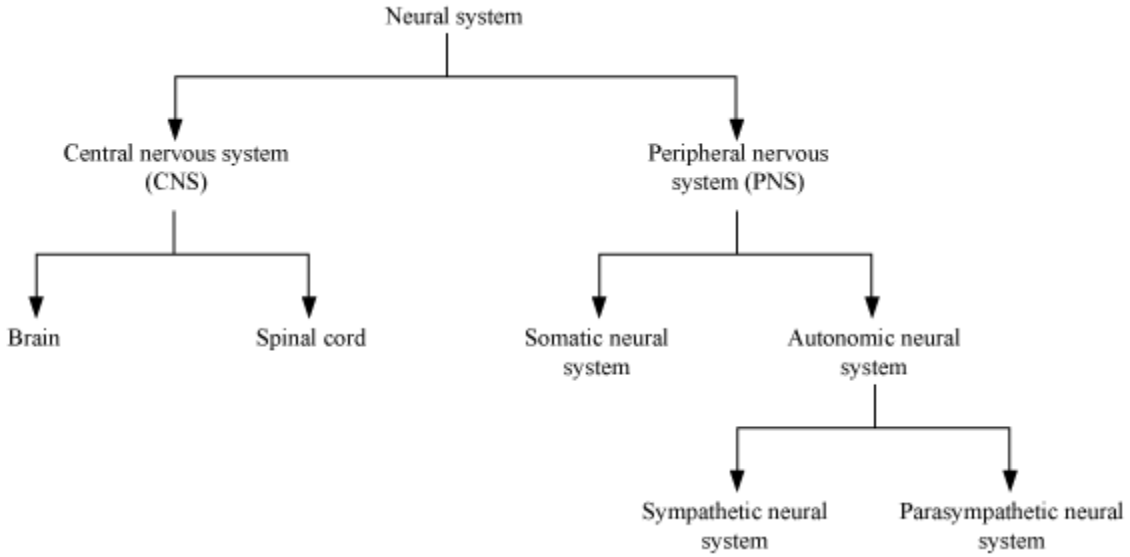
Neural Control and Coordination

Human Neural System
Neural system

- It provides rapid coordination among the organs of the body.
- The coordination may be in the form of electric impulses, which is quick and short-lived.



Neurons

- Neurons are structural and functional units of nervous system.
- **Structure of neuron**

1. **Cell body – Contains Nissl's granules**
2. **Dendrite** – Conducts messages towards cell body
3. **Axon** – Conducts messages away from cell body

- **Neurons are of three types:**

1. **Unipolar**
2. Bipolar
3. Multipolar

- **Axons are of two types:**

2. **Myelinated nerve fibre**

- Fibre is coated with myelin sheath, which is impermeable to ions. Schwann cells enveloped the myelin sheath.
- The place where myelin sheath is not present on the myelinated nerve fibre is called node of Ranvier.
- Conduction of nerve impulse is from node to node in a jumping manner. Hence, the conduction is fast.
- Found in spinal and cranial nerves

3. **Non-myelinated nerve fibre**

- Fibres are not coated by myelin sheath.
- Conduction of nerve impulse occurs along the whole length of nerve fibre. Hence, the conduction is slow.
- Found in autonomous and somatic neural systems

Conduction of nerve impulse

- **During resting condition:**

- Concentration of K^+ ions is more inside axoplasm while concentration of Na^+ is more outside axoplasm.
- Ionic gradient is maintained across membrane by transport of 3 Na^+ outward and 2K^+ into the cell.
- Membrane becomes positively charged outside and negatively charged inside. Nerve fibre is said to be polarized nerve fibre.

- **When stimulus is given to nerve fibre:**

- Action potential is generated.
- Nerve fibre becomes permeable to Na^+ ions than to K^+ ions.
- Membrane becomes positively charged inside and negatively charged outside the axoplasm. The nerve fibre is said to be depolarized nerve fibre.

- **Synapse**

- It is a small gap found between the last portion of axon of one neuron and dendrite of next neuron.
- There are two types of synapses:
- **Electrical synapse**

- **Chemical synapse**

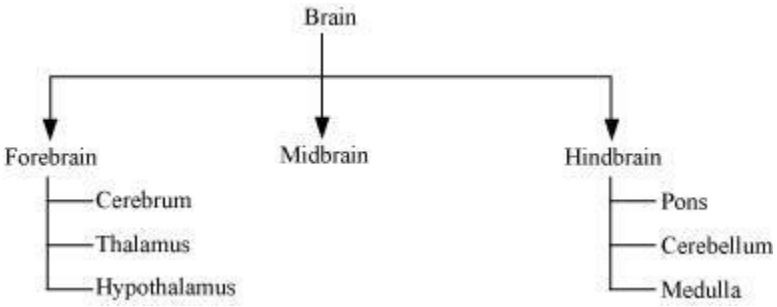
Reflex action –

- It is an automatic action or response provoked by a stimulus.
- **Reflex** pathway is comprised of the following.
- **Afferent neuron** – Receives signal from sensory organ and transmits impulse into CNS(spinal cord level).
- **Efferent neuron –** Carries signal from CNS to effectors

Central nervous system

- **Brain**

- It is the main coordinating centre of the body.
- Brain is protected by the skull and covered by cranial meninges.
- Cranial meninges consist of three layers - outer dura mater, middle arachnoid, and inner pia mater.



