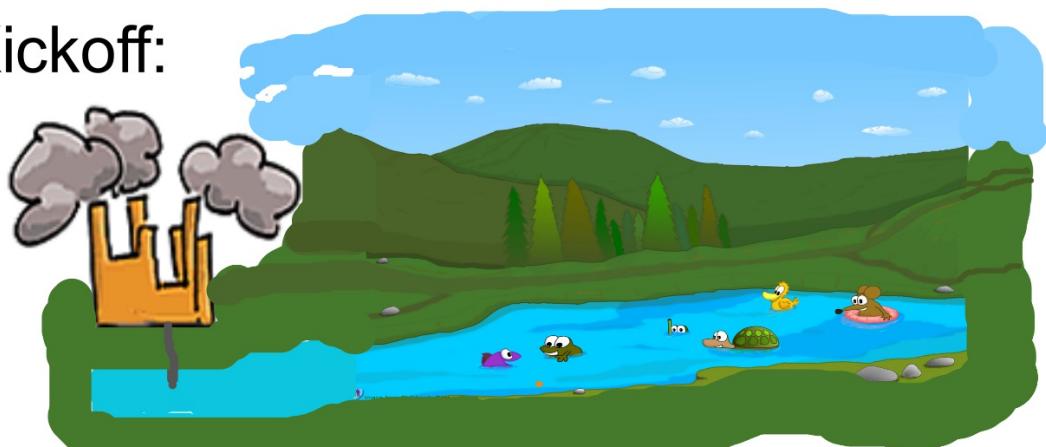


Kickoff:



A chemical company decides to release liquid pollutants into a nearby lake when there is little to no water movement. Would there be any environmental impact to wildlife on the opposite side of the lake? Explain your answer.

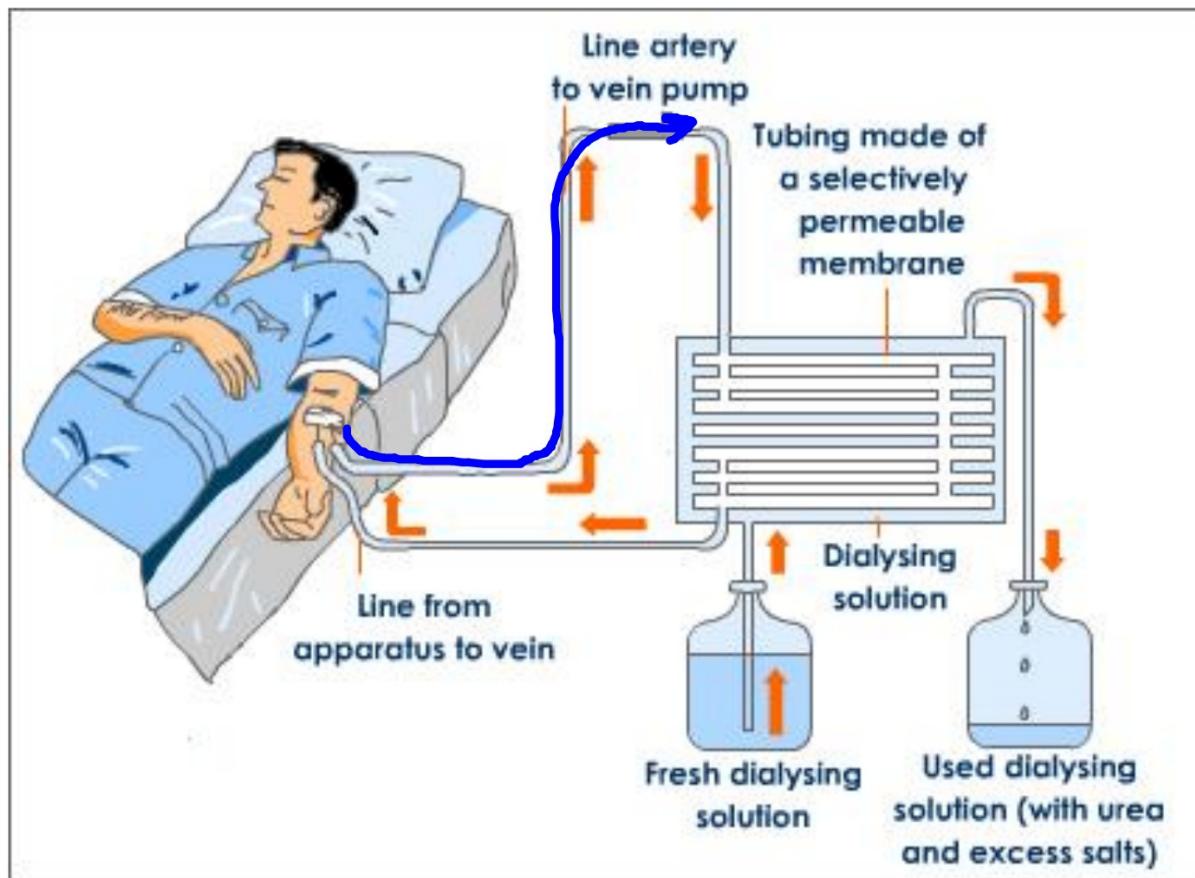


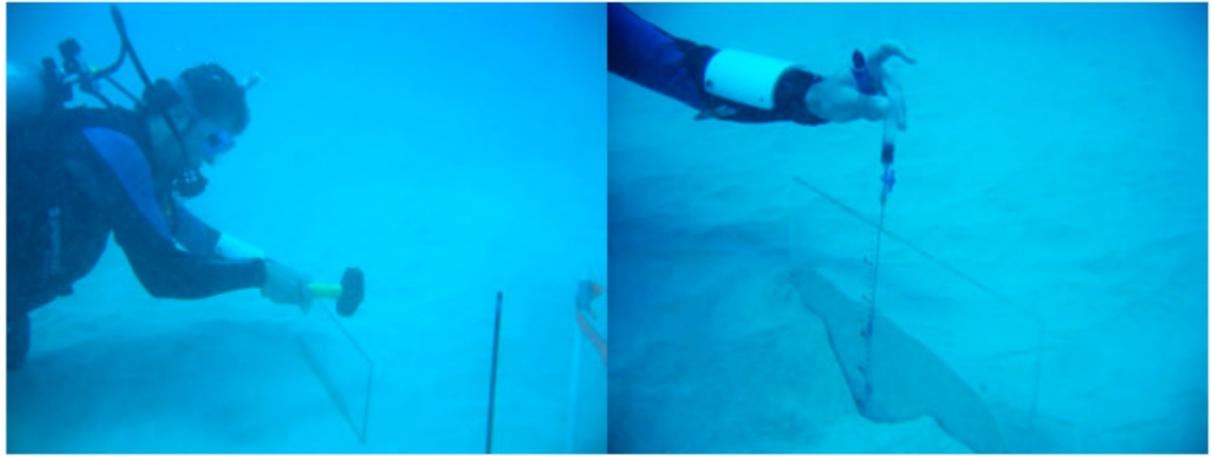
[commons.wikimedia.org/wikiFile:Diffusion.gif](https://commons.wikimedia.org/wiki/File:Diffusion.gif)



