Anatomy of Nervous system : **Anatomically the nervous system is divided into :**

A- Somatic nervous system :

I-Central N.S. : (CNS) that include brain & spinal cord .

II- Peripheral N.S. : that include peripheral nerves & ganglia

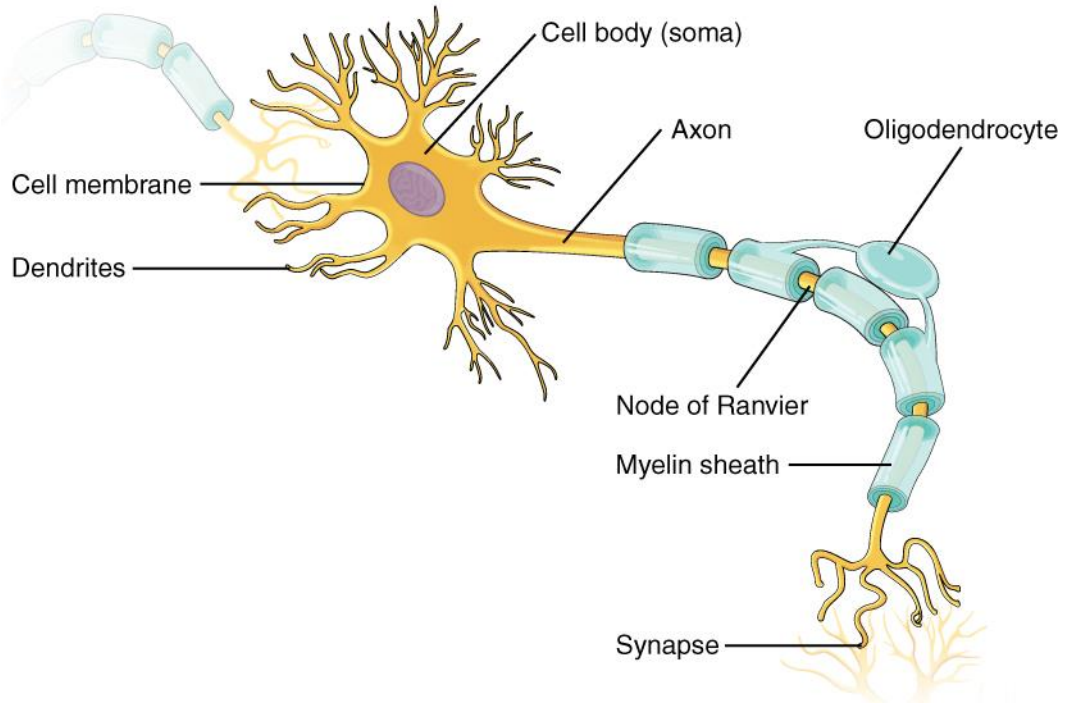
B - Autonomic nervous system:

1- sympathetic

2- parasympathetic

Histologically the N.S. is consist of neurons & supporting tissues .The neuron is consist of :

1. **cell body (soma) with dendrites**
2. **axon with or without myelin sheath**



The neuron can be generate & propagate a bioelectrical changes in their limiting membrane which is called *the action potential*

I -The Central N.S.: **is consist of :**

❖ **Brain :** **is one of the largest and most complex organs in the human body. It is made up of more than 100 billion nerves that communicate in trillions of connections called synapses.**

The brain is made up of many specialized areas that work together :

Brain is consist of the following parts :

- ***Cerebrum:*** **is the largest part of the brain and is composed of right and left hemispheres. It performs higher functions like interpreting touch, vision and hearing, as well as speech, reasoning, emotions, learning, and fine control of movement. It is divided into several lobes as :**

  1.The frontal lobes are responsible for problem solving and judgment and motor function

  2.The parietal lobes manage sensation, handwriting, and body position

  3.The temporal lobes are involved with memory and hearing

  4.The occipital lobes contain the brain's visual processing system

- ***The cortex*** **is the outermost layer of brain cells . Thinking and voluntary movements begin in the cortex.**

- ***The brain stem :*** **acts as a relay center connecting the cerebrum and cerebellum to the spinal cord. It performs many automatic functions such as : breathing , heart rate, body temperature, wake and sleep cycles, digestion, sneezing, coughing, vomiting, and swallowing .**

- ***The basal ganglia:*** **are a cluster of structures in the center of the brain. The basal ganglia coordinate messages between multiple other brain areas.**

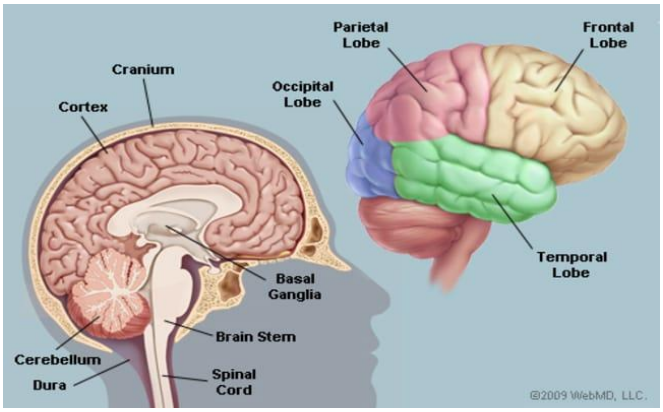
- ***The cerebellum :*** **is at the base and the back of the brain , located under the cerebrum . Its functions are:**

1- coordination of muscle movements .

