Movement Through the Membrane

Cytology

Selective Permeability

- The **plasma membrane** is described as **selectively** (or **differentially**) **permeable** since it controls the passage of particles in and out of the cell

- Particles can move across the membrane in a number of ways depending on:

    - The **size** of the particle
    - The **concentration gradient** of the particle
    - Whether or not the particle is **lipid soluble (**ie: can it pass through the non-polar tails of the bilayer)
    - Note: Note- polar molecules and ions are lipid **insoluble** and therefore cannot easily pass through the non polar

Passive vs Active Mechanisms

Passive Transport: A mechanism of transport across the membrane is considered **passive** if it does not require the energy stored in **ATP.**

Passive Transport includes: Diffusion, osmosis, and facilitated transport

Active Transport: A mechanism of transport across the membrane is considered **active** if it **does** require the energy stored in **ATP.**

Active Transport includes: Carrier protein pumps, exocytosis, and 2 mechanisms of endocytosis, called phagocytosis and pinocytosis

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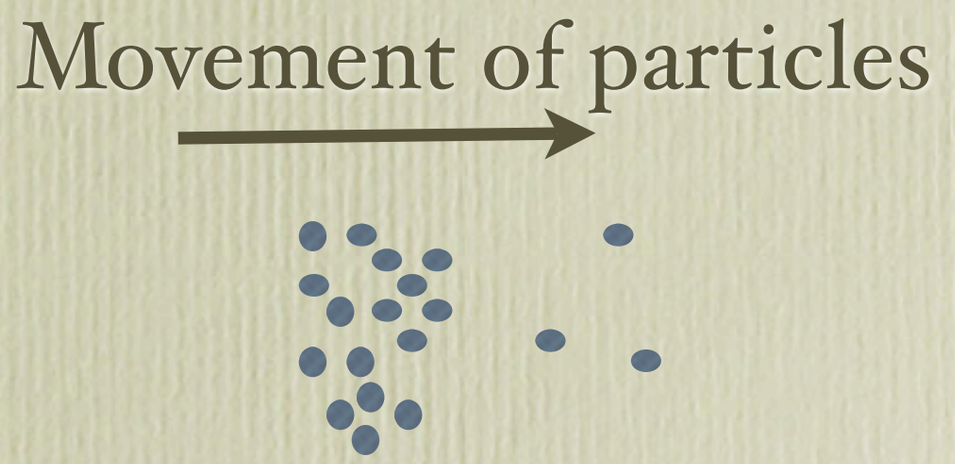
Passive Transport:
Diffusion

Diffusion is the movement of particles from an area of **HIGH** concentration to an area of **LOW** concentration (**DOWN** the concentration gradient)

This is a **PASSIVE** process and does NOT require energy

Particles diffusing across the plasma membrane move between the phospholipids or through protein channels



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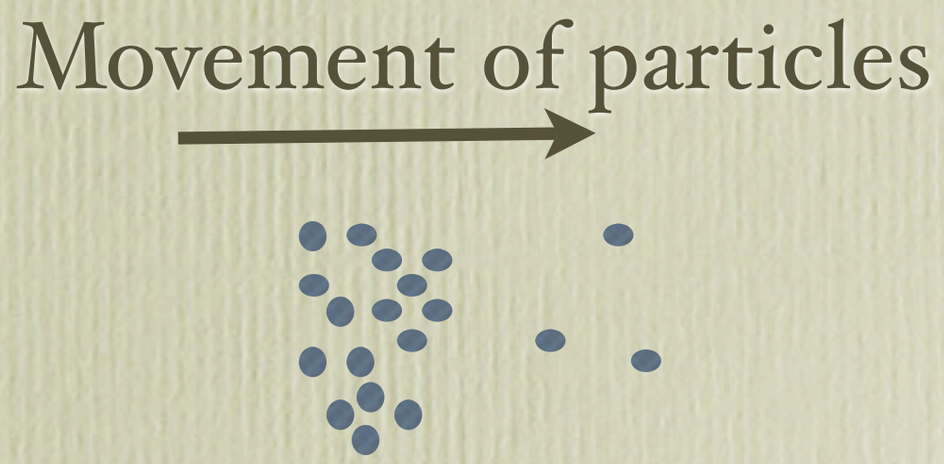

