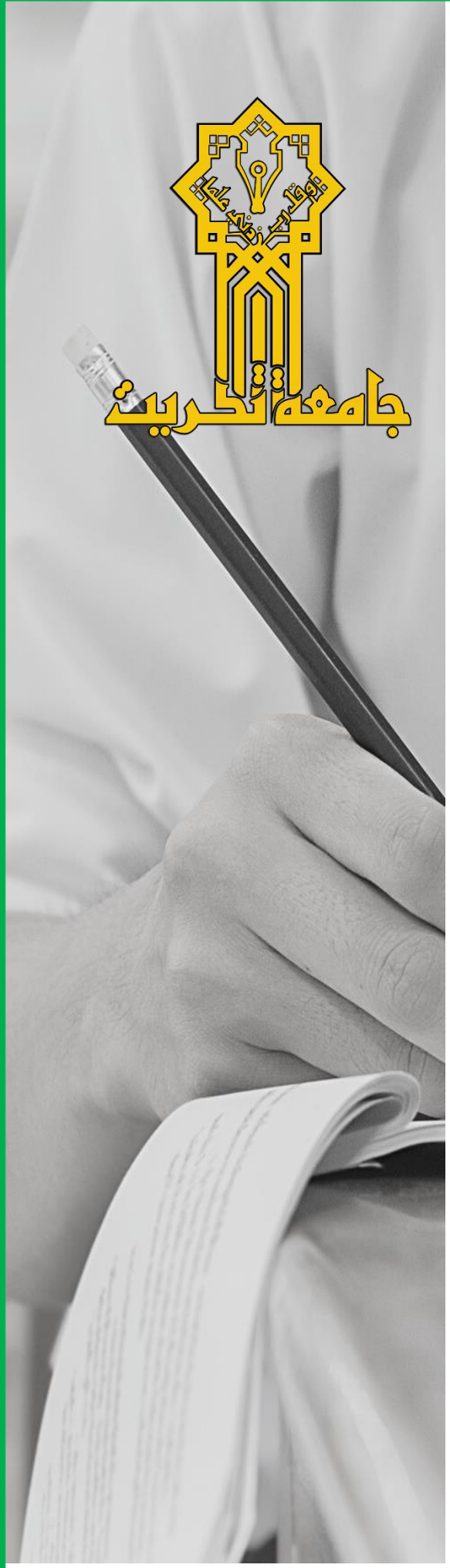

Tikrit University
College of Veterinary Medicine

Introduction to physiology

Subject name: physiology

Subject year: 2024

Lecturer name: Prof. Khalid A. Hadi

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SCAN ME
Lecturers link

Physiology

The task of physiological research

* How
* Why
* Influence of environment
* Adaptation and regulation

Physiology / is one of basic medical science that seeks to understand the function of living organisms and their constituent parts.

Body fluid (60% of body weight)

* Intracellular fluid (40%)
* Extracellular fluid (20%)
    - Plasma (5%)
    - Interstitial fluid (15%)
    - Lymph (<1%)
    - Cerebrospinal fluid (<1%)
    - Aqueous humor (<1%)

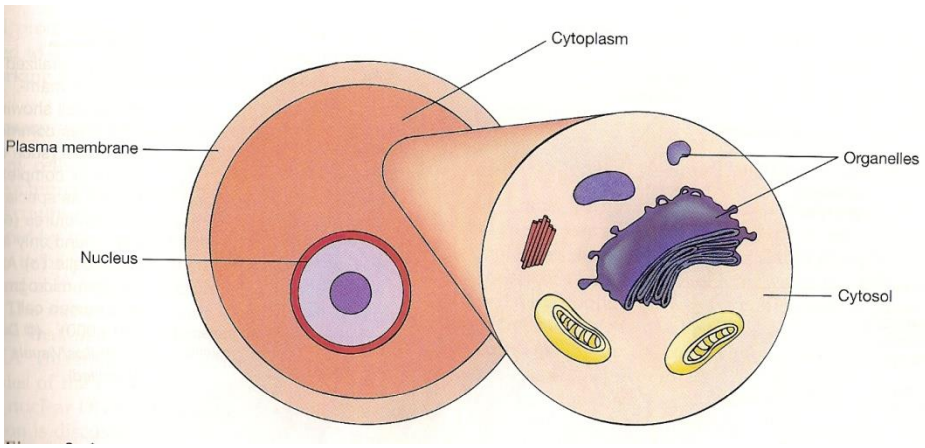
Cell

- Basic living unit of structure & fix of the body.

General Cell Structure & Function

Component	*Structure*	*Function*
Plasma (cell) membrane	Membrane composed of double layer of phospholipids in which proteins are embedded	Surrounds, holds cell together & gives its form; controls passage of materials into & out of cell
Cytoplasm	Fluid, jellylike substance , cell membrane & nucleus in which organelles are suspended	Serves as matrix substance in which chemical reactions occur.
Nucleus: - Nuclear envelope - Nucleolus - Chromatin	Double-layered membrane that surrounds nucleus, composed of protein & lipid molecules Dense nonmembranous mass composed of protein & RNA molecules Fibrous strands composed of protein & DNA	Supports nucleus & controls passage of materials , nucleus & cytoplasm Produces ribosomal RNA for ribosomes Contains genetic code that determines which proteins (including enzymes) will be manufactured by the cell

Plasma (cell) membrane



General composition of cell membrane

- Proteins ……. 55%
- Lipids …….. 41%
    - Phospholipids … 25%
    - Cholesterol ……. 12%
    - Glycolipids …….. 4%
- Carbohydrates …… 3%

