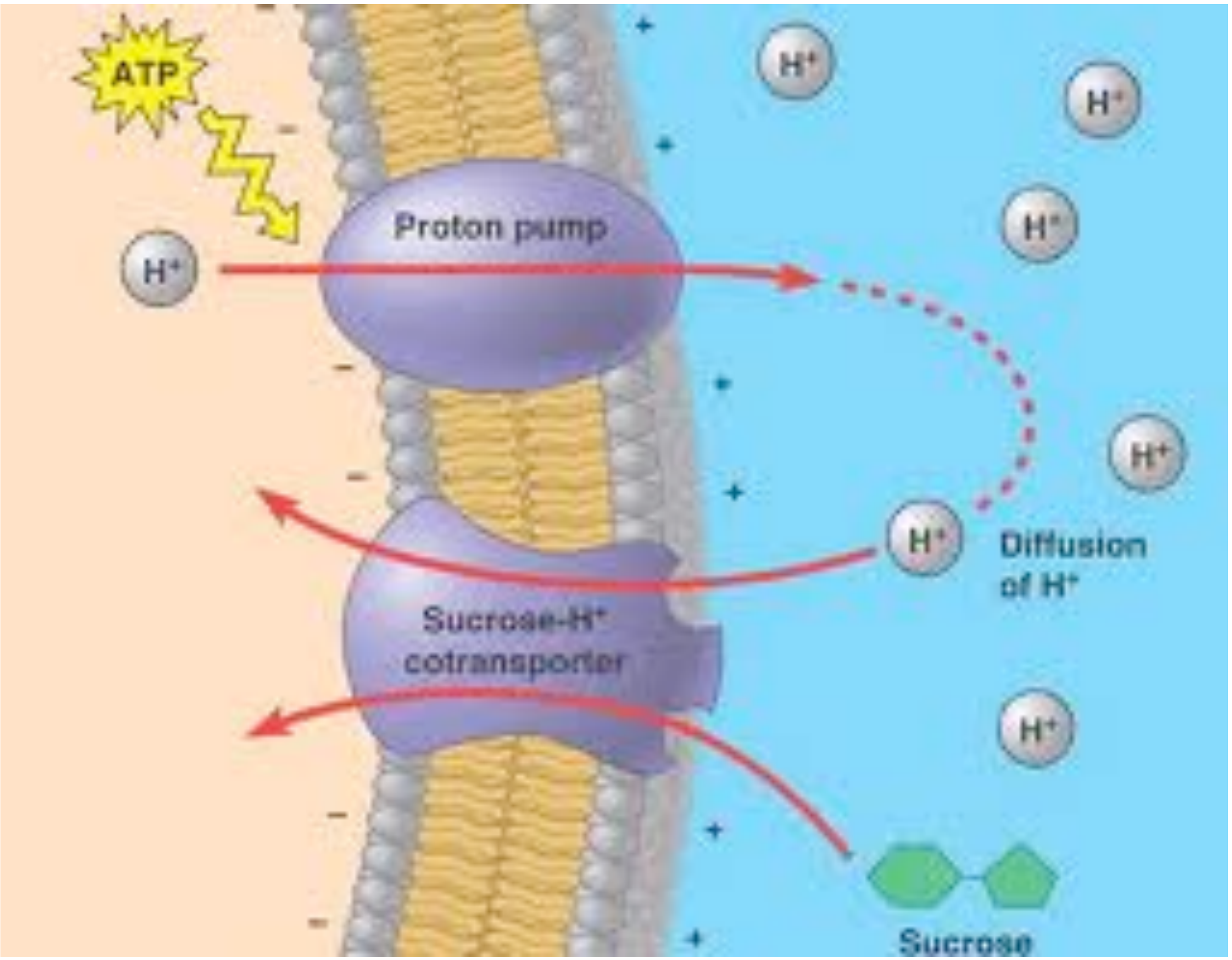


Against gradient=
use energy

SODIUM POTASSIUM PUMP



Cotransport: The transport of an ion from high to low concentration can provide the energy for transport of the second species up a concentration gradient.

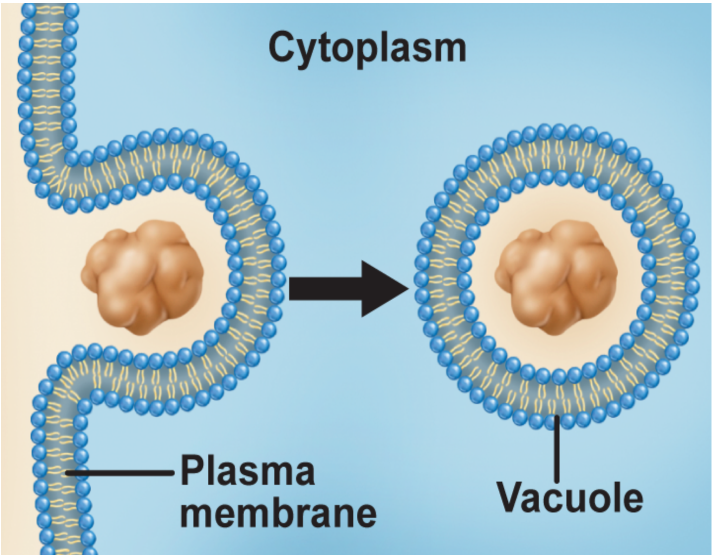


http://highered.mcgraw-hill.com/olcweb/cgi/pluginpop.cgi?it=swf::535::535::/sites/dl/free/0072437316/120068/bio04.swf::Cotransport

