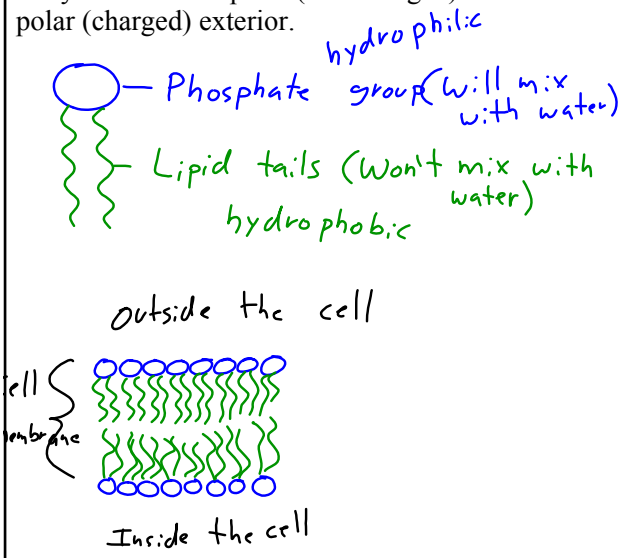
The Cell Membrane p.52

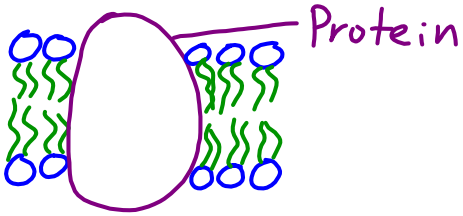
- All cells have membranes.

- **Fluid mosaic model** – Cell membranes are made up of several different types of molecules, most of which can move within the membrane.
- The cell membrane contains:
  1. **Phospholipid bilayer** – The bulk of the membrane is made of two layers of molecules. They create a non-polar (non-charged) interior and polar (charged) exterior.

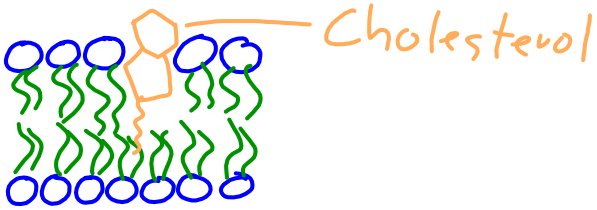


The Cell Membrane

2. **Proteins** – These can be used for support of the membrane, attachment of the cell to other cells, or as transport channels for other molecules.

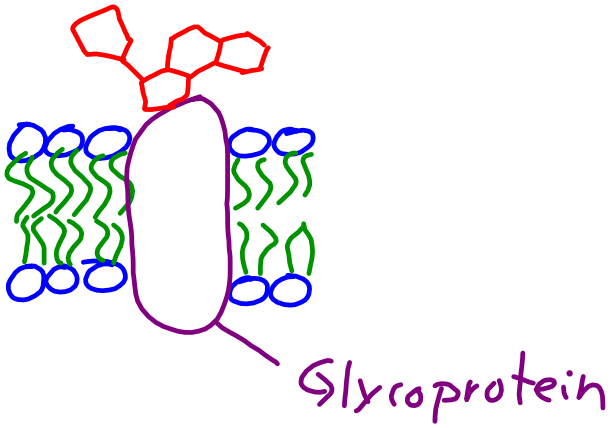


3. **Cholesterol** – Helps keep the phospholipids from sticking together at low temperatures and from moving too far apart at high temperatures.



The Cell Membrane

4. **Glycoproteins** – Proteins with carbohydrates attached. These are used for identification of cells by other cells. E.g. antibodies.



