

Transport Across Plasma Membranes

Chapter 1 pg. 24-37

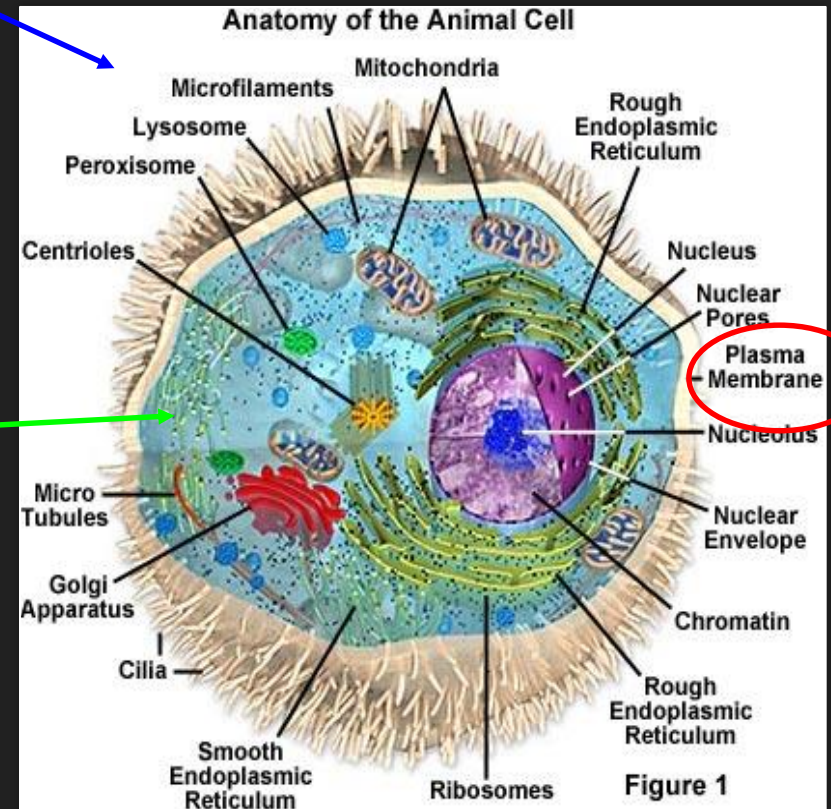
A Cells Environment

External environment

Material outside the plasma membrane

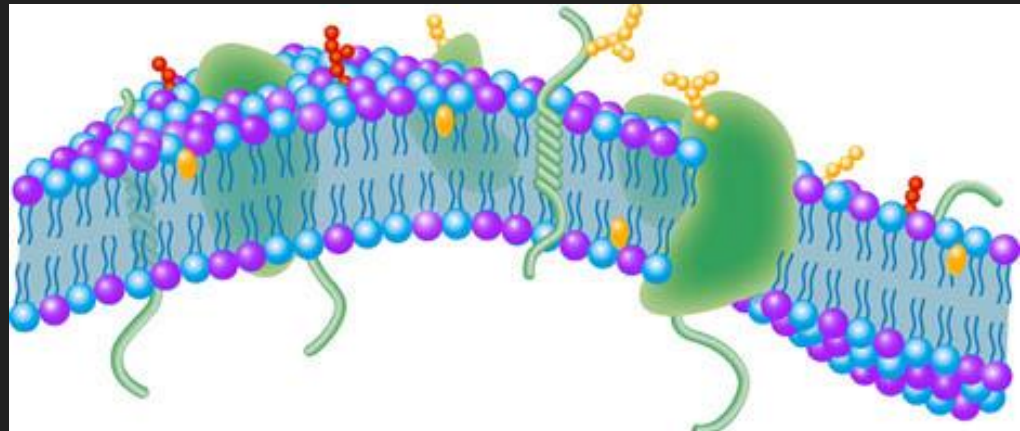
Internal environment

Material inside the plasma membrane



Plasma Membrane overview

- Maintains internal environment of cell by controlling the entry of dissolved substances
- Contains a 'fluid-like' double layer of lipids and embedded proteins (**phospholipid bilayer**)
- Proteins form channels for substance movement over the membrane in each direction, which is known as the **fluid mosaic model**
- Membrane is **semi** or **partially permeable** (*allows some dissolved material to pass through*)
- Various processes are responsible for substance movement over the membrane (*E.g. Diffusion*)