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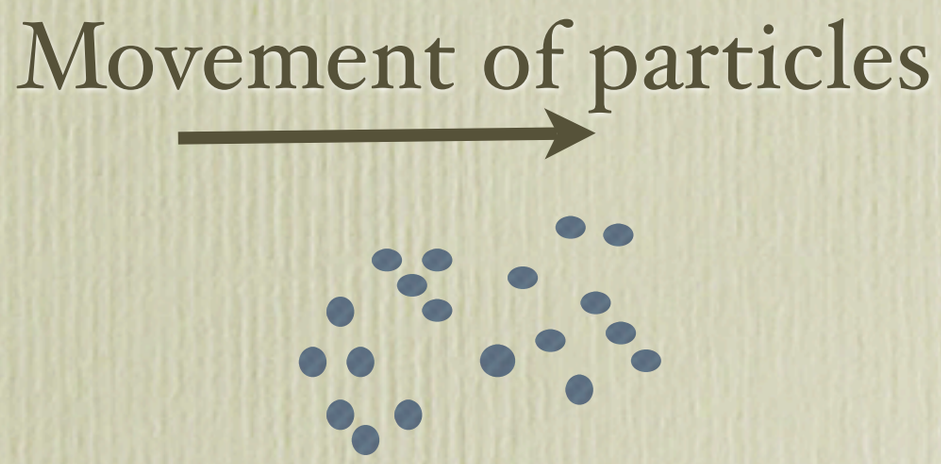

Imagine...

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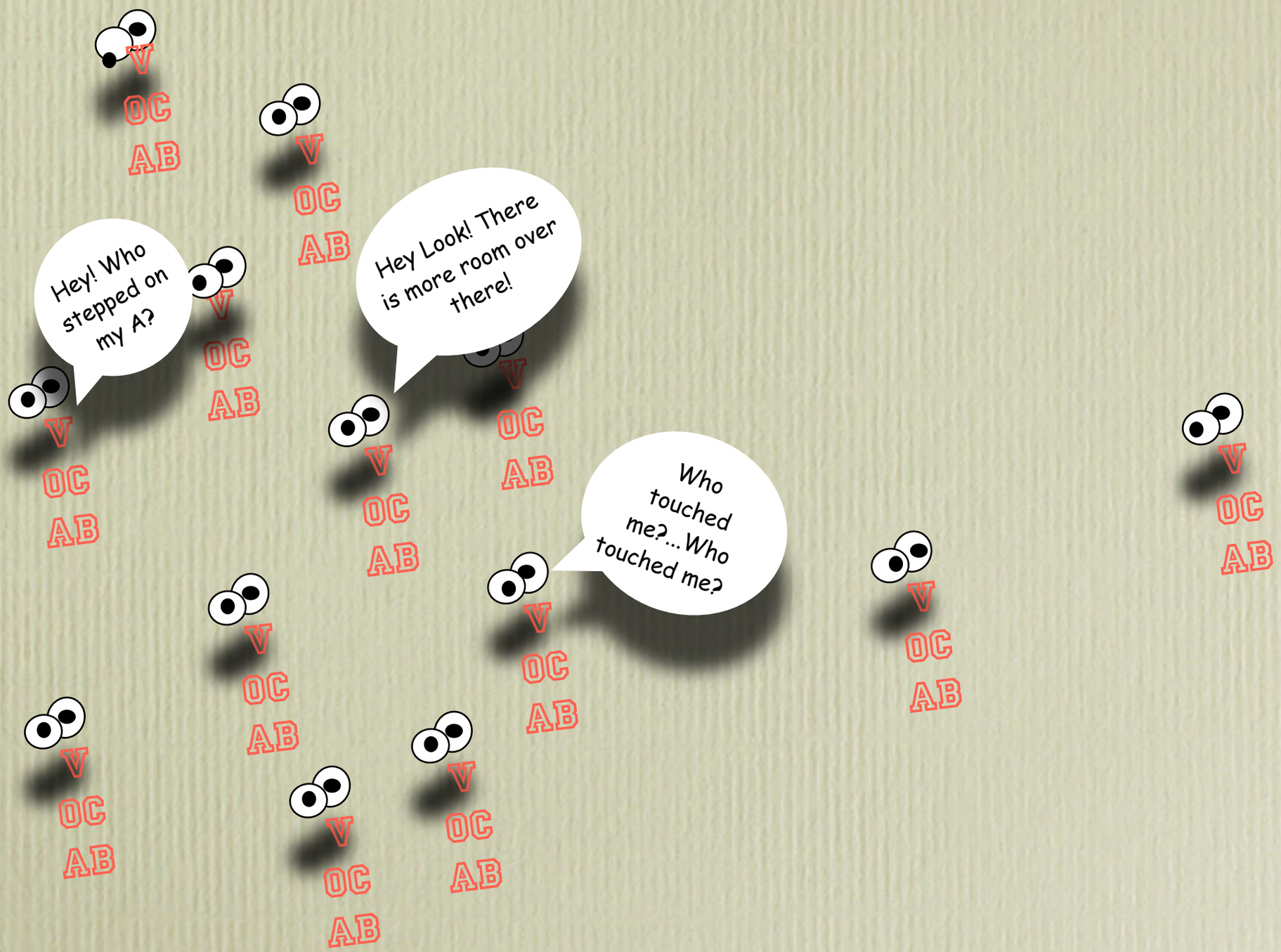

