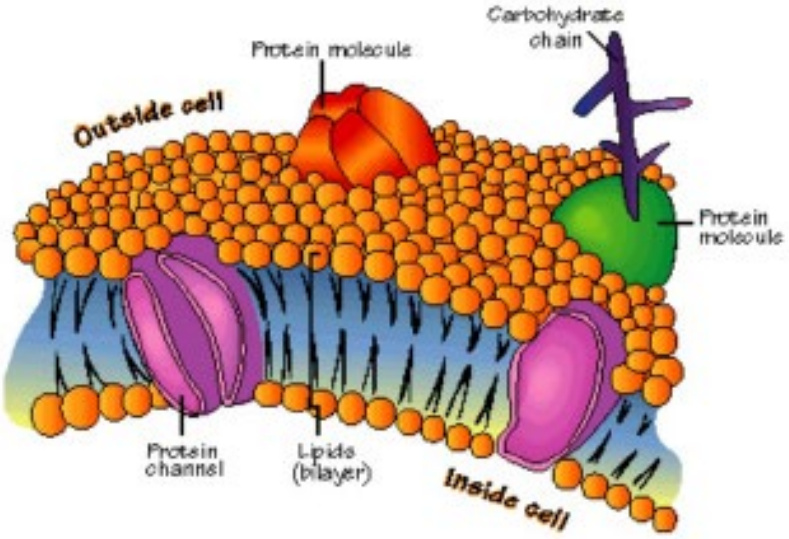
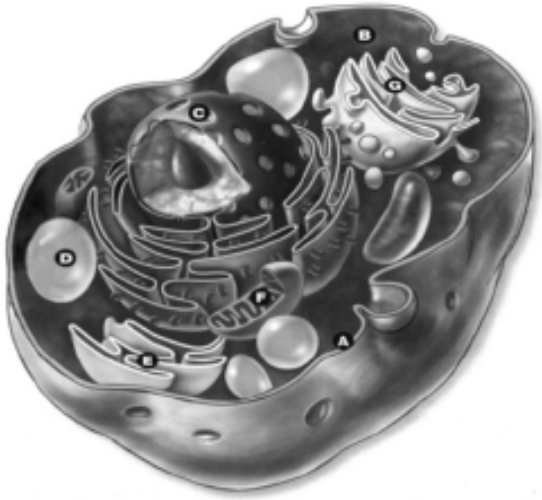
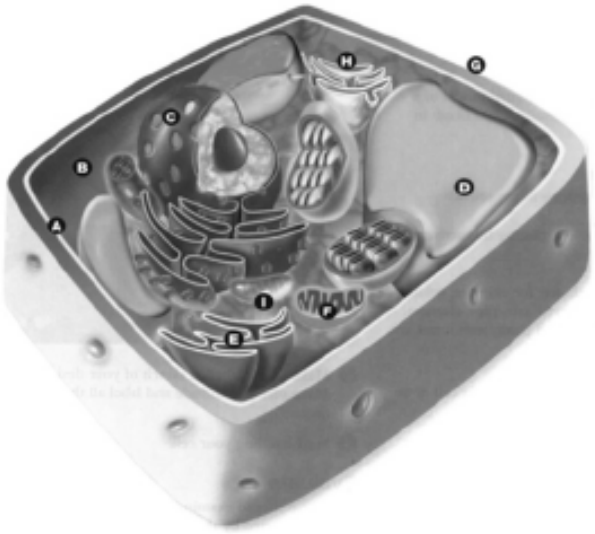
Science 10 Unit C: Biology

The Cell Membrane and Transportation







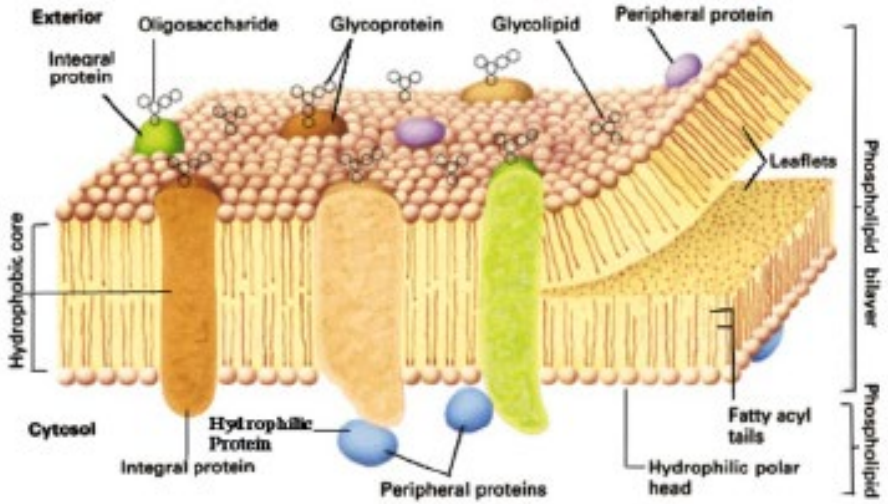
Recall from our study of the cell that both plant and animal cells contain a cell membrane.