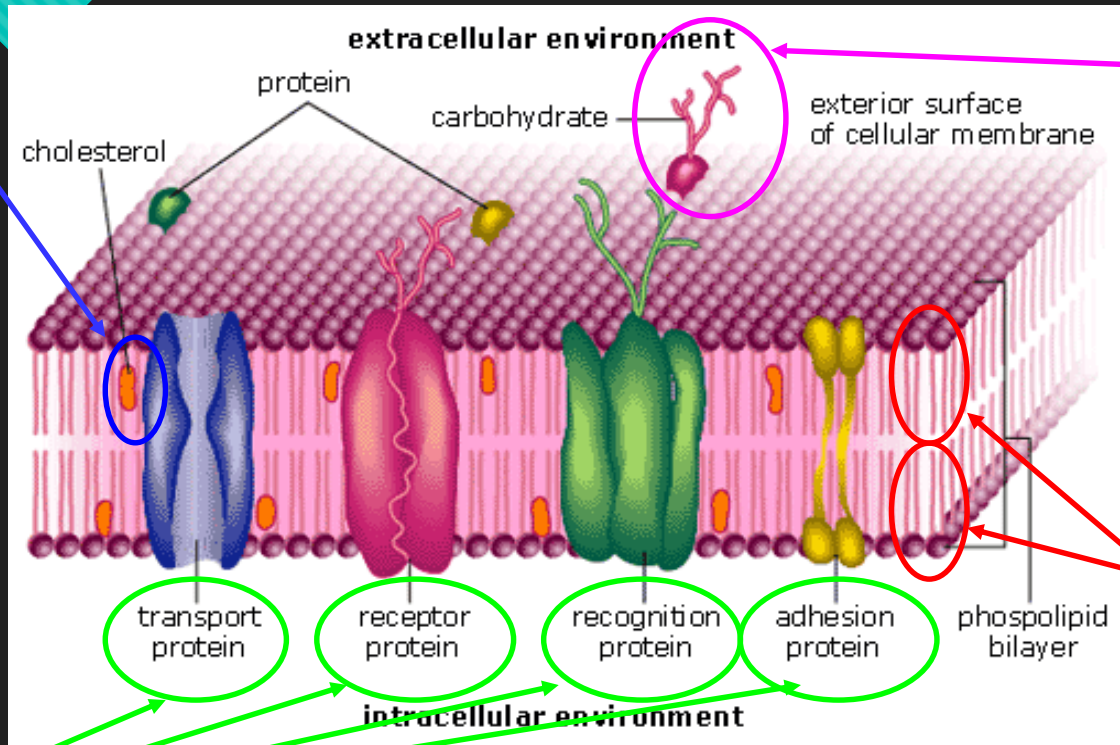


“The active boundary around all living cells that consists of a phospholipid bilayer and associated proteins and which separates the cell contents from their external environment.”

Plasma Membrane – working definition

Structure of Membranes

Cholesterol



Carbohydrates

Lipids (phospholipid)

Proteins

Phospholipid bilayer

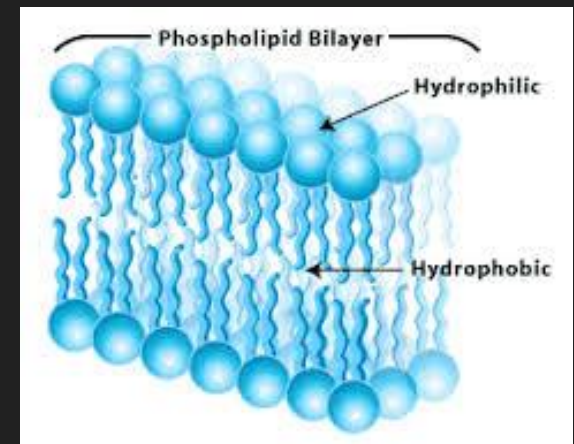
Hydrophilic Vs. Hydrophobic

Hydrophilic 'water loving'

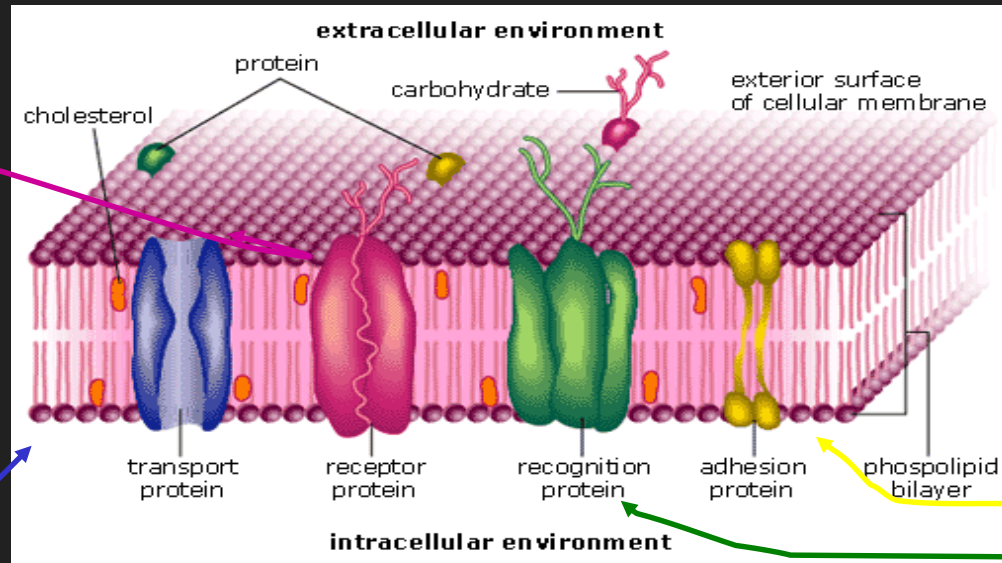
- Substances that dissolve readily in water
- The phosphate group (head) of phospholipid molecules.

Hydrophobic or Lipophilic

- Substances that have low water solubility, or do not dissolve in water
- The fatty acid end (tail) of phospholipid molecules is made up of two strings of carbon and hydrogen atoms.