Endocytosis

- takes particles **<u>into</u>** the cell

- phagocytosis for solids= cell eating
- pinocytosis for water= cell drinking



Exocytosis

- Secretion of material **<u>out of</u>** the plasma membrane

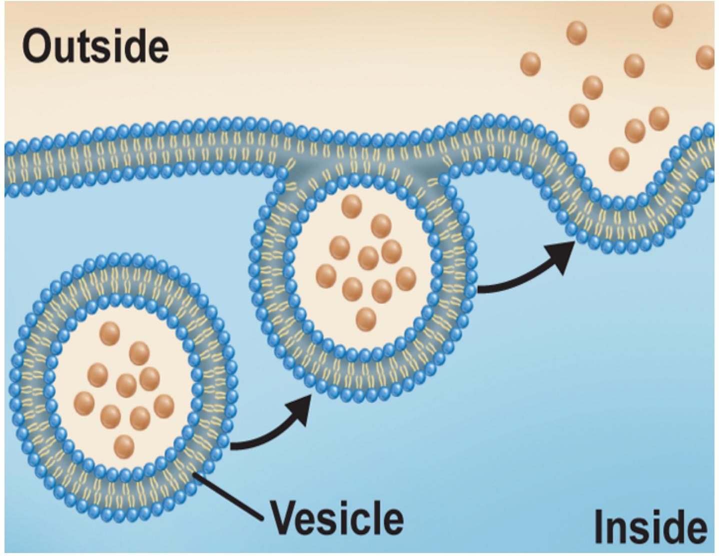
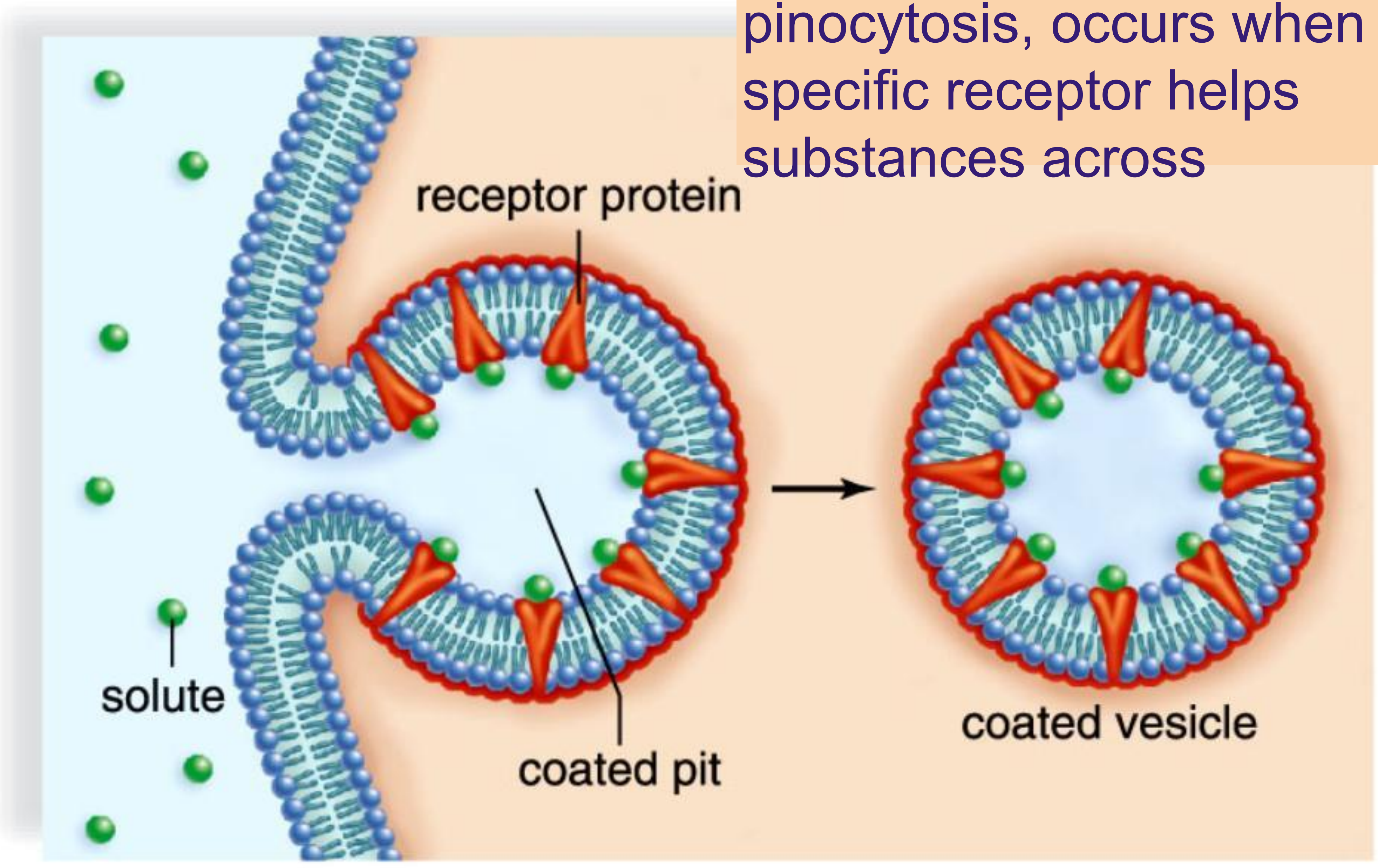


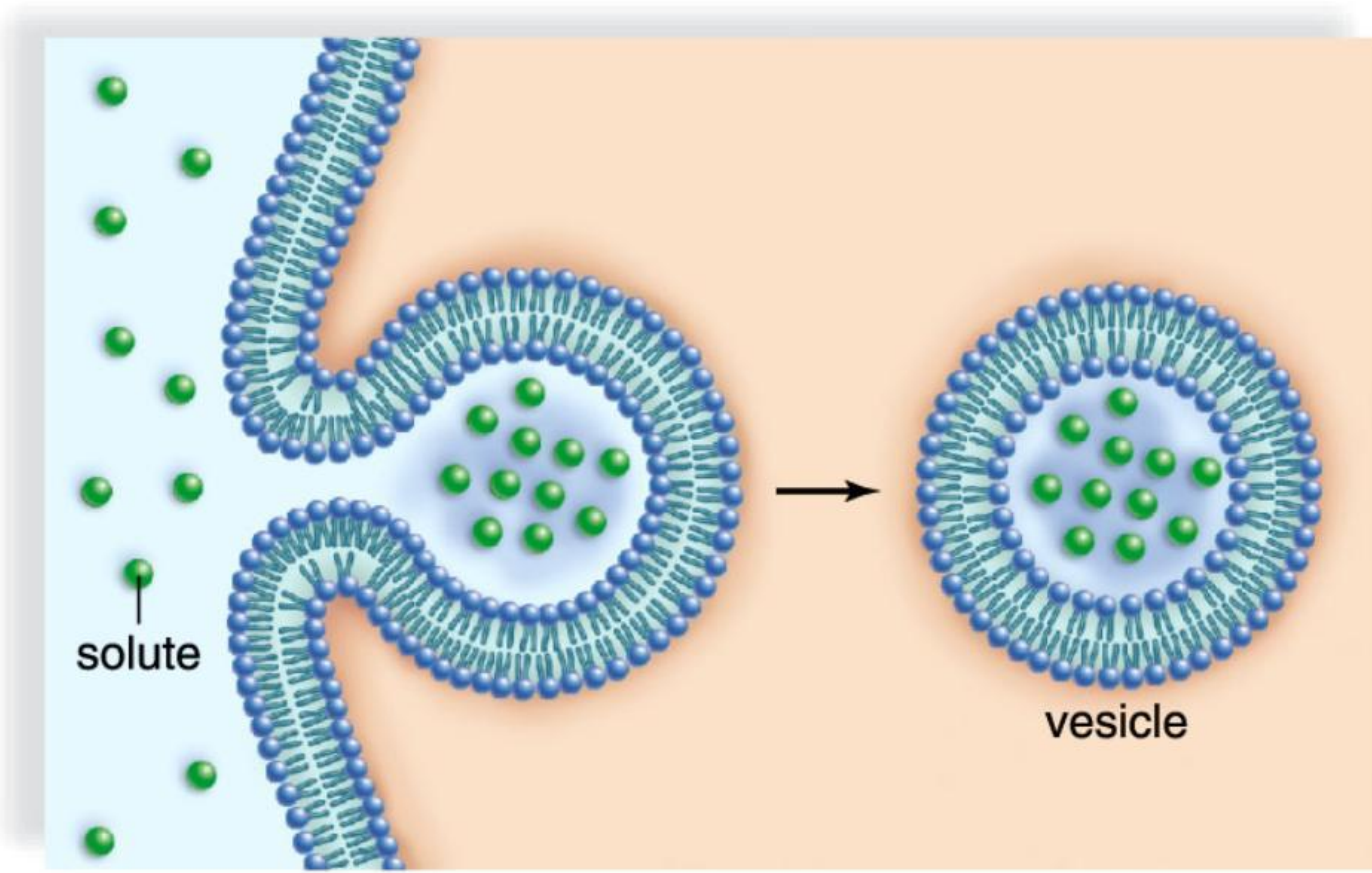
Figure 5.13ca

Receptor mediated endocytosis, a form of pinocytosis, occurs when specific receptor helps substances across