Hey! Who stepped on my A?
Hey Look! There is more room over there!
Who touched me?... Who touched me?

Imagine...

We want to go where there is more space.
Particles act the same way.

Examples of Diffusion

Particles that move across the membrane by diffusion are typically **small** and **lipid** soluble
Examples are the gases **oxygen** and **carbon dioxide**

Gylcerol, water and **alcohol** are also able to easily diffuse through the membrane as they can slip though the hydrophyllic heads of the phosphoplipids and pass through the hydrophobic tails of the membrane

Factors Effecting Diffusion

Temperature: The higher the temperature, the more kinetic energy the particles will have (move faster)
Therefore, the **higher** the temperature, the **faster** the rate of diffusion

Particle Size: For a given temperature, a **small** particle will move faster than a **large** particle
Therefore, **small** particles diffuse **faster** than **large** particles

Factors Effecting Diffusion

Concentration Gradient: The concentration gradient is the **difference** in **concentration** across the cell membrane
The **greater** the concentration gradient, the **faster** the rate of diffusion

Density of the Medium: The medium is the material through which the particles are diffusing and density refers to how tightly packed the molecules are

At higher density, there is greater resistance to movement of the diffusing particle

Therefore, in **low density** mediums (such as gases), particles will diffuse the **fastest**

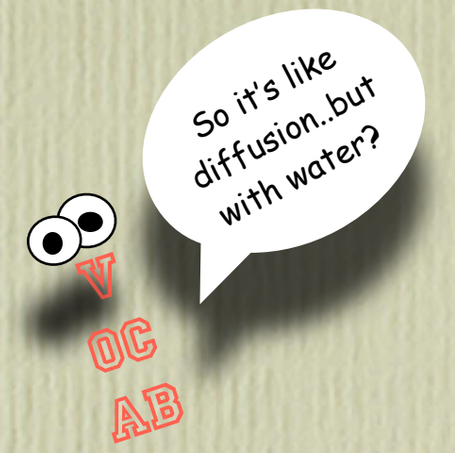
Osmosis

Osmosis is the movement of **water** across a membrane

During osmosis, water moves from and area of **high water concentration**, to an area of **low water concentration**

Osmosis is a passive mechanism since it does not require the energy stored in ATP
During Osmosis, water moves between loosely packed phospholipids or through protein channels