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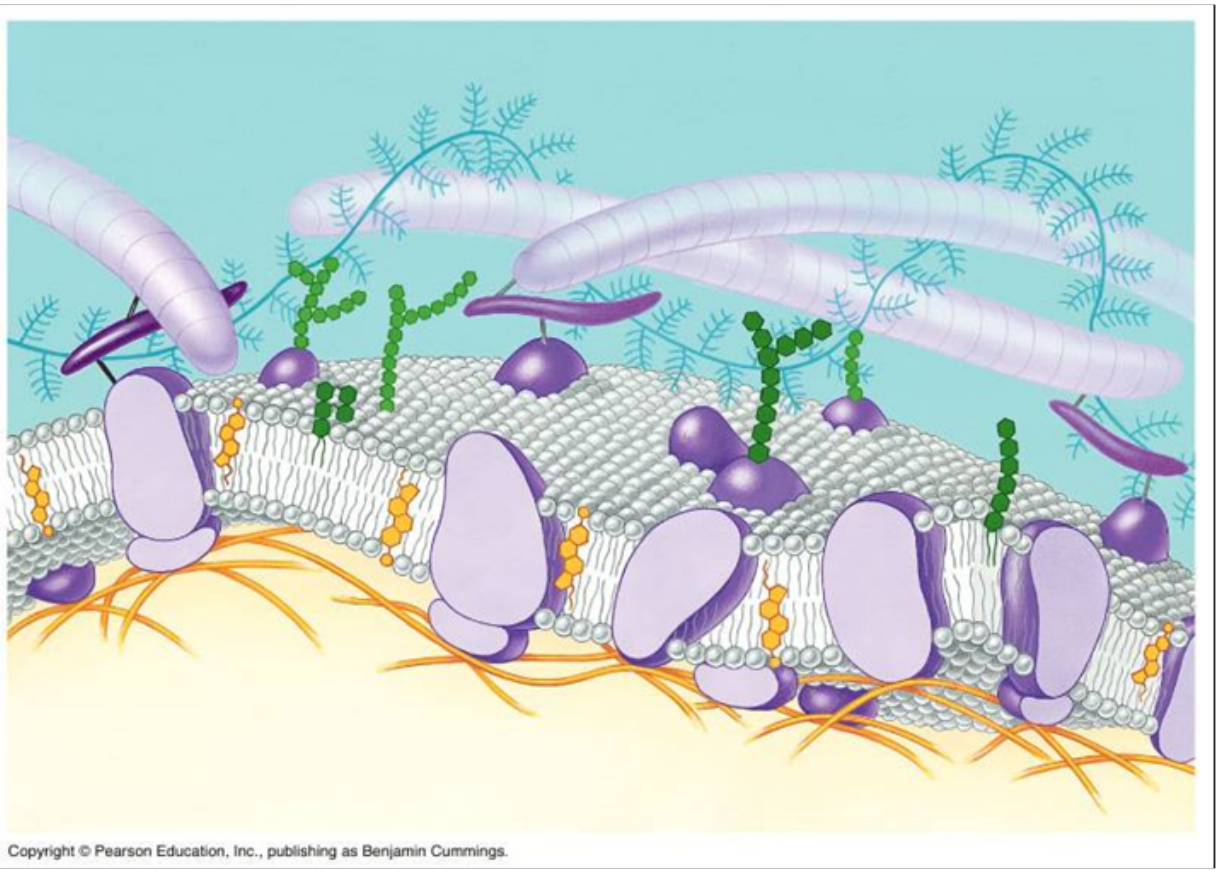