- **Forebrain** is the largest and most developed region of brain.
- **Hypothalamus** region of forebrain regulates body temperature and the urge for eating and drinking.
- **Midbrain** is concerned with the sense of sight and hearing.
- The dorsal portion of the midbrain consists of four round swellings called **corpora quadrigemina**.
- **Cerebellum** maintains posture and equilibrium of the body.
- **Mechanism of vision:**

Light rays falls on retina
↓
Dissociation of retinal from opsin
↓
Structure of opsin changes
↓
Permeability of membrane changes
↓
Generation of action potential in ganglionic cells
↓
Transmission of impulse to cortical region of brain
↓
Image formed on retina

Sense Organs: Organs that helps us to be aware of our surroundings are known as sense organs.
Receptors: Any cell or tissue sensitive to a selective stimuli are called receptors.

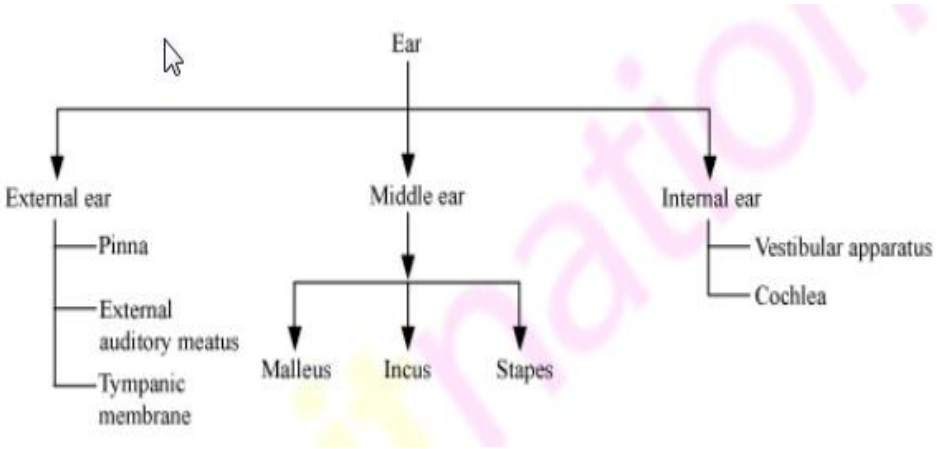
Eye
Composed of three layers:

- **Outermost layer-** sclera and cornea
- **Middle layer-** choroid, ciliary body, iris
- **Innermost layer-** retina, with rod cells and cone cells.
- Just behind the iris, a transparent, biconvex, and elastic structure called **lens** is present.
- **Rods –** Contain rhodopsin pigment that is highly sensitive to dim light
- **Cones –** Contain iodopsin pigment that is sensitive to high intensity light. Cones are also responsible for colour vision.
- **Blind spot –** Area where photoreceptors such as rods and cones are absent
- **Fovea –** Area that contains only cones. Vision is finest and sharpest in this zone.
- **Aqueous chamber –** Space between cornea and lens; contains **aqueous humour**.
- **Vitreous chamber –** Space between lens and retina; contains **vitreous humour**
  Pupil regulates the amount of light entering into the eyes.
- **Specific abilities of eyes**
  - Power of Accommodation

- Stereoscopic Vision

Ear

- Organ for hearing and equilibrium



- **Crista and macula** are receptors of vestibular apparatus that are responsible for maintaining body balance and posture.

- **Organ of corti** is the main hearing structure of internal ear. It is located on basilar membrane that has hair cells. The middle ear contains three small bones – malleus, incus, and stapes (arranged from outside to inside).

- **Mechanism of hearing**

Pinna collects sound waves and directs it towards ear drum
↓
Transmission of vibrations towards fenestra ovalis through ear ossicles
↓
Generation of sound waves in lymph
↓
Ripple created in basilar membrane bends the hair cells (of organ of corti) against tectorial membrane
↓
Sound waves converted into nerve impulses
↓
Impulse carried to cortex of brain
↓
Impulse analyzed and sound is recognized

Role of Ear in balancing Body

When we turn our head

fluid inside the semicircular canals moves

pushing against the sensory hair cells

sending nerve impulse to brain -->via auditory nerve

cells present in the semicircular canals are highly sensitive to dynamic equilibrium.

we are able to balance our body.

Nose

- It is the sense organ of smell.
- Sensory receptors are present in the nasal cavity.
- Sends impulses through olfactory nerve.

Skin

- It is the sense organ for the sense of touch and feel.
- Also protects the body.
- Has two layers, epidermis and the dermis.
- Has sweat glands, oil glands and hair follicles.

Tongue

- It is the sense organ of taste.
- Have taste buds to recognize tastes like sweet, sour, bitter and salty.