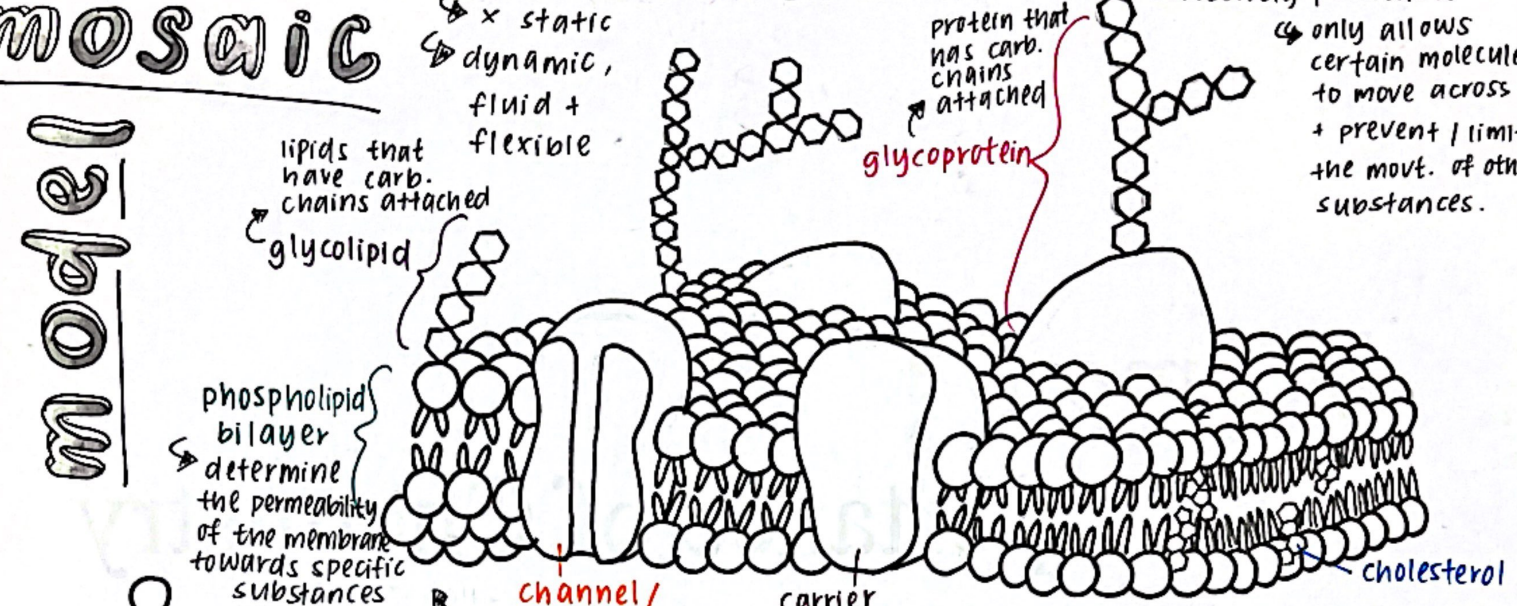
structure of plasma membrane

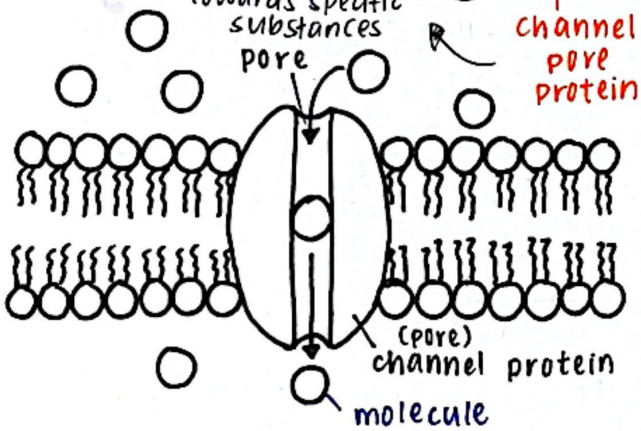
fluid mosaic

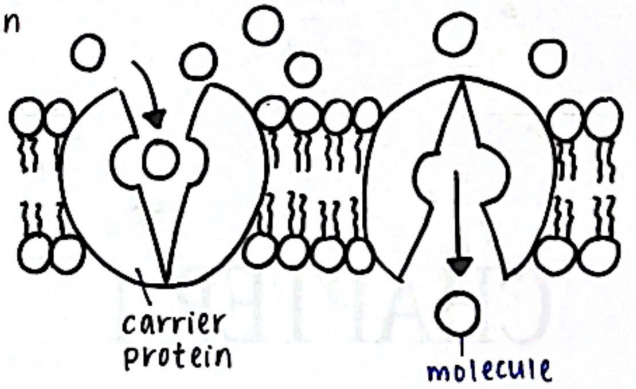
- ↳ semi-permeable / partially permeable / selectively permeable
  - ↳ only allows certain molecules to move across it + prevent / limit the movt. of other substances.

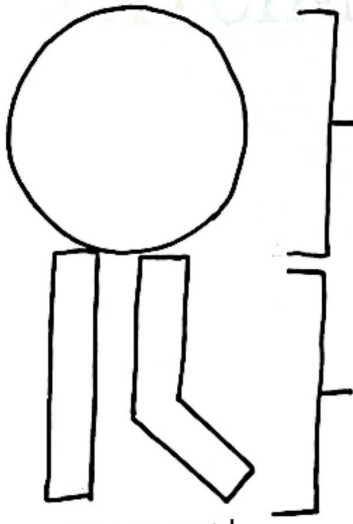
- ↳ x static
- ↳ dynamic, fluid + flexible