Membrane Proteins



Transport protein: allow substances to pass into and out of cell

Receptor protein: binds substances which cause changes in the cell, e.g. hormones

Recognition proteins: binds with carbohydrate to form an glycoprotein which acts as 'self' markers so body can distinguish between 'self' and 'non-self'

Adhesion proteins: act as a link between cells, allowing them to stick together

Have you been paying attention?

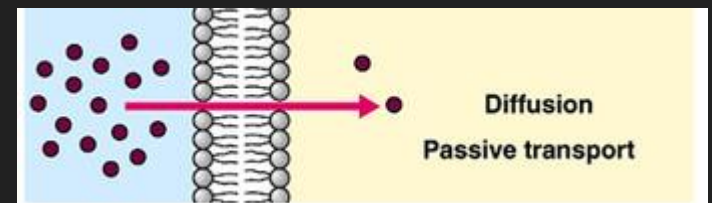
1. What are the two major components of a plasma membrane?
2. What part of the plasma membrane is responsible for its flexibility?
3. Is the plasma membrane impermeable, selectively permeable, or fully permeable?
4. What is the role of transport proteins?

Moving through Membranes

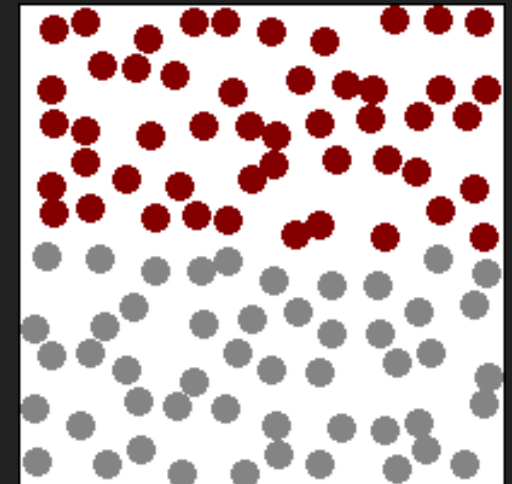
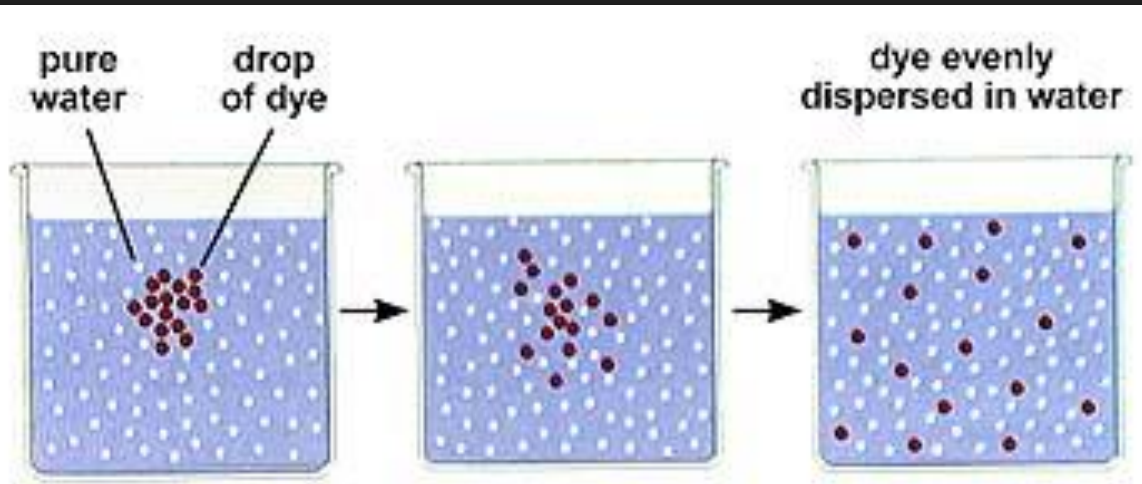
- Diffusion
- Osmosis
- Active Transport
- Endocytosis
- Exocytosis



Simple Diffusion



- The **net movement** of particles from a region of high concentration to a region of low concentration.
- The difference in concentration is known as the **concentration gradient**. This always takes place wherever a gradient exists until **equilibrium** is reached.
- Diffusion is a passive movement (does not require energy) Only O_2 , CO_2 , H_2O and small uncharged particles move via this way
- High concentration, temperature, size of molecule and medium affect the speed of diffusion



Osmosis

- Is the diffusion of **water** into or out of cell
- It is defined as the:

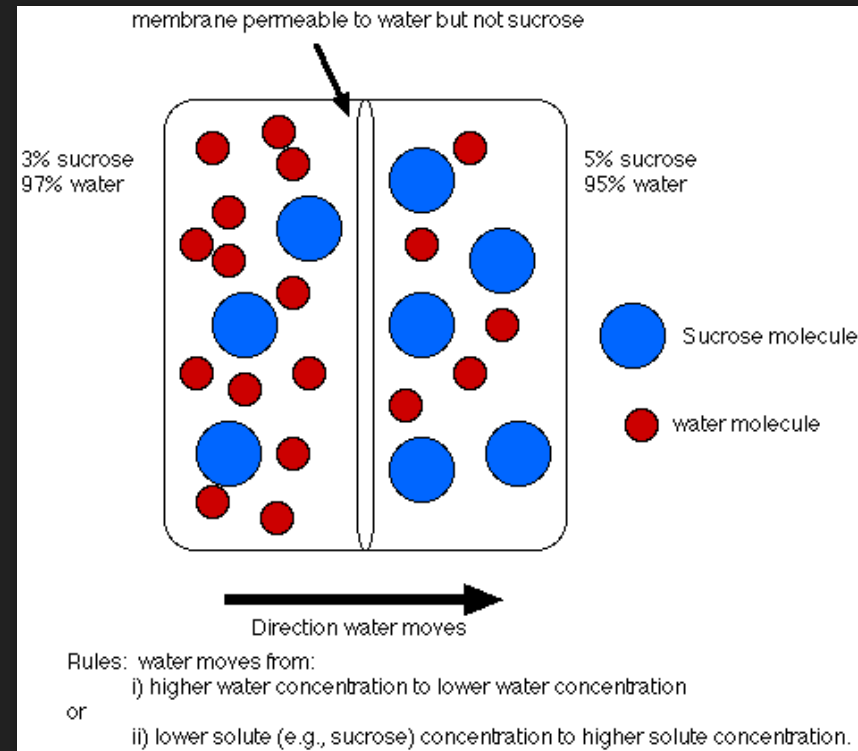
“Net movement of a water (solvent) from a region of low solute concentration to high solute concentration across a differentially permeable membrane”*

Low solute (high H₂O, low **solute***) to high solute (low H₂O, high solute)

- Requires no energy
- H₂O moves to balance out solution concentrations.

* **Solvent**: a substance in which other substances can dissolve

* **Solute**: a substance that dissolves in a solvent



Osmosis Continued

There are three types of solutions:

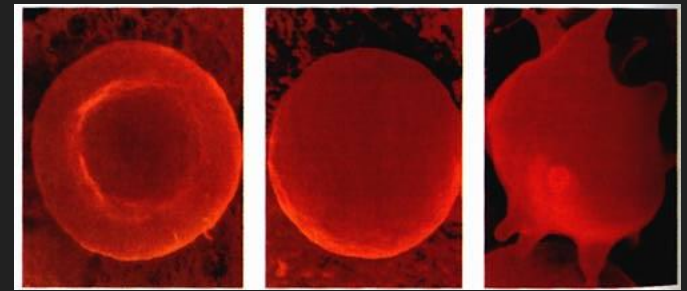
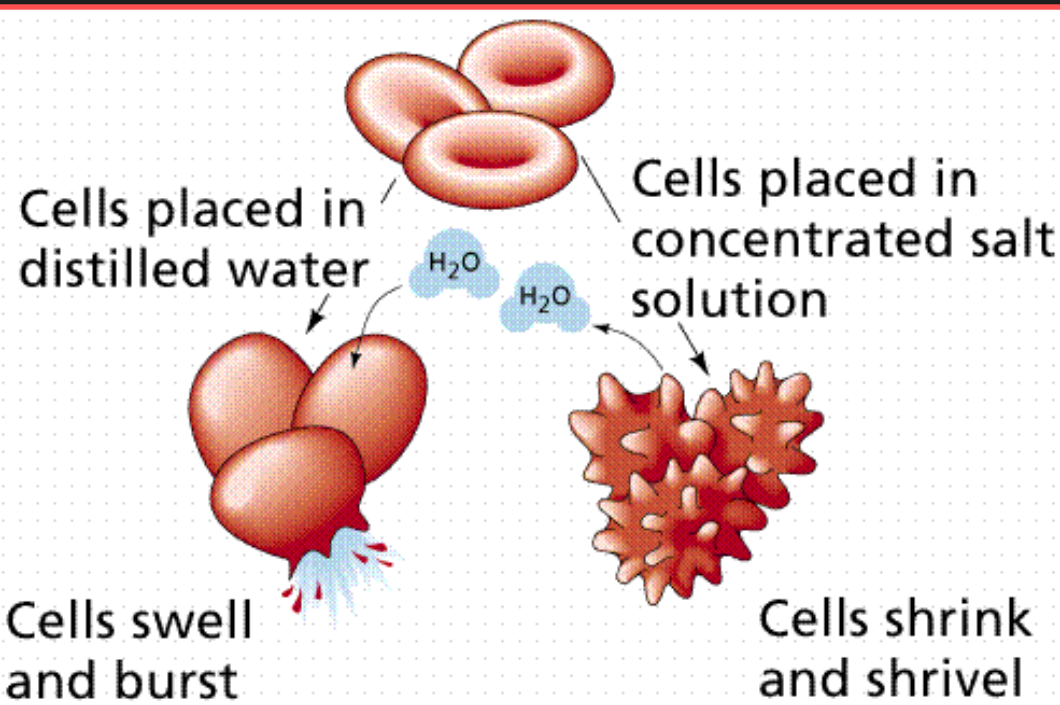
Hypotonic - Solution concentration outside is lower than inside.
Water moves in

Isotonic - solution concentration inside and outside of cell are equal. No net movement of water. Cell stays the same size.