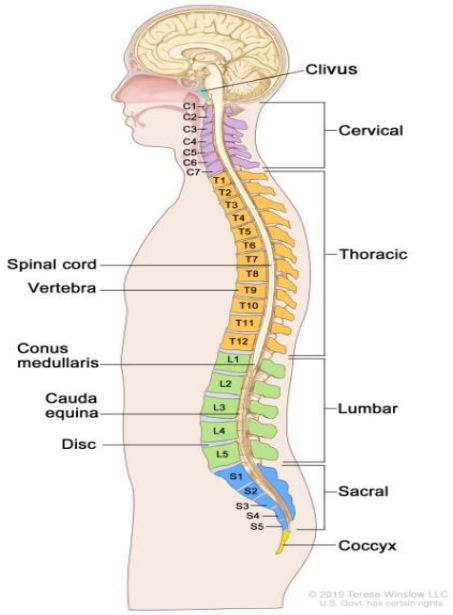
2- maintain posture, and balance.

The brain is surrounded by a layer of tissue called the meninges. The skull (cranium) helps protect the brain from injury.

- ***medulla oblongata :*** **Which continue to pass through foramen magnum to the beginning of the spinal cord .**



❖ **Spinal cord :** **Is a tubular bundle of nervous tissue and supporting cells that extends from the brain stem (medulla oblongata) to the lumbar vertebrae. Surrounded by the spinal meninges containing cerebrospinal fluid.**



❖ The Meninges:

There are three layers of membranes known as meninges protect the brain and spinal cord :

1. **The delicate inner layer is the pia mater.**
2. **The middle layer is the arachnoid, a web-like structure filled with fluid that cushions the brain.**
3. **The tough outer layer is called the dura mater.**

❖ Cerebro-Spinal fluid (C.S.F) :

The fluid that present in the subarachnoid space , its colorless fluid, similar to the lymphatic fluid in their continence and function .It's used for the diagnosis some disease through lumber puncture.

II-Peripheral N.S. : **Is including :**

1. cranial nerves :

(12) pairs (which supply the head and neck except vagus nerve (tenth) supply the thoracic and abdomen structures).

1. Olfactory / (smell)

2. Optic nerve / (transforms information about vision)

3. Oculomoter nerve / (rotating eyeball)

4. Trochlear / (handling and turning the eye).

5. Trigeminal / (sensory functions related to nose, eyes, tongue and teeth).

6. Abducent / (turning eye laterally).

7. Facial / (different types of facial expressions).

8. Vestibulocochlear / (balance of head and hearing)

9. Glossopharyngeal / (swallowing food).

10. Vagus / (pharynx, larynx, esophagus, trachea, bronchi, some portion of heart and palate).

11. Spinal accessory nerve / (spinal cord)

12. Hypoglossal nerve / (muscles of tongue)

2.Spinal nerves: which are (31) pairs

1. **Cervical (8) pairs**
2. **Thoracic (12) pairs**
3. **Lumbar (5) pairs**
4. **Sacral (5) pairs**
5. **Coccygeal (1) pair**

The spinal nerves that arise from the end of the spinal cord are bundled together, forming a structure known as the cauda equina

The synapse :

Is the junction between two neurons . The 1st. that contributing the axon or axon terminals is called pre synaptic neuron & the 2nd. that contributing the dendrites is called post synaptic neuron . The synapse permits conduction of impulses in one direction only from pre synaptic to post synaptic neuron .

The transmission of the impulses may be :

1. **At most junctions is chemical . The impulse in pre synaptic axon terminals will liberates chemical mediators (neurotransmitter) by exocytosis .**
   Theses mediators include :
   ***Acetyl choline (Ach)**
   ***** **nor epinephrine (nor adrenaline)**

Then the neurotransmitter bind to the receptors on surface of postsynaptic cell.

2. **Some of junction is electrical.**
3. **Few of junctions are conjoint synapses the transmission is both chemical & electrical.**

The reflex :

Is involuntary activity of the effecter organ . The reflex action is initiated by an input stimulus & results an out put response . The basic unit of integrated neural activity is called the reflex arc .

