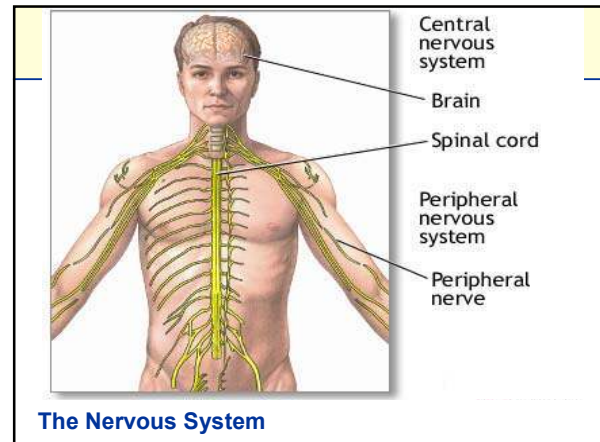


CENTRAL NERVOUS SYSTEM

Presented by:

Nweboh Malaika Nain



Central Nervous System

- CNS: brain and spinal cord
- Necessary for the maintenance of homeostasis
- Contains 10^{11} neurons
- Contains 10^{14} synapses
- Responsible for everything we perceive, do, feel, and think
- Protected by the skull (brain) and vertebrae (spinal cord), CSF and meninges

- From inside the layers of the meninges include;

- Dura mater

- Arachnoid and

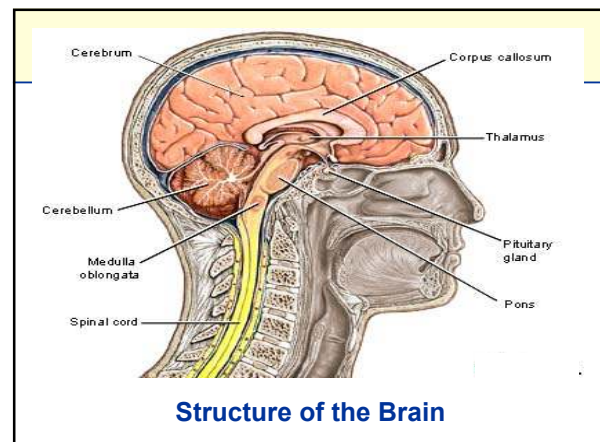
- Pia mater

- Between the arachnoid and pia mater is the sub arachnoid space which is filled with CSF



1. The Brain

- 1^o receiver, organiser and distributor of information of the body.
- < 1 pound at birth and ~ 3 pounds by age 20
- Apart from neurones, important brain cells are glia cells
- Enclosed within the skull
- Separated from the blood stream by the blood brain barrier



Blood-Brain Barrier

Special anatomy of CNS capillaries which limit exchange

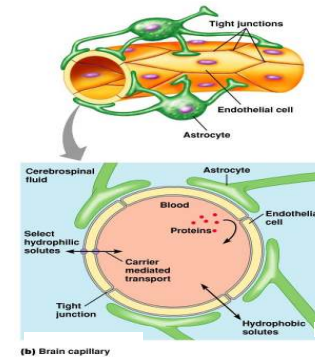
Separation of circulating blood and CSF in CNS

Consists of tight junctions around the capillaries

Allows diffusion of small hydrophobic molecules

Restricts diffusion of large hydrophilic molecules

Blood-Brain Barrier

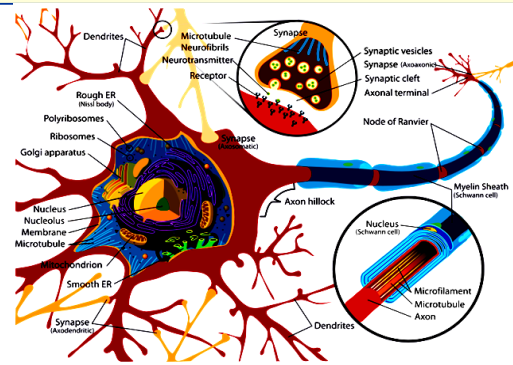


The Brain

- Receives sensory input from spinal cord as well as from its own nerves

- Processes its various inputs and initiates appropriate and coordinated motor output

