

Cell Physiology

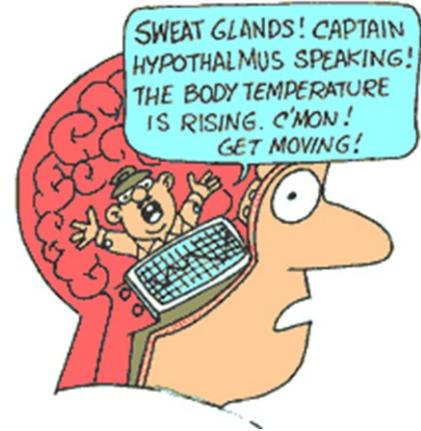
Physiology = the study of the **vital processes** of an organism

1) Homeostasis

= a steady state that a tissue, organ, system or organism maintains by self-regulating adjustments

= **ability to adapt to a change and stay in a balanced state**

- ie)
 - kidney will double in size if the other is removed
 - goose bumps & shivering conserve body heat
 - going into shock in an emergency
- cells maintain homeostasis with their environment by means of the plasma membrane
- the cell membrane is a **differentially permeable** or **semi permeable** membrane between the cell and its environment (or neighboring cell)
 - = allows certain substances to cross into and leave the cell while other substances are prohibited



Video : [plasma membrane https://www.youtube.com/watch?v=ipa1vmQ7H_4](https://www.youtube.com/watch?v=ipa1vmQ7H_4)

2) Structure of the Plasma Membrane (a.k.a. Fluid Mosaic Model)*

= lipid bilayer embedded with proteins

- the 2 layers are composed of **mobile phospholipid molecules**

: phospholipids have a polar water soluble end (hydrophilic) and a non polar fat soluble end (hydrophobic)

: the hydrophilic ends face the **outer environment** & the **inner** cell components

-special protein molecules (glycoproteins) embedded in the lipid bilayers

serve different functions:

a. **Markers** = so cells can identify each other

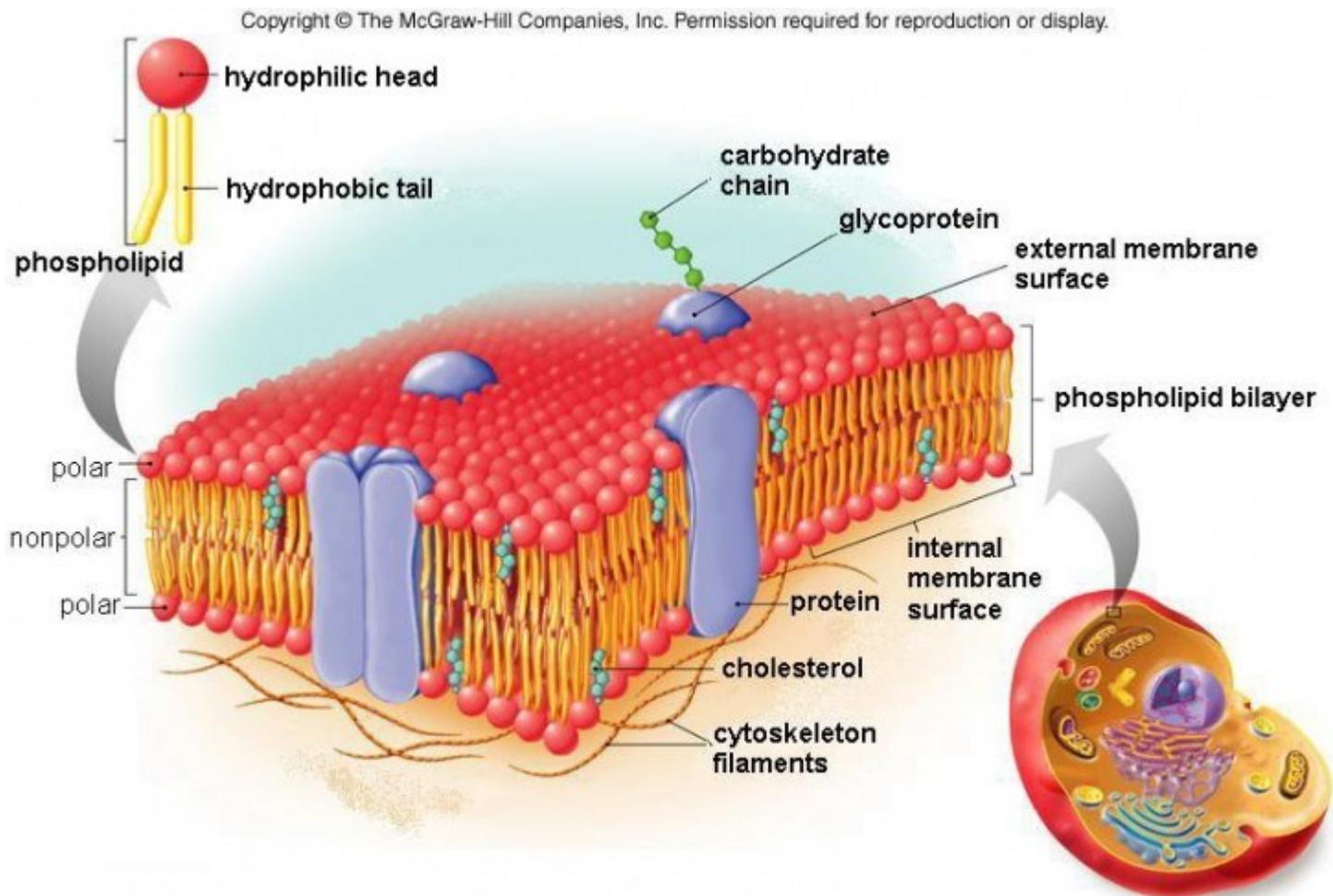
- explains transplant and transfusion rejection