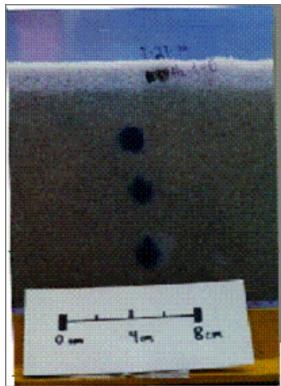
STEM Integration

- **Science:** Diffusion is the natural process that moves materials from a more concentrated area to a less concentrated area. Wastes would accumulate in one place if it were not for diffusion. Diffusion regulates cellular processes in order for survival.
- **Technology:** DNA sequencing (electrophoresis)
- **Engineering:** Materials engineering has led to the development of dialysis tubing (poor kidneys).
- **Mathematics:** We can calculate and graph the concentration changes as materials come to equilibrium

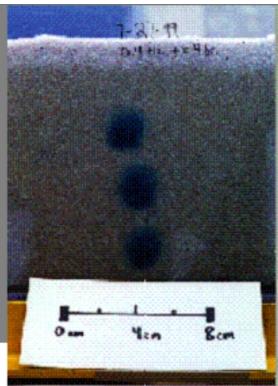




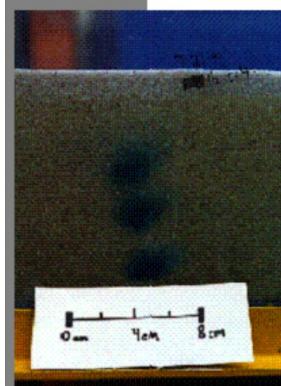
(Above) Postdoctoral researcher Andy Hebert installs a "sediment window" to observe dye mixing in sandy sediment porewater. (Click on image to open a larger version in a new window.)



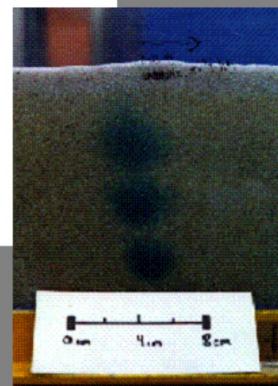
$t = 0$



$t = 4 \text{ h}$
 $0.40 \text{ Hz}, 0.5 \text{ cm}$



$t = 4 \text{ h}$
 $0.99 \text{ Hz}, 1.1 \text{ cm}$



$t = 4 \text{ h}$
 $1.9 \text{ Hz}, 1.7 \text{ cm}$

Exchange with the Environment

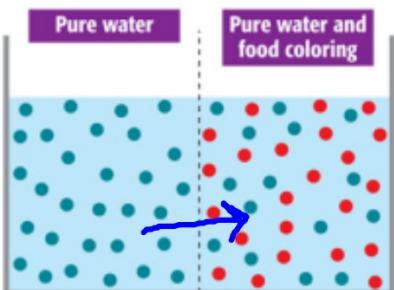
What Is Diffusion?

"Spread out"

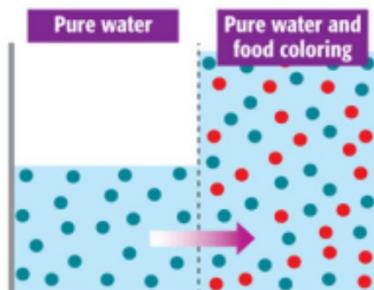
- **Diffusion** is the movement of particles from regions of higher density to regions of lower density. "with a concentration gradient"
- **Diffusion of Water** The diffusion of water through cell membranes is called **osmosis**.

Osmosis

- 1 The side that holds only pure water has the higher concentration of water particles.



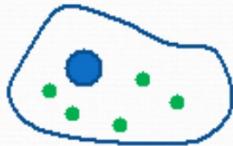
- 2 During osmosis, water particles move to where they are less concentrated.



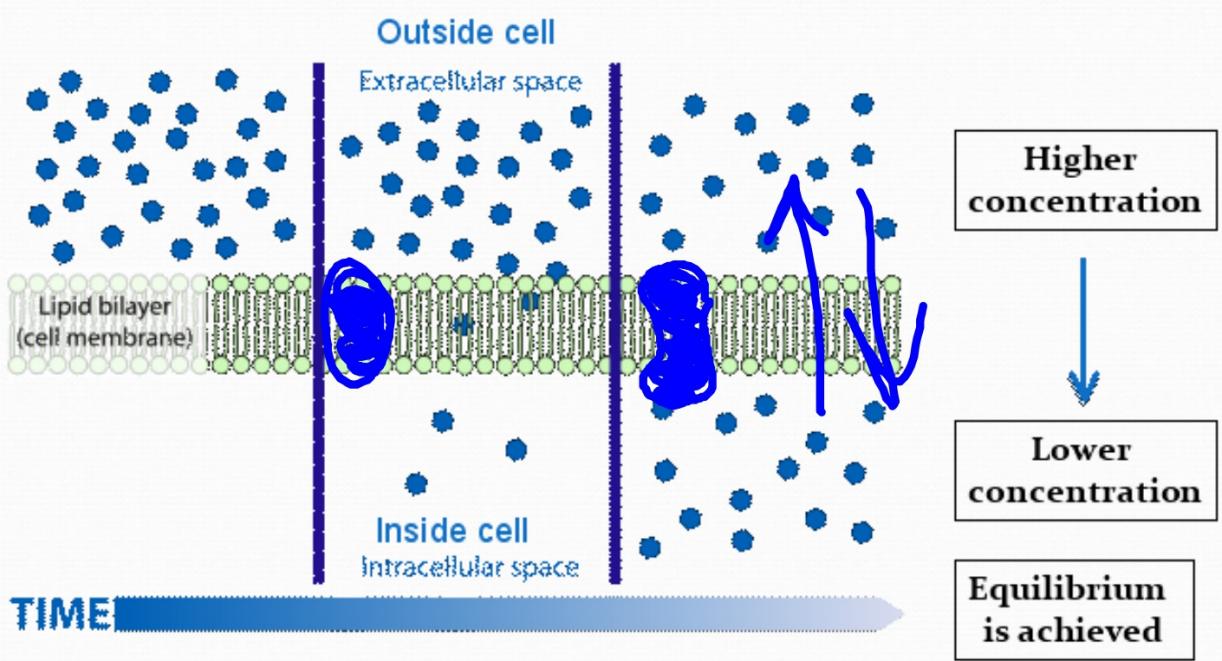
What did he say?