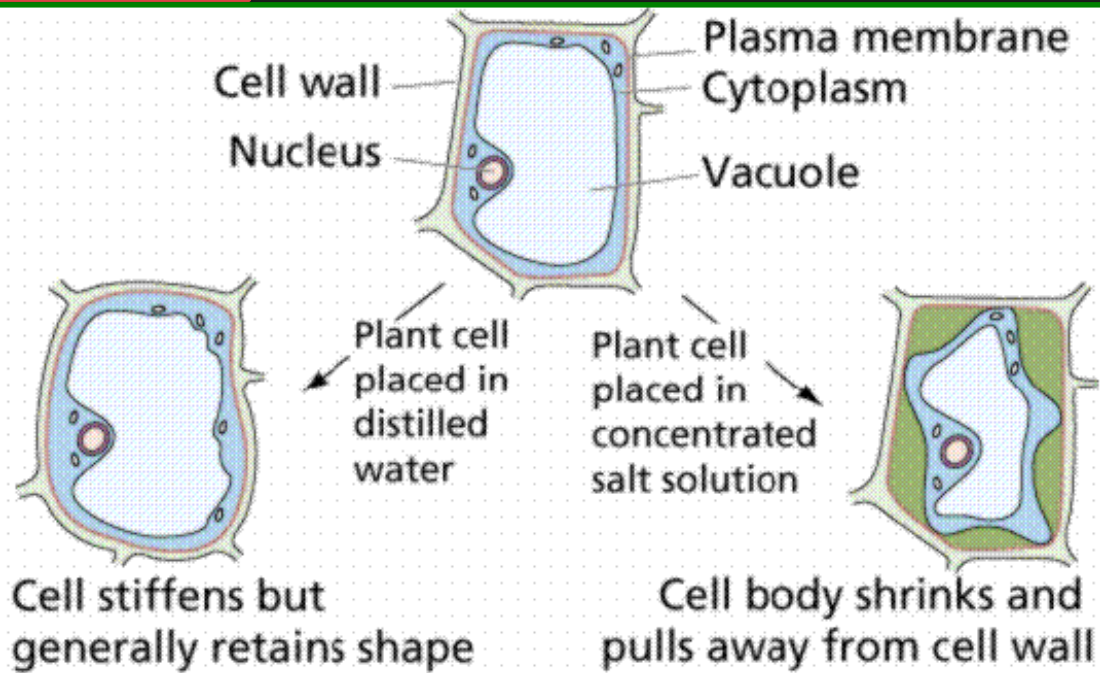
Hypertonic - Solution concentration outside is higher than inside
water moves out

Plant and animal cells have different reactions to these concentrations.
Prokaryotes have contractile vacuoles to pump out water

Animal cells



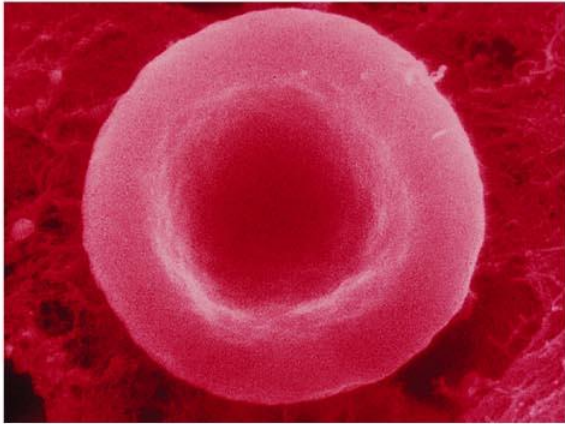
Plant cells



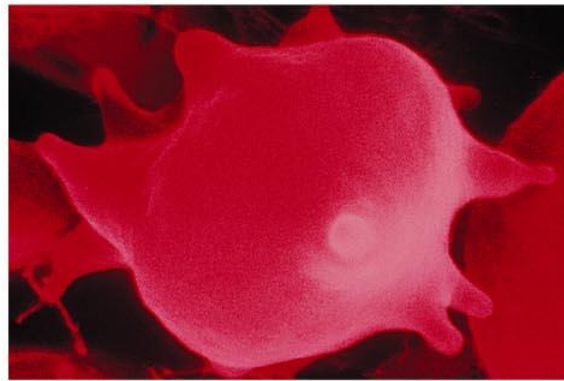
Have you been paying attention?

What category of saline solution is each red blood cell in?

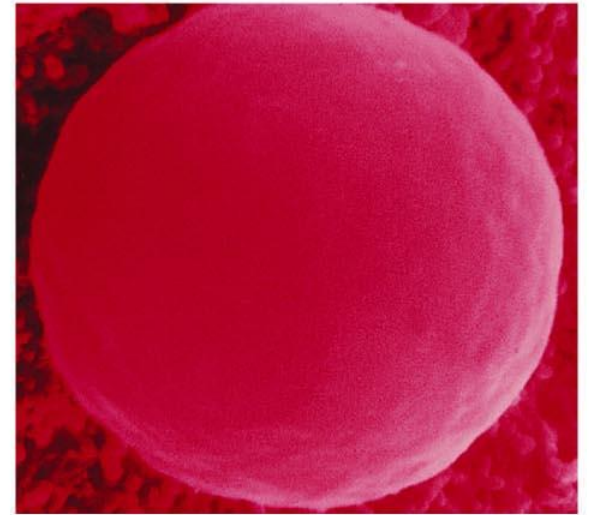
Saline is NaCl solution used in intravenous drips. It is an isotonic solution when compared with our blood.