This membrane is very important to maintaining an equilibrium, or balance, in the cell.

The membrane acts as a barrier, allowing select substances in and out of the cell.

The ability for the membrane to let only certain substances in and out makes it <u>semi-permeable</u>.

ex) cheesecloth is semi-permeable

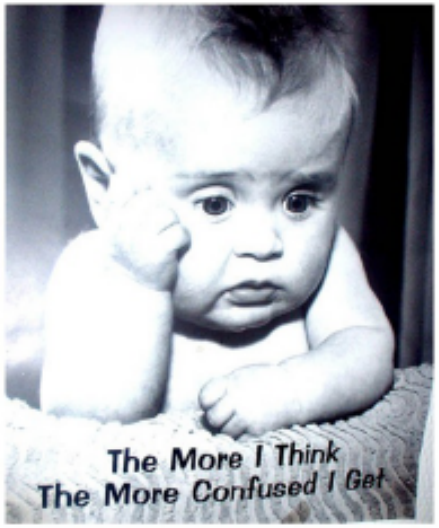


ex) the cell membrane is semi-permeable

The membrane is made up of a

Phospholipid Bilayer.

What???



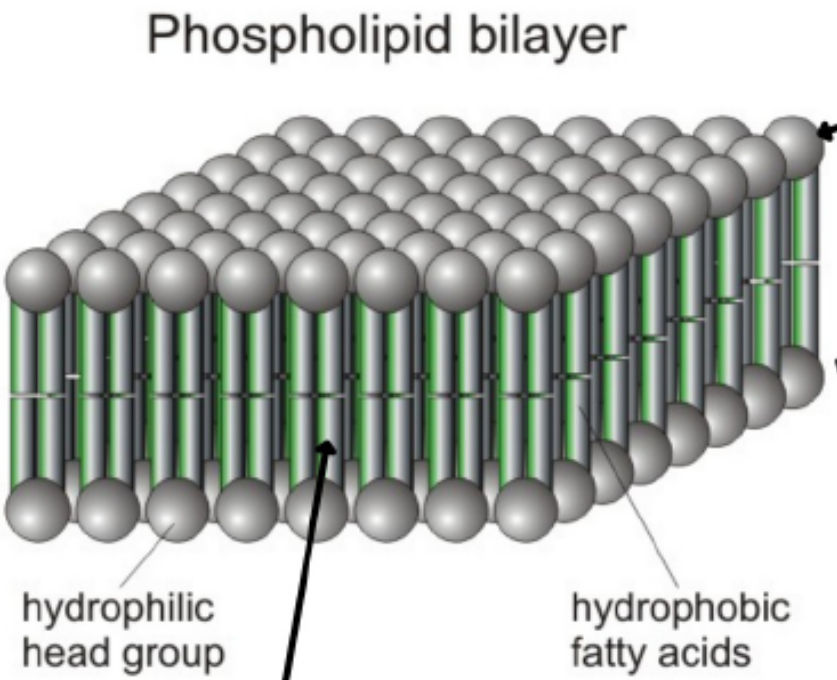
The word seems tough, but just break it down…

Phospholipid Bilayer

Bilayer =
two layers

phospho=
phosphates,
layer 1

lipid=
fat, layer 2



The phosphates are chemical groups that love water (are able to react with water) and are on the outside of the layer.

Groups that love water are called <u>hydrophilic</u>.

The lipids are fats that are found on the inside layer. They are <u>hydrophobic</u>, or hate water (will not react with it).

Quick summary:

Phosphates love water!