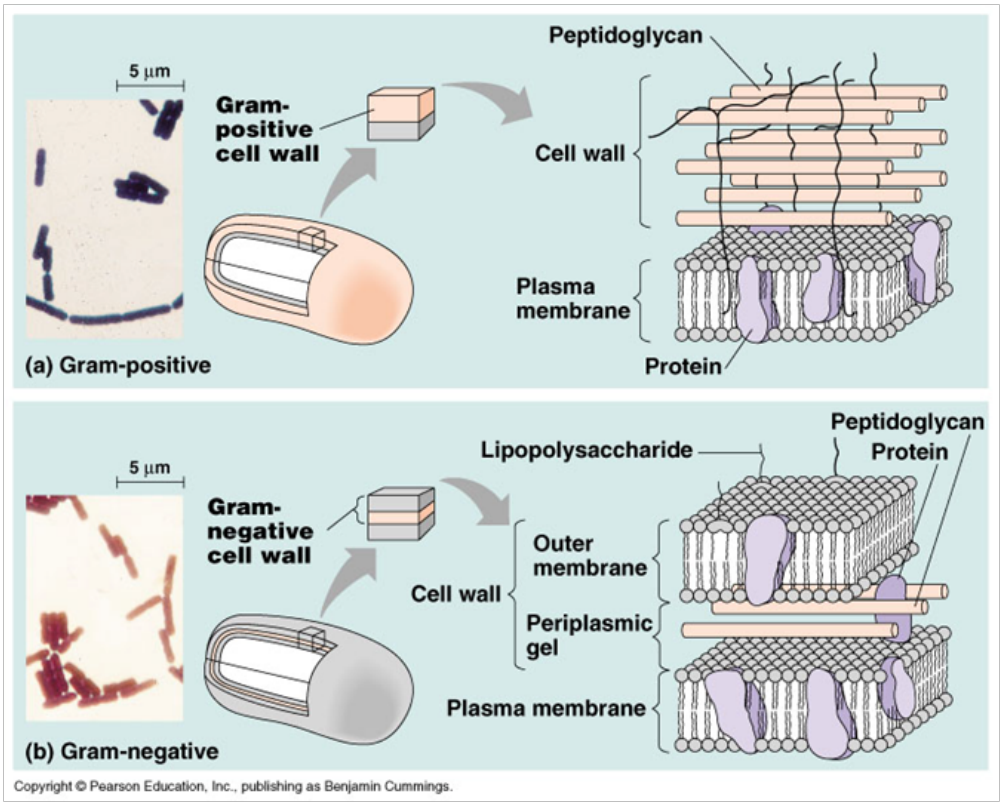

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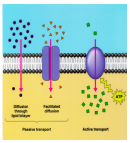


Cell Transport p.53-64

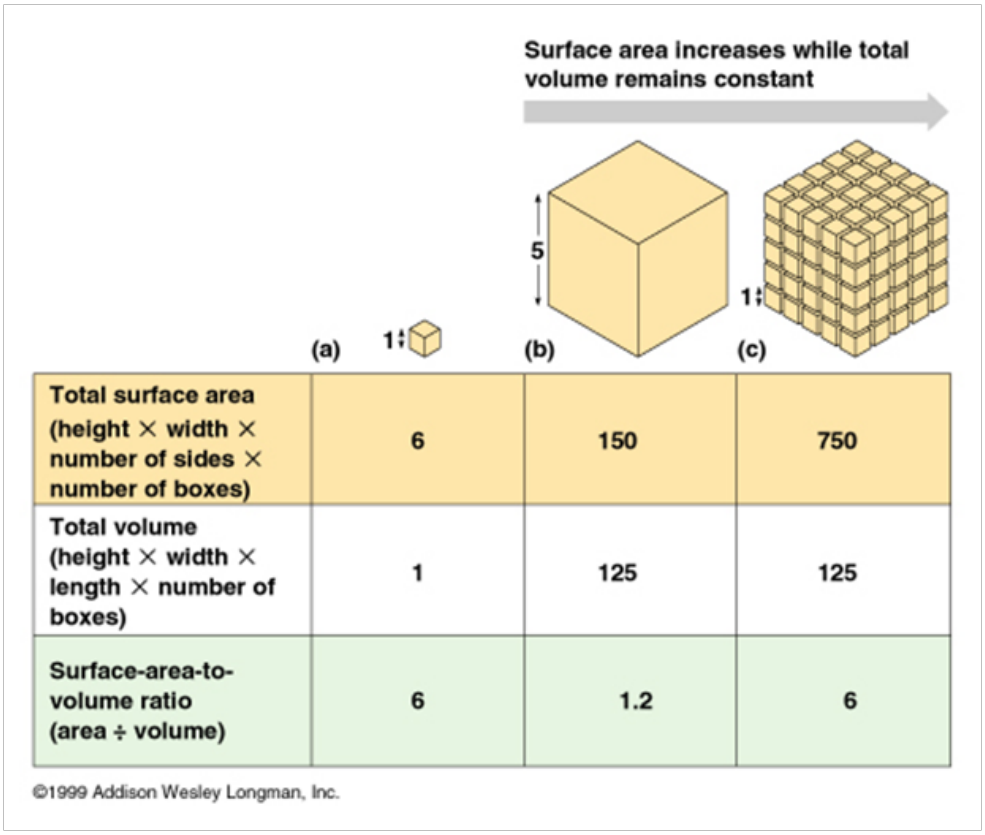
- Cells need to transport materials into the cell and wastes have to be removed.
- All transport is done through the cell membrane (their surface area).