Here are some terms you will hear throughout the day:

- **Concentration** – refers to how much stuff is in a solution
- **Permeable** – capable of being passed through (opposite is *impermeable*)
- **Equilibrium** – concentration is equal throughout



Molecular Diffusion across a permeable membrane



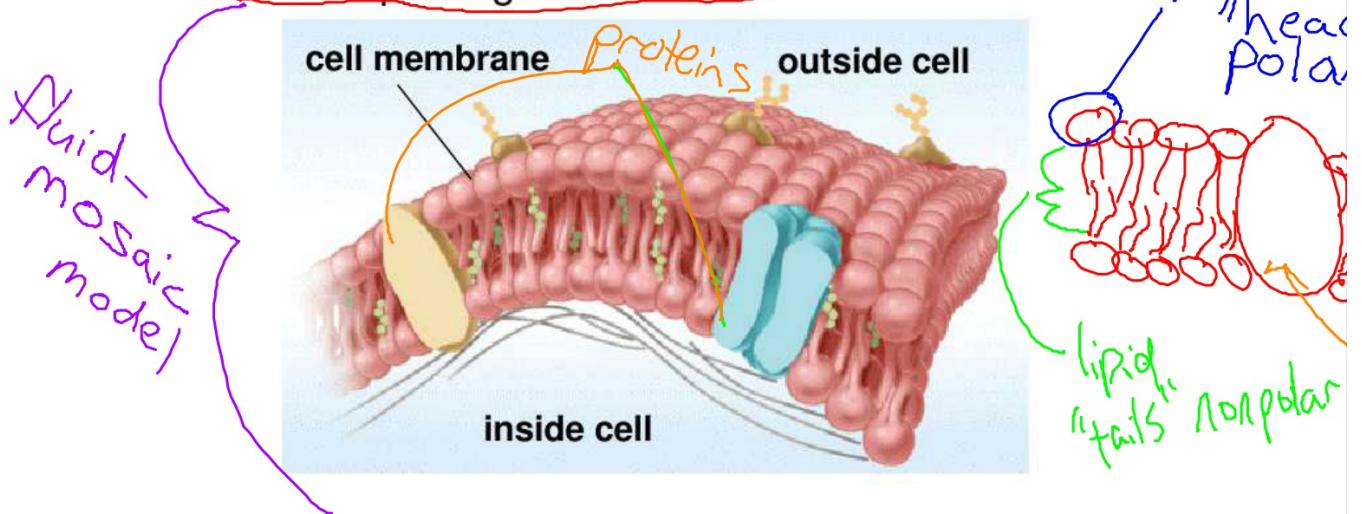
3.3 Cell Membrane

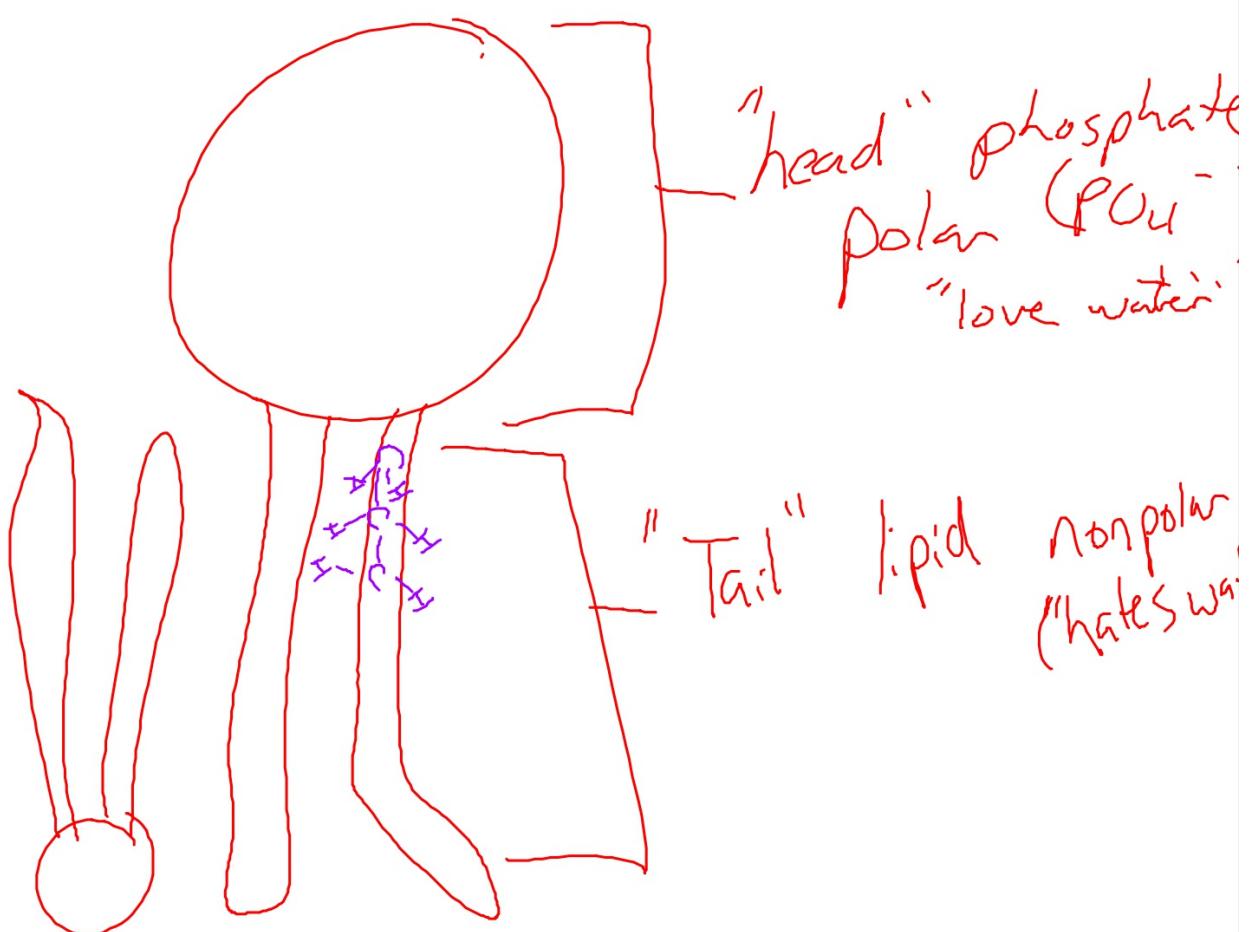
- Cell membranes are composed of two phospholipid layers.