(a)



(b)

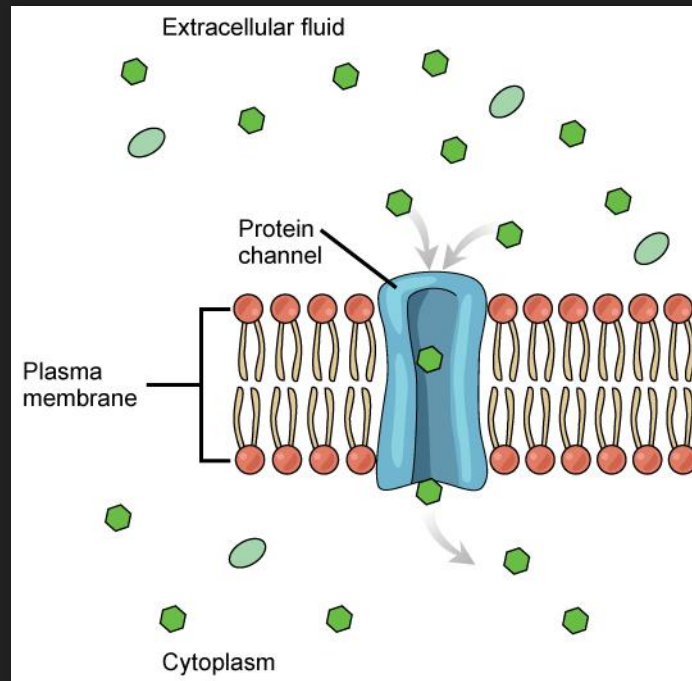


(c)

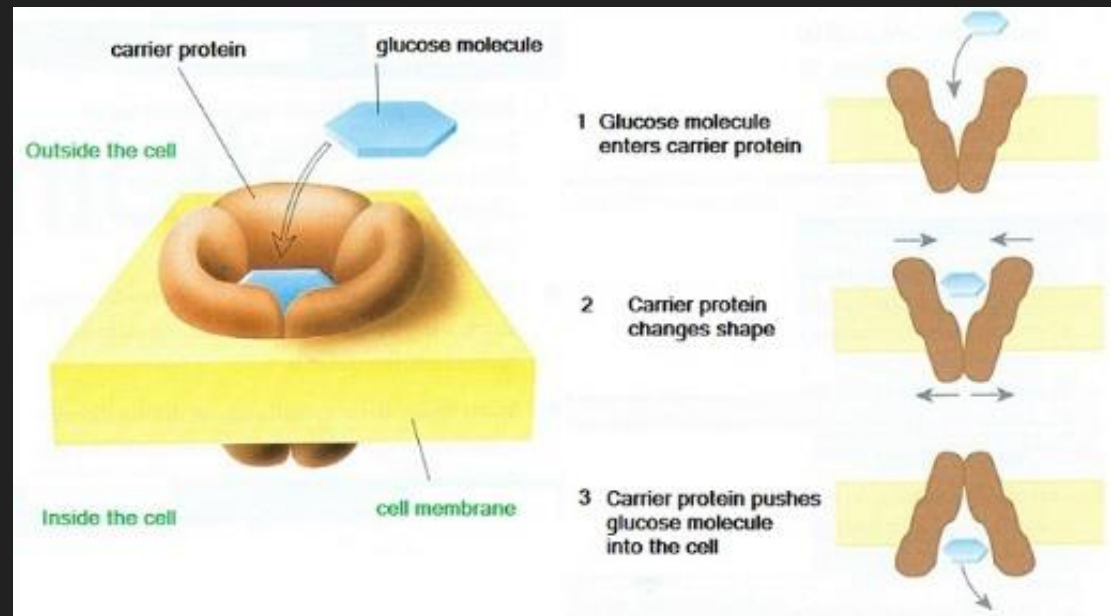
Facilitated Diffusion

- This allows larger molecules such as glucose, and charged particles such as sodium and chloride ions to move through the membrane.
- In order to do this they need a bit of help from channel proteins and carrier proteins.
- **Carrier proteins**
 - bind to specific molecules or ions on one side of the membrane, change shape and release the particular molecule or ion on the other side of the membrane.
- **Channel proteins**
 - allow small ions to diffuse rapidly from a **high concentration to a low concentration** through the plasma membrane.
- A concentration gradient must exist.
- Facilitated diffusion does not require energy.