- Cells therefore need a **lot of surface area**.

- The greater the volume of the cell the slower materials will move to its center and the slower wastes can be removed.

- Cells therefore need to have a **small volume**.

- These two factors are looked at together in the **surface area/volume ratio**, which needs to be as large as possible.

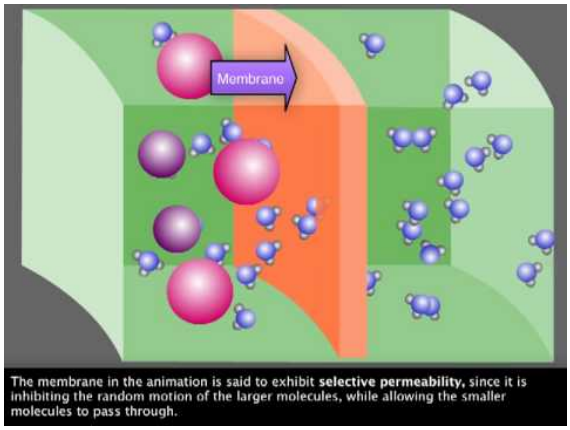


Total surface area (height × width × number of sides × number of boxes)	6	150	750
Total volume (height × width × length × number of boxes)	1	125	125
Surface-area-to-volume ratio (area ÷ volume)	6	1.2	6

Cell Transport

- The cell membrane is **selectively permeable** (similar to a window with a screen).

- It has several mechanisms to allow only selected small molecules and ions into the cell.



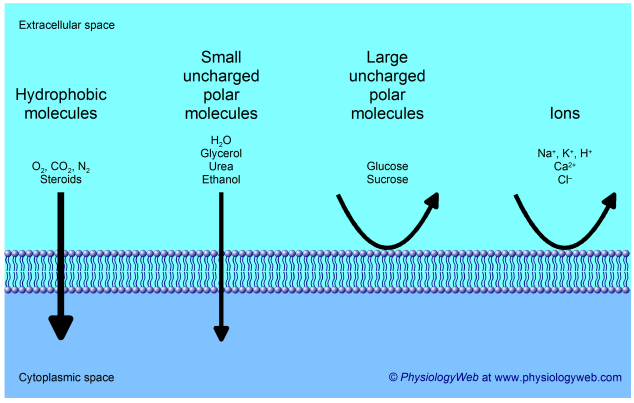
The membrane in the animation is said to exhibit **selective permeability,** since it is inhibiting the random motion of the larger molecules, while allowing the smaller molecules to pass through.

1. **Permeability of the lipid bilayer**

- Hydrophobic core excludes ions (H^+ and Na^+) and polar molecules (glucose).

- Hydrophobic molecules such as hydrocarbons and oxygen pass through with ease.

- H_2O and CO_2 are small enough to squeeze through.

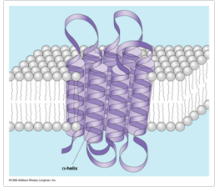


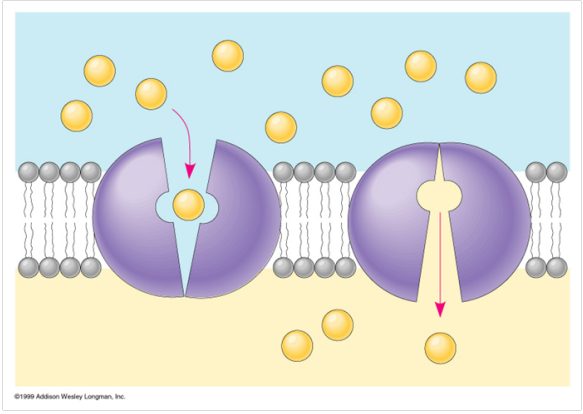
Cell Transport

2. **Transport proteins**

- These proteins span the lipid bilayer and help specific ions and certain polar molecules to pass through the membrane.

- Movement through these proteins can be active or passive.



