

BIOLOGY

Topic Summary

LT11—SIMPLE & FACILITATED DIFFUSION

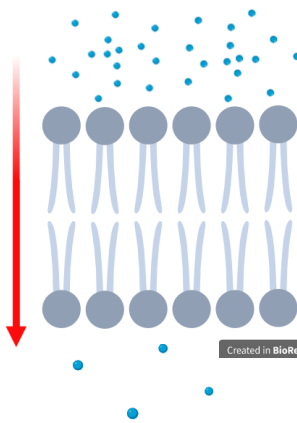
Diffusion, along with osmosis and active transport, are methods of transporting substances between cells and their environment. Diffusion occurs naturally and is often described as a passive process. A passive process does not require cellular energy.

Simple Diffusion

Diffusion is defined as the net movement of molecules/ ions from a region of high concentration to a region of low concentration. It is the movement of molecules/ ions down a concentration gradient.

This is a passive process, meaning it does not require energy from other sources as particles already have this energy as kinetic energy. Particles are constantly moving due to their kinetic energy. In regions where there is a high concentration of molecules (like oxygen), the molecules will move to a region where there is less via diffusion. This happens until molecules are equally distributed in both regions (until they reach equilibrium).

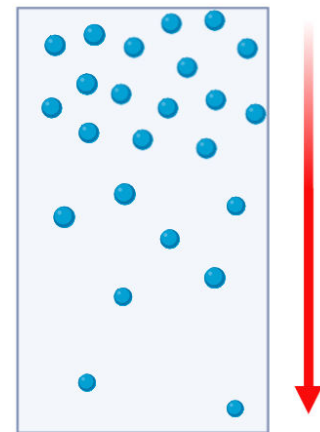
The phospholipid bilayer is selectively permeable meaning it only allows certain molecules to pass through the cell membrane. Only small, uncharged, non-polar molecules can pass through easily. Oxygen and carbon dioxide can pass through the cell membrane very easily via simple diffusion.



Both diagrams show molecules moving down the concentration gradient via simple diffusion.

Molecules move from an area of a high concentration to an area of low concentration

Small, uncharged molecules are able to diffuse through the phospholipid bilayer easily via simple diffusion. These molecules will move down the concentration gradient until they are equally distributed on both sides.



Down the concentration gradient, from high concentration to low concentration.

$$\text{Rate of Diffusion} = \frac{\text{Surface Area} \times \text{Concentration Difference}}{\text{Thickness of Membrane}}$$

This equation can be used to find the rate of diffusion in a given direction across an exchange surface.

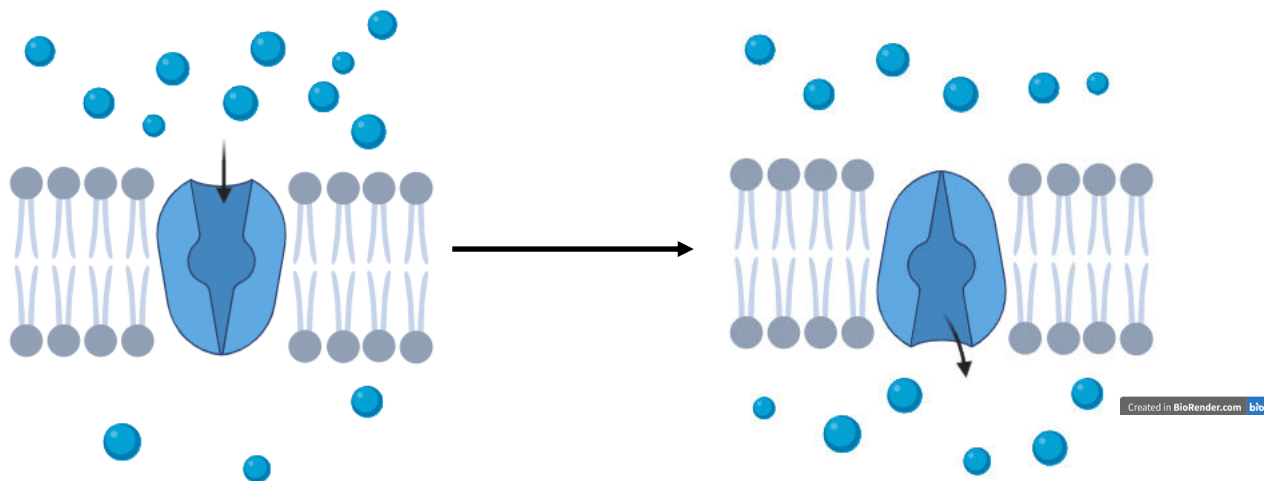
'Thickness of membrane' may also be referred to as the 'length of diffusion path'.

Facilitated Diffusion

The non-polar, hydrophobic tails of phospholipids act as barriers to most substances, preventing them from crossing the membrane. Large, hydrophilic and charged molecules are unable to easily diffuse through the membrane. Facilitated diffusion, however, makes it easier for these molecules to pass through as they are still required by the cell.

Facilitated diffusion is very similar to simple diffusion in that it is the net movement of molecules from a region of high concentration to a region of low concentration. It is also a passive process and occurs naturally.

However facilitated diffusion takes place with transmembrane proteins such as carrier proteins and channel proteins. Ions usually diffuse through the membrane using channel proteins while larger substances, like glucose, diffuse using carrier proteins.



These diagrams above shows facilitated diffusion. The diagram on the left shows the difference in concentration between both sides. There are more molecules outside of the cell than inside and will therefore be transported via facilitated diffusion using the carrier proteins embedded within the cell membrane. The carrier proteins will change shape depending on the size of the molecule. The diagram on the right shows the carrier protein opening on the other side and now there is similar distribution on both sides of the membrane.

Factors Affecting Diffusion

Molecules can move around constantly at a rate which is determined by how much energy they have as well as their environment and mass. These all affect the rate of diffusion.

The higher the temperature the higher the rate of diffusion as molecules will have more kinetic energy and can therefore move faster. Lower temperatures will decrease the rate of diffusion as molecules will have less kinetic energy.

The greater the difference in concentration between two regions the faster the rate of diffusion. This is because the movement from a region of high concentration to a low concentration will be greater.

The heavier a substance the slower the rate of diffusion as they move more slowly.

A thicker membrane will decrease the rate of diffusion. This is because the diffusion path is greater, meaning substances have to travel more. Therefore the greater the distance the slower the rate of diffusion.