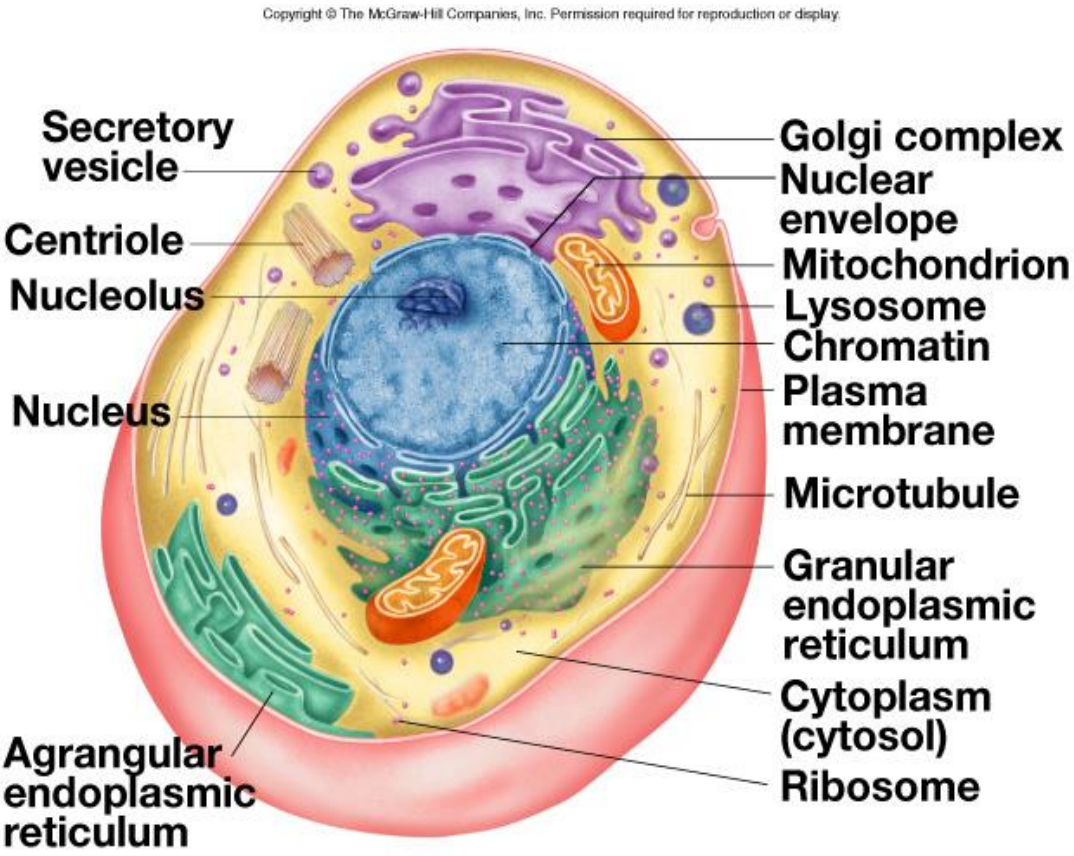
General functions of cell membrane proteins

1. Provide structural support.
2. Transport molecules across the membrane.
3. Enzymatic control of chemical reactions at cellular surface.
4. Some of it as receptors for hormones.
5. Some of it as regulatory molecules, that arrive at outer surface of the membrane.
6. Some serve as ‘markers’ (antigens), that identify tissue type of an individual.

General functions of cell membrane carbohydrates

1. Attach cells to each other.
2. Act as receptor substances.
3. Some enter in immune reactions.
4. Give most of cells overall surface charge, which affects the interaction of regulatory molecules w the membrane.

Cytoplasm & Organelles



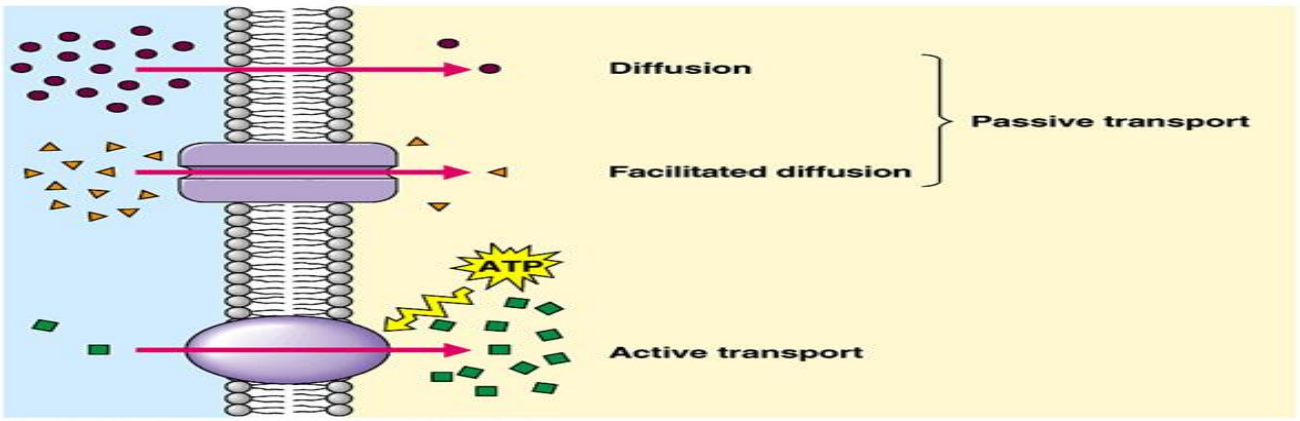
Cytoplasm

- The aqueous content of a cell (fluid, jellylike substance), that lies between cell membrane & nucleus in which organelles are suspended.
- Serves as matrix substance in which chemical reactions occur.
- 'cytosol' is the term used to describe fluid portion of the cytoplasm.