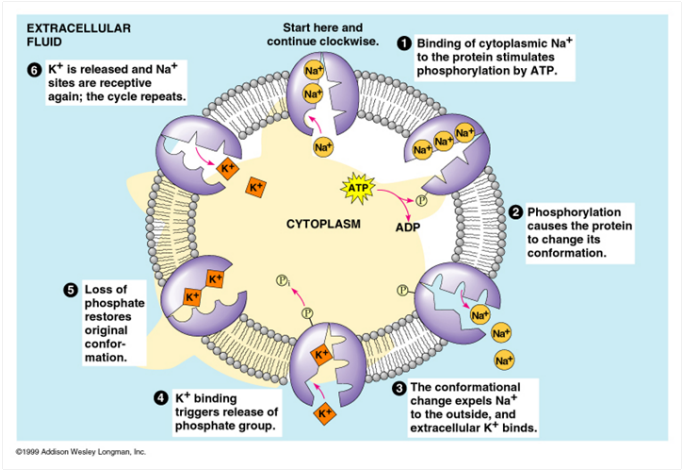


Cell Transport

3. Active Transport- Movement across a membrane that goes against the concentration gradient and requires metabolically supplied energy.

- The energy is supplied by ATP (Adenosine triphosphate).

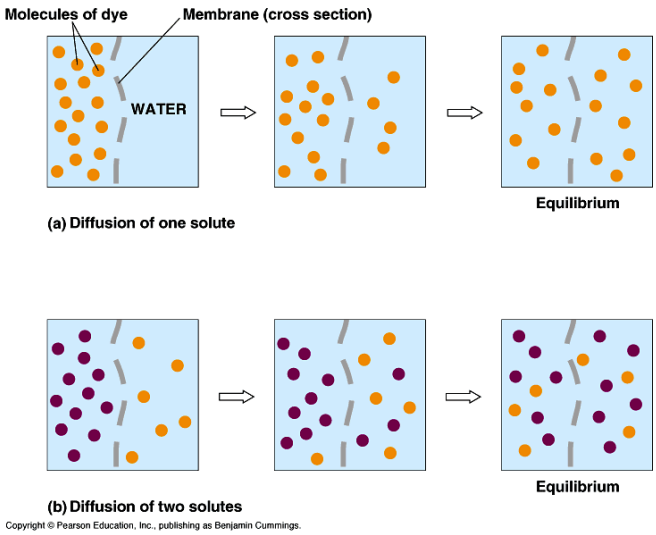
- Water and gases are not actively transported.



Cell Transport

4. Diffusion (Passive transport) - The transport of particles from an area of higher concentration to lower concentration.

- Concentration Gradient - A difference in the number of molecules (or ions) of a substance between two adjacent regions.



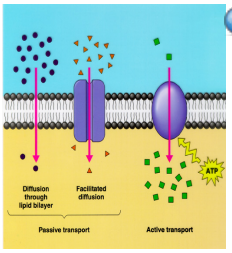
Review

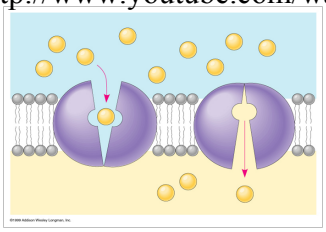
- Cells are small
- SA/V ratio must be high
- Transport of small particles:

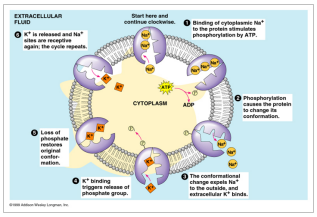
- Permeability of the lipid bilayer
- Transport proteins
- Active Transport
- Passive Transport (Diffusion)

http://www.youtube.com/watch?v=LP7xAr2FDFU&feature=related

http://www.youtube.com/watch?v=kfy92hdaAH0







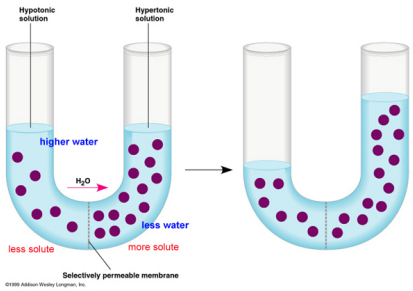
http://www.youtube.com/watch?v=7-QJ-UUX0iY&feature=related

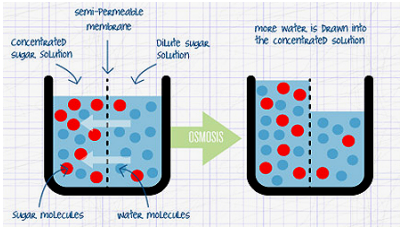
Cell Transport

5. Osmosis - The flow of *solvent* (usually water) through a semi-permeable membrane.

- Solution - Mixture consisting of molecules or ions less than 1nm in diameter, suspended in a fluid medium (water in most biological systems).

