CBSE Class 11 Biology Chapter 21
Neural Control And Coordination Notes

The process through which two or more organs interact and complement the functions of one another is termed as coordination. The neural system and the endocrine system in our body coordinate and integrate all activities of the organs so that they function in a synchronized fashion. While the neural system provides an organized network of point-to-point connections for rapid coordination the endocrine system renders a chemical integration through hormones. Learn in detail through neural control and coordination notes at the class 11 level.

Topics Covered in Neural Control And Coordination

- **Neural System**
- **Human Neural System**
- **Neuron as Structural and Functional Unit of Neural System**
- **Central Neural System**
- **Reflex Action and Reflex Arc**
- **Sensory Reception and Processing**

Neural System

- It comprises of highly specialized cells known as neurons which can detect, receive and transmit different kinds of stimuli
- In lower invertebrates, it is very simple such as that observed in Hydra, where a network of neurons are found
- The system is better in insects, where a brain along with numerous ganglia and neural tissues are found. It is highly developed in vertebrates

Human Neural System

It is divided into two parts in humans:

- The central neural system (CNS) - it includes the brain and the spinal cord. It is the site of information processing and control
- The peripheral neural system (PNS) - comprises of nerves of the body linked with the CNS. The nerve fibres of PNS are of two types:
    - Afferent fibres - transmits impulses from tissues/organs to the CNS
    - Efferent fibres - transmit regulatory impulses from CNS to concerned peripheral tissues/organs
- The PNS is divided into two divisions known as somatic neural system(relays impulses from CNS to skeletal muscles) and autonomic neural system(transmits impulses from CNS to involuntary organs and smooth muscles).
- Furthermore, the autonomic neural system is classified into a sympathetic neural system and parasympathetic neural system

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Neuron as Structural and Functional Unit of Neural System

- Neurons are composed of three major parts - cell body, dendrites and axon. Cell body consists of cytoplasm with typical cell organelles and few granular bodies known as Nissl's granules.
- Dendrites are the short fibres which repeatedly branch and emerge out of the cell body. They transmit impulses towards the cell body.
- Axons are long fibres whose distil end id branched. Each branch terminated as a bulb-like structure known as synaptic knob comprising of the synaptic vesicles containing neurotransmitters.
- Axons transmit nerve impulses away from the cell body to a synapse. Based on the number of axons and dendrites, neurons are divided into three types - multipolar and two or more dendrites. There are two types of axons - myelinated and non-myelinated
- Myelinated nerve fibres are enclosed with Schwann cells forming the myelin sheath around the axon
- Gaps between two adjacent myelin sheath known as nodes of Ranvier
- Myelinated nerve fibres are found in spinal and cranial nerves while unmyelinated nerve fibres are enclosed by a Schwann cell that do not form a myelin sheath around the axon and is typically found in autonomous and somatic neural systems.

Generation And Conduction Of Nerve Impulses

- When neurons are in their resting phase (not conducting any impulse), the axon membrane is more permeable to potassium ions and impermeable to sodium ions and the negatively charged proteins found in axoplasm
- Plasma in axons contain a low concentration of sodium ions and a high concentration of potassium ions and proteins, but the fluid outside the axon contains a high concentration of sodium ions and low concentration of potassium ions thus forming a concentration gradient
- Active transport of ions takes place across the membrane by the sodium-potassium pump where three ions of sodium are transported outwards and two ions of potassium move into the cell as a result of which the outer surface of the membrane turns positively charged while the inner surface is negatively charged hence the cell is said to be in a polarized state developing a resting potential(electrical potential difference across the resting plasma membrane)
- When a stimuli is applied at the site on a polarised membrane, the membrane at the site becomes freely permeable to sodium ions hence sodium ions move into the cell. The outer side of the membrane gets negatively charged while the inner side is positively charged. Now, the membrane is said to be in a depolarized state.
- The electrical potential difference produced across the plasma membrane at this site is known as action potential
- This area becomes a stimulus for the neighbouring area of the membrane which becomes depolarized. The previous membrane gets repolarized due to the movement of sodium ions outside the cell. This is how impulses are conducted

Transmission Of Nerve Impulses

- Nerve impulses are transmitted from one to another neuron through junctions known as synapses which is formed by membranes of a pre-synaptic and post-synaptic neuron.
- Synapses are of two types - electrical synapses and chemical synapses

- When an impulse arrives at the axon terminal, it triggers the movement of synaptic vesicles towards the membrane where they fuse with plasma membrane to release neurotransmitters in the synaptic cleft which in turn bind to specific receptors found on the post-synaptic membranes