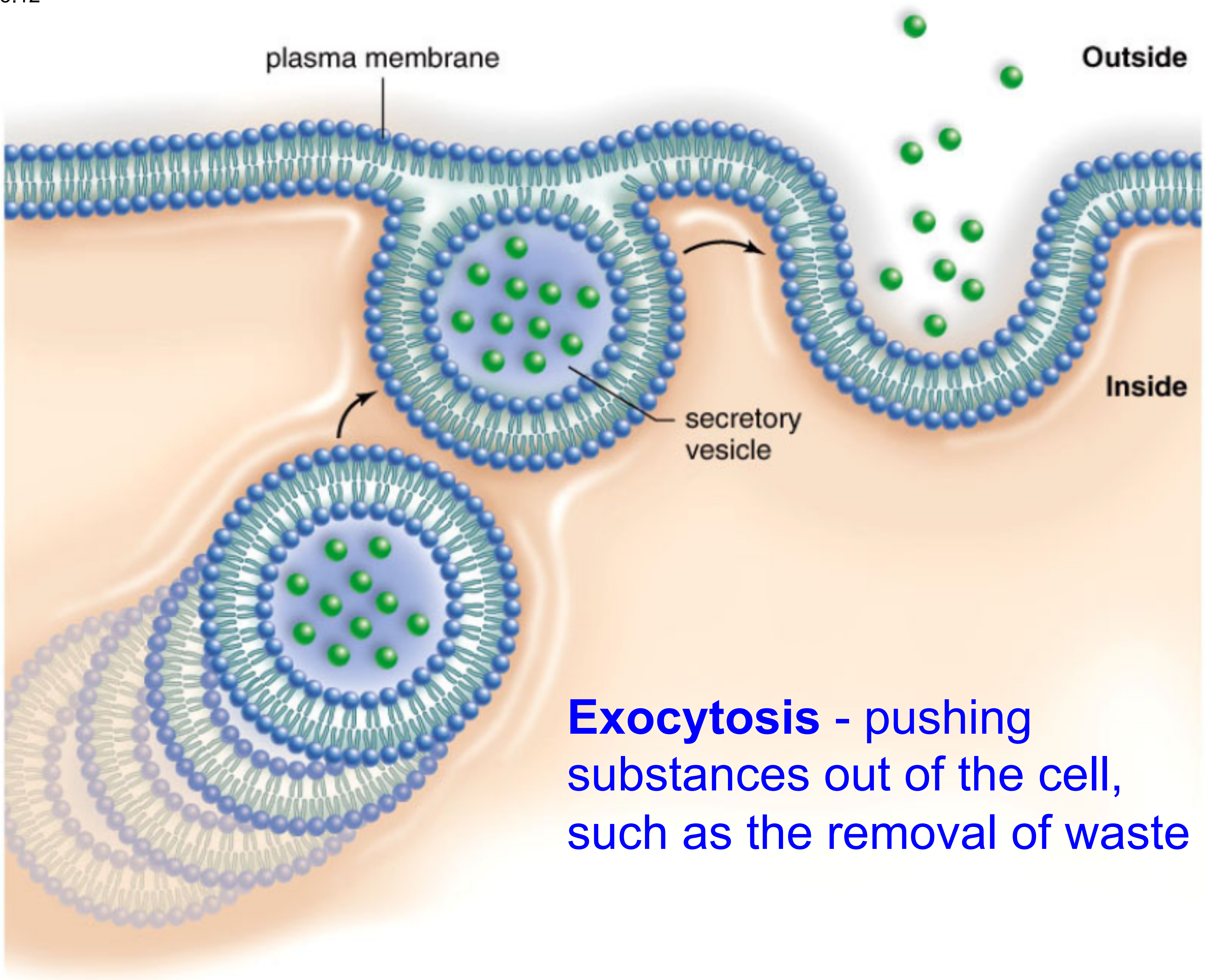
c. Receptor-mediated endocytosis

Figure 5.13ba



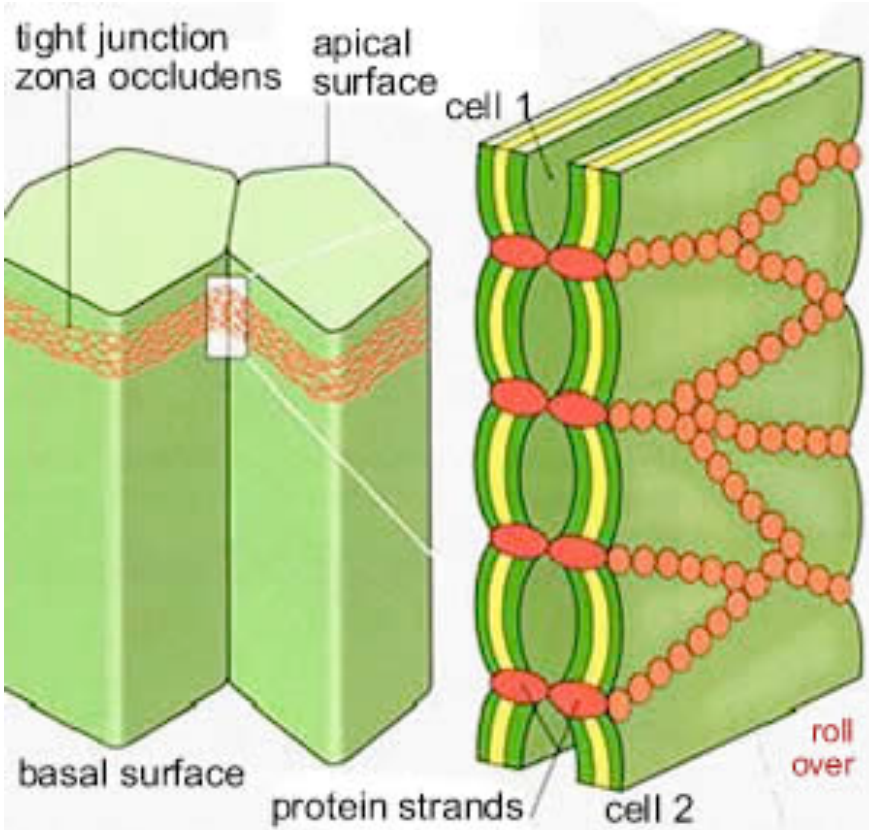
b. Pinocytosis

Figure 5.12



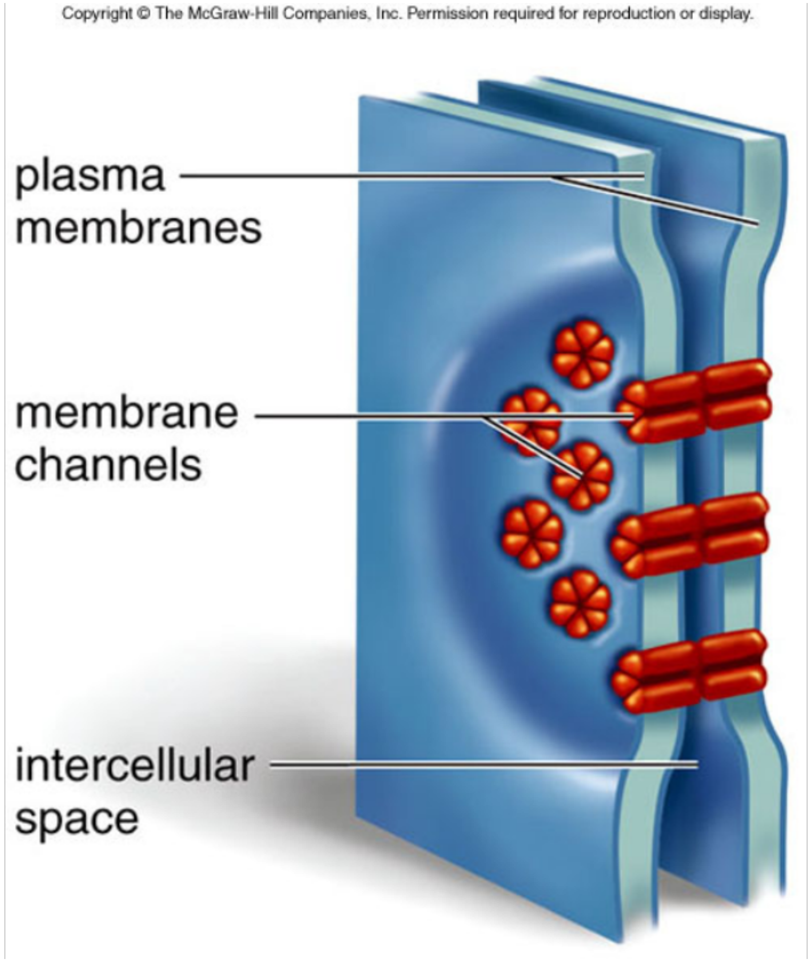
Exocytosis - pushing substances out of the cell, such as the removal of waste