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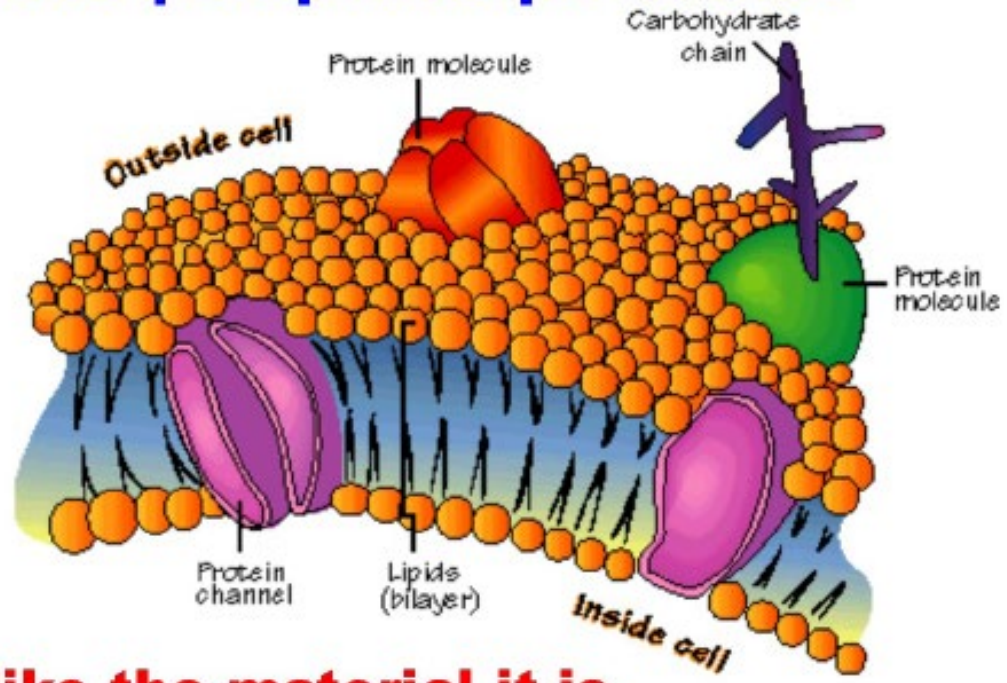
Cats hate water!

Stuck inside of this delicious phosphate/lipid mix are channel proteins.



The channel proteins act like doors allowing passage in and out of the cell.

Each protein is shaped like the material it is allowing to pass.

This makes for a selectively permeable membrane.

It is important to understand that the cell membrane is not rigid like a wall but is flexible and can move, like a plastic sack.

The theory that describes this membrane is called the Fluid Mosaic Model.

Because the membrane is not solid, but can move.

Because the membrane is made up of many different parts; phosphates, lipids, proteins, etc.

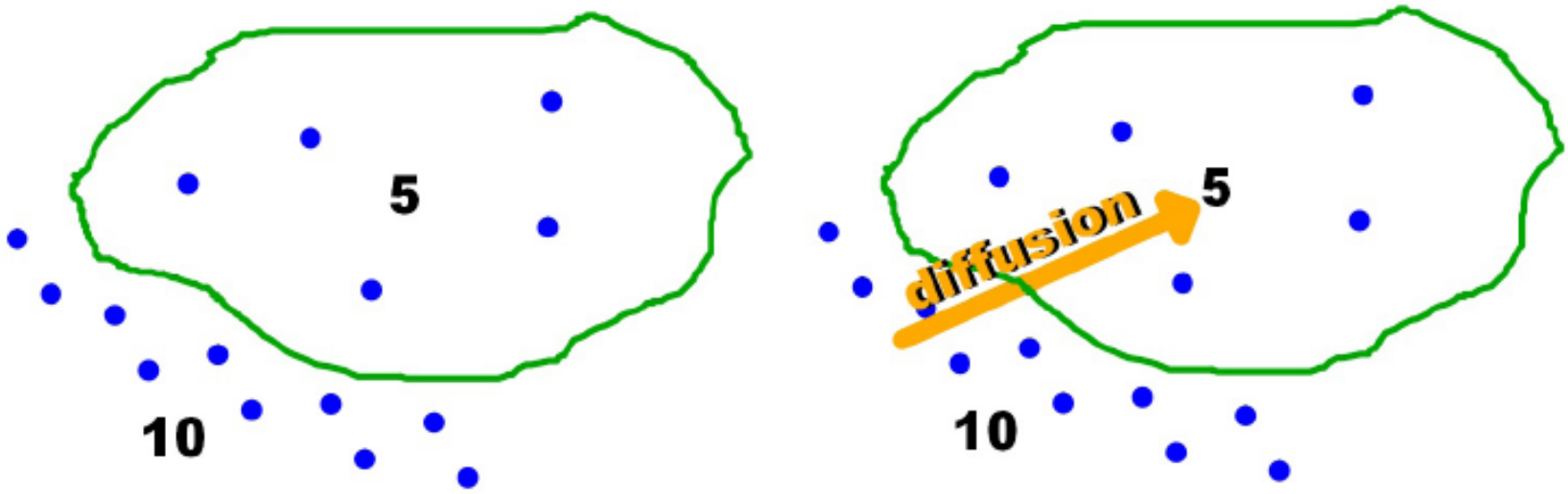
So, how do these proteins decide how much goes in and out?