Component	Function
Endoplasmic reticulum	Agranular (smooth) ER metabolizes nonpolar compounds & stores Ca2+ in striated muscle cells; granular (rough) ER assists in protein sysnthesis
Ribosomes	Synthesize proteins
Golgi complex	Synthesizes carbohydrates & packages molecules for secretion. Secretes lipids & glycoproteins
Mitochondria	Release energy from food molecules & transform energy into usable ATP
Lysosomes	Digest foreign molecules & damaged organelles
Peroxisomes	Contain enzymes that detoxify harmful molecules & break down hydrogen peroxide
Centrosome	Helps to organize spindle fibers & distribute chromosomes during mitosis
Vacuoles	Store & release various substances within the cytoplasm
Microfilaments & microtubules	Support cytoplasm & work as cytoskeleton, transport materials within the cytoplasm
Cilia & flagella	Move particles along cell surface, or move the cell

<u>There are 2 types of cell membrane transport:</u>

- Passive Transport : Things flow from High to low
- Active Transport : Things flow from Low to high

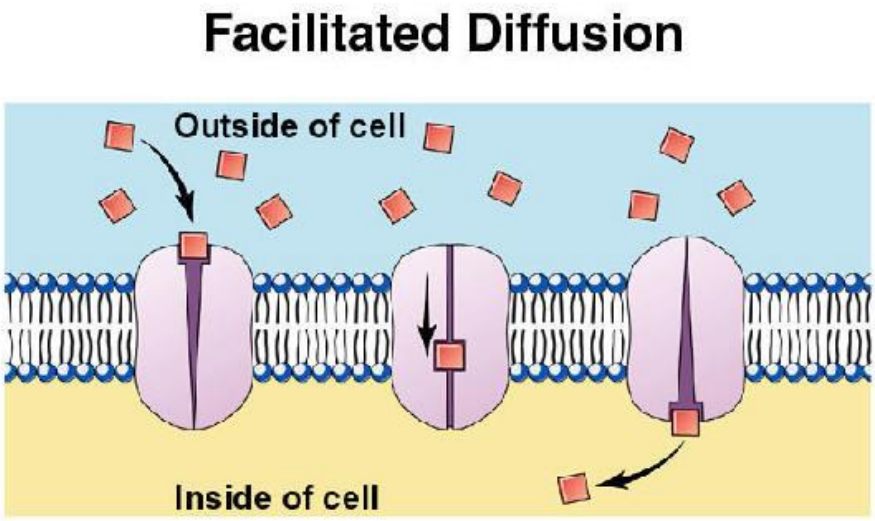


- Diffusion

movement of particles from areas of high concentration to low concentration

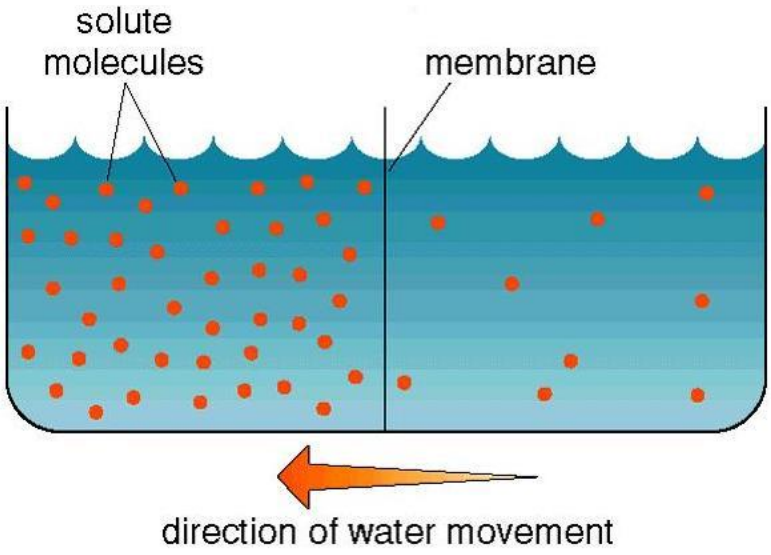
- Facilitated Diffusion

Particles flow from high concentration to low concentration but this time they need the help of proteins to get through the cell membrane.