Tight Junction



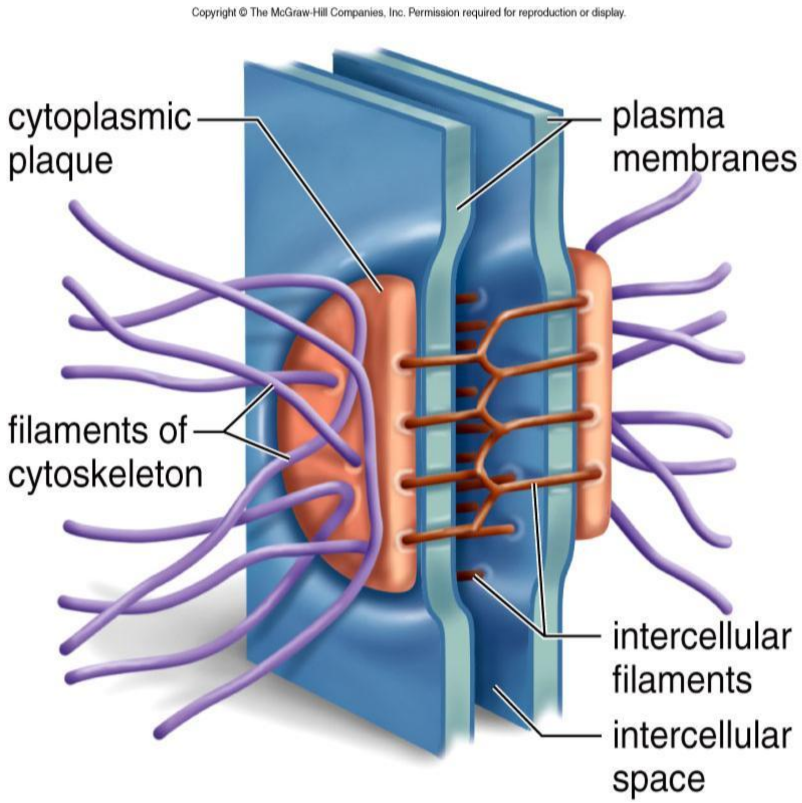
- Plasma membrane proteins attach to each other

Gap Junction



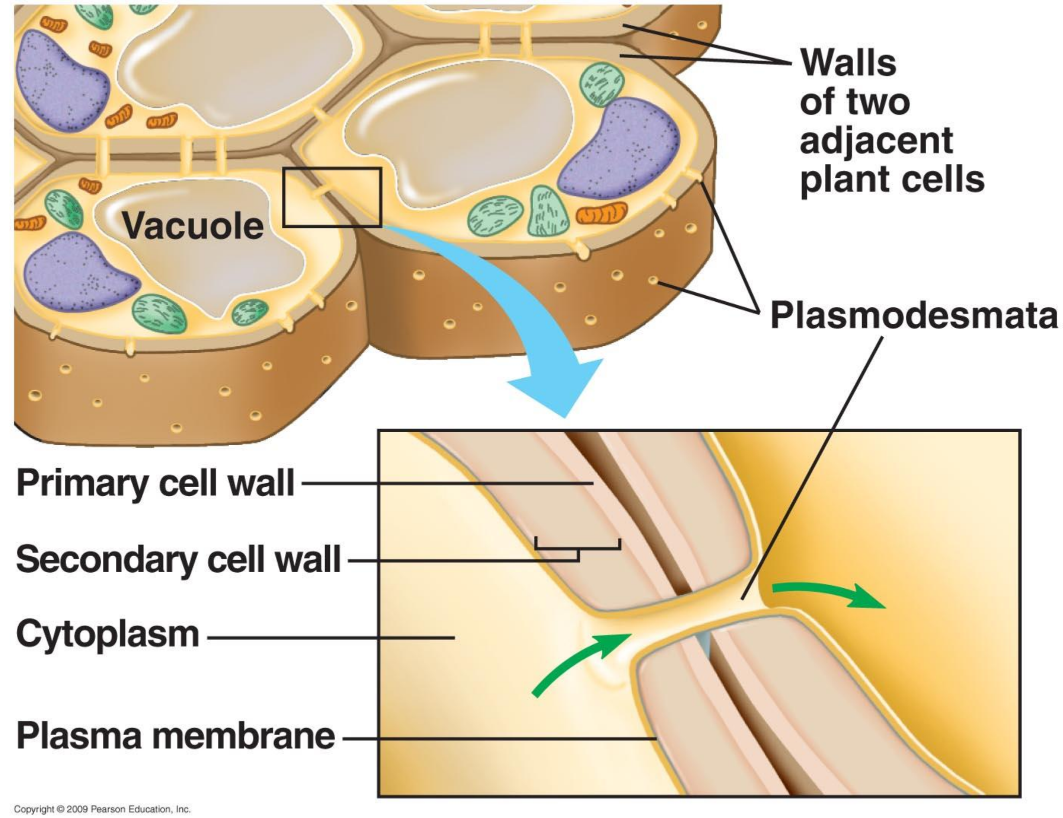
- Identical plasma membrane channels join- allows cell to cell communication