- Solute - Dissolved substance in a solution.
- Solvent - Dissolving medium in a solution.





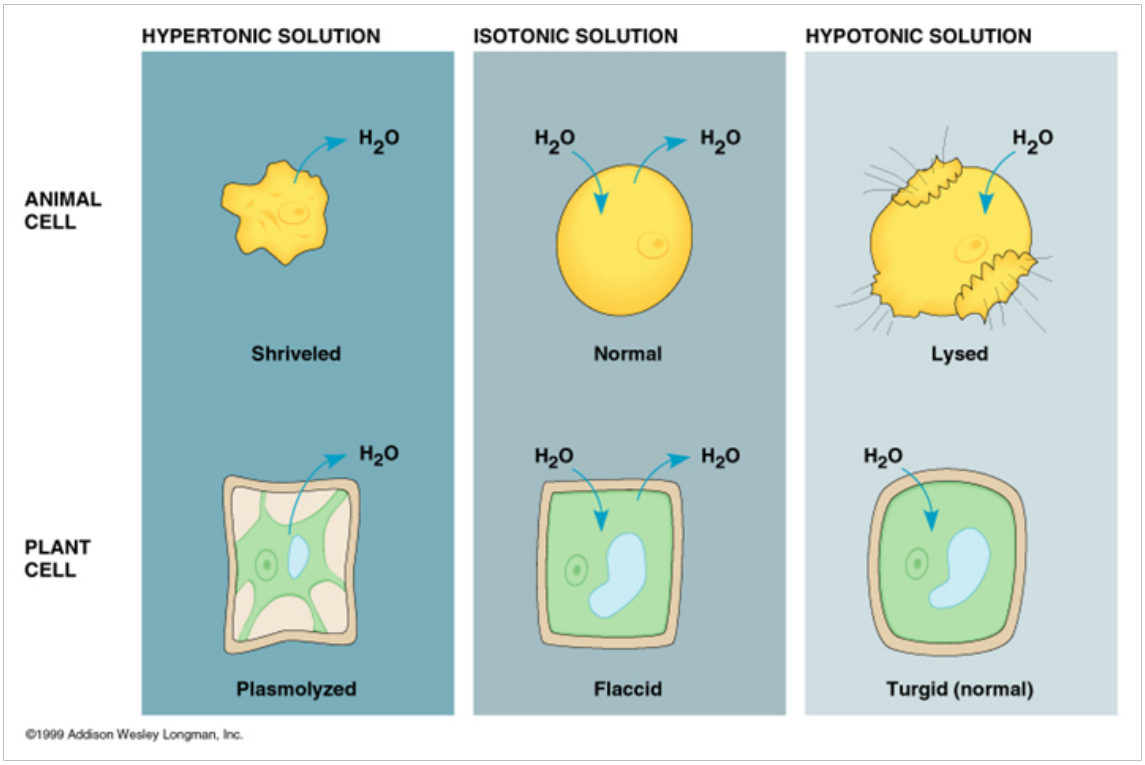
Cell Transport

- A solution can be in one of these 3 conditions when compared to another solution:

1. Hypertonic - Having a greater concentration of solute molecules and a lower concentration of solvent (water) molecules.

2. Hypotonic - Having a lower concentration of solute molecules and a higher concentration of solvent (water) molecules.

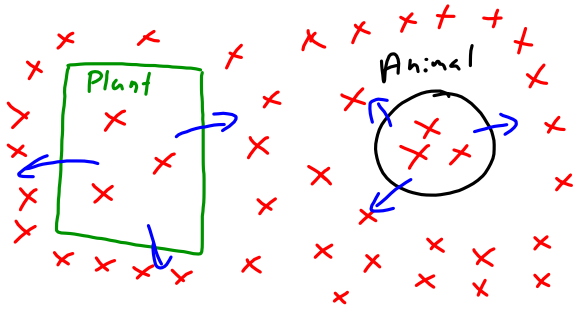
3. Isotonic - Solutions of equal solute concentrations.