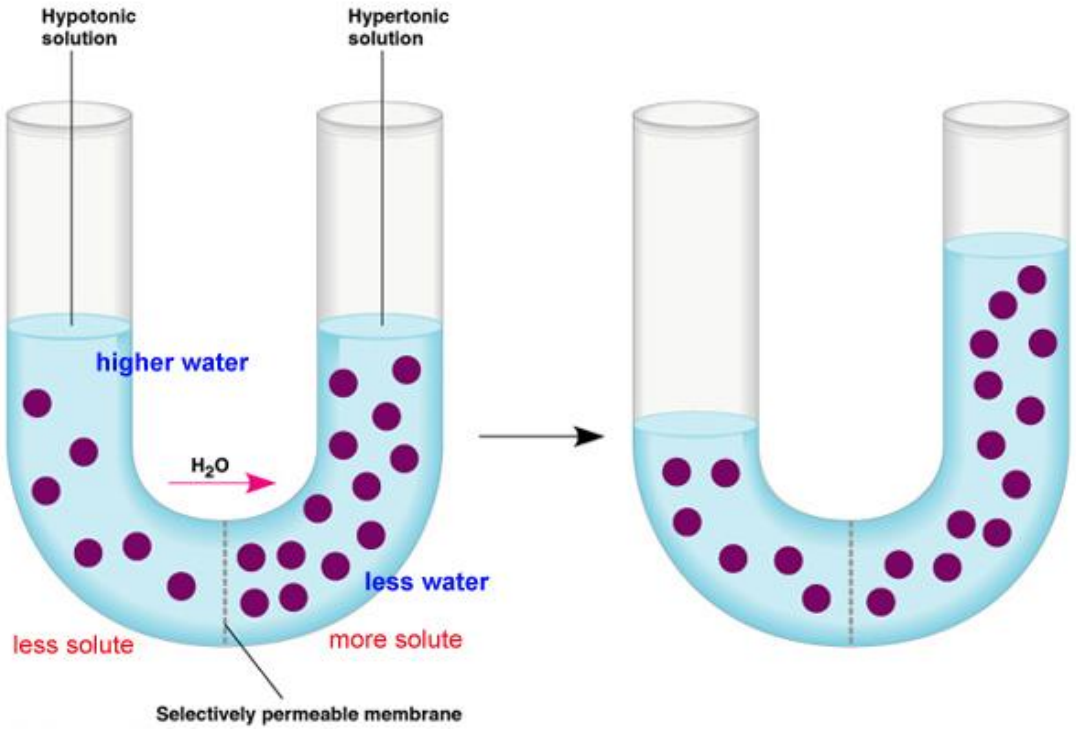


- Passive transport
- Osmosis

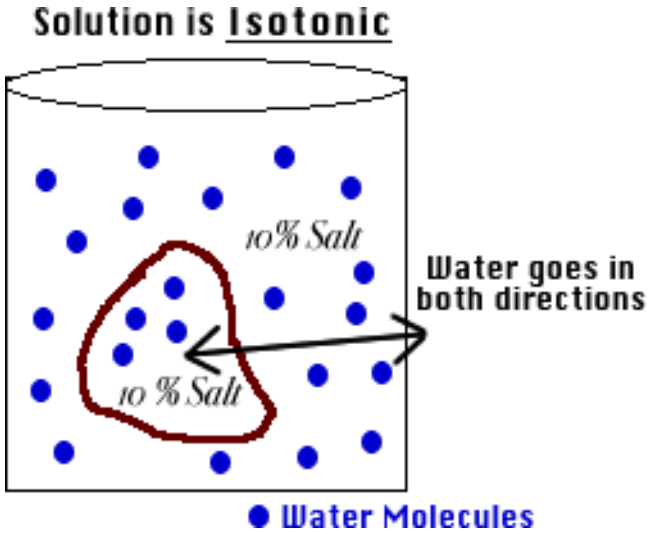
The diffusion of water across a selectively permeable membrane



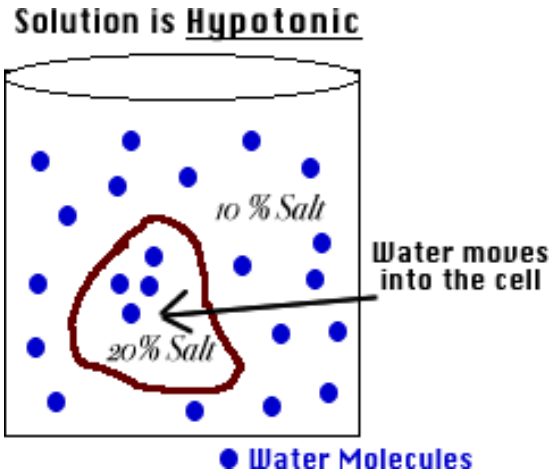
- Osmosis is controlled by the amount of solutes on either side of a membrane



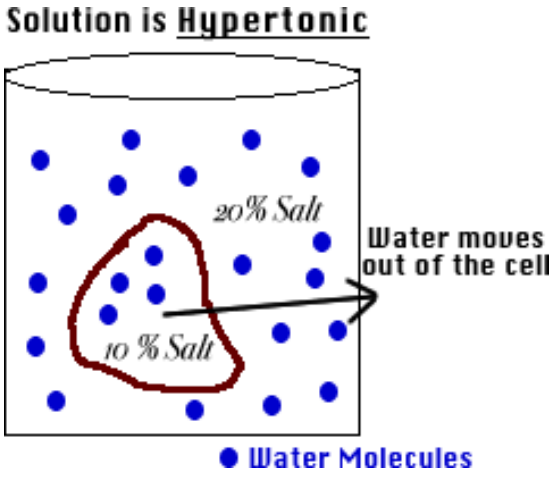
- Isotonic solution – Concentration of solute is the same in the cell and the area around the cell.



- Hypotonic Solution – Concentration of solute is lower in the solution than in the cell.

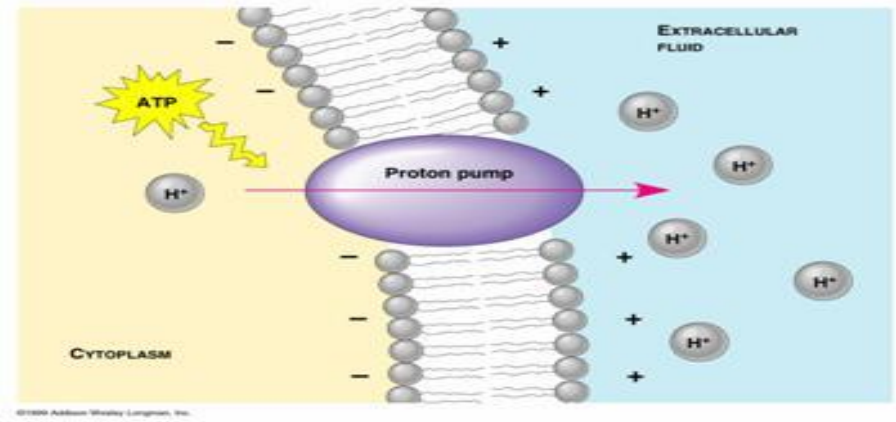


- Hypertonic solution – concentration of solute is higher in the solution than in the cell.