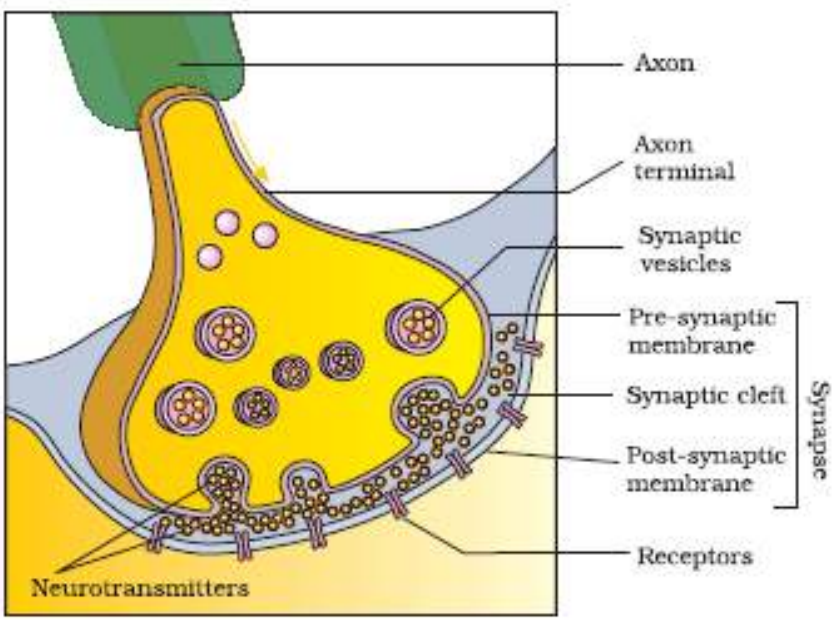


Figure Diagram showing axon and terminal and synapse

Central Neural System

- The central information processing organ of our body is the brain which serves as the command and control system. It controls the voluntary movements and is also the site for processing of vision along with performing many other functionalities
- It is well protected by the skull, inside of which it is covered by cranial meninges consisting of outer layer known as dura mater, arachnoid and inner layer known as pia mater. The brain can be divided into - forebrain, midbrain and the hindbrain