Desmosomes (anchors)



- Intercellular filaments join cytoskeleton of cells

Plasmodesmata



- Connect cytoplasm of plant cells

QOD

1. What is the difference in a solute and solvent?

Draw a picture of a cell in a

2. Hypertonic
3. Hypotonic
4. Isotonic solution

Include arrows showing water flow

A simple rule to remember is:

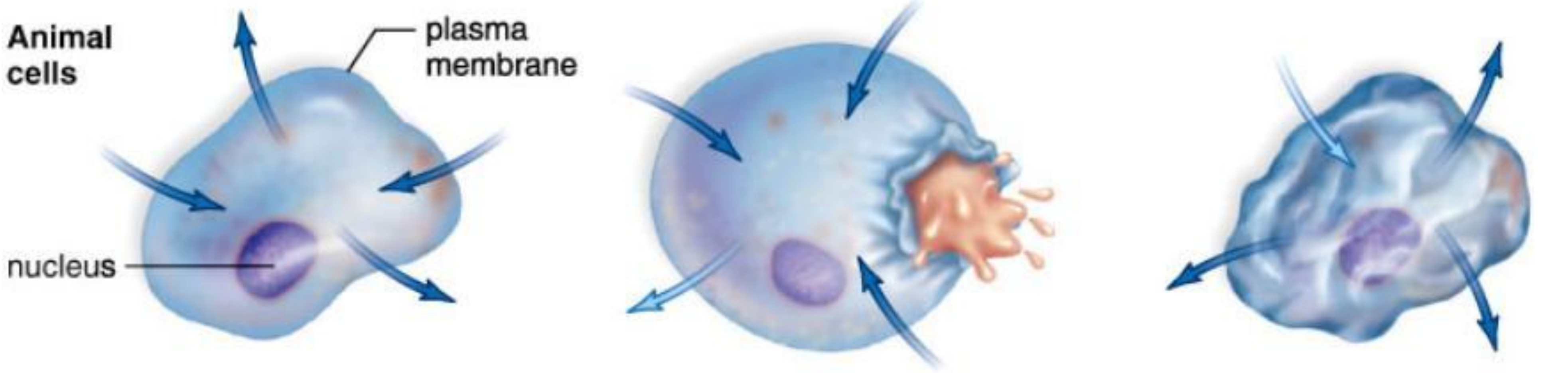
SALT SUCKS

Salt = solute water = solvent

When salt is concentrated it will draw the water in its direction.

This is also why you get thirsty after eating something salty.

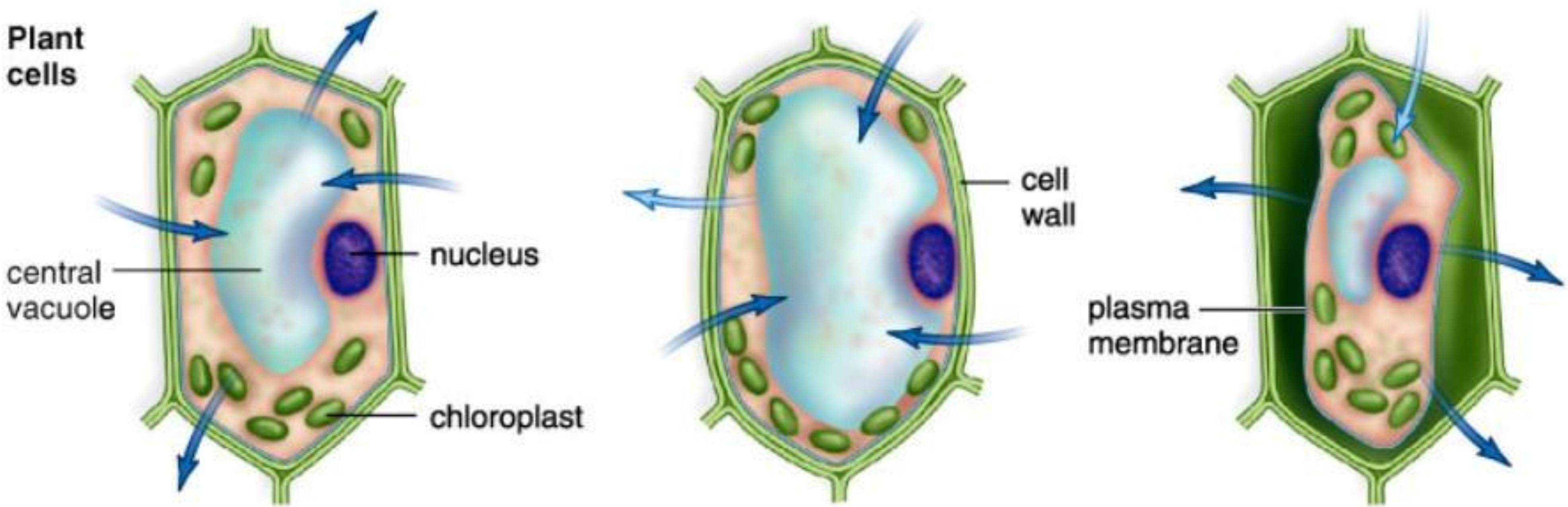
Figure 5.9



In an isotonic solution, there is no net movement of water.

In a hypotonic solution, water enters the cell, which may burst (lysis).

In a hypertonic solution, water leaves the cell, which shrivels (crenation).