The Neuron

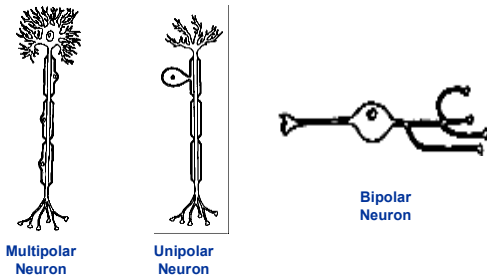


THE NEURONS

- Basic functional unit of the nervous system
- Consist of a cell body, axon and dendrite
- Neurons transmit impulses all over the body
- Functionally there are 3 types,
 - Sensory
 - Motor
 - Interneurons which are exclusive to the CNS
- Structurally there are 3 types

- Bipolar neuron has two processes; 1 axon and 1 dendrite. They are sensory neurons in the retina of the eye
- Unipolar neuron has only one process from the cell body. Conducts impulses to the CNS
- Multipolar has lots of dendrites and one axon. Could either be motor and cause muscle contraction or association neurones conducting and permitting communication in CNS

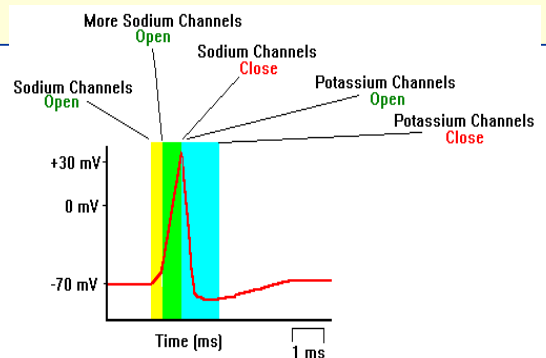
Types of Neuron



- Neurons are able to ;
 - Receive stimuli
 - Conduct impulses
 - Communicate with each other and with other cells like muscle cells
 - Impulses are conducted via action potentials

Action Potential

- This is a very rapid change in membrane potential
- It occurs when the nerve cell membrane is stimulated
- The membrane potential goes from -70mV to +30mV
- It occurs when the membrane is stimulated enough so that Na^+ open completely
- The minimum stimulus needed to achieve an action potential is called the threshold stimulus.



Graphical Representation of Action Potential

Steps involved

- At rest the inside of the membrane is more negative with resting membrane potential (RMP) -70mV
- Na^+ moves into the cell causing an action potential
- Influx of Na^+ makes the inside more positive
- K^+ flow out of the cell restoring the resting potential net charges
- Na^+ is pumped out and K^+ is pumped inside restoring RMP

Conduction Velocity

- Impulses travel along neurons at a speed of between 1-120m/s
- Speed of conduction can be influenced by ;
 - Diameter of the fibre
 - Presence or absence of myelin

Synapse

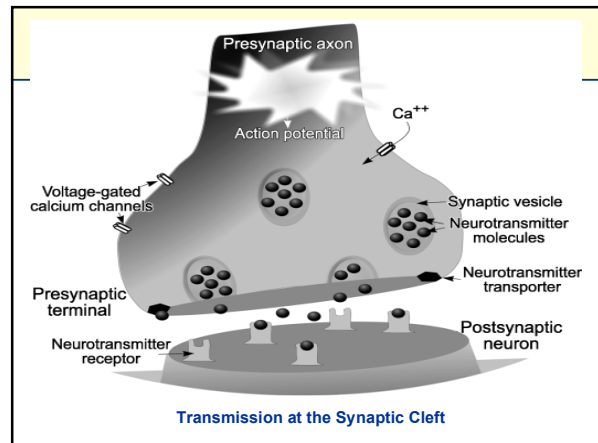
- Small gaps separating neurons
- Synapses consist of
 - Presynaptic ending
 - Post synaptic ending and
 - synaptic cleft
- Action potentials cannot cross the synaptic cleft
- Nerve impulses are carried by neurotransmitters

Transmission of impulses across the synaptic cleft

- Action potential reaches the pre synaptic cleft
- Voltage gated Ca^{2+} channels open and Ca^{2+} flow in
- Synaptic vesicles fuse with the membrane
- Neurotransmitters bind to neuroreceptors on Post synaptic membrane
- Causing Na^+ channels to open and Na^+ flows into the post synaptic membrane