They use a chemistry principle called diffusion.

Diffusion: the movement of particles from high to low concentration.

The rate of diffusion can be increased by increasing energy (heat/stirring).

For a simple example, imagine if we had a simple cell with 5 particles inside and 10 particles outside.

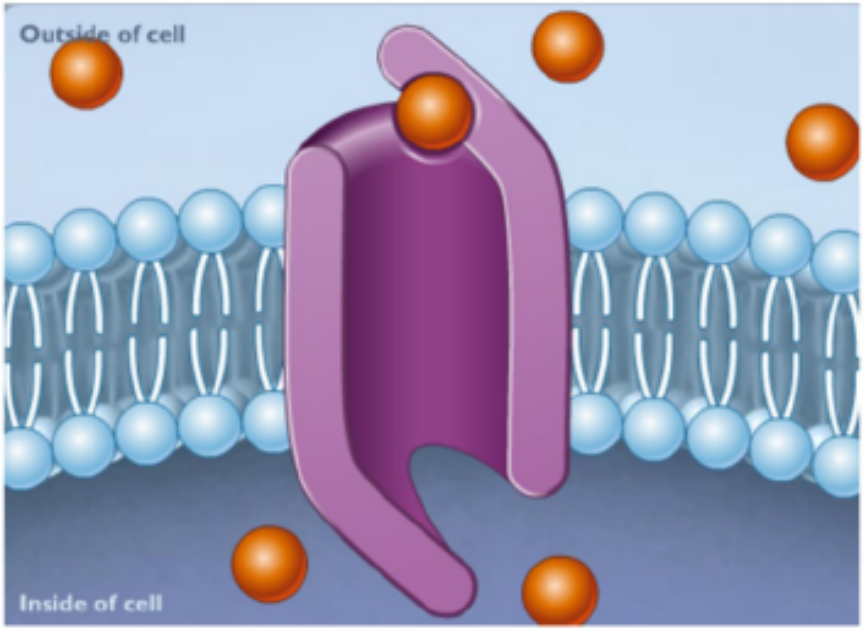


The particles will move from the area of high concentration (outside the cell) to the area of low concentration (inside the cell).

The difference in concentration is called a concentration gradient.

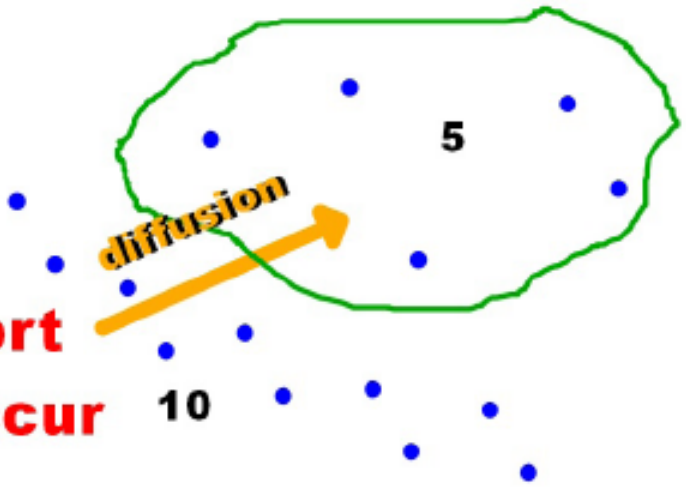
Particles move into and out of the cell through proteins that act like doorways. These proteins are called channel proteins. Channel proteins work well for small particles.

Larger particles must move through the membrane by the use of carrier proteins. These proteins attach to larger particles and help move the particle past the membrane. This process is called facilitated (helped) diffusion.