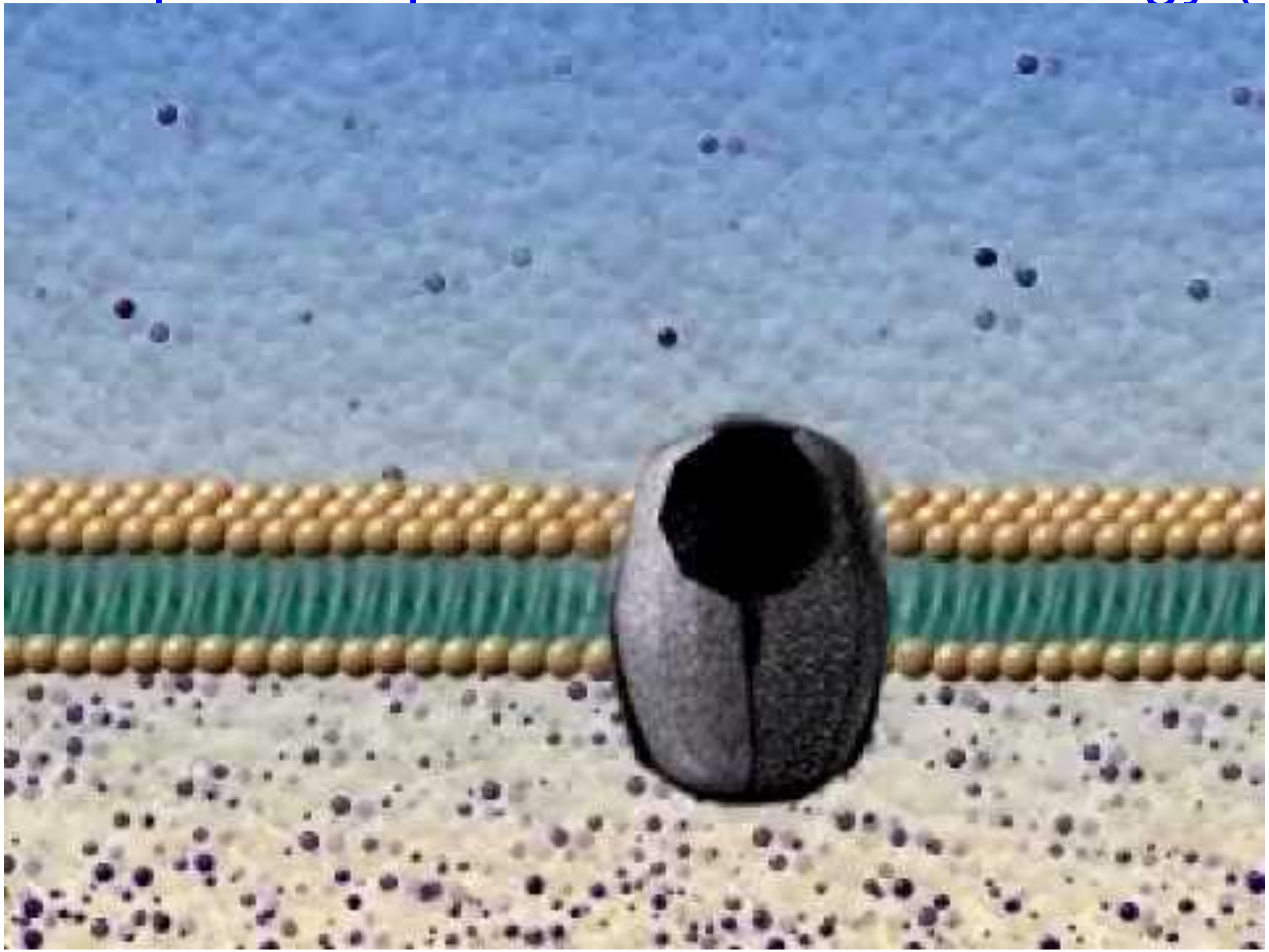
In an isotonic solution, there is no net movement of water.

In a hypotonic solution, vacuoles fill with water, turgor pressure develops, and chloroplasts are seen next to the cell wall.

In a hypertonic solution, vacuoles lose water, the cytoplasm shrinks (plasmolysis), and chloroplasts are seen in the center of the cell.

Passive Transport - requires no energy (diffusion, osmosis)

Active Transport - requires the cell to use energy (ATP)

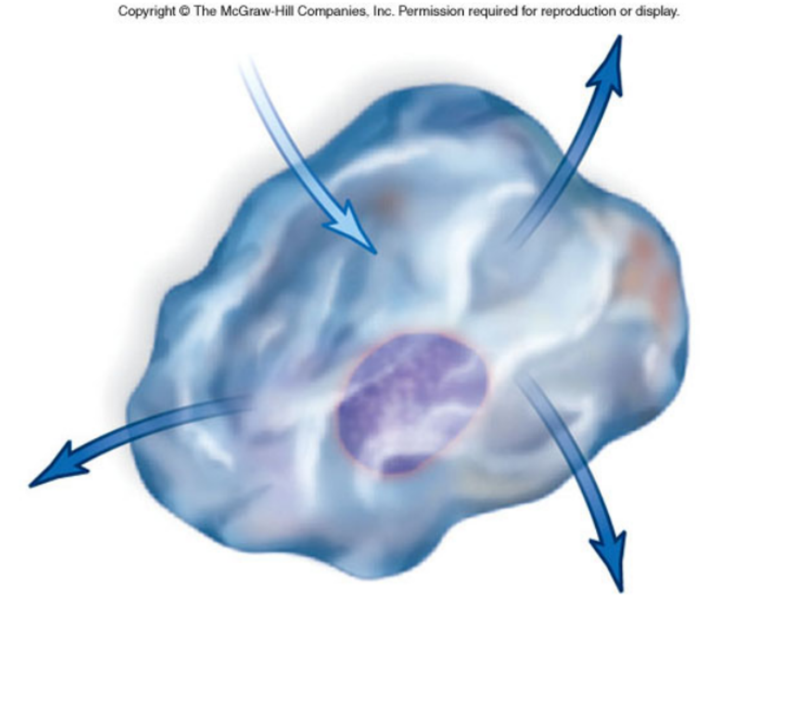


Labs

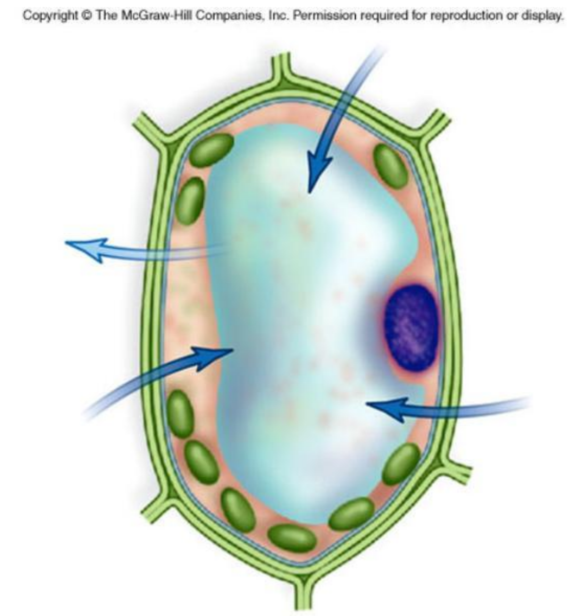
1. Place a baggie full of start in a beaker that has iodine (an indicator for starch). Observe what happens.