fluid









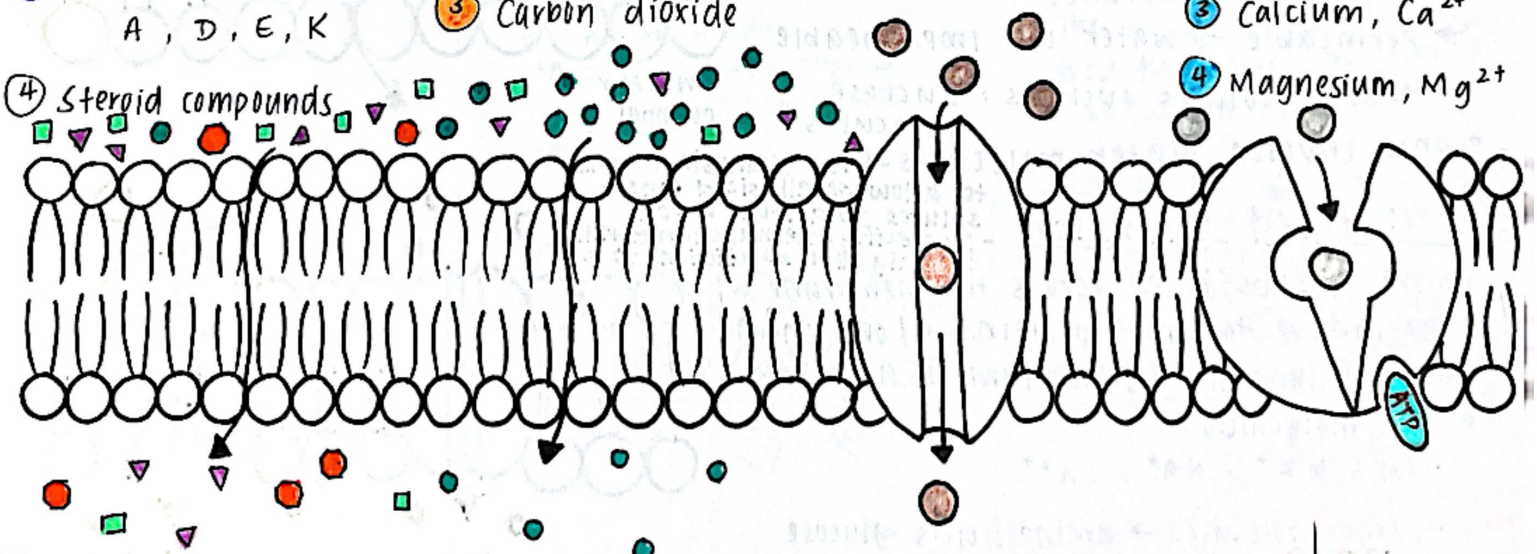
- glycoprotein + glycolipid
  - ↳ receptors to hormones : insulin
  - ↳ stabilise the membrane by forming hydrogen bonds w/ H_2O
  - ↳ act as antigens for cell identification.
- Cholesterols
  - ↳ found btw the phospholipid molecules
  - ↳ make the phospholipid bilayer stronger, more flexible + less permeable to water-soluble substances : ions