b. **Receptors** for chemical messages (hormones)

c. **Regulators** of what enters or attaches to cells

d. **Transporters** carrying specific materials into & out of the cell

FLUID MOSAIC MODEL OF THE PLASMA MEMBRANE



- Factors Affecting the Selective Permeability of the Plasma Membrane:

1. Particle **size**
2. Particle **solubility**
3. **Concentration** inside or outside of the cell
4. **Electrical charge** of the Particle
(ions move across the membrane slowly if same charge as cell membrane)
5. Plasma membrane **structure**

3) Transport of Substances

- substances are moved through the cell membrane in a variety of ways:

A) Passive Transport Video: [Passive Transport https://www.youtube.com/watch?v=suckY-l_rsM](https://www.youtube.com/watch?v=suckY-l_rsM)

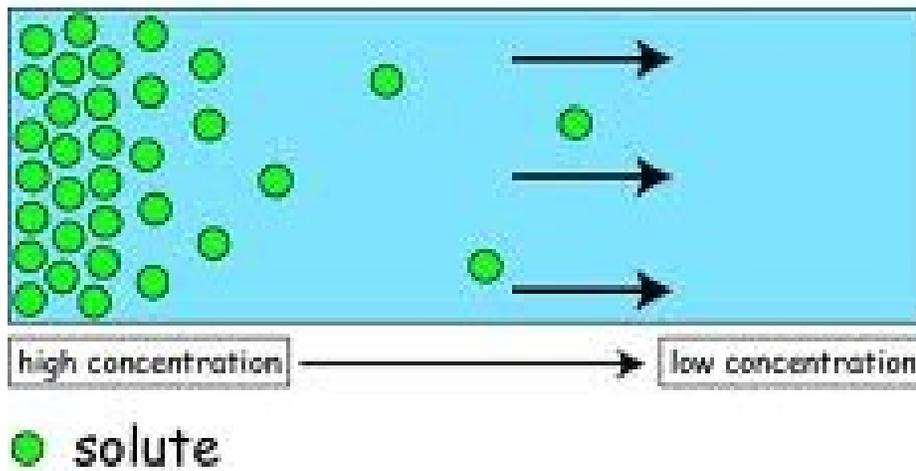
= movement of materials across a cell membrane without the cell using its own energy
(with the concentration gradient)

- modes of passive transport:

1. Simple Diffusion

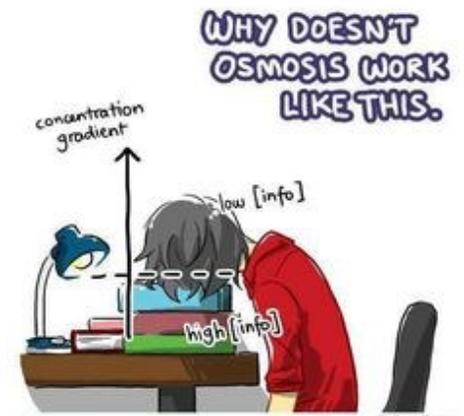
= the random movement of substance from an area of high concentration to an area of low concentration

- establish equilibrium (although motion is not stopped on the microscopic level)
- used for small, non-polar molecules, ions and gases
- factors affecting diffusion = concentration, temperature, & pressure



2. Osmosis

- is the diffusion of water
- as water molecules enter a cell, pressure occurs inside against the cell membrane
- in plant cells this pressure is referred to as **turgor pressure**
 - : gives plants their rigidity
 - : when turgor pressure = osmotic pressure, **equilibrium** is reached
- the type of solution the cell is in will affect osmosis:

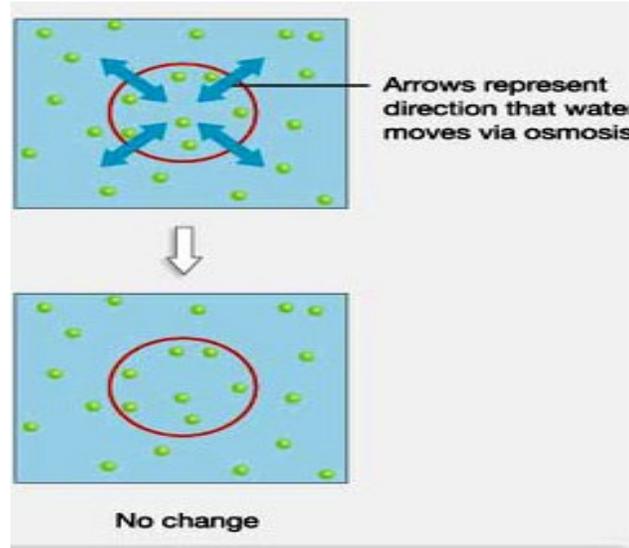


a) Isotonic Solution

: iso = **same**, tonic = **strength**

: solute concentration (**molecules dissolved in water**) inside the cell **equals** the solute concentration outside the cell

: is perfect for cells

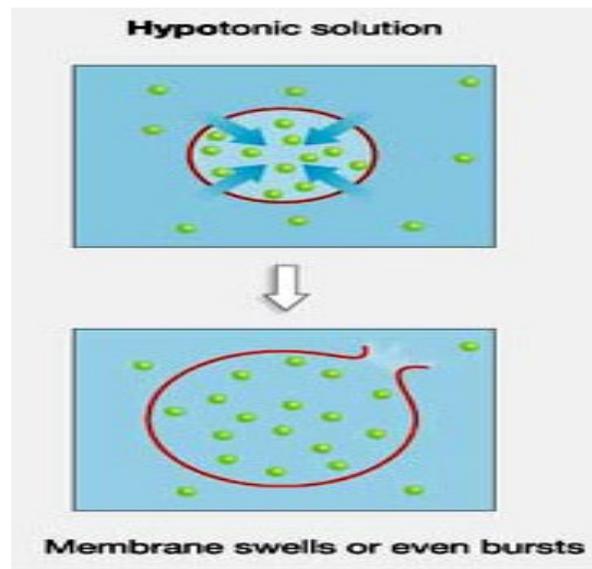


b) Hypotonic Solution

: hypo = **lower**

: solute concentration outside the cell **is less than** that found inside the cell

: water flows **inward** causing increased **pressure** within the cell



: the cell walls of plant cells allow them to withstand this pressure

: animal cells lack cell walls so would swell and eventually burst (**cytolysis**) therefore they have water removing mechanisms