Note- Even though water is a **polar** molecule, it is able to move through the **non polar tails** of the phospholipids because they are loosely packed



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Facilitated Diffusion

Facilitated diffusion is the movement of particles from an area of **high** concentration to an area of **low** concentration

Involves the use of a **carrier protein**

The carrier proteins are specific to different types of molecules

They carrier protein binds to the molecule and changes shape to release it on the other side of the membrane

It is a passive mechanism, as it does NOT require energy

Examples of Facilitated Diffusion

Particles that move across the membrane by facilitated diffusion are **lipid insoluble** which is why they require a carrier protein

Examples of particles that move across the membrane by facilitated diffusion are **glucose** and other sugars, and **amino acids**

Active Transport

Active transport is the movement of particles from an area of **LOW** concentration to an area of **HIGH** concentration (**AGAINST** the concentration gradient)

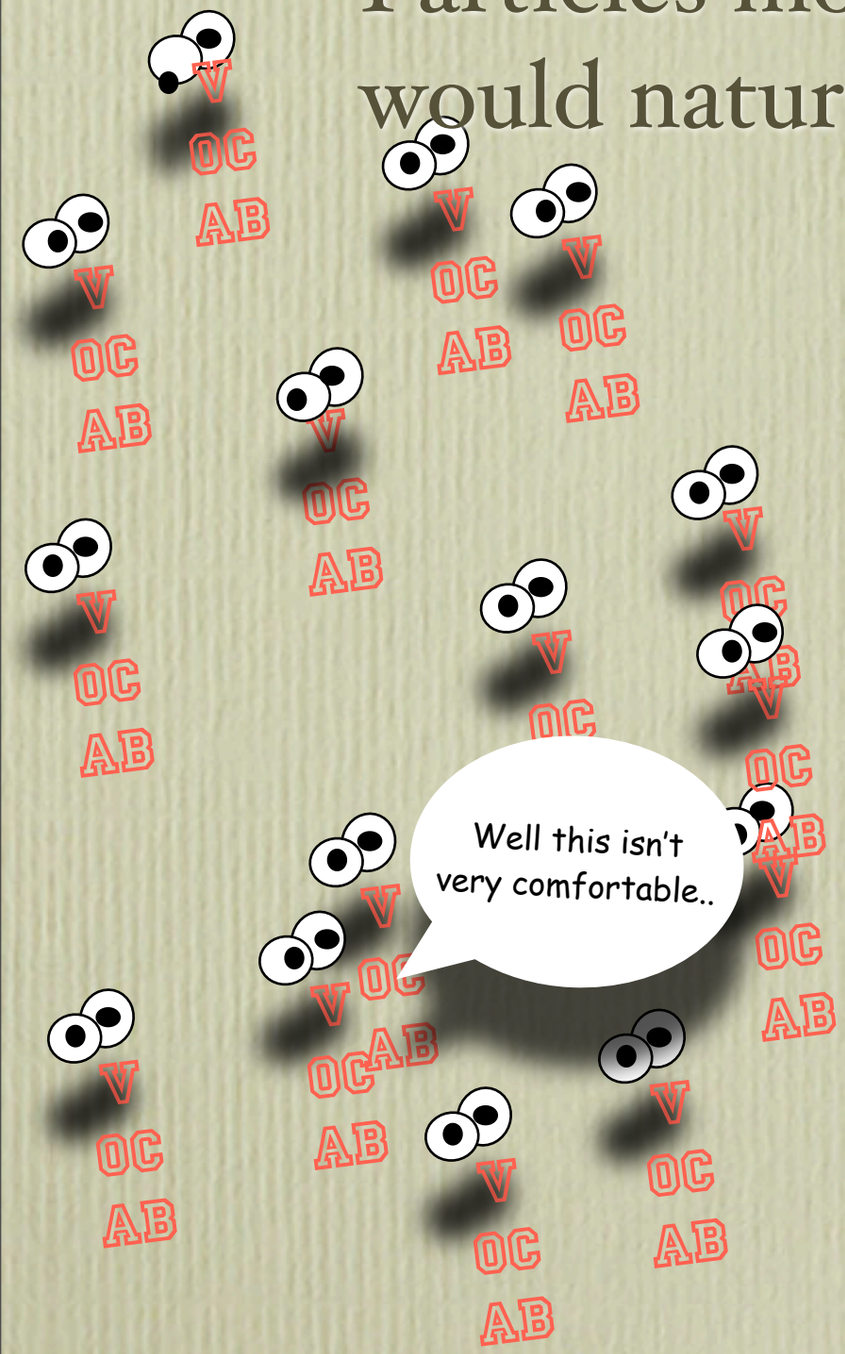
Active transport requires a **carrier protein**, these are often reffered to as **“pumps”** because they pump molecules against the gradient in the same way that a water pump pumps water against gravity