concept of movement of substances across a plasma membrane

characteristics of movt. of substances across a plasma membrane

3 factors:
1. molecule size
2. polar molecule
3. ionic charge

- able to move across plasma membrane
  - Lipid soluble substances
    1. Fatty acids
    2. Glycerol
    3. Fat soluble vitamin : A , D , E , K
    4. Steroid compounds
  - uncharged small molecules
    1. water molecules
    2. oxygen
    3. Carbon dioxide
- unable to move across plasma membrane
  - Large molecules
    1. Glucose
    2. amino acids
  - charged ions
    1. Sodium , Na^+
    2. Potassium , K^+
    3. Calcium , Ca^{2+}
    4. Magnesium , Mg^{2+}



simple diffusion

osmosis

facilitated diffusion

active transport

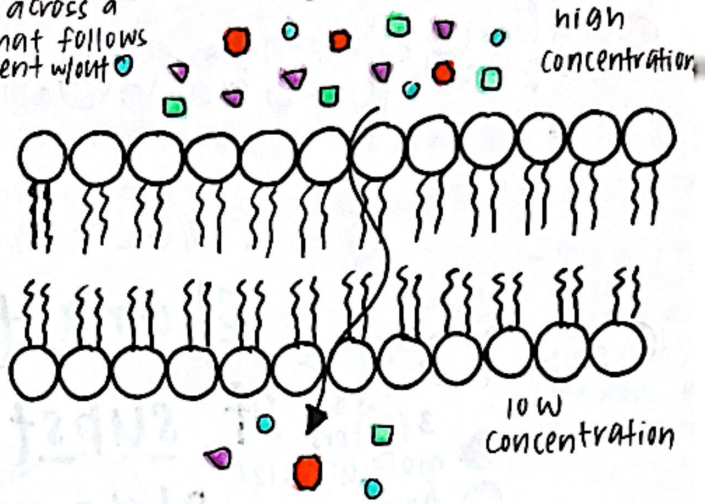
passive transport

passive transport

↳ movt. of substances across a plasma membrane that follows the concentration gradient w/out energy by the cell

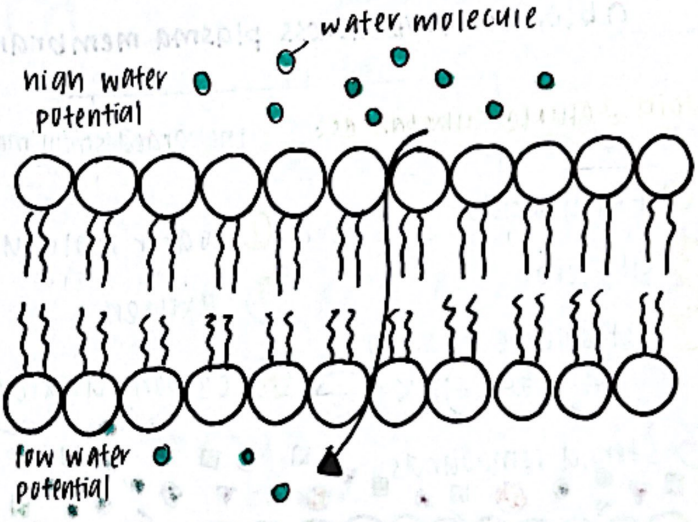
① Simple diffusion

- movt of molecules / ion from an area of high concentration to an area of low concentration until a dynamic equilibrium is achieved
- may occur w/ or w/out plasma membrane
- exp molecules that diffuse thru phospholipid bilayer thru simple diffusion:
  - lipid soluble molecules
    - ↳ fatty acids
    - ↳ glycerol
  - oxygen
  - carbon dioxide