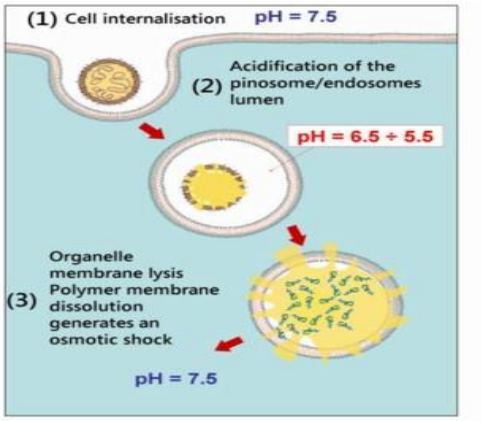
Active Transport

- Molecules move from low concentration to high concentration



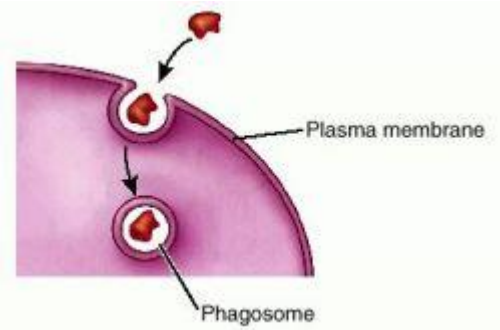
- Endocytosis

Engulfing of large particles or liquids from outside the cell



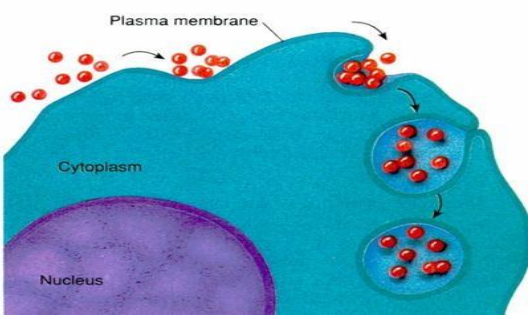
- Phagocytosis

Engulfing of large particles from outside the cell



- Pinocytosis

Engulfing of liquids from outside the cell



- Exocytosis

Release of large particles or liquids from inside the cell

The Nervous System

The Nervous System consist of :

1- Central Nervous System (CNS)
2- Peripheral Nervous System (PNS)

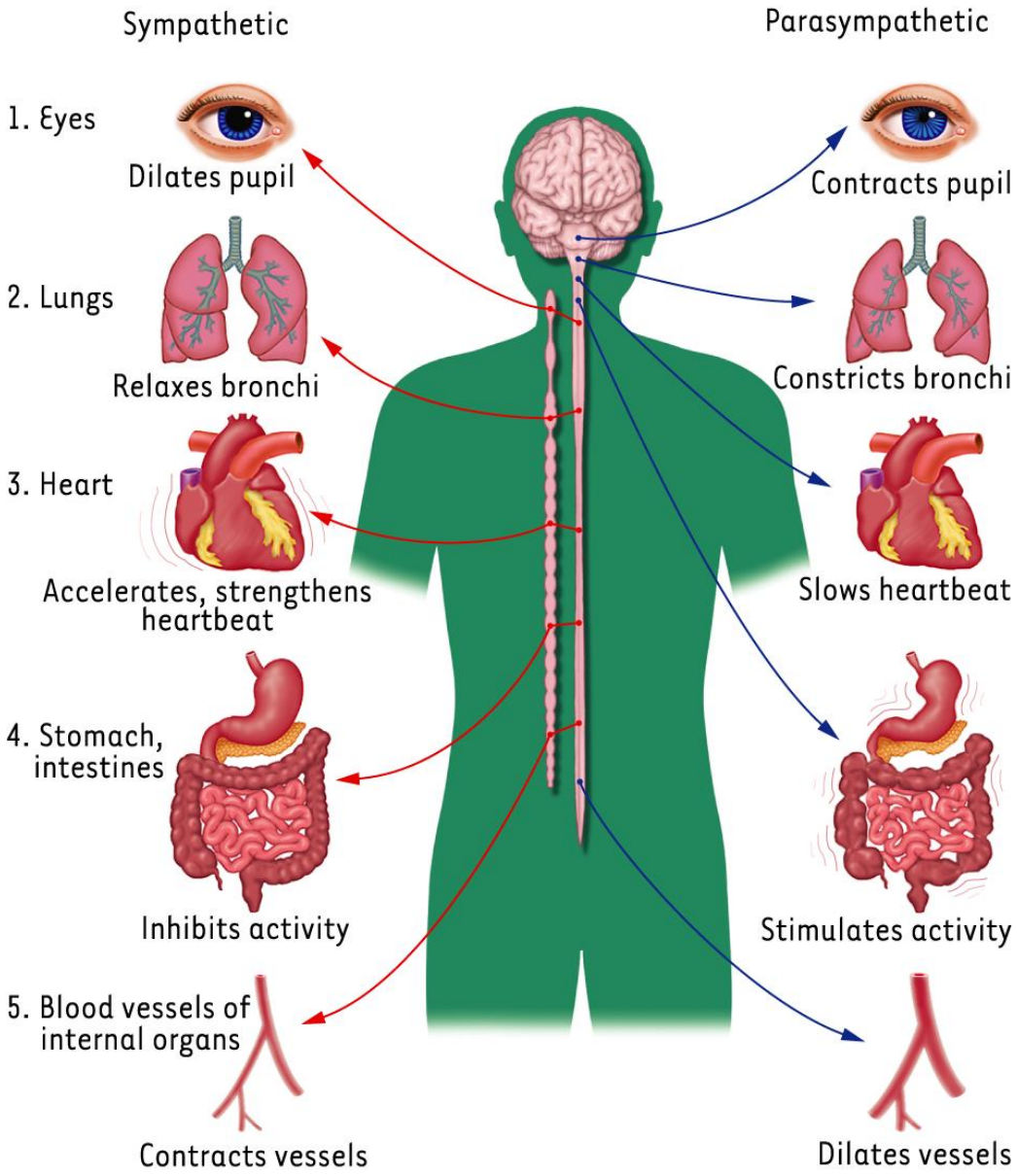
Central Nervous System (CNS) consist of : Brain and spinal cord