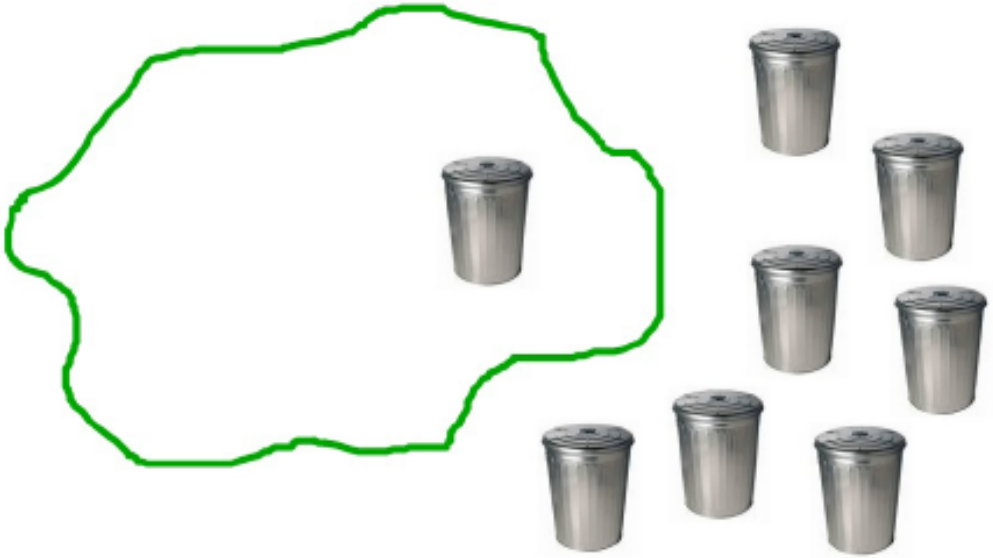


How facilitated diffusion works

The movement of material due to diffusion is called passive transport as no energy is used for this to occur (it happens "automatically").



In other situations, the cell must move substances against the concentration gradient...

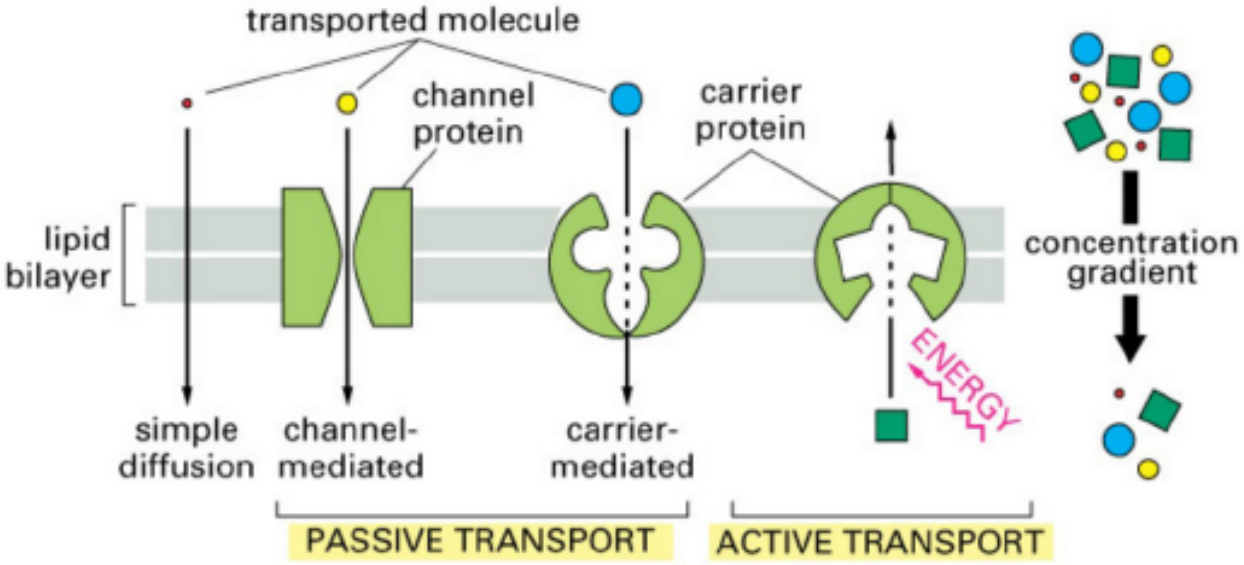


Imagine a cell trying to move waste out into a high concentration of waste outside the cell.

Diffusion won't do this for us.

In order to go against diffusion, it takes energy input. This is called active transport.

In active transport, the cell uses energy (the energy is called ATP, adenosine triphosphate) from the mitochondria to move transport against the concentration gradient.



How active transport works

So, what is moving in and out of the cell?

- **nutrients**
- **minerals**
- **ions**
- **waste**
- **water**

Oh, this is an important one!