(plasma)

- The ~~cell~~ membrane has two major functions.

- forms a boundary between inside and outside of the cell
- controls passage of materials

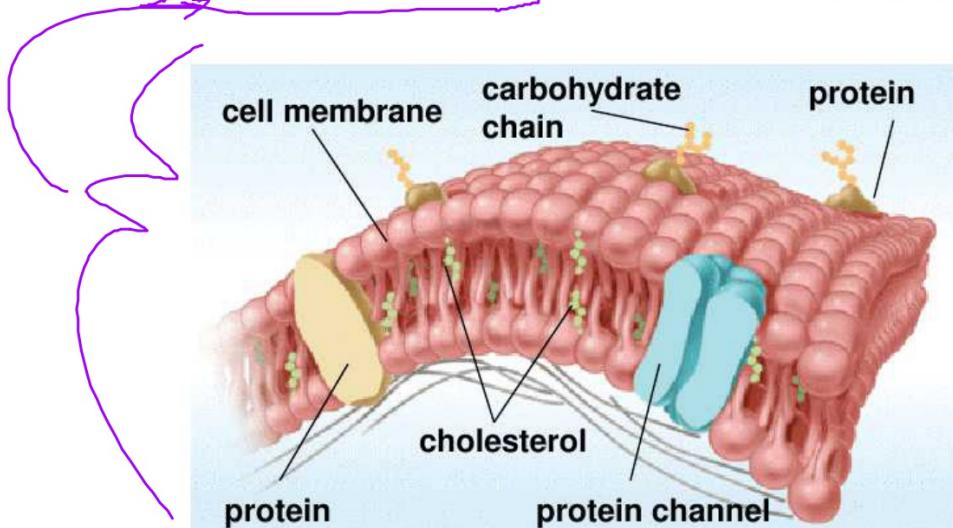




3.3 Cell Membrane

- Cell membranes are composed of two phospholipid layers.

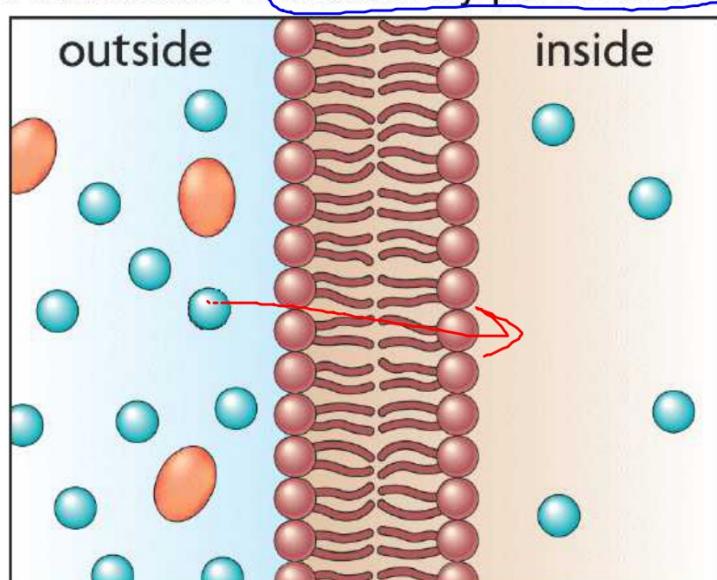
- The cell membrane is made of a phospholipid bilayer.
- There are other molecules embedded in the membrane.
- The fluid mosaic model describes the membrane.



3.3 Cell Membrane

- Cell membranes are composed of two phospholipid layers.

- The cell membrane is selectively permeable.



Some molecules can cross the membrane while others cannot.

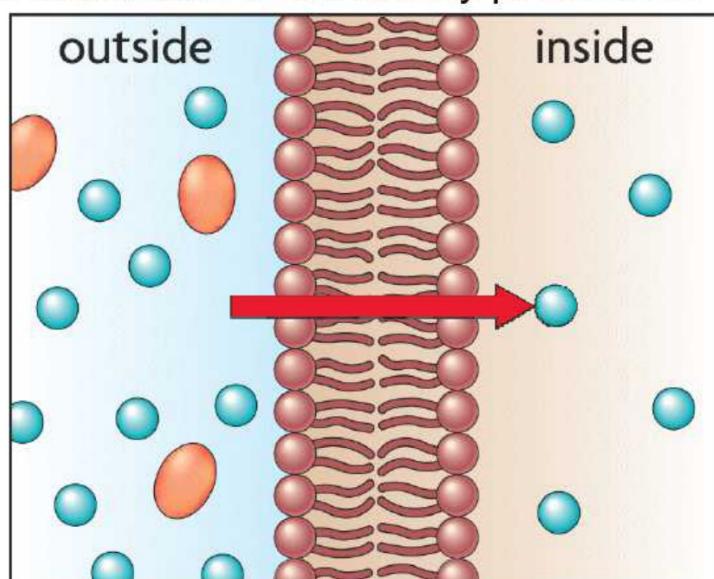
Semi-permeable

capable of
being passed
through

3.3 Cell Membrane

- Cell membranes are composed of two phospholipid layers.

- The cell membrane is selectively permeable.



Some molecules can cross the membrane while others cannot.

3.3 Cell Membrane

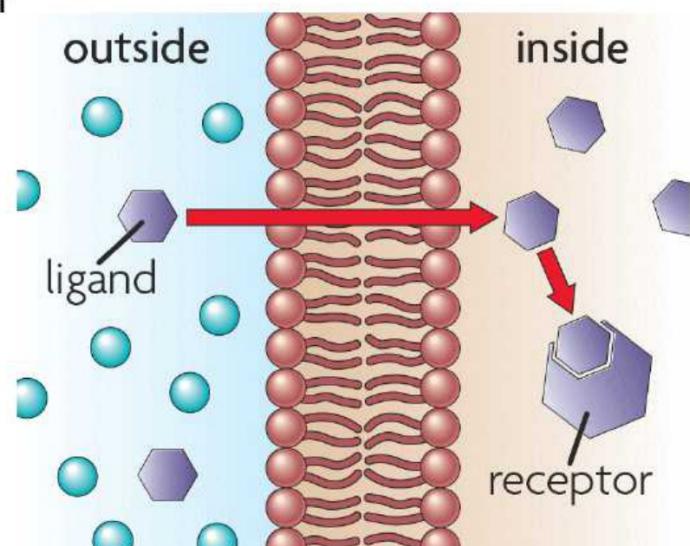
- ▶ **Chemical signals are transmitted across the cell membrane.**

- Receptors bind with ligands and change shape.
- There are two types of receptors.