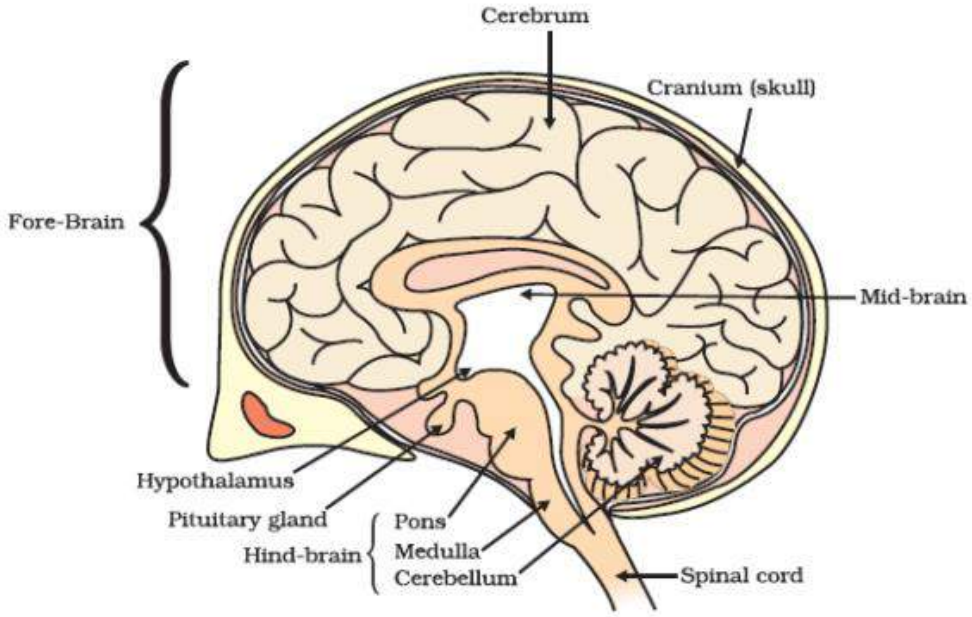
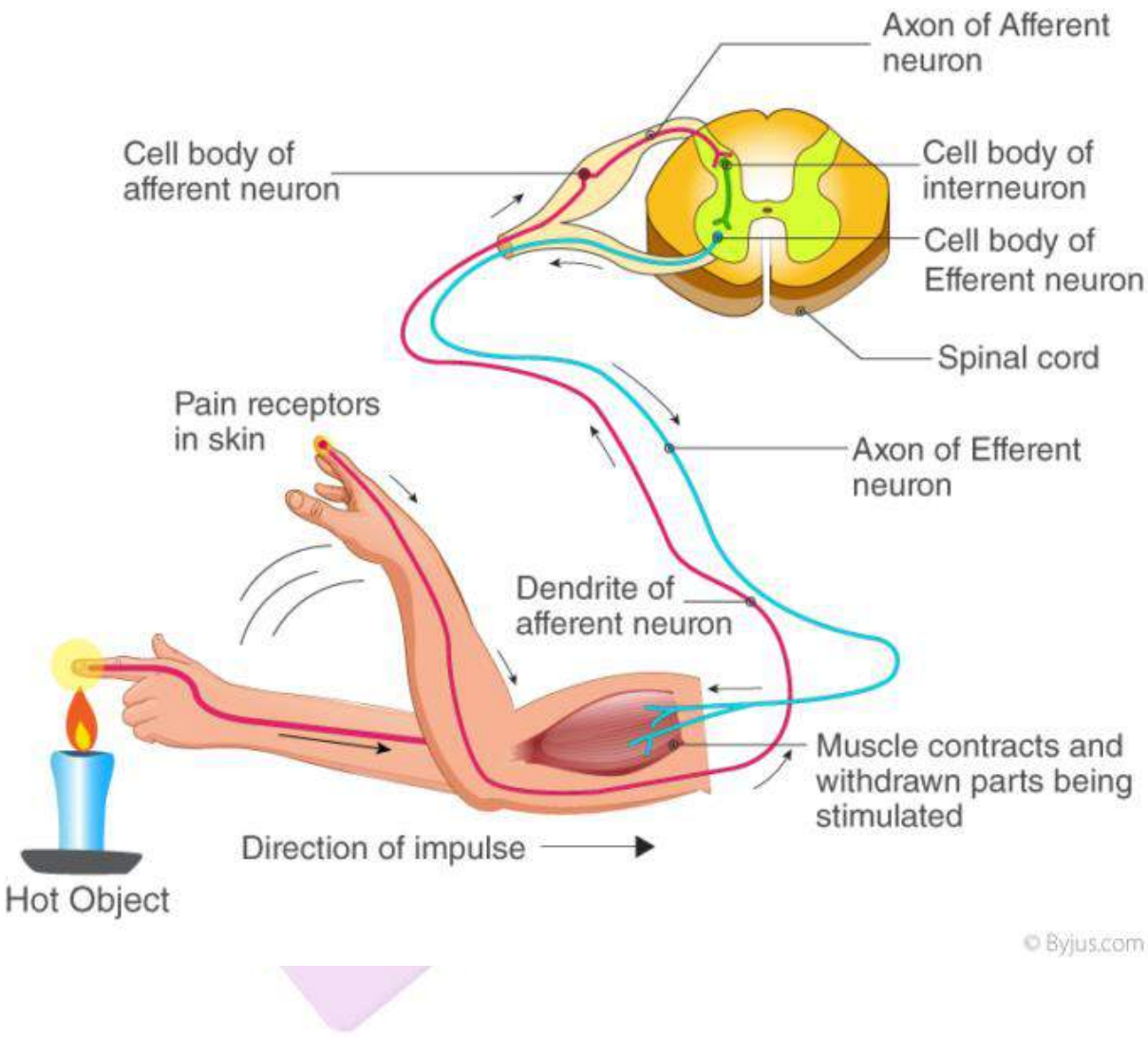