- single celled organisms **have contractile vacuoles** (ie. Paramecium)

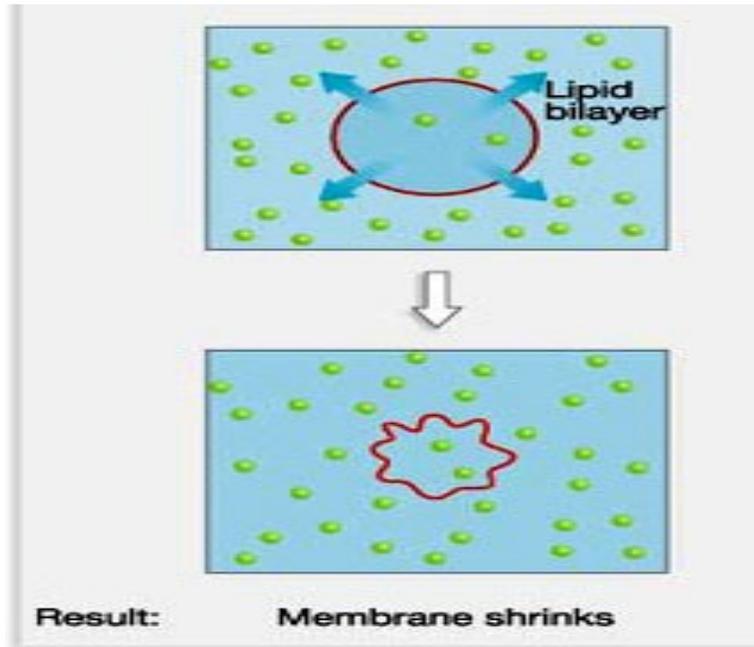
- multicellular organisms **have specialized organs** (ie. Kidneys, lungs sweat glands)

c) Hypertonic Solution

: hyper = **higher**

: solute concentration outside the cell is **greater** than that found inside the cell

: the organism loses water = **cells shrink**



: causes **plasmolysis** (a.k.a. Reverse osmosis)

- plants cell **wilt**

(caused by lack of water, excess fertilizer)

- animals cells **dehydrate**

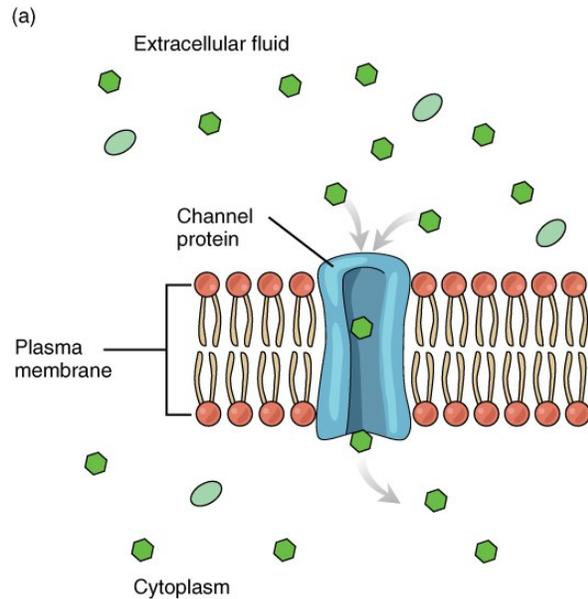
(caused by drinking salt water, swimming in high

content salt water, treating a cut with salt solution)



3. Facilitated Diffusion

- special **channel protein** molecules in the cell membrane speed up the movement of molecules **already** moving across the cell membrane
 - = it gets a '**fast pass**' (like at an amusement park)
 - very selective
 - ie. **Glucose diffuses into red blood cells 100's of times faster than other sugars)**



B) Active Transport

video : Active Transport <https://www.youtube.com/watch?v=2-icEADPOJ4&list=RDCMUCxby2oPQwaY2poKTg5pSRqA&index=1>

- = movement of substances across the cell membrane requiring the cell to use its own energy
- energy is needed to move molecules from an area of low concentration to an area of high concentration (against the concentration gradient)