Transmission across synaptic cleft (continues)

- Action potential is initiated if threshold is reached
- Neurotransmitter is either
 - broken down by the enzymes near the receptors
 - Quickly pumped back into presynaptic nerve terminal via transporters
 - Diffuse into the surrounding area



Types of Synapses

- Excitatory Ion Channel Synapse
- Inhibitory Ion Channel Synapse
- Non Channel Synapse involved in longlasting responses like learning and memory
- Electrical synapses which are very fast and quite rare occuring in the heart and eye

Neurotransmitters

- Compound that bind to receptors on neurons and either stimulates or inhibits action potentials
- The main function is to activate one or more types of receptors
- Commonly used neurotransmitters include;
 - GABA, inhibitory in the brain and Glycine inhibitory in the spinal cord
 - Glutamate, excitatory at both brain and spinal cord
 - Substance P, transmission of pain from sensory neurons to CNS

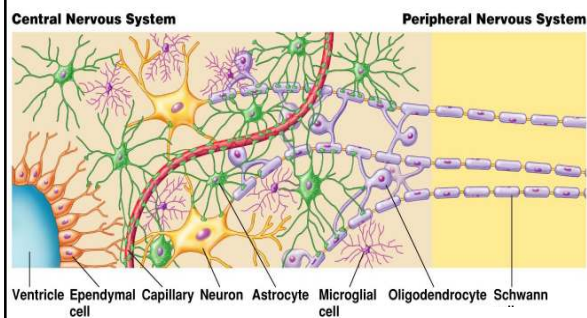
Neurotransmitters (continues)

- Serotonin, regulates appetite, sleep, temperature, mood etc
- Dopamin

Glial Cells

- 90% of CNS composed of glia
- Five types of glial cells
 - Astrocyte—repair neurons, structural support, suck up excess neurotransmitters
 - Ependymal cells—line cavities
 - Microglia—phagocytes
 - Oligodendrocytes—form myelin
 - Schwann cells (located in PNS)—form myelin

Glial Cells



Functions of the different parts of the brain

Medulla (also called medulla oblongata) –

- continuous with spinal cord 2 - contains ascending & descending tracts that communicate between the spinal cord & various parts of the brain
- contains 3 vital centers:
 - cardioinhibitory center, which regulates heart rate
 - respiratory center, which regulates the basic rhythm of breathing
 - vasomotor center, which regulates the diameter of blood vessels
- origin of five cranial nerves

Pons –

- 1 - Bridge connecting spinal cord w/ brain & parts of brain w/ each other
- 2 - Origin of four cranial nerves
- 3 - contains pneumotaxic center (a respiratory center)

Hypothalamus

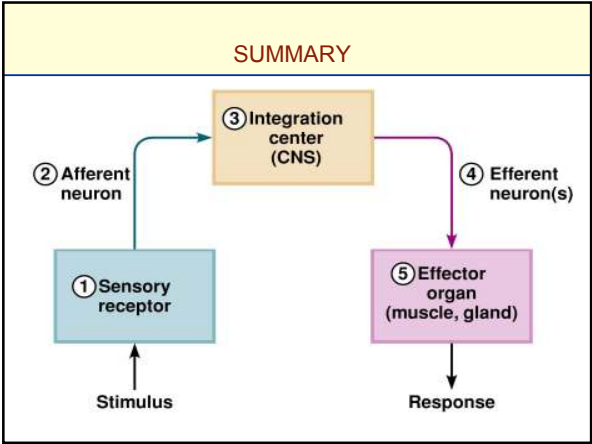
- 1 - Control of Autonomic Nervous System 2 - Reception of sensory impulses from viscera
- 3 – Main neural control centre
- 4 - Control of body temperature

Cerebellum (little Brain)

- functions in coordination, maintenance of posture, & balance

Cerebrum

- Occipital lobe; Visual processing
- Temporal lobe; Perception and recognition of auditory stimulus
- Parietal lobe: Interpretation of pain
- Frontal lobe: Associated with reasoning, parts of speech etc.



**THANKS FOR YOUR KIND
ATTENTION**