Active transport is an active mechanism as it requires energy from ATP

Imagine...

Imagine...

Particles move the opposite way that they would naturally.



Examples of Active Transport

Iodine collects inside thyroid gland cells

Sodium and Potassium ions move across the cell membranes of nerve cells (Na/K pump)

Endocytosis

Endocytosis is the movement of **large** particles to the **inside** of the cell membrane through the formation of a vesicle by the plasma membrane

The two forms of endocytosis are **pinocytosis** and **phagocytois**

Both are **active** mechanisms since they require the energy stored in ATP

Phagocytosis

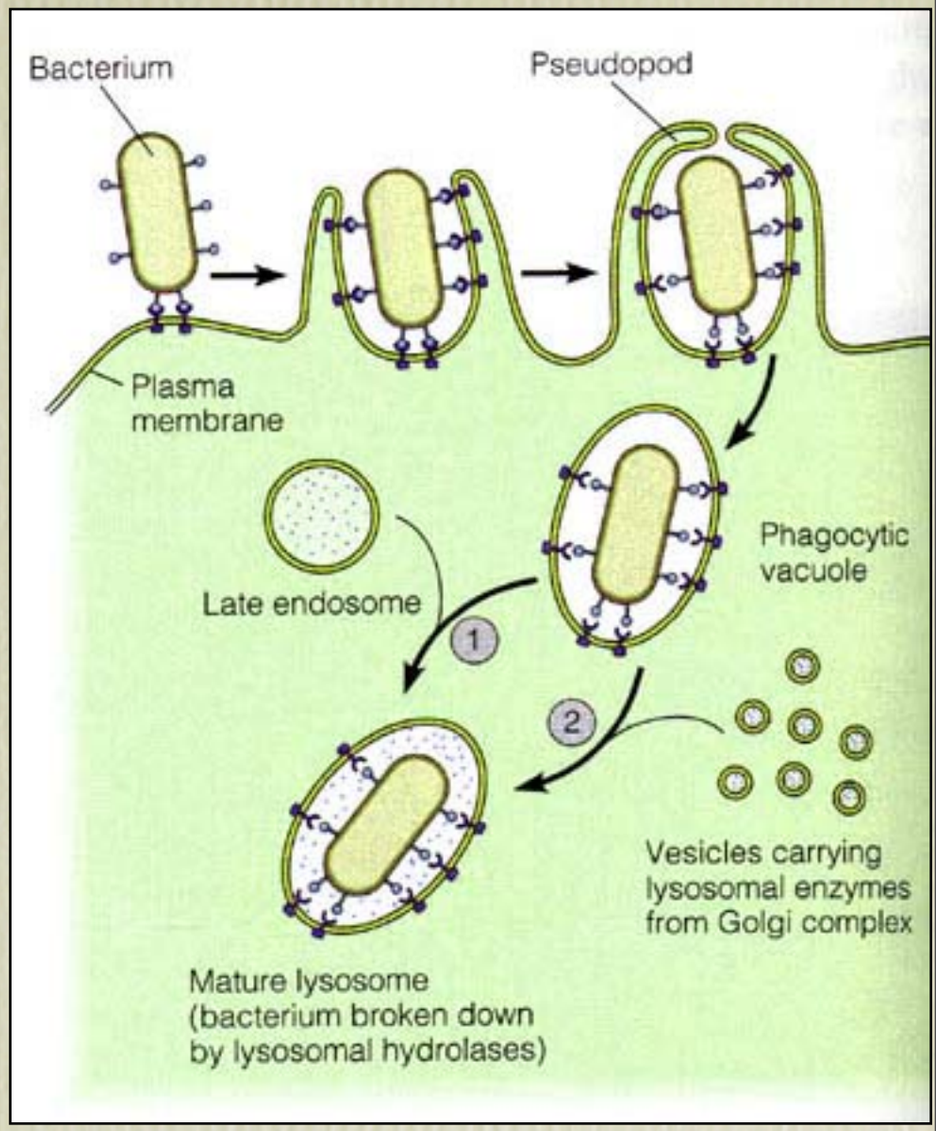
"Eat" "Cell"