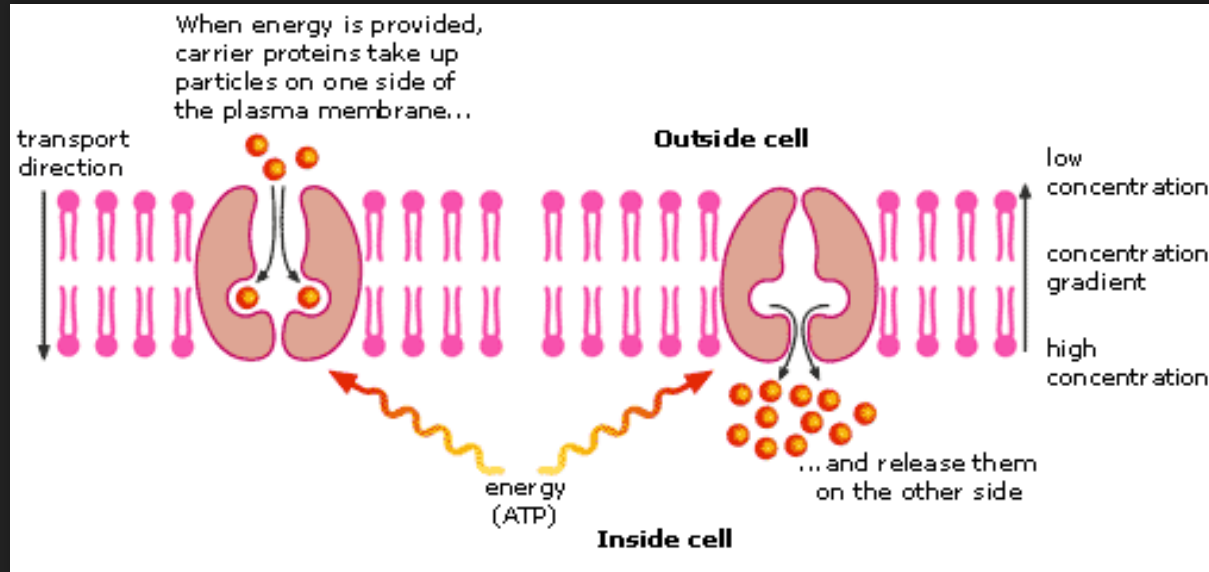
Channel Protein



Carrier Protein

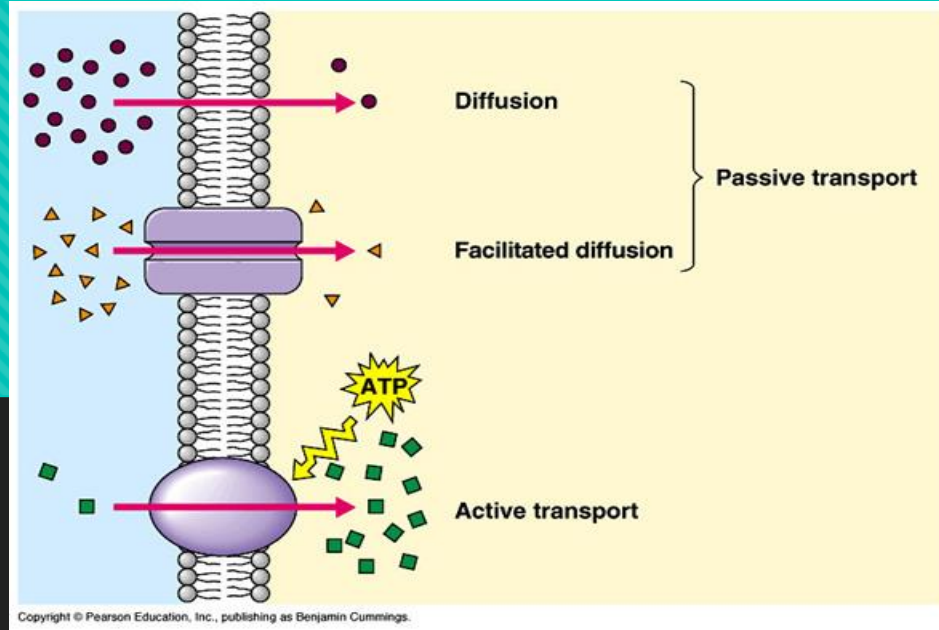


Active Transport



- The movement of molecules or ions *against* a concentration gradient, and thus a **region of low concentration to a region of high concentration**.
- Requires energy (ATP) for molecules or ions to move against the concentration gradient
- Involves **pumps** which transport specific substances. These have a transport function and an enzyme function to speed up the energy releasing reaction.
- Only works in one direction.
- Molecules transported this way include: glucose, cell waste, potassium, sodium, vitamins amino acids

Summary



	Diffusion	Osmosis	Active transport
Down a concentration gradient	✓	✓	X
Against a concentration gradient	X	X	✓
Energy needed	X	X	✓
Substance moved	Dissolved solutes	Water	Dissolved solutes
Notes	Gases also diffuse	Partially permeable membrane needed	Carrier protein needed