3.3 Cell Membrane

- ▶ **Chemical signals are transmitted across the cell membrane.**

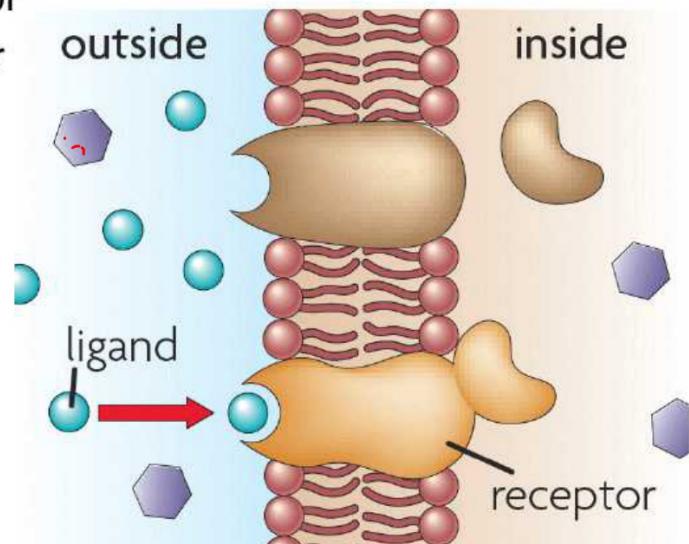
- Receptors bind with ligands and change shape.
- There are two types of receptors.
 - intracellular receptor



3.3 Cell Membrane

- ▶ **Chemical signals are transmitted across the cell membrane.**

- Receptors bind with ligands and change shape.
- There are two types of receptors.
 - intracellular receptor
 - membrane receptor

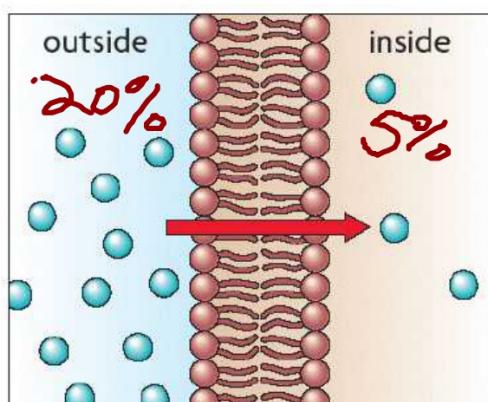


Kickoff:

1. How is diffusion different than osmosis?
2. Why do you suppose plants wilt (go limp) when not watered regularly?
3. What do you think would happen if a wet-mount of Elodea was done with a 10% NaCl solution? Describe what would happen.

3.4 Diffusion and Osmosis

KEY CONCEPT Materials move across membranes because of concentration differences.



3.4 Diffusion and Osmosis

Passive transport does not require energy input from a cell.

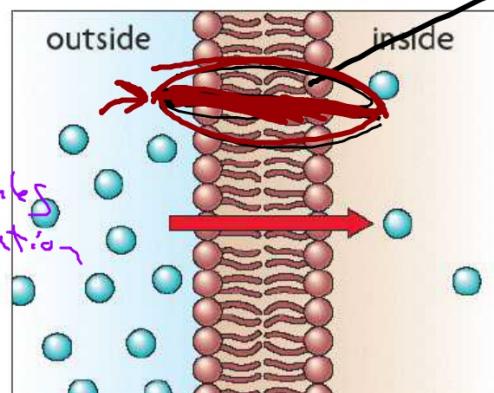
- Molecules can move across the cell membrane through passive transport.

- There are ~~two~~³ types of passive transport.

- diffusion = movement of molecules from a high concentration to a low conc.

- osmosis

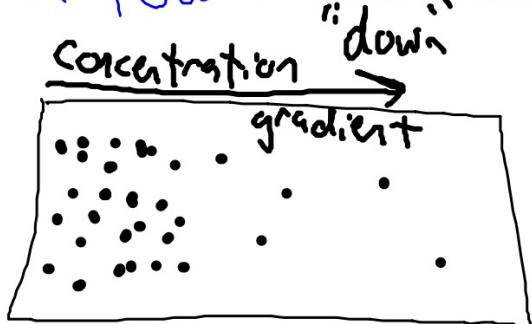
- water diffusion of*
- Facilitated diffusion → go through membrane protein channels



3.4 Diffusion and Osmosis

Diffusion and osmosis are types of passive transport.

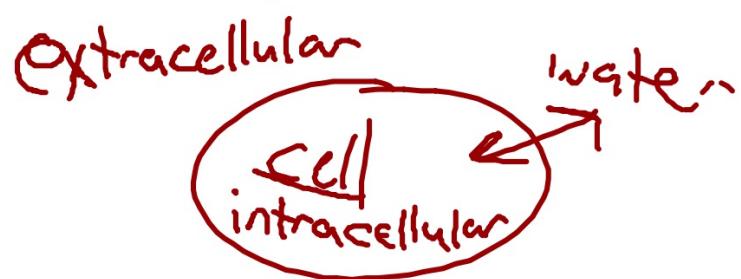
- Molecules diffuse down a concentration gradient.
- Molecules move from a high concentration to a low concentration.



3.4 Diffusion and Osmosis

Diffusion and osmosis are types of passive transport.

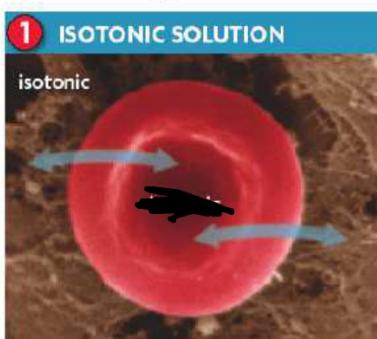
- Osmosis is the diffusion of water molecules across a semipermeable membrane.



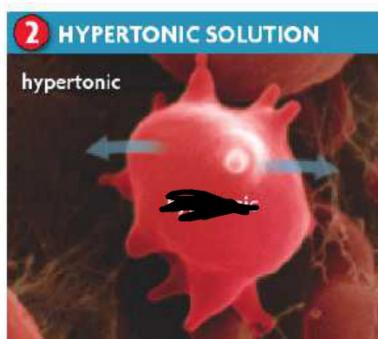
3.4 Diffusion and Osmosis

Diffusion and osmosis are types of passive transport.