Used by a cell to engulf very **large** particles such as a food particle or another cell

When the particle comes up against the cell, extensions of the membrane wrap around the particle and enclose it in a large vacuole

Once inside the cell, the vacuole often fuses with a lysosomes so its contents can be digested

Phagocytosis is the mechanism used by white blood cells to destroy pathogens



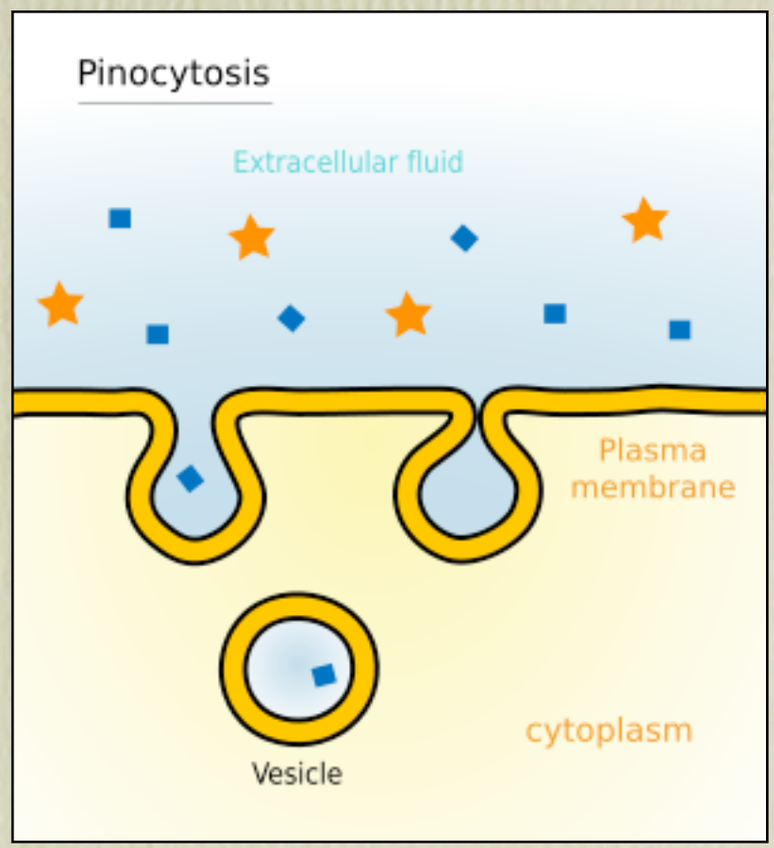
Pinocytosis

"Drink" "Cell"

Pinocytosis is used by cells to engulf moderately sized particles such as polypeptides

During pinocytosis the membrane folds, drawing the particle and a **small amount of fluid** into a small pit which eventually pinches off, enclosing the particle in a vesicle

Once inside the vesicle may fuse with a lysosome



Exocytosis

Exocytosis is the movement of large particles to the **outside** of the cell by fusing a secretory vesicle with the cell membrane

Exocytosis is an **active** mechanism since it does require ATP energy

The golgi is involved in packaging and producing secretory vesicles

Molecules exported from the cell in this way include proteins and hormones