② Osmosis → thru phospholipid bilayer

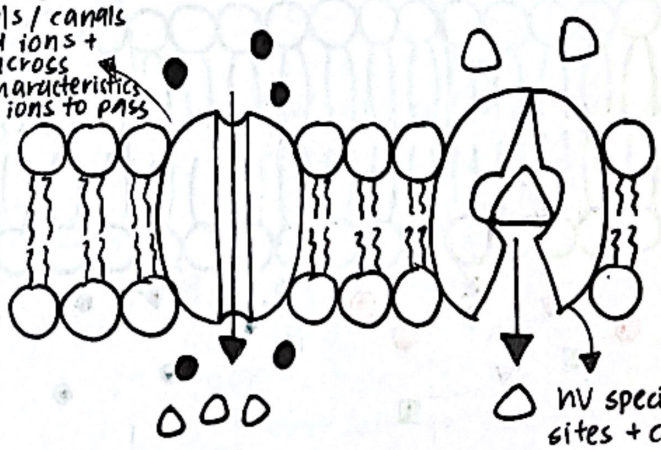
- net movt. of water molecules from an area of high water concentration / low solutes concentration to an area of low water concentration / high solutes concentration thru a selectively permeable membrane.
  - ↳ permeable to water but impermeable to some solutes such as: sucrose molecules
- only involve water molecules



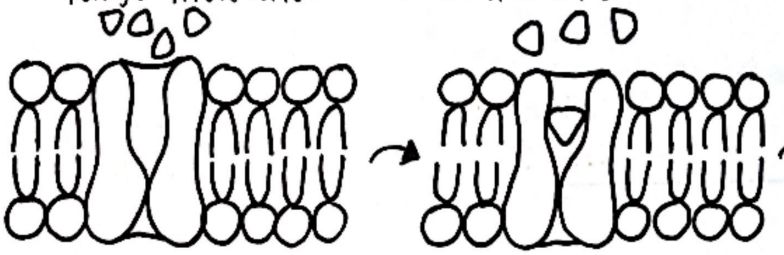
③ Facilitated diffusion

- movt of substances across the membrane w/ the aid of transport proteins w/ out energy until a dynamic equilibrium is achieved
- exp molecules:
  - ions → K^+, Na^+, Ca^{2+}
  - large molecules → amino acids, glucose

- form channels / canals to allow small-sized ions + solutes to diffuse across
- hv specific internal characteristics that only allow specific ions to pass



hv specific sites + can only bind to a specific molecule.
↳ glucose
↓
glucose carrier protein

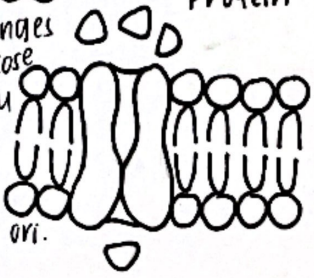


Extracellular glucose concentrations are higher than cytoplasm.

Glucose binds w/ specific site of the protein.

carrier protein changes shape to allow glucose molecules to pass thru the protein + enter the cell.

carrier protein returns to their ori. shape



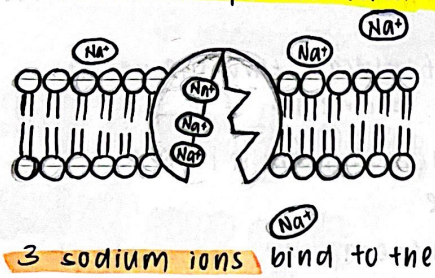
active transport

↳ results in the accumulation / excretion of molecules / ions in the cell
↳ carrier proteins involved are known as pumps