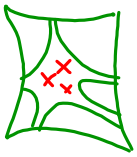
http://www.youtube.com/watch?v=7-QJ-UUX0iY&feature=related

Examples in Living Cells

E.g. 1 : In hypertonic solutions (very salty water)



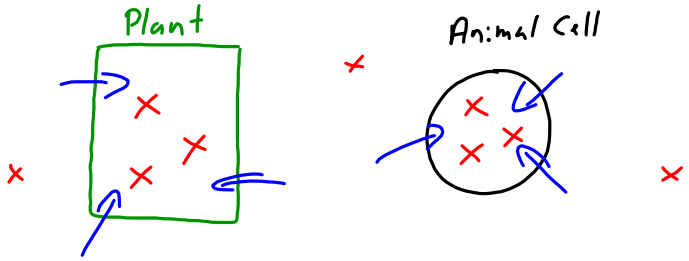
Water moves out of the cells



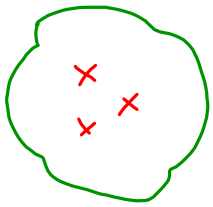
Cell is plasmolyzed

Cell is shriveled

E.g. 2 : In hypotonic solution (pure water)



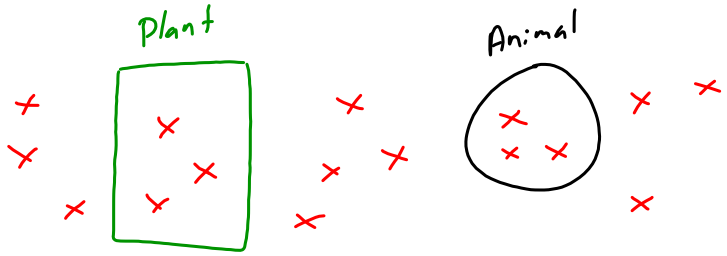
Water moves in to the cells



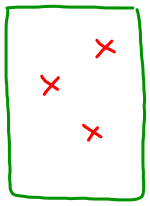
Cell is turgid

Cell is lysed

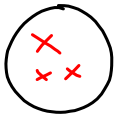
E.g. 3: In Isotonic solutions.



Water does not move



Cell does not change



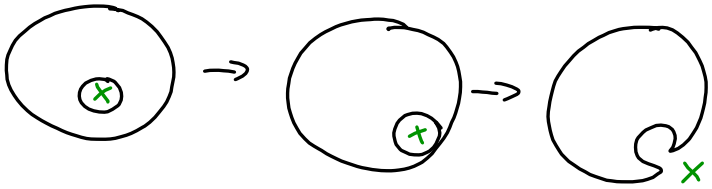
Cell does not change

Transport of Large Particles

- Small ions, molecules and atoms are transported by diffusion or osmosis.

- Larger compounds are transported by one of these mechanisms:

1. Exocytosis - The secretion of macromolecules by fusion of vesicles with the cell membrane.

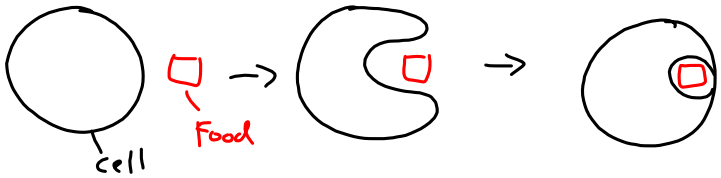


2. **Endocytosis** - The uptake of macromolecules and particles by regions of the cell membrane that surround the substance and pinch off to form a vesicle.

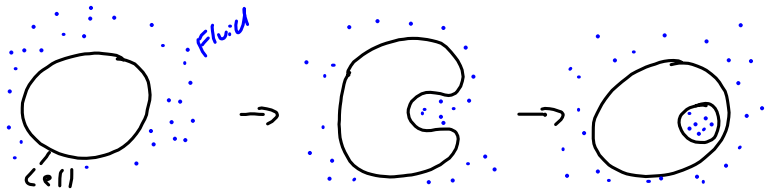
Transport of Large Particles

- There are two types of endocytosis:

1. **Phagocytosis** - The endocytosis of particulate material. (Solid).
   E.g. white blood cells, *Amoeba*.