Peripheral Nervous System (PNS) consist of : Motor Neurons and Sensory Neurons

- Motor Neurons consist of :Somatic Nervous System (voluntary movements via skeletal muscles) and Autonomic Nervous System (Sympathetic and Parasympathetic in organs, smooth muscles)

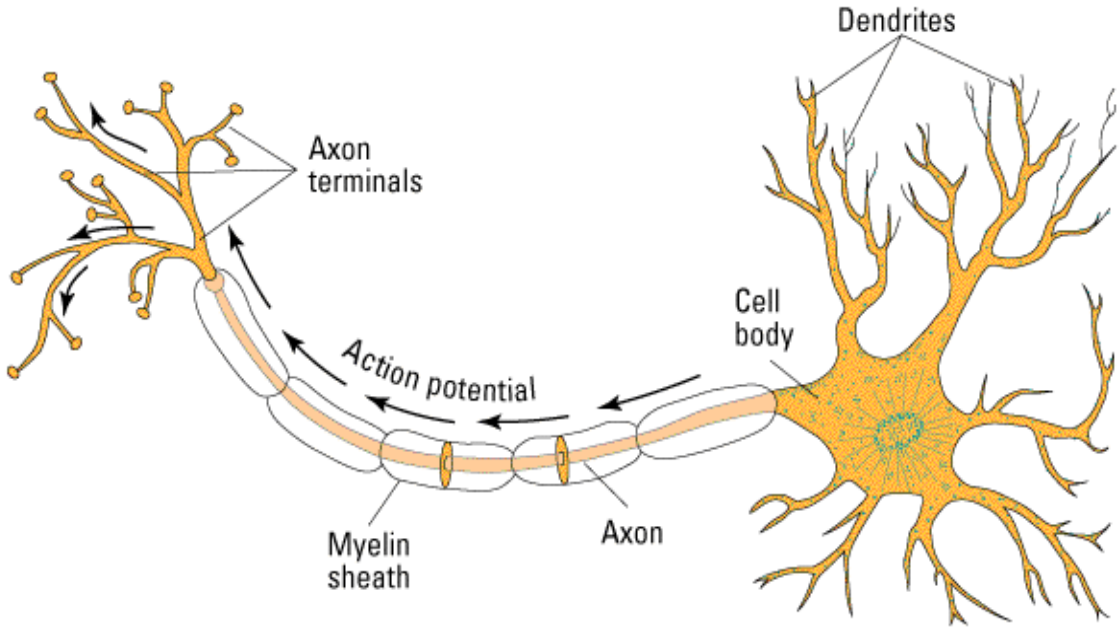
The sympathetic division of the nervous system prepares the body for action, whereas the parasympathetic returns it to a resting state.

Divisions of the autonomic nervous system



Cells that make up the Nervous System (*Neurons* and *Glial Cells*)

Neurons: An single nerve cell is called a neuron. There are about a trillion neurons in the human nervous system.

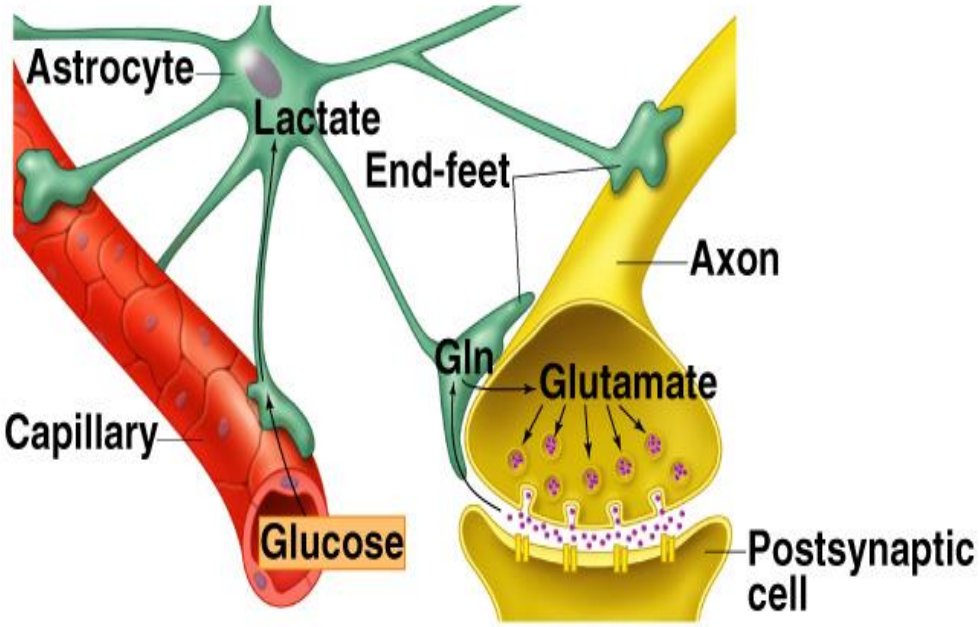


Glial cells: are the other major cell type that make up the nervous system. Glial cells are also called neuroglia. There are four major types of glial cells in the CNS – (astrocytes, oligodendrocytes, microglia and ependymal cells). Unlike neurons, glial cells do not conduct nerve electrical signals**.**