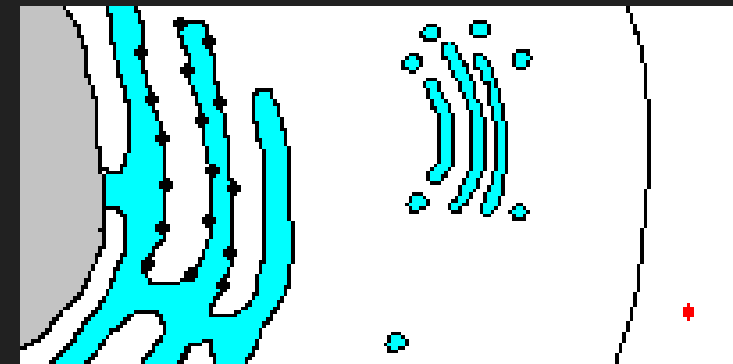
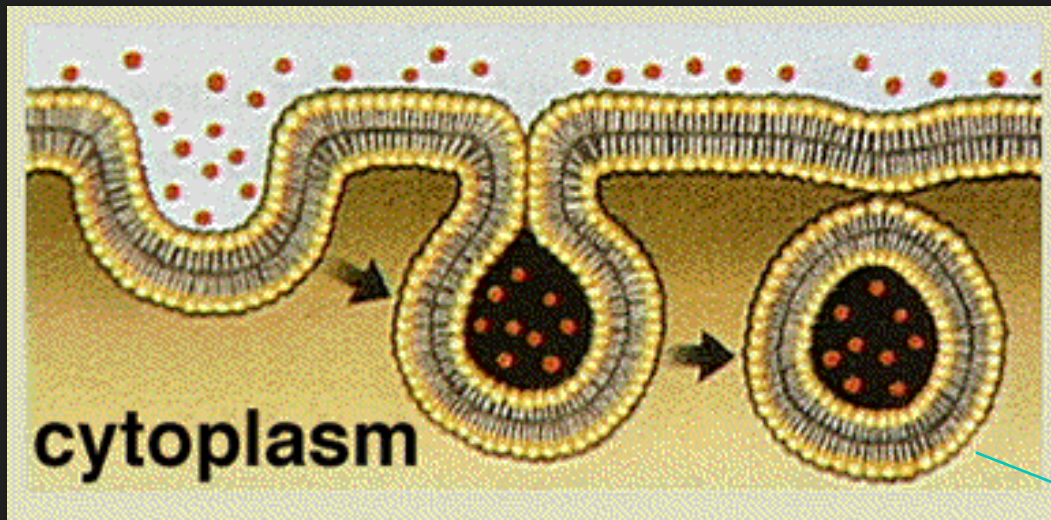
Bulk Transport

- This involves the movement of large molecules across membranes via **endocytosis** and **exocytosis**

Endocytosis

(en = enter)

- Movement of large molecules **into** a cell
- Two types:
 - Phagocytosis: moving solid material
 - Pinocytosis: moving liquid material



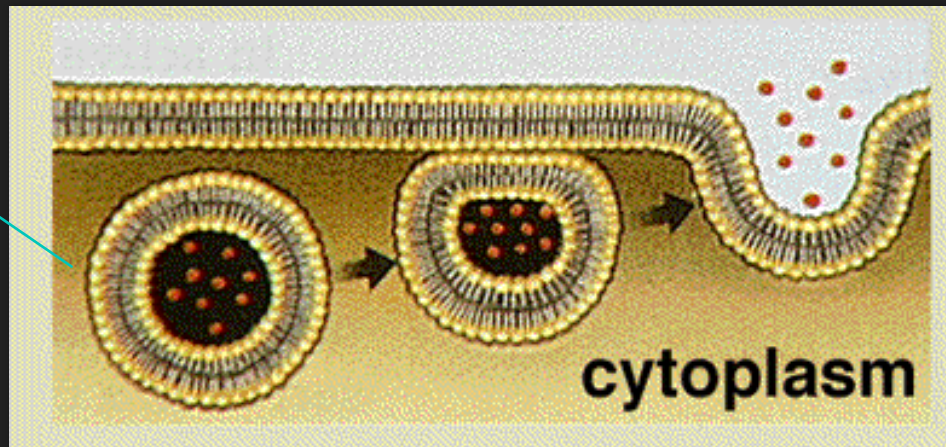
Membrane-bound vesicle

Exocytosis

(ex = exit)

- Movement of large molecules **out** of a cell
- This process moves molecules such as enzymes, hormones, antibodies, and building materials of cells (which often come from the golgi apparatus)

Membrane-bound vesicle



Have you been paying attention?

1. What is the process whereby bulk materials are exported out of the cell?
2. Identify one difference between diffusion and active transport
3. By which process do cells of the stomach lining manage to move hydrogen ions out of the cells to produce a highly acidic gastric secretion?
4. Give two factors that can increase the rate of diffusion.
5. If salad greens such as lettuce are left for a period of time, they become limp. To restore their crispiness they can be soaked in cold water. Explain the reason for this.

Websites

Diffusion

http://www.wisc-online.com/objects/index_tj.asp?objid=AP1903

http://cpr.molsci.ucla.edu/cpr/cpr_info/rsc_preview.asp?aid=400233&rid=res003&e=e

Osmosis

http://www.wisc-online.com/objects/index_tj.asp?objID=AP11003

Active Transport – Endocytosis and Exocytosis

http://www.wisc-online.com/objects/index_tj.asp?objID=AP11203

Homework

- Recap q.3 pg.23
- Recap q.2 pg.27
- Recap q.3 pg.30
- Recap q.3 pg.37
- Chapter Review q.2,5,8,12,13,18,29 pg.44-46