

Diffusion and Osmosis (A.k.a. *passive transport*)

ICP review → Electrons of atoms are constantly moving
→ *All* particles of matter are in constant motion

1827
Scottish scientist, Robert Brown

Used a microscope to observe pollen grains suspended in water
Noticed that the grains constantly moved
Repeated this experiment with dye particles (non-living)
Saw the same thing
This motion has since been called **BROWNIAN MOTION**

BROWNIAN MOTION – random motion of visible molecules

As we have already learned, the cell membrane is selective about what it lets into and out of the cell. But a cell must move things in and out in order to survive.

One way of moving molecules into and out of a cell is through **DIFFUSION**

DIFFUSION – the net movement of particles from an area of **HIGHER** concentration to an area of **LOWER** concentration

Diffusion results because of the **RANDOM MOVEMENT OF PARTICLES**.

Results of diffusion

- ★ Ions continue to move and collide (remember, they are moving from an area of higher concentration to an area of lower concentration)
- ★ Eventually no net change will occur
- ★ This is called **DYNAMIC EQUILIBRIUM**

DYNAMIC EQUILIBRIUM – occurs when molecules are evenly dispersed – the molecules are still moving but there is no longer any *net change*

- ☺ Maintaining a DYNAMIC EQUILIBRIUM is one of the characteristics of HOMEOSTASIS

(Homeostasis...hmmm...if I remember correctly homeostasis refers to an organism's ability to maintain a steady state of *internal* operation regardless of any changes in the *external* environment of the organism)

FACTS ABOUT DIFFUSION

- ☞ Also called PASSIVE TRANSPORT because the cell uses no energy to move the particles
- ☞ Cannot occur unless a substance is in higher concentration in one region than it is in another
- ☞ This difference in concentration is called a CONCENTRATION GRADIENT
- ☞ Substances that are moving due to diffusion will always move “with a gradient”
- ☞ Diffusion will continue until there is no concentration gradient
- ☞ At this point, DYNAMIC EQUILIBRIUM has occurred

WHAT TYPES OF SUBSTANCES EASILY DIFFUSE THROUGH A CELL MEMBRANE?

Water

Oxygen

Nitrogen

Carbon dioxide

A few other small, non polar molecules

WHAT ABOUT OSMOSIS---WHAT IS OSMOSIS?

OSMOSIS is the diffusion of water molecules through a selectively permeable membrane

- ⊛ From an area of ***higher water concentration*** to an area of ***lower water concentration***

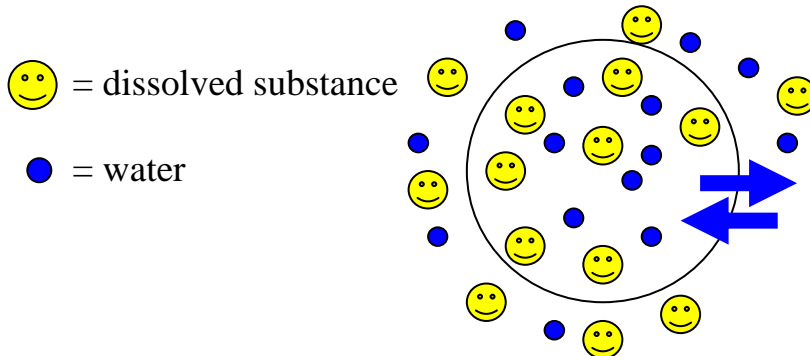
During osmosis, water diffuses across a selectively permeable membrane when one side of the membrane has a higher concentration of a dissolved material (which means that it has a lower concentration of water) that ***cannot pass through the membrane.***

SO WHY DO WE NEED TO KNOW ABOUT OSMOSIS?

☑ Most cells are subject to osmosis because they are surrounded by water solutions.

Types of solutions:

1. **ISOTONIC** – concentration of dissolved substances is the same both inside and outside the cell

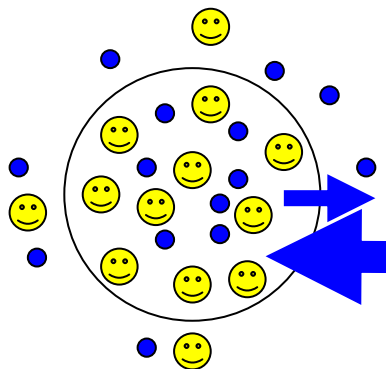


- ★ Water molecules still move into and out of cell
- ★ No net movement occurs, though
- ★ No osmosis occurs
- ★ Cell is in dynamic equilibrium with outside environment

Interesting fact:

Most solutions injected into our bodies are **ISOTONIC**, so that the cells of our body are not damaged by a sudden loss of water.

2. **HYPOTONIC** – concentration of dissolved substances outside the cell is **LOWER** than the concentration inside the cell



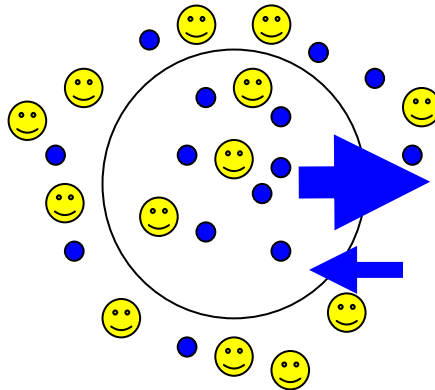
- ★ Osmosis will cause water to move **INTO** the cell
- ★ Cell will swell (and maybe burst)
- ★ Internal pressure increases – this pressure is called **TURGOR PRESSURE**

Interesting Fact:

Cell walls (in plants) prevent the plant cells from bursting when the turgor pressure gets high. In fact, the rigidity produced by turgor pressure in plant cells gives shape and support to plants that are not woody, such as tulips and tomatoes.

Plants wilt when they are deprived of water. Wilting occurs because the plant cells lose turgor pressure.

3. **HYPERTONIC** – concentration of dissolved substances outside the cell is **HIGHER** than the concentration inside the cell



- ★ Osmosis will cause water to move **OUT** of the cell
- ★ Cell will shrink
- ★ Turgor pressure decreases
- ★ This **DECREASE** is called **PLASMOLYSIS**

Interesting Fact:

Cookbooks suggest that you not salt meat before cooking. The salt forms a hypertonic solution on the meat's surface, and the water inside the meat's cells diffuses out (through osmosis, of course). The result is cooked meat that is dry and tough.

So let's review what we know about diffusion---

- Substances move from *higher* concentration to *lower* concentration
- The movement of water in this way is called osmosis
- No energy is used by the cell
- Only a few substances can easily fit (diffuse) through the cells membrane