2. **Pinocytosis** - The endocytosis of fluids.



- Endo and exocytosis occur only in eukaryotes because a cytoskeleton is required to organize and perform the movement.

Review

- **1. Exocytosis** - The secretion of macromolecules by fusion of vesicles with the cell membrane.

2. **Endocytosis** - The uptake of macromolecules and particles by regions of the cell membrane that surround th substance and pinch off to form a vesicle.

1. **Phagocytosis** - The endocytosis of particulate materia

2. **Pinocytosis** - The endocytosis of fluids.

Cycling of Matter

- **Organic chemicals**– Chemicals that contain a lot of carbon, nitrogen, hydrogen and oxygen. Usually they are made by organisms.

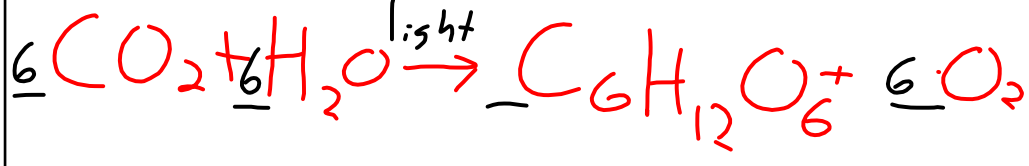
- **Inorganic chemicals**– All others.

The Carbon Cycle p. 70 - 90

- In biological systems, carbon exists in solids, liquids and gases.
- The solids include organic molecules such as glucose.
- The gas is carbon dioxide.
- Two biological reactions cycle carbon between these forms:

1**. Photosynthesis** – The process where plants use light energy to produce sugar (glucose).

- This process takes carbon from a gas and puts it into a solid.



The Carbon Cycle

2. **Cellular respiration** – The process where plants and animals use glucose to produce energy.
- This process takes carbon from a solid and puts it into a gas.

- This process is also known as aerobic respiration.

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O +$ chemical energy

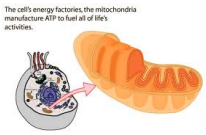
Some organisms can:

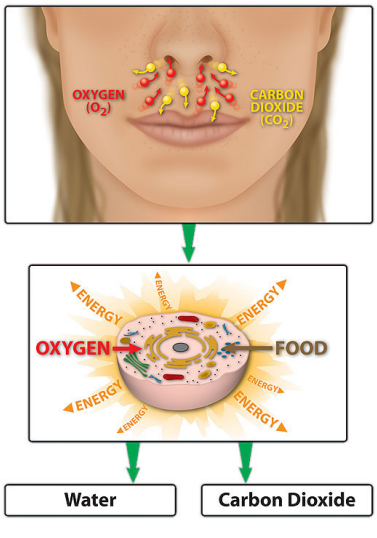
anaerobic respiration: metabolizing without the presence of oxygen.

The Carbon Cycle

What organelle is responsible for aerobic respiration?

Mitochondria!



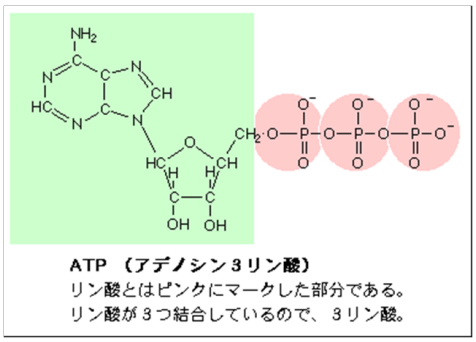


The Carbon Cycle

- Note how the reactions look like opposites.
- The reactions are actually *complimentary*.
- This means that the reactants of one are the products of the other.
  i.e. What one makes the other uses.
- Carbon can go from a solid to a gas in other ways. E.g. a fire.
- The process of carbon going from a solid to a gas form and back again is the carbon cycle.

The Carbon Cycle

- Note the "chemical energy" refers to adenosine triphosphate (**ATP**).
- ATP stores energy for only a brief period in a phosphate bond.
- This energy is released to drive chemical reactions (i.e. active transport).



http://www.youtube.com/watch?v=0Vwa6qtEih8

http://www.youtube.com/watch?v=Q0-Vj4CQrJ8