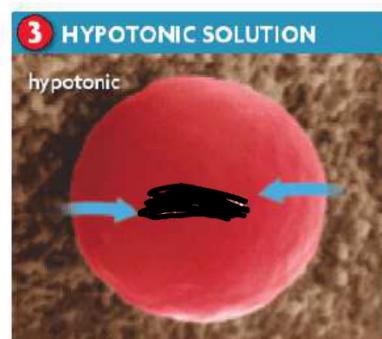
- There are three types of solutions.
 - isotonic – solutes in the cell and in solut. are equal
 - hypertonic – more solutes in solution than the cell
 - hypotonic – less solutes in solution than in cell (water in)



A solution is isotonic to a cell if it has the same concentration of solutes as the cell. Equal amounts of water enter and exit the cell, so its size stays constant.



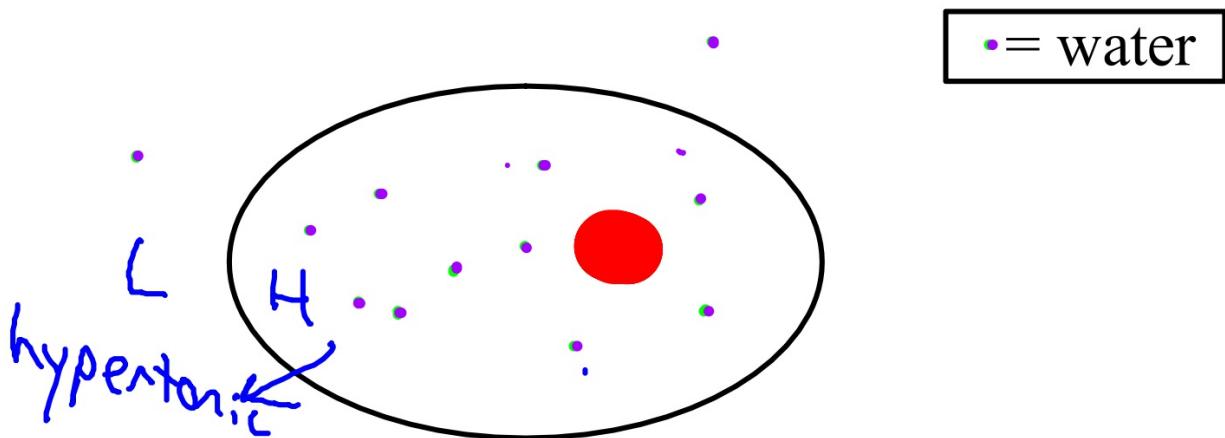
A hypertonic solution has more solutes than a cell. Overall, more water exits a cell in hypertonic solution, causing the cell to shrivel or even die.



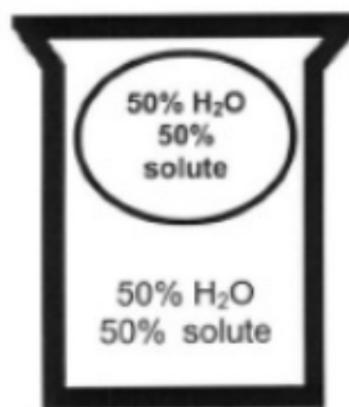
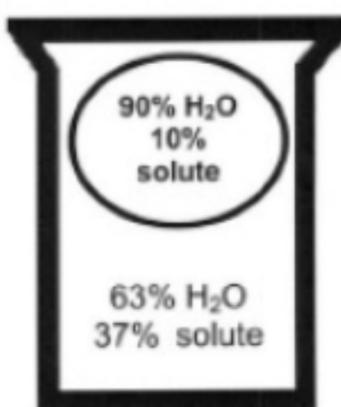
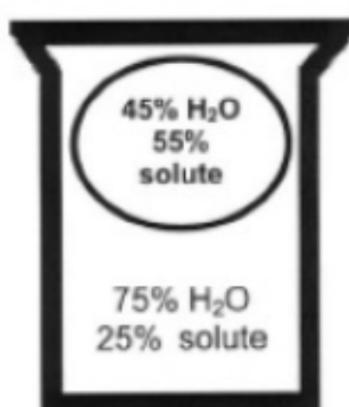
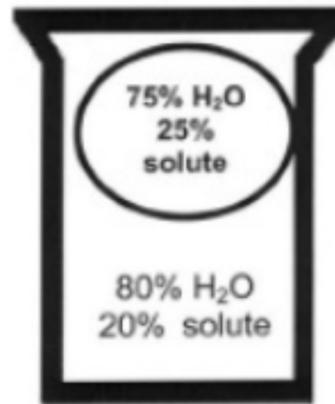
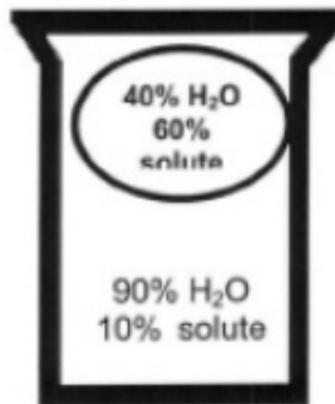
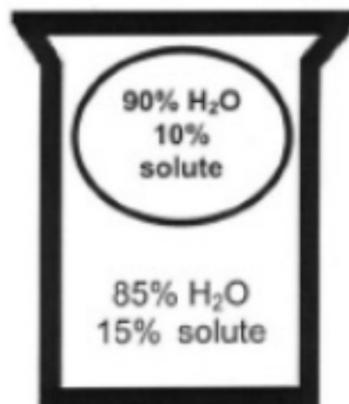
A hypotonic solution has fewer solutes than a cell. Overall, more water enters a cell in hypotonic solution, causing the cell to expand or even burst.

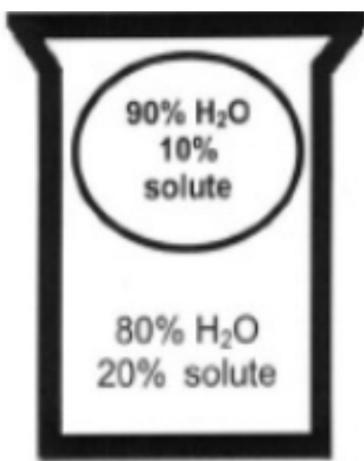
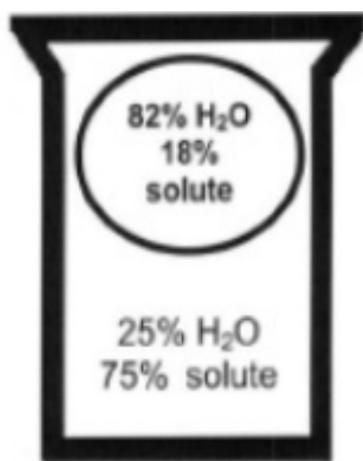
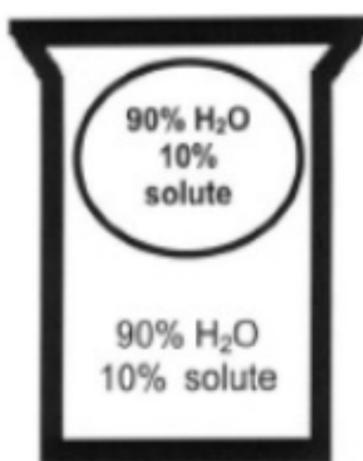
Kickoff:

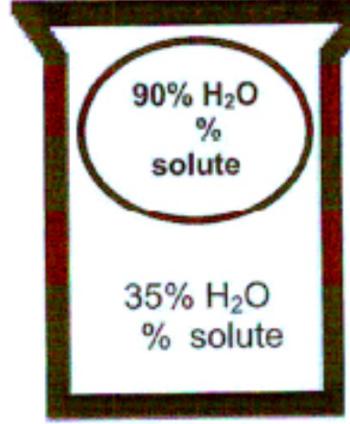
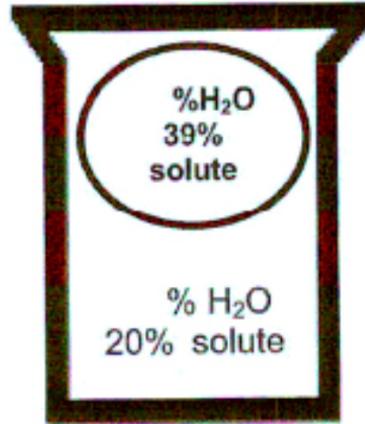
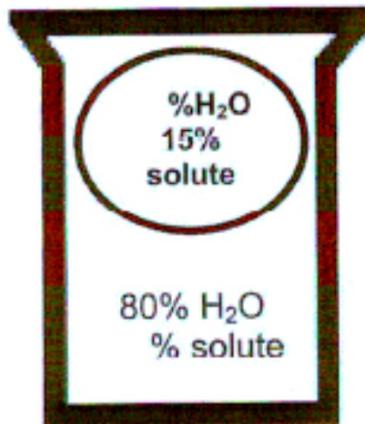
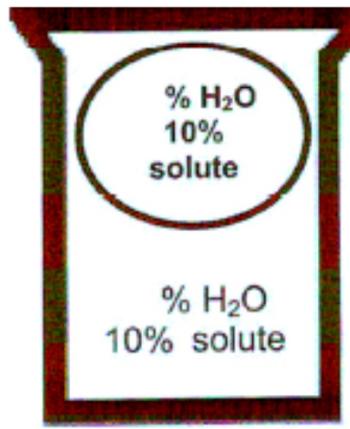
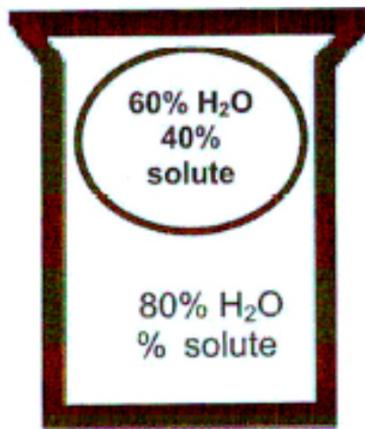
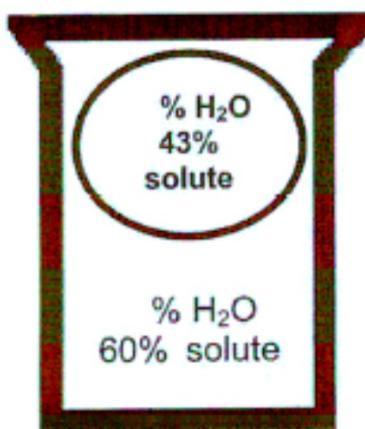
If I put vanilla extract into a balloon, will you be able to smell it?



Which direction will the ~~green~~ molecules move?
What is the tonicity of the solution outside the cell?







3.4 Diffusion and Osmosis

Passive transport

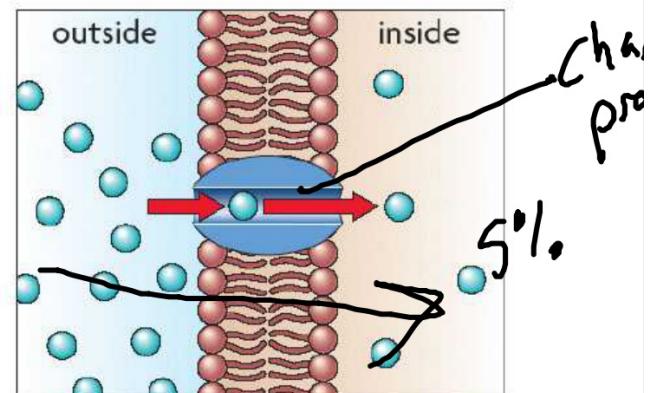
Some molecules can only diffuse through transport proteins.

(Size)

- Some molecules cannot easily diffuse across the cell membrane.
- Facilitated diffusion is diffusion through transport proteins.

Protein channel

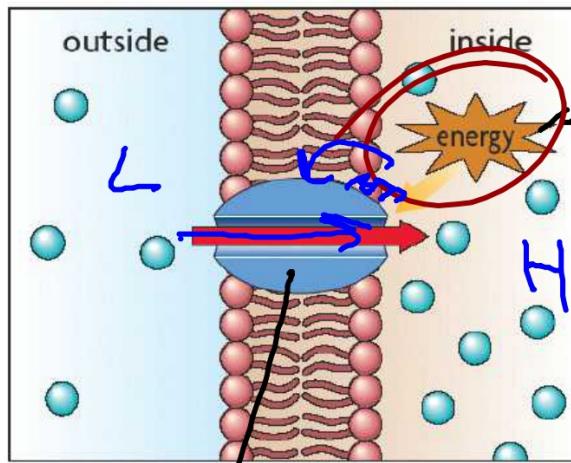
20%



3.5 Active Transport, Endocytosis, and Exocytosis

KEY CONCEPT Cells use energy to transport materials that cannot diffuse across a membrane.