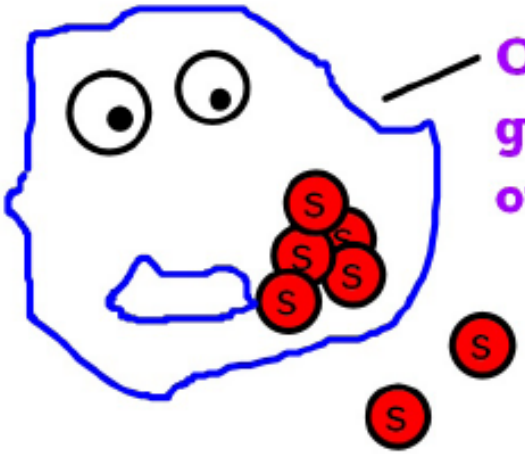
The movement of water in and out of the cell is called

Osmosis

- an example of passive transport

- occurs when concentration gradients are present but the solute molecule is too large to move through the membrane.

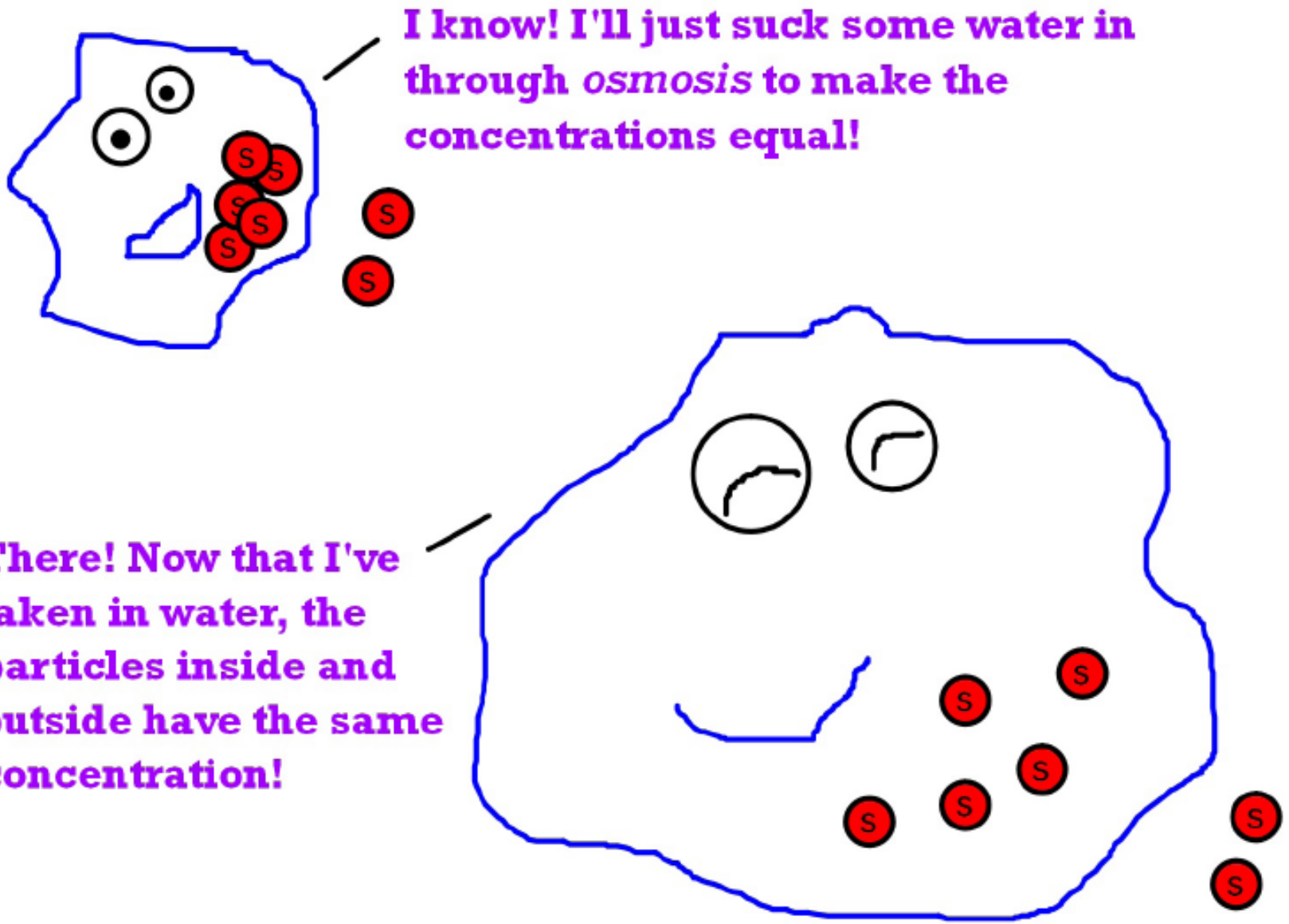
Cartoon Example: Say you are a cell and you need to get rid of some particles because of a concentration gradient:



Oh man! Look at this concentration gradient! 5 particles inside and only two outside! That's not equal!