2. Create a wet mount of plant and observe what happens to the cells when you add salt water.

1. Label the images.



a. ______________________________



b. ______________________

2. How is the arrangement of phospholipids and proteins account for the semi-permeable nature of the cell membrane?

3. Describe and contrast the three methods of endocytosis.

4. During diffusion, molecules move from areas of ______ concentration to areas of _____ concentration.

5. How does solute concentration affect osmosis?

6. What cell structures can prevent cell bursting in hypotonic solutions?

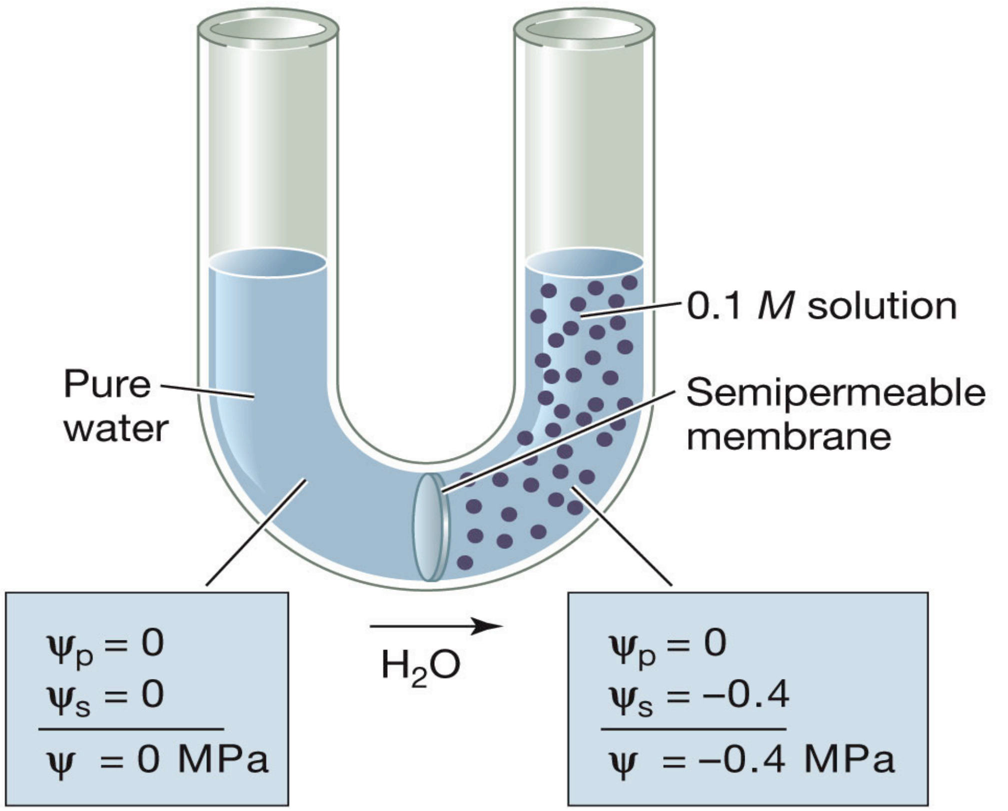
1. Calculate the solute potential of a 0.1 M NaCl solution at 25 C. If the concentration of NaCl inside the plant cell is 0.15 M, which way will the water diffuse if the cell is placed into the 0.1 M NaCl solutions?
2. What must the turgor pressure equal if there is no net diffusion between the solution and the cell?

$\psi = \psi_P + \psi_S$

Water Potential = Pressure Potential + Solute Potential
*if open air, pressure potential = 0, so water potential is equal to the solute potential:

$(\psi_S) = -\,iCRT$,
I = ionization constant,
C = molar concentration,
R = the pressure constant
(R = 0.0831 liter bars/mole-K)
T = temperature in K (273 + C°).

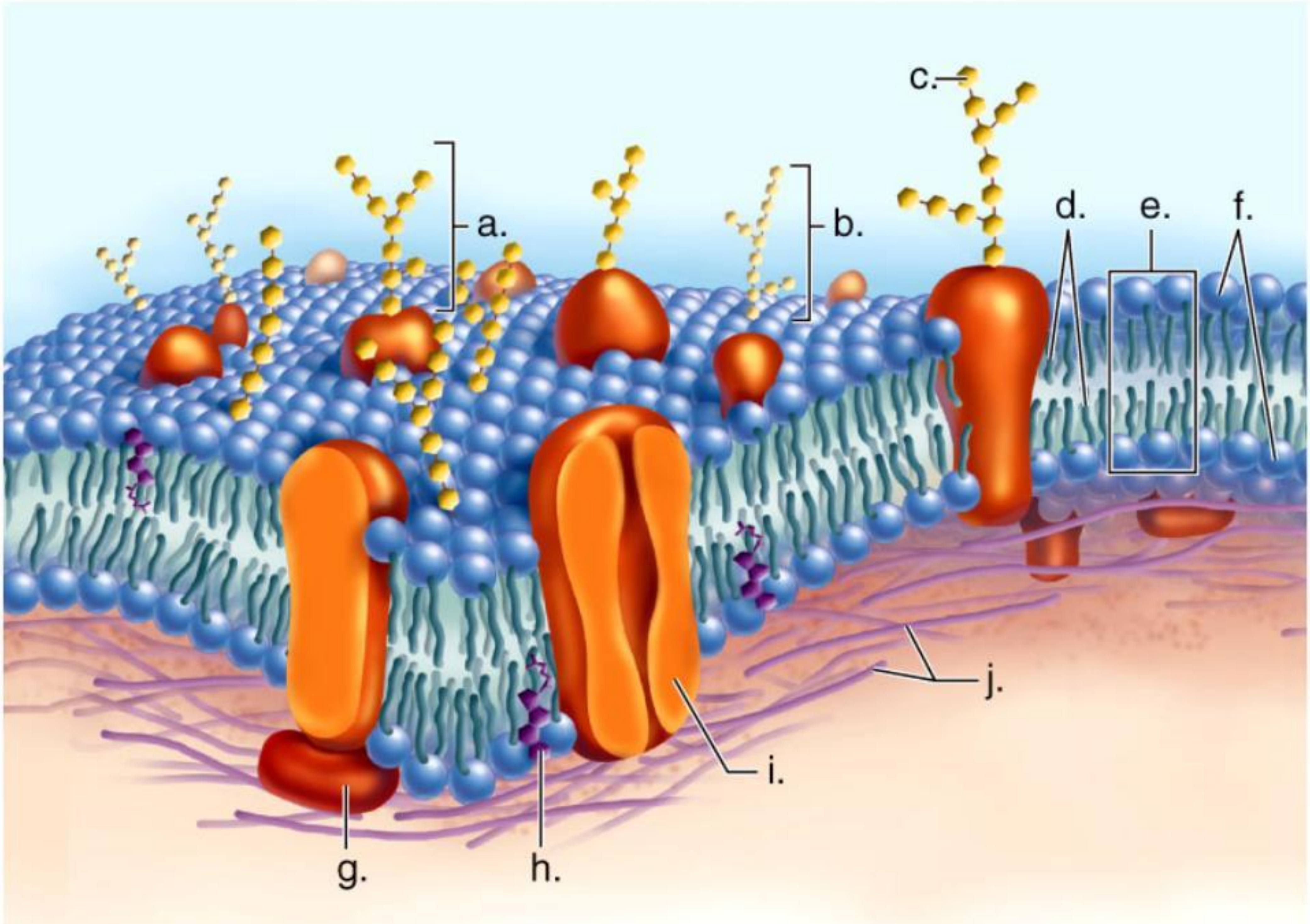
(A)



