Nervous System

1. Living organisms have a unique ability of responding to the changes in the environment. This is called **irritability**.

2. All living organisms have a special mechanism and organ system to identify and respond to stimulus.

3. In higher organisms, control and coordination of various body systems is brought about by the nervous and endocrine system.

4. There are three main constituents of the nervous system in higher organisms and these are:

(i) **Receptors:** These are organs that receive stimulus from the environment. Example, sense organs.

(ii) **Effectors:** These organs show visible response to stimulus. Example, muscles and glands.

(iii) **Conductors:** These are tissues that connect receptors and effectors, and help in the conduction of stimulus. Example, nerve cells.

5. Commonly used terms related to the nervous system are:

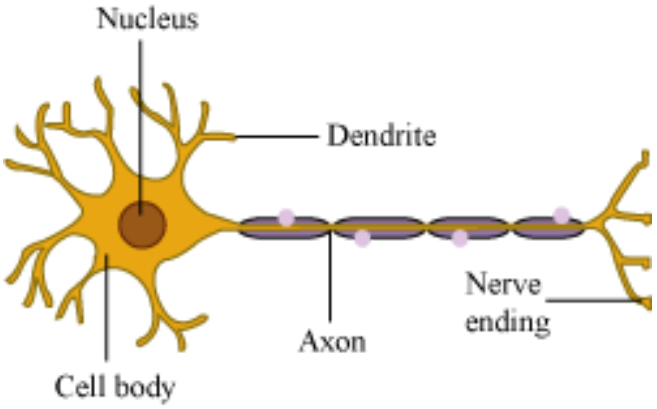
(i) **Stimulus:** It is the change in the environment that would result in change in the activity of our body.
(ii) **Impulse:** It is a sensation/wave of electrical disturbance that travels through the nerves to the brain.
(iii) **Response:** It is the activity our body shows in response to a stimulus.

Control and coordination

- Working together of various integrated body systems in response to changes in the surrounding for the maintenance of bodily functions is known as **control and coordination**
- **Nervous system and endocrine system** provide control and coordination in animals.

Nervous system

- **Neurons** -functional units of the nervous system, conduct messages in the form of electrical and chemical impulses
    - Neuron composed of cell body and dendrite, axon and nerve endings.

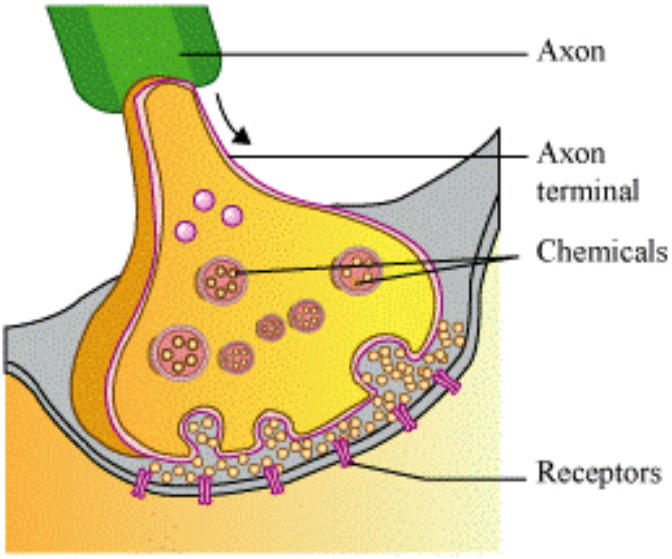


- **Types of neuron:-**
    - Sensory neuron
    - Motor neuron
    - Relaying or intermediate neuron

- **Nerve:** A nerve is a collection of nerve fibres (or axons) enclosed in a tubular medullary sheath. This sheath acts as an insulation and prevents mixing of impulses in the adjacent fibres.

- **Transmission of nerve impulse:**
  Under normal conditions, the outer side of the nerve fibre consists of positive charge as more Na+ ions are present outside axon membrane. The neuron is then said to be in polarised state. On stimulation, the membrane becomes more permeable and Na+ ions move inside causing depolarisation. Such a region is known as excited region. The point of depolarisation behaves as stimulus for the neighbouring area and this goes on. In the mean time, the previous area becomes repolarised due to active transport (using ATP) of Na+ ions with the help of **sodium pump**.