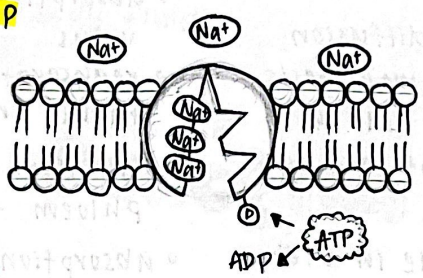
Characteristics

- movt of molecule / ion substances across a plasma membrane occurs against the concentration gradient
- requires energy from ATP (adenosine triphosphate) molecules generated during cellular respiration
- requires specific carrier protein with specific sites to bind w/ certain molecules / ions
- carrier proteins possess receptors to bind w/ ATP molecules
- carrier proteins change shape when a phosphate group attaches to it

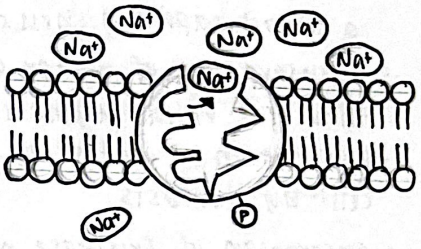
1) Sodium-potassium pump



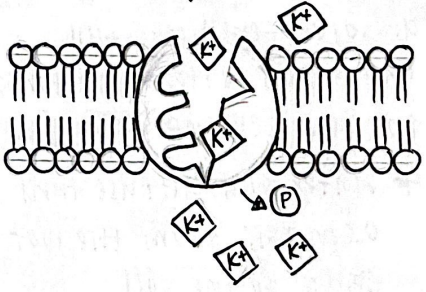
3 sodium ions bind to the carrier protein.



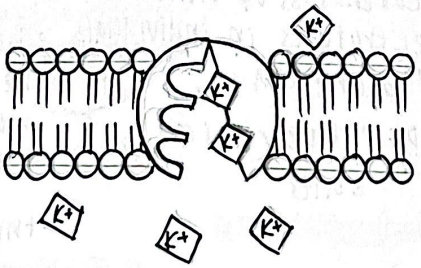
ATP molecules (adenosine triphosphate) decompose inz ADP (adenosine diphosphate) and P (phosphate)
↳ bound to the carrier protein.



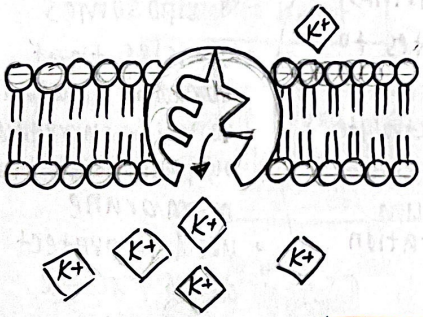
Phosphate bond provides energy + changes the shape of the carrier protein
The sodium ion is transported thru the carrier protein out of a cell.



2 potassium ions from outside the cell bind w/ a carrier protein. The phosphate group leaves the carrier protein.



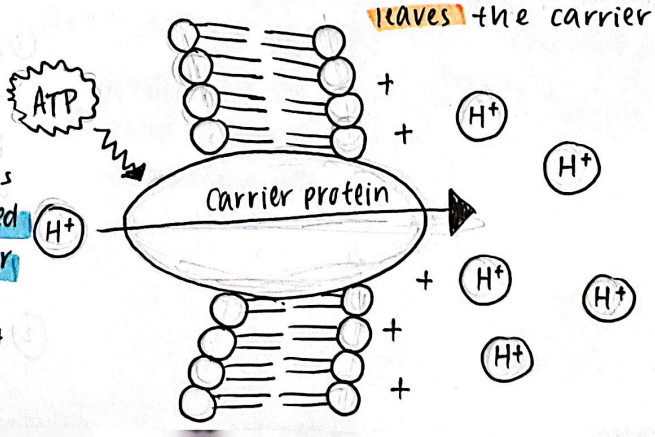
The loss of the phosphate group restores the og shape of the carrier protein.



Potassium ion is transported thru the carrier protein inz the cell.