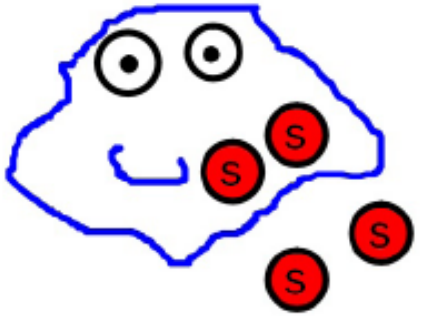
But, these particles are WAY to big to fit through my membrane!

What's a cell to do?

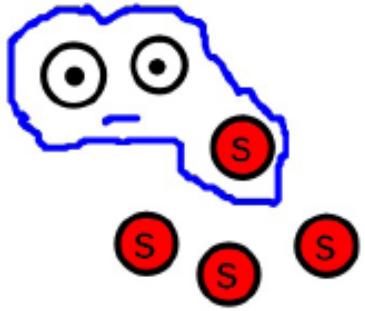

I know! I'll just suck some water in through *osmosis* to make the concentrations equal!
There! Now that I've taken in water, the particles inside and outside have the same concentration!

Three Scenarios for Osmosis:

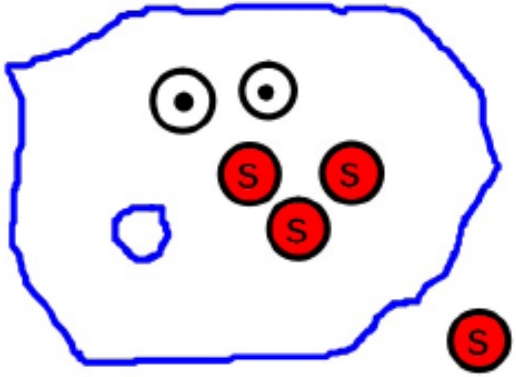
1. Isotonic - the concentration of solutes (particles) inside the cell is equal to the concentration outside the cell. No water moves in or out.

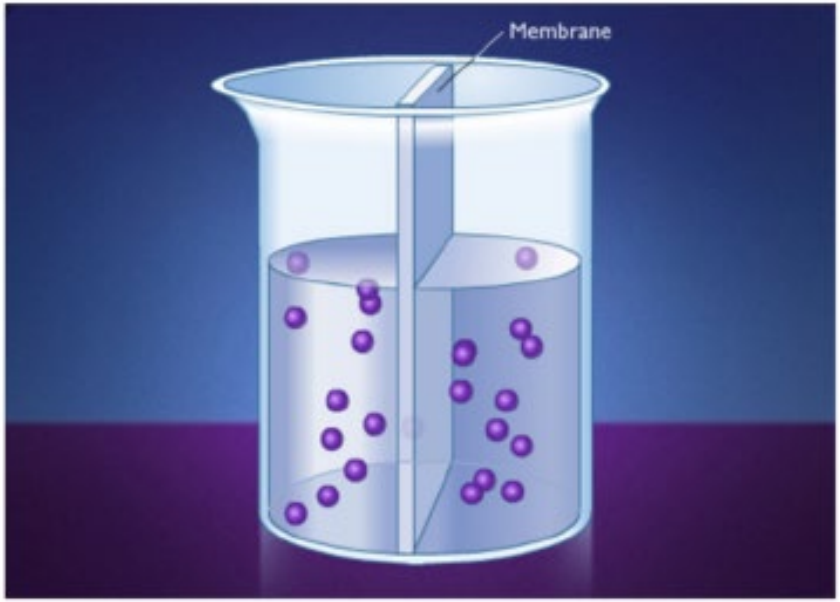


2. Hypertonic - the concentration of solutes (particles) outside the cell is larger than inside the cell. Water will move out of the cell.



3. Hypotonic - the concentration of solutes (particles) outside the cell is smaller than inside the cell. Water will move into the cell.