- modes of active transport:

1. Facilitated Transport

= a 'protein pump'

- special protein carrier molecules in the cell

membrane receive an energy boost

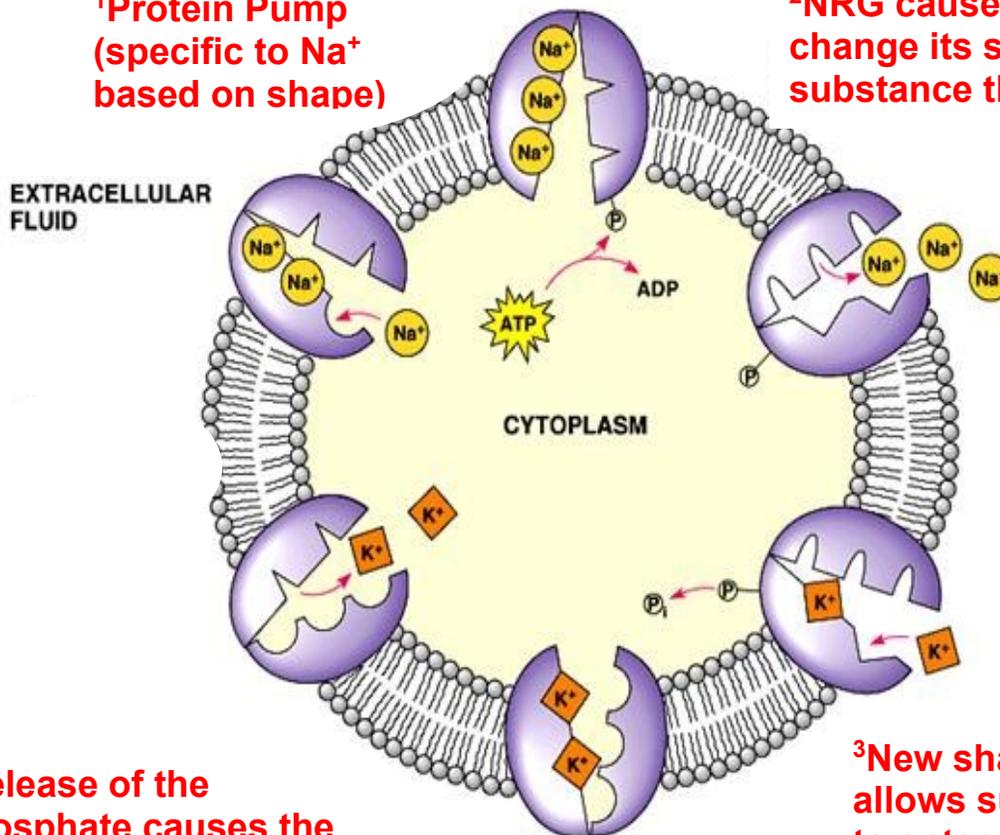
from the cell which helps them transport molecules against the concentration gradient*

- some actively pump materials out of the cell as well

- Energy used is in the form of ATP (Adenosine Triphosphate)