35.2 (Part 1)

Ionization constant: is a given:
(1.0 for sucrose, 2.0 for NaCl, 3.0 for $CaCl_2$)

7. Label the image.



Movement across the plasma membrane

Passive Transport

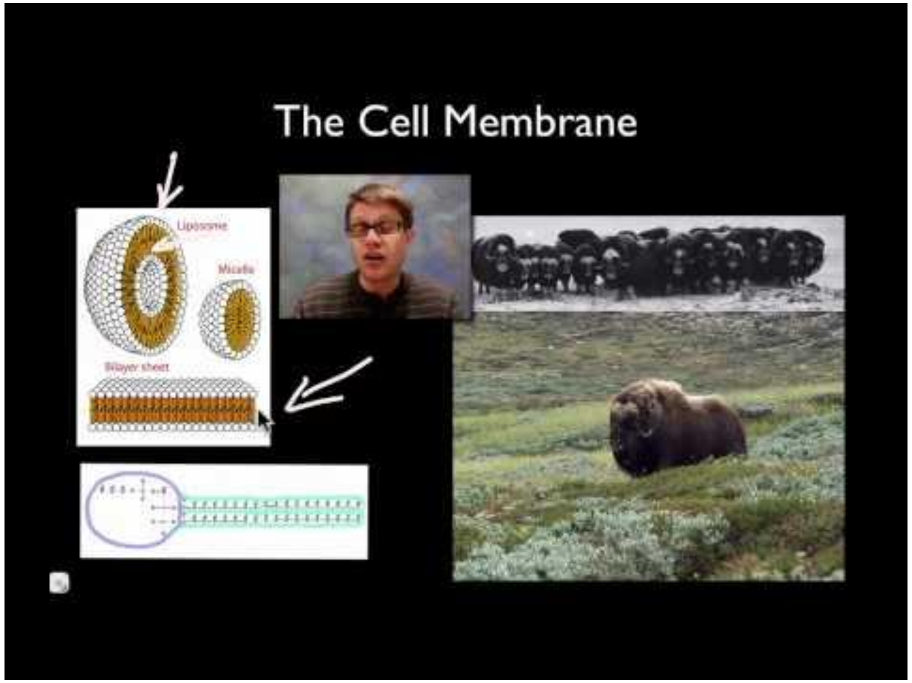
- **Diffusion**
- **Osmosis**
- **Facilitated Diffusion**

Active Transport

Add these to the tree map (put some in more than one place):

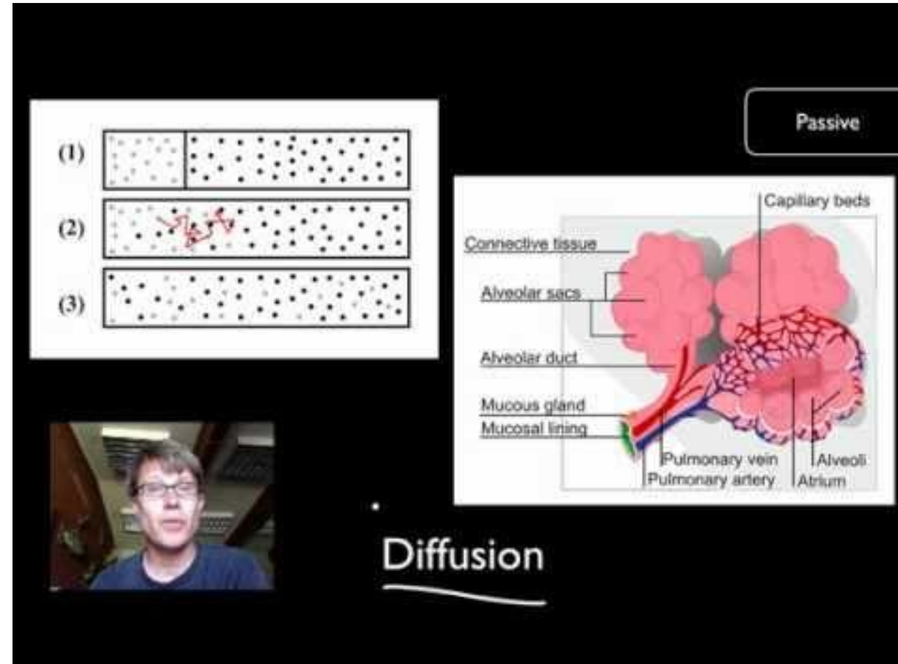
- Requires energy
- Does not require energy
- Water
- High to low concentration gradient
- Low to high concentration gradient
- Requires a protein
- CO2 and O2
- Glucose
- Na^+/K^+ pump

Watch the two podcasts on the cell membrane by Paul Anderson. (Youtube channel = Bozeman Science)



http://youtube.com/v/S7CJ7xZOjm0

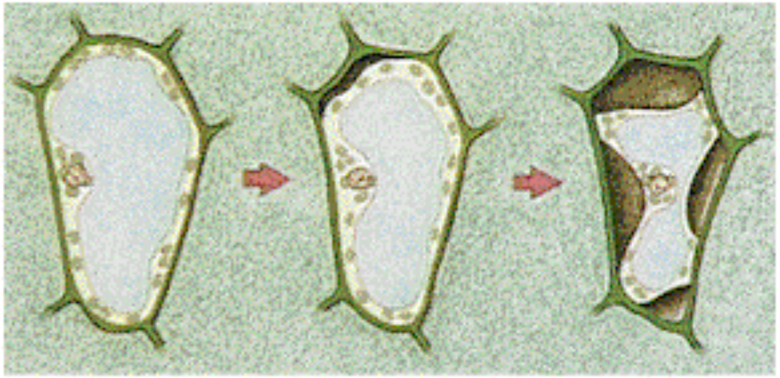
1. How is a phospholid lke a musk ox?
2. What are the two major parts of the cell membrane?
3. What keeps phopholipids from getting too close to each other?
4. What types of molecules can get through the cell membrane?
5. What is an aquaporin?



http://youtube.com/v/RPAZvs4hvGA

1. What are the two kinds of transport in a cell?
2. What type of transport brings oxygen into the lungs?
3. Describe the U-Tube experiment.
4. Why does the slug die when you put salt on it?
5. What happens if you inject salt water into blood?
6. How is glucose taken into the cell? Does this require energy?
7. The Sodium Potassium pump moves ___ to the ouside and ____ to the inside, a process that requires ________.
8. Compare endocytosis to exocytosis.
9. What is a phagolysosome?

- How is plasmolysis different from just a cell in a hypertonic solution?



- Can salt diffuse through a plasma membrane?