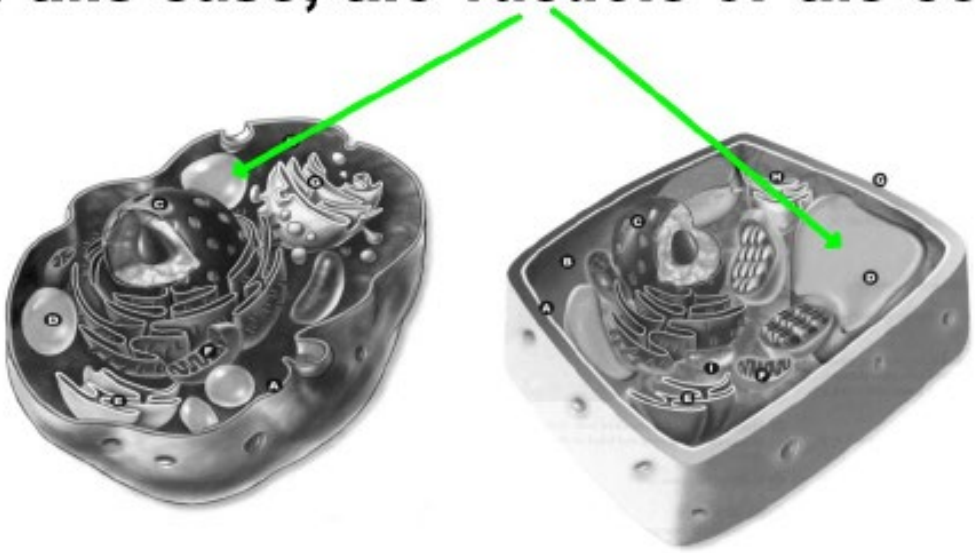




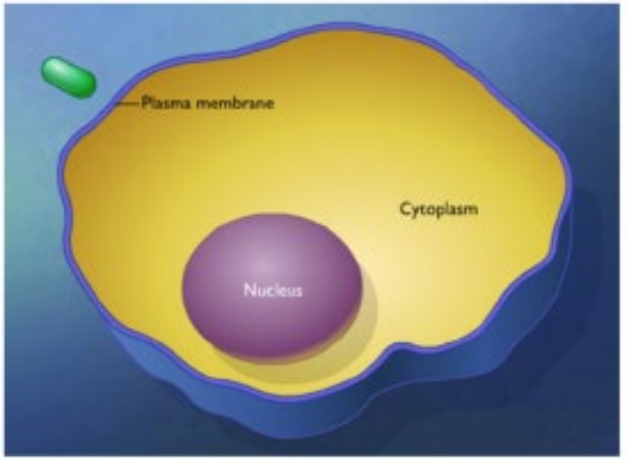
How osmosis works

The last type of transport we look at takes place when the particles to be moved is too big for even the carrier proteins.

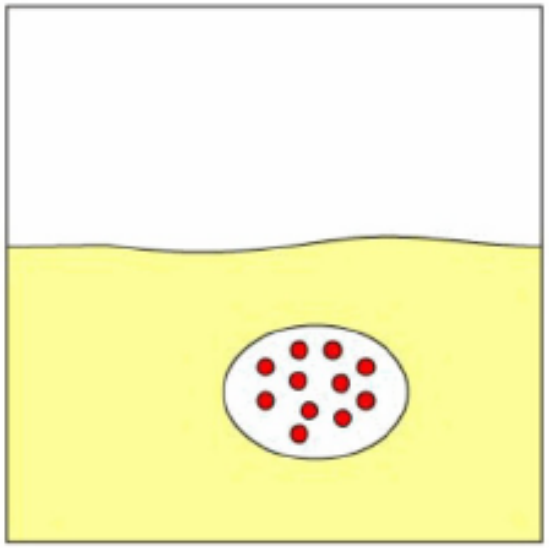
In this case, the vacuole of the cell will take over.



[Endocytosis]

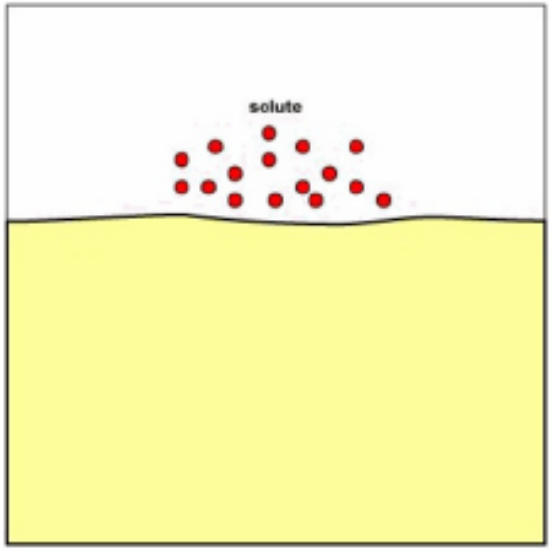


The vacuole can surround large particles and escort them out of the cell this exit process is called exocytosis.



Exocytosis

In a similar way, the vacuole can envelope large particles and bring them inside the cell. This entrance process is called endocytosis.



Endocytosis