1 Protein Pump (specific to Na⁺ based on shape)

2 NRG causes the pump to change its shape forcing the substance through (Na⁺)

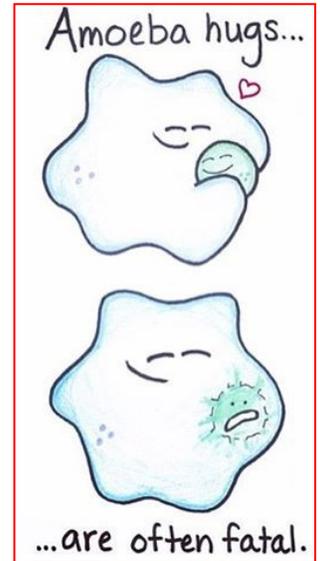


4 Release of the phosphate causes the pump to revert to original shape forcing Substance 2 (K⁺) through

3 New shape of pump allows substance 2 (K⁺) to enter

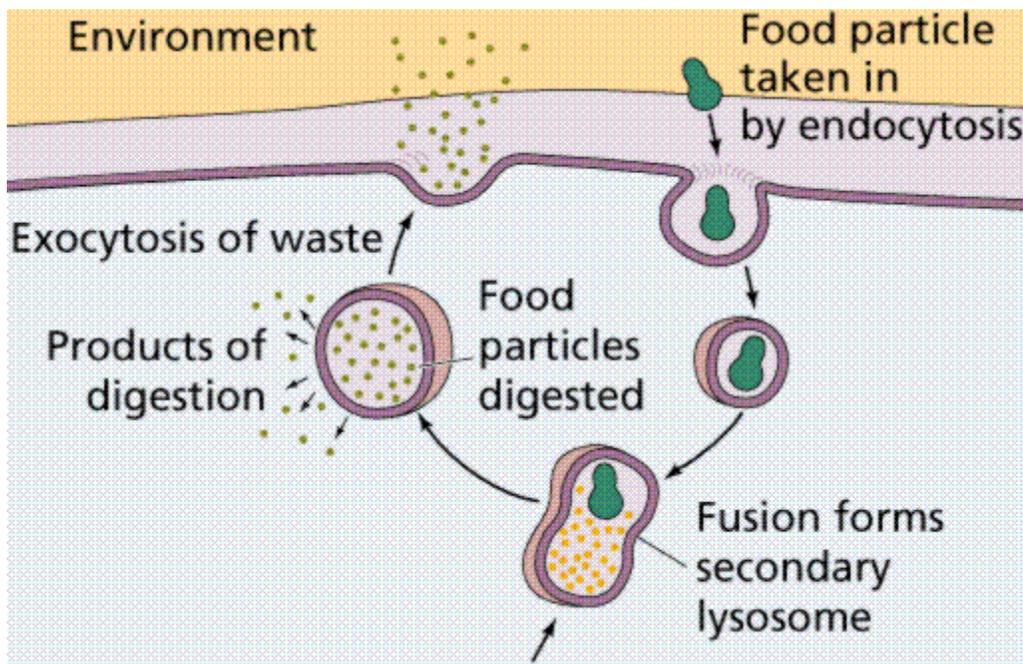
2. Endocytosis

- endo = into; cytosis = movement of substances within the cell by means of the cytoplasm
- transport of large molecules (ie. lipids, proteins, amino acids) into the cell by **engulfing (surrounding) the molecule with pseudopods until it has been enclosed within a vacuole**
- molecules are then digested by enzymes from the lysosomes
- two forms of endocytosis:
 - a) Phagocytosis
 - : process through which cells engulf **solid particles**
 - : ie. **amoeba, white blood cells**
 - b) Pinocytosis
 - : process through which cells engulf **liquid droplets**
 - : ie. **fat droplets** are engulfed by cells in the small intestine