1- Astrocytes

"Astro" means "star" and "cyte" means cell. Astrocytes are so named because they have a star-like shape. They are the most abundant glial cells and have the following crucial functions:

- They act as a "glue" to hold neurons together in their proper positions.
- They cause the small blood vessels in the brain to change and establish the blood-brain barrier.
- They help in repairing brain injuries .
- They play a role in neurotransmitter activity by bringing the actions of some chemical messengers to a halt by taking up the chemicals.
- They also break down these taken-up chemicals and transform them into raw materials that are used to make more of these neurotransmitters
- They take up excess potassium ions from brain fluid to help stabilise the ratio between sodium and potassium ions



2- Oligodendrocytes

Oligodendrocytes form sheaths around the axons of the CNS that serve as insulation. These sheaths are made of myelin, which is a white material that enables the conduction of electrical impulses.

3- Microglia

Microglia act as the immune defence cells of the CNS.

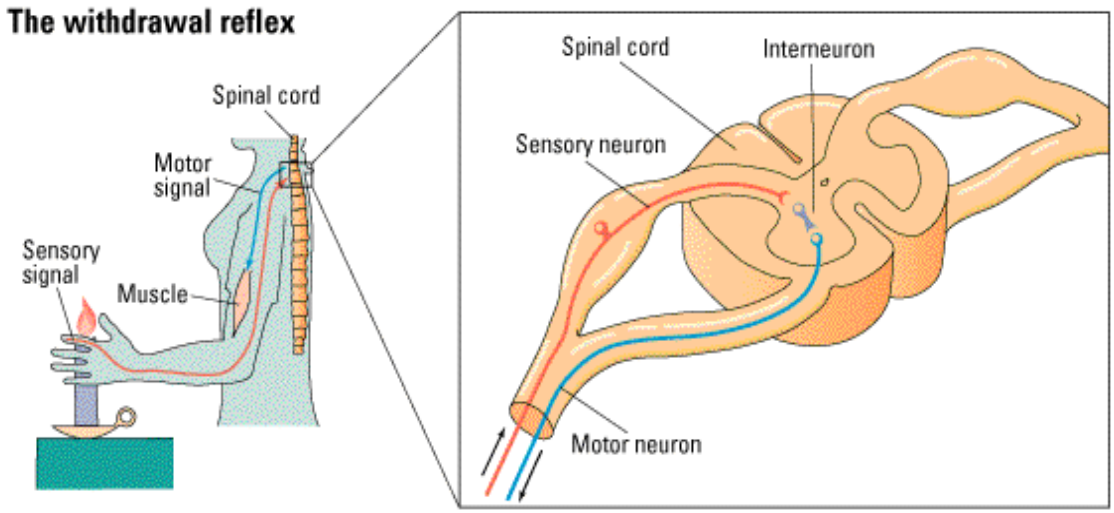
4- Ependymal Cells

Ependymal cells line the internal cavities of the CNS. The ependymal cells that line the cavities of the brain also contribute to the formation of cerebrospinal fluid (CSF). These cells have tail-like projections called cilia. The beating of this cilia assists the flow of CSF throughout the brain cavities.

Three parts types of neurons

- Sensory Neurons
- Interneurons

- Motor Neurons



Neural Anatomy

Dendrite

the bushy, branching extensions of a neuron that receive messages and conduct impulses toward the cell body

Axon

the extension of a neuron, ending in branching terminal fibers, through which messages are sent to other neurons or to muscles or glands

Synapse

junction between the axon tip of the sending neuron and the dendrite or cell body of the receiving neuron

tiny gap at this junction is called the *synaptic gap* or *cleft*

Resting Membrane Potential

Membrane potential at which neuron membrane is at rest, ie does not fire action potential and Written as Vr

Ionic Equilibrium Potential

Membrane Potential (potential difference across the plasma membrane) at which the net flow of an ion type = zero

The number of ions moving into the cell = the number of ions moving out of the cell for a particular species of ion

Action Potential

When dendrites stimulated, the delicate balance is altered Membrane breaks down

Positively charged ions rush in (depolarization)