Figure *Human brain*

Reflex Action And Reflex Arc

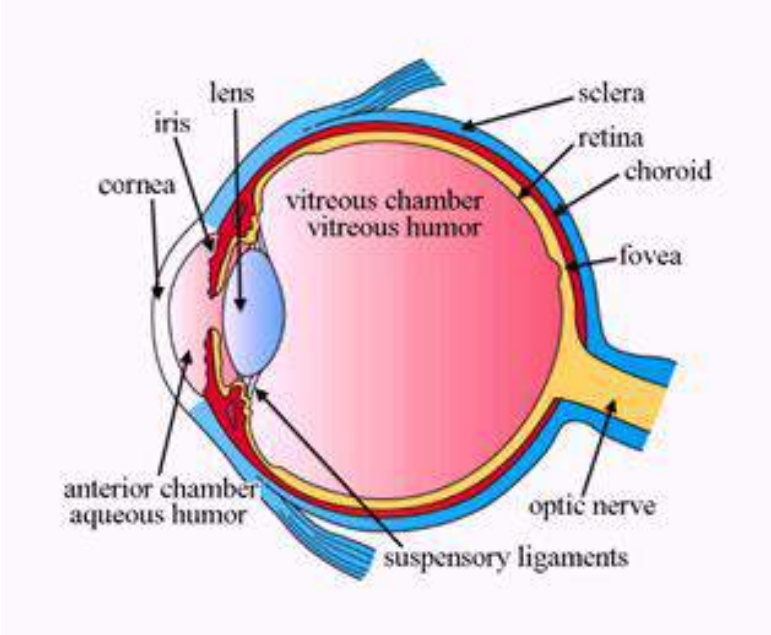
- The process of responding to a peripheral nervous stimulation occurs involuntarily requiring the involvement of a part of the CNS known as a reflex action.
- The reflex pathway consists of at least one afferent neuron and one efferent neuron
- The afferent neuron receives signals from sensory organs and transmits the impulse via a dorsal nerve root into the CNS
- The efferent neuron then carries signals from CNS to the effector. The stimulus and response hence form a reflex arc as seen in the figure

REFLEX ACTION



Eye

- Eyes are located in the sockets of the skull known as orbits. The adult eyeball is almost a spherical structure where the wall of the eyeball is composed of three layers - the external layer is composed of a dense connective tissue known as the sclera, the anterior portion of it is the cornea, the middle layer choroid consists of several blood vessels. The ciliary body itself continues forward forming a pigmented and opaque structure known as iris
- The eyeball consists of a transparent crystalline lens held in place by ligaments attached to the ciliary body. The aperture surrounded by the iris in front of the lens is the pupil whose diameter is regulated by muscle fibres of the iris



The Ear

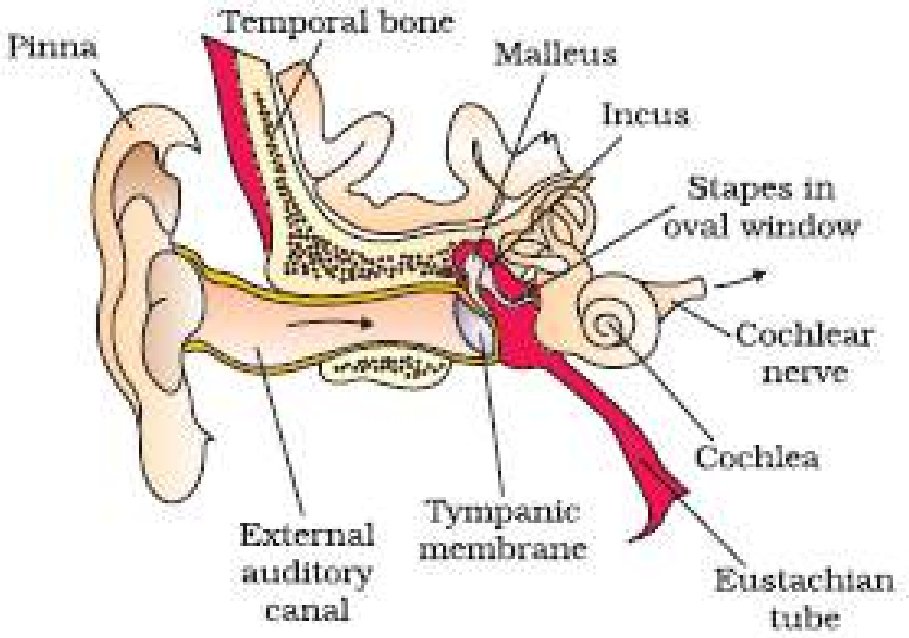


Figure Diagrammatic view of ear

- The ear performs two sensory functions - hearing and maintaining body balance. The ear can be divided into three major sections - the outer ear, middle ear and inner ear
- The outer ear consists of the pinna and external auditory meatus. The pinna collects vibrations producing sound, the external auditory meatus extends to the eardrum
- The tympanic membrane is composed of connective tissues covered with skin outside and with mucus membrane inside.
- The middle ear contains three ossicles called malleus, incus and stapes which are attached to one another in a chain-like fashion.
- An Eustachian tube connects the middle ear cavity with the pharynx. It helps in equalising the pressures on either side of the eardrum.
- The fluid-filled inner ear called labyrinth consists of two parts, the bony and the membranous labyrinths.