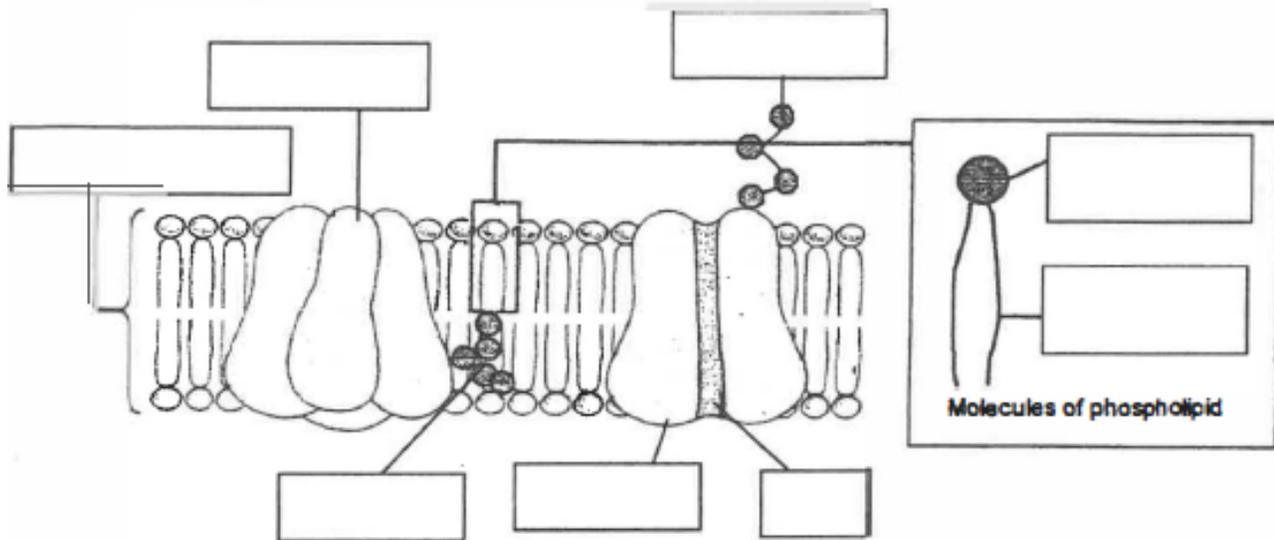
3. Exocytosis

- exo = out of
- large molecules (ie. wastes, excess water) are stored in vacuoles **which move to and join with the cell membrane expelling their contents**
- = opposite of endocytosis



WORKSHEET 3.2 The Structure of the Plasma Membrane

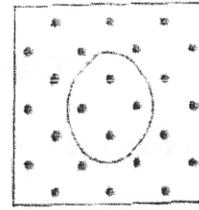
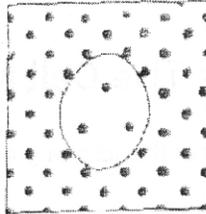
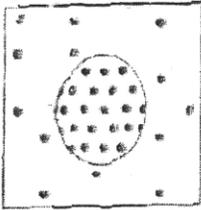
Label the structure of the plasma membrane in the diagram below.



1. The plasma membrane, according to the fluid-mosaic model is composed mainly of _____ and protein.
2. Each phospholipid molecule consists of two parts:
 - A polar head that gives it a _____ property so are attracted to water
 - A pair of non-polar tails that give it a _____ property so are repelled by water
3. In plasma membranes, phospholipids arrange themselves into two layers (bilayer).
 - The hydrophilic heads of the outer layer face the _____ fluid.
 - The hydrophilic heads of the inner layer face the _____ fluid.
4. The _____ acts as a barrier which isolates the two sides of the membrane.
5. The phospholipid bilayer also contains _____ which strengthens the membrane and links the fatty acids together.
6. Cholesterol makes the plasma membrane stable, stronger, more flexible and less permeable to water-soluble substances such as ions.
7. There are two different types of proteins.
 - _____ protein : the protein molecule that forms a canal or pore
 - _____ protein : the protein molecule that acts as a pumpBoth proteins are referred to as transport proteins.
8. Some membrane proteins lipids have branching carbohydrate chains attached to them on their outer surface form _____ and glycolipids respectively.

OSMOSIS

Label the pictures below (isotonic, hypertonic, or hypotonic)



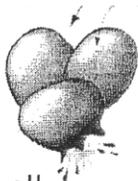
_____ tonic means there is a **GREATER** concentration of solute molecules **OUTSIDE** the cell than inside.

_____ tonic means there is a **LOWER** concentration of solute molecules **OUTSIDE** the cell than inside.

_____ tonic means there is the **SAME** concentration of solute molecules outside the cell as inside.

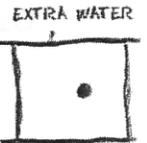
The pressure inside a plant cell caused by water pushing against the cell wall is called _____ pressure.

The **SWELLING AND BURSTING** of animal cells occurs because _____



Cells swell and burst

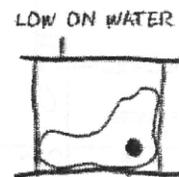
This happens when a cell is placed in a _____ tonic solution.



Placing plant cells in a **HYPOTONIC** solution causes the osmotic pressure to _____.

increase decrease

Plant cells will _____ when water leaves so the cell membrane away from the cell wall.



pulls

It happens when a plant cell is placed into _____ tonic solution.