Charge = less negative

Causes release of chemicals from terminal buttons

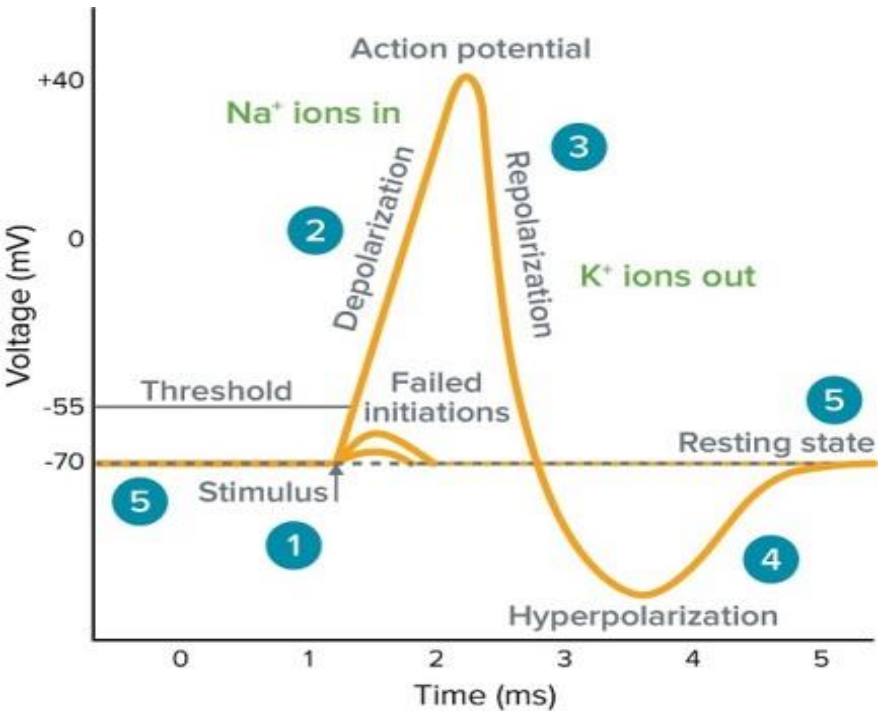
Action potential is the state of the neurone membrane when a nerve impulse passes by A small change in the membrane voltage will depolarise the membrane enough to flip open Na^+ channels

These are called **voltage-gated Na^+ channels**

As Na^+ moves into the cell more and more Na^+ channels open

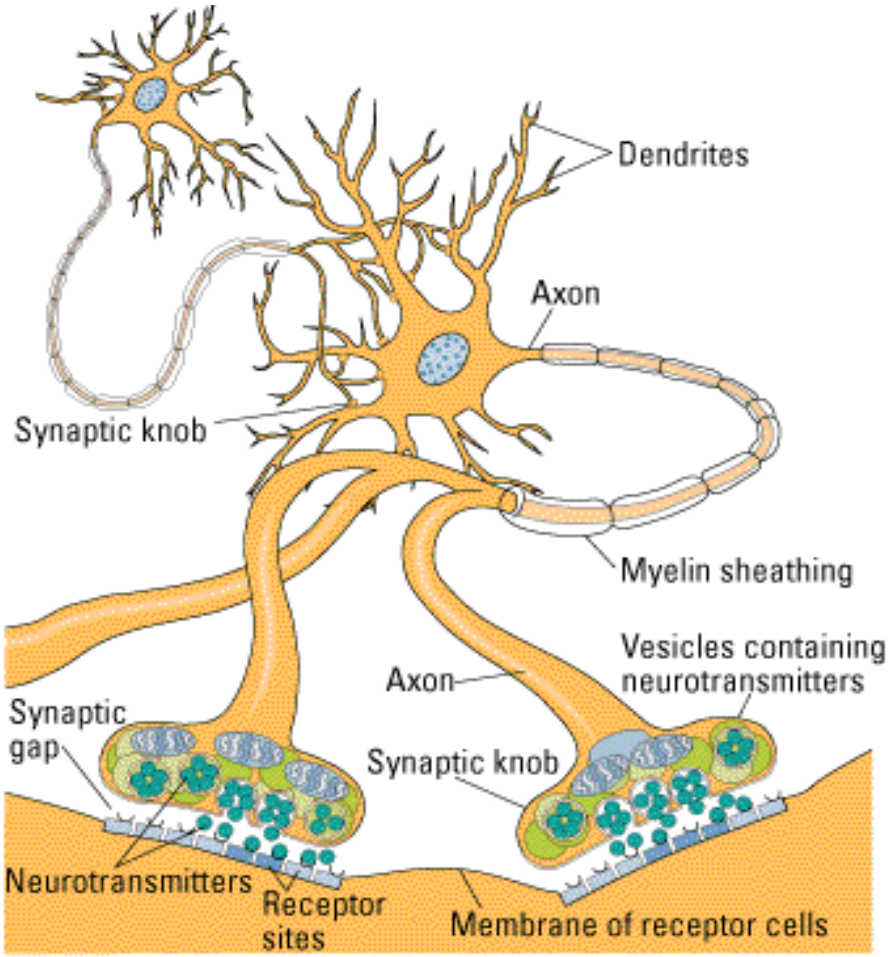
A small change in the membrane permeability to Na^+ results in a **big change** in membrane potential

threshold the minimum value of membrane current or membrane potential necessary to induce an action potential



Communication

- Impulse releases neurotransmitter from vesicles
- Neurotransmitter enters synaptic gap
- Neurotransmitter binds to receptors on the receiving neuron



Myelin Sheath

– Fatty material made by glial cells

– Insulates the axon

– Allows for rapid movement of lectrical impulses along axon

– Nodes of Ranvier: gaps in myelin sheath where action potentials are transmitted

Neurotransmitters

chemical messengers that traverse the synaptic gaps between neurons when released by the sending neuron, neurotransmitters travel across the synapse and bind to receptor sites on the receiving neuron, there by influencing whether it will generate a neural impulse

Q1 / Define the physiology, cytoplasm , Neurotransmitters , osmosis , diffusion , action potential .

Q2 / enumerate components of cell and explain the function of each one .

Q3 / enumerate functions of proteins in cell membrane .

Q4 / enumerate functions of carbohydrate in cell membrane .

Q5 / explain in details mechanism of action potential with drawing .

Q6 / fill in the blanks :

Endocytosis : ……

Phagocytosis : .....

Pinocytosis : .....

Exocytosis : .....

Q7 / enumerate cells that make up Nervous System and explain functions of (any one) ?