L → H

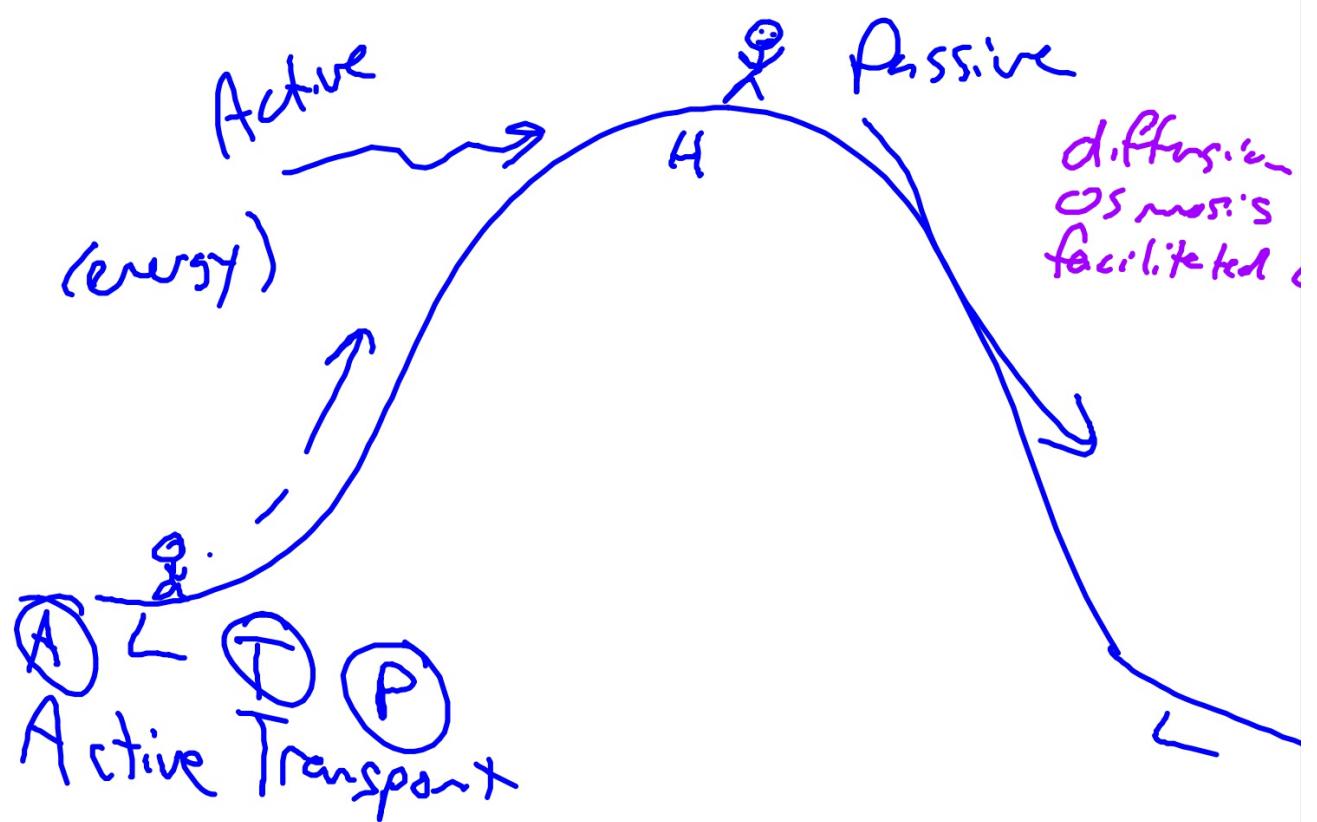


adenosine triphosphate (ATP)

(up)
against conc
grā

low concentration
high concentration

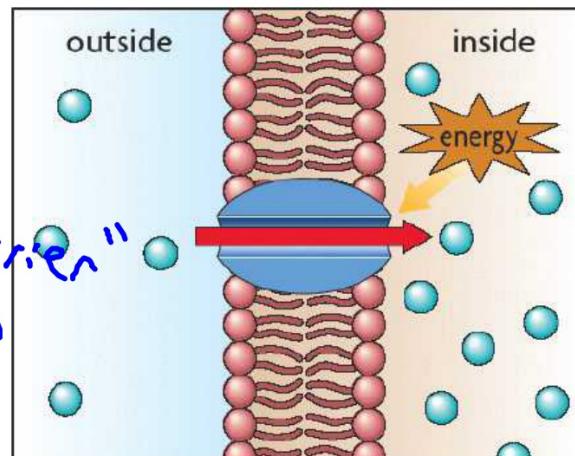
Carrier Protein



3.5 Active Transport, Endocytosis, and Exocytosis

Active transport requires energy input from a cell and enables a cell to move a substance against its concentration gradient. $L \rightarrow H$ (^{up})

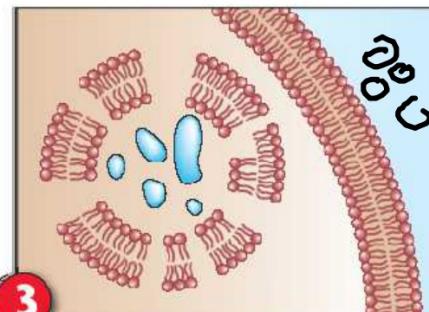
- Passive transport requires no energy from the cell. $H \rightarrow L$
- Active transport is powered by chemical energy (ATP). $L \rightarrow H$
- Active transport occurs through transport protein (pumps). Na^+/K^+ pump
- Cells use active transport to maintain homeostasis.



3.5 Active Transport, Endocytosis, and Exocytosis

A cell can import and export large materials or large amounts of material in vesicles during the processes of endocytosis and exocytosis.

- Cells use energy to transport material in vesicles.
- Endocytosis is the process of taking material into the cell.
- Phagocytosis is a type of endocytosis.



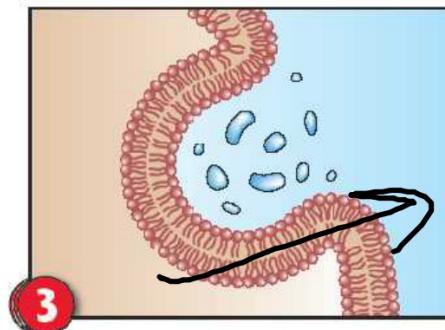
endocytosis -
moves (large)
particles in to
cell

3.5 Active Transport, Endocytosis, and Exocytosis

A cell can import and export large materials or large amounts of material in vesicles during the processes of endocytosis and exocytosis.

• Cells use energy to transport material in vesicles.

• Exocytosis is the process of expelling material from the cell.



3
Exocytosis
(exit)

<u>Passive</u>	<u>Active</u>
no energy required	requires energy
does not need carrier proteins	needs carrier proteins
$H \rightarrow L$ with/down gradient	$L \rightarrow H$ up/against gradient
diffusion osmosis facilitated diff.	endo/exocytosis