2) Proton pump

- found on the epithelial cells lining the stomach cavity
- causes the acidity of the stomach contents
- ATP enables hydrogen ion to be transported by carrier proteins towards the extracellular fluid
  ↳ causes accumulation of hydrogen ion + acid production



Energy is × required

occurs following the concentration of the gradient

Moving a substance across a membrane

requires energy

occurs against the concentration of the gradient

passive

occurs until ~~thru~~ a ~~set~~ dynamic equilibrium is achieved

occurs thru a selectively permeable membrane

- gaseous exchange btw an alveolus + a blood capillary thru simple diffusion
- reabsorption of water occurs by osmosis thru the renal tuble in the kidney
- absorption of water by a plant root hair cell by osmosis
- absorption of fructose molecule in the villus by facilitated diffusion

active

there are accumulation + disposal of molecules or ions

- absorption of glucose + amino acids in the villus
- reabsorption of glucose thru the renal tubule in the kidney
- transport of sucrose from a leaf to a phloem tissue
- absorption of mineral ions by a plant root hair cell

application in daily life

Plant wilting

- excessive use of fertilisers
- dissolve fertilisers will cause soil water hypertonic to the cell sap of roots.
  - water will diffuse thru osmosis from the root cells to the soil
    - cells become plasmolysed
- prolonged plasmolysis will cause death of plant

rehydration drinks

- recover loss of water + electrolytes in individuals w/ diarrhoea
- exp: rehydration salts

Isotonic drinks

- help athletes to recover loss of water + electrolytes
  - exp: · potassium · sodium thru perspiration

Saline solution

- normally used in med.
- isotonic solution to blood plasma
- 0.85g - 0.90g NaCl per 100 ml

Liposomes

- vesicles that contain aqueous solution surrounded by phospholipid bilayer membrane
- used to protect drugs / active substances taken orally be destroyed by gastric juice
  - drugs can reach target cell

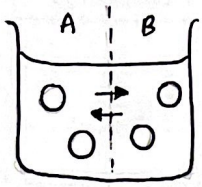
Reverse osmosis

- extract fresh water from seawater using desalination process

① pressure is applied to push the seawater thru a semi-permeable membrane
  - allows water molecule to pass, but × foreign particles, salt + microorganisms

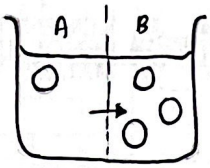
② only pure fresh water is released

isotonic, hypotonic and hypertonic solution



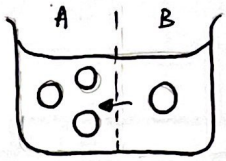
Isotonic solution

- solution A + B hv the same concentrations of solutions
- solutions A ~~are~~ + B are isotonic toward each other. x net movt of water.



hypotonic solution

- solution A has a low solutes concentration + high water concentration / potential
- solution A is hypotonic to solution B. water diffuses from A to B thru osmosis



hypertonic solution

- solution A has a high solutes concentration + low water potential concentration
- solution A is hypertonic to B. water diffuses from solution B to A via osmosis

effects on animal cells

hypotonic solution

- water will diffuse ~~out~~ into ~~of~~ the cell by osmosis, causing the cell to swell + burst
  - plasma membrane is too thin to withstand the osmotic pressure built up in the cell
  - haemolysis

isotonic solution

- water diffuses in + out of the cell at the same rate
- x net movt of water across the plasma membrane
- cell remain its biconcave disc shape / normal shape

hypertonic solution

- water diffuses out of the cell via osmosis
- cell will shrink → crenation

effects on plant cells

hypotonic solution

- water diffuses in2 the cell via osmosis
- vacuoles expand + push the cytoplasm + plasma membrane against the cell wall
  - become turgid
- x burst → cell wall is rigid + strong
- turgo pressure → gives support → maintains the shape
- turgidity → allow stomata to remain open for photosyn.

isotonic solution

- water potential is the same
- water diffuses in + out of the cell at the same rate
- cell becomes flaccid

hypertonic solution

- water diffuses out of the cell
- cytoplasm shrinks + plasma membrane is pulled away from the cell wall
  - plasmolysis
    - plant stems + leaves bend downward + wilt
- can regain turgidity if are returned to a hypotonic solution immediately
  - deplasmolysis