The reflex arc is consist of :

1. **Receptor organ (sensory organ) , which act as transducer to transform the different forms of energy in external & internal environment of the subject into action potential in nervous system.**

   The forms of the energy may be :

   a- mechanical → touch & pressure
   b- chemical → odor, taste, O2 content of the blood
   c- thermal → hot & cold
   d- electromagnetic → light

2. **Afferent neuron (sensory neuron)**
3. **One or more synapses in brain or spinal cord.**
4. **Efferent neuron (motor neuron)**
5. **Effecter organs : * muscle (skeletal, smooth & cardiac) *glands**

❖ ***Examples of reflexes within brain are :***

Light reflexes **Corneal reflexes** **Salivatory reflexes**
Swallowing reflex **Suckling reflexes** **Vomiting reflexes**

❖ ***Examples of reflexes within spinal cord are :***

- **myotatic reflexes (stretch reflexes) including :**
  - **knee jerk**
  - **ankle jerk**
  - **Abdominal reflexes**
- **withdrawal reflexes**
- **crossed extensor reflexes**
- **scratched reflexes**

The autonomic nervous system : (A.N.S)

This system is control the involuntary functions of the body . It is consist of :

1. **Sympathetic division**
2. **Parasympathetic division**

The difference between these two divisions is depend on :

1// Anatomic distribution of the nerve fibers .

2// Types of neurotransmitters that secreted at nerve ending .

3// Stimulatory effect of two divisions on the affected organs are always antagonistic .

1// Anatomically the A.N.S is consist of several neurons as :

afferent neuron , efferent neuron & other neurons that is composed the reflex arc . The A.N.S is characterized by ganglia specially in the sympathetic division .

- **The sympathetic nervous system originates from thoracolumbar region of spinal cord (all thoracic + 1st. , 2nd. & 3rd. lumbar segments) . The medulla of adrenal gland is also sympathetic ganglia .**
- **The parasympathetic division is originate from cranio-sacral regions as :**

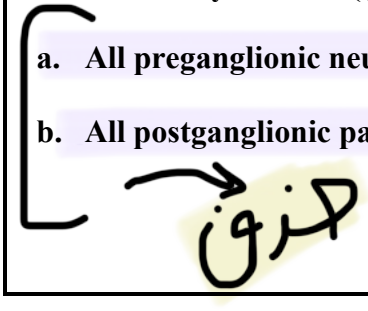
a. **Brain mainly tenth cranial nerve (X or vagus nerve) which is supply fibers to the heart , lung & most organ of the abdomen . Other cranial nerves as : III , VII & IX**

b. **Sacral regions of the spinal cord 2 , 3 & 4 segments .**

2// The principle transmitters agents are :

A// Acetylcholine ((Ach)) , that is secreted at :

a. **All preganglionic neurons of A.N.S ((sympathetic & parasympathetic divisions))**
b. **All postganglionic parasympathetic neurons .**



c. Some of postganglionic sympathetic neurons that innervate sweat glands , blood vessels of skeletal muscles .

The neurons that release Ach are called cholinergic neurons , after releasing the Ach are binding to specific receptors . Depending on pharmacological properties the Ach receptors are :

1. Muscarinic receptors : found in smooth muscles & glands . They can be blocked by atropine drug .
2. Nicotinic receptors : found in motor - end plate of the skeletal muscles . Non affected with atropine drug .

B// Norepinephrine ((Noradrenalin)) :

Secrete at most postganglionic sympathetic divisions of A.N.S & medulla of adrenal gland . The neurons that secrete these substances are called noradrenergic or adrenergic neurons . These substances act on two types of receptors found in the tissues are :

1. α-receptors ((α1 & α2))
2. β-receptors ((β1 & β2))

3// Most organ of the body are receive innervation from both divisions of A.N.S .

The main function of A.N.S is protection of the cellular environment (internal environment) within person . The maintenance of internal environment at relatively constant composition is called *homeostasis* .

When a sever stress is applied , the activity of sympathetic division is increased markedly , such response is referred to *fight or flight responses* . Most of these responses are aimed toward mobilization of energy & shunting of the blood & nutrients to organs having a vital functions in fight or flight situations . Ex. :

1- Vasoconstriction of the blood vessels in skin .
2- Vasodilation of blood vessels in skeletal muscles , heart & brain .
3- Increase heart rate & blood pressure .

4- Dilate the pupil & relax the accommodation for far vision .

5- Increase blood glucose & free fatty acids levels (supplying more energy) .

6- Inhibition of visceral activity .

7- Relaxation of bronchial smooth muscles .

The function of parasympathetic division is primarily for acquisition & conservation of energy & maintenance a constant internal environment . Ex. :

1- Decrease heart rate

2- Favor the digestion & absorption of food by increase the activity of intestinal muscles & increase gastric secretion & relaxing of the pyloric sphincter & vasodilation of blood vessels in digestive system .