- **Synapse**- a small gap between the axon of one neuron and the dendrite of the next neuron

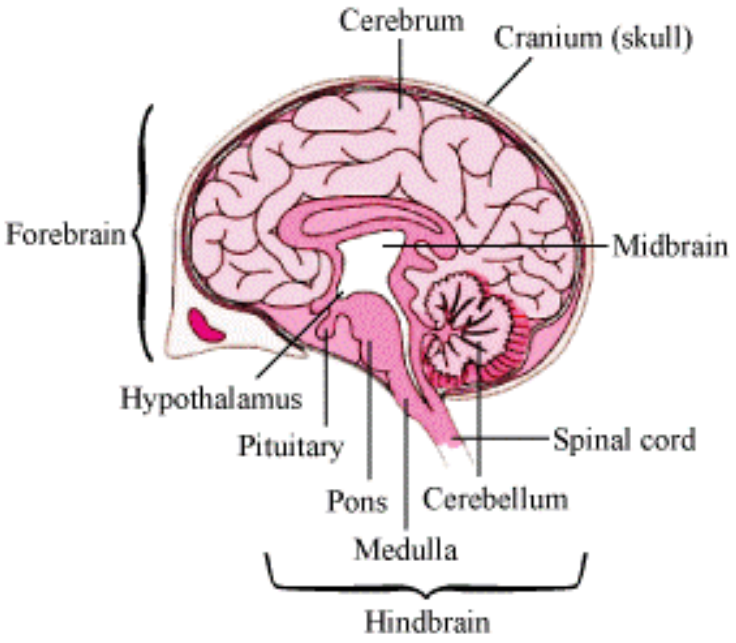


Parts of the nervous system

- Human nervous system divided into- central nervous system (CNS) and peripheral nervous system (PNS)
- CNS consists of the brain and spinal cord
- PNS consists of the nerves that connects the CNS to different parts of the body
- The Brain, spinal cord, and nerves are the important parts of the nervous system

Brain

- The brain is enclosed in a bony box called the **cranium** and spinal cord is protected by **vertebral column**.
- The brain and spinal cord are externally covered by protective covering called **meninges**.
- It is made up of three layers namely **duramater (outer layer)**, **arachnoid (middle laye**r), **piamater (inner lay**er).
- The space between meninges is filled by a watery fluid called **cerebro- spinal fluid (CSF)**.



Human brain is classified into- forebrain, midbrain, and hindbrain.

- **Forebrain-** It consists of cerebrum, thalamus, and hypothalamus.
- It has following functions:
    - It is the thinking part of the brain.
    - The forebrain has sensory regions that receive sensory impulses from various receptors.
    - It has motor regions that control the movement of various muscles (such as the leg muscles).
    - Cerebrum controls intelligence, learning, memory, thinking, and speech.
    - Hypothalamus contains many areas that control things such as body temperature, urge for eating and drinking, etc.
- **Midbrain-** It is mainly concerned with the sense of sight and hearing.
- **Hindbrain-** It consists of pons, medulla, and cerebellum.
- It has following functions:
    - Most of the involuntary actions such as heartbeat, blood pressure, movement of food in the alimentary canal, salivation, etc., are controlled by the midbrain and medulla of the hindbrain.
    - Cerebellum is responsible for voluntary actions and maintaining the posture and equilibrium of the body.

Spinal Cord

- It is the continuation of the medulla oblongata and runs through the vertebral column.
- The spinal cord is made up of two similar halves fused together to form a central canal containing the cerebrospinal fluid.

- The outer portion of the spinal cord is known as the **white matter**, which consists of nerve fibres.
- The inner portion contains the cell bodies of neurons and is known as the **grey matter**.

- Three types of responses of the nervous system are- **reflex action, voluntary action and involuntary action**
    - **Reflex action**
        - Sudden movement or response to a stimulus
        - Occurs in very short duration of time
        - Does not involve will or any thinking of brain
        - E.g. If we touch hot plate, we immediately pull our hand back.
    - **Voluntary action**
        - Actions such as writing, talking etc. that can be controlled consciously.
    - **Involuntary action**
        - Actions such as breathing, digestion etc. that cannot be controlled consciously.

- **Reflex action –**

    - It is an automatic action or response provoked by a stimulus.

    - Reflex pathway is comprised of the following:
        - **Receptor:** It includes sense organs that receive stimulus.
        - **Sensory or afferent neuron:** It conducts the nerve impulse from receptor to the spinal cord or brain.
        - **Association neuron:** It helps to transmit nerve impulse from sensory neuron to motor neuron.
        - **Motor or efferent neuron:** It transmits nerve impulse to the effector organs like muscles or glands.
        - **Effector:** It includes muscles or glands where action takes place in response to stimulus.