When water leaves a plant cell, the osmotic pressure will _____.

increase decrease



Cells shrink and shrivel

ANIMAL cells that are placed in a **HYPERTONIC** solution will shrink because _____

Cells stay the same size when placed in an _____ tonic solution because the amount of water leaving the cell is the same and the amount of water entering.

Transport Across The Cell Membrane

Use Figure 1.25 on page 43 to help you answer the following 4 questions:

1. A cell that is 70 % water (30% concentrated) is placed into a 30 % sugar water solution, what will happen to the cell? Water will move ___?___ of the cell equally.

- a) in only b) in and out c) out only

2. A cell that is 60% water (40% concentrated) is placed into a 30 % sugar solution in water. What will happen to the cell? Water will ___?___ move the cell.

- a) into b) in and out c) out of

3. If a cell that is 80% water (20% concentrated) is placed into a 30% sugar in water solution, what will happen to the cell? Water will move ___?___ the cell.

- a) into b) in and out c) out of

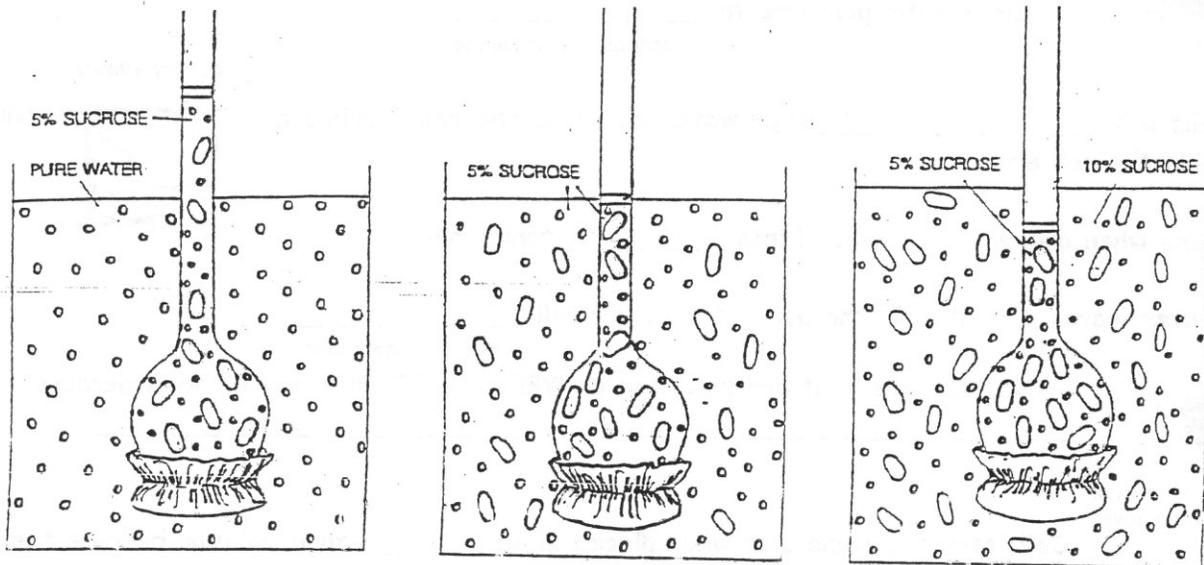
4. If a cell that is 80% water (20% concentrated) is placed into a distilled water solution, what will happen to the cell? Water will move ___?___ the cell.

- a) into b) in and out c) out of

Osmosis Diagram

A) Label each of the following diagram as being: **isotonic**; **hypertonic**; **hypotonic**

B) Using a **red pen**, draw arrows to indicate the direction of water flow for each diagram.



Cellular Transport Summary

Types of Transport	Active or Passive	With or Against Conc Gradient	What is used to help: Channel Protein Protein Pump Cytoplasm Nothing	Examples of Substances Transported This Way
DIFFUSION				
FACILITATED DIFFUSION				
OSMOSIS				
FACILITATED TRANSPORT				
ENDOCYTOSIS (phagocytosis)				
ENDOCYTOSIS (pinocytosis)				
EXOCYTOSIS				