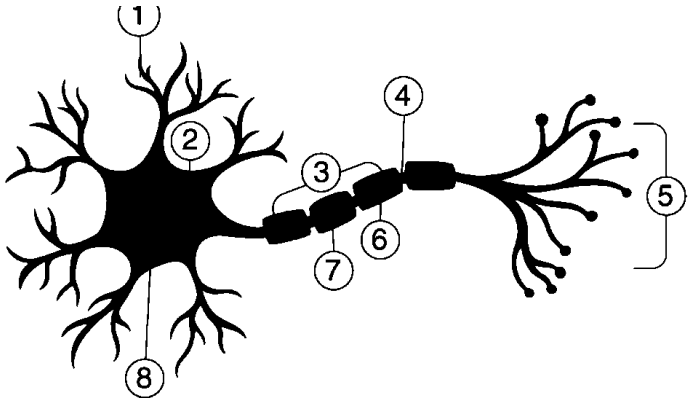
NCERT Exemplar Solutions of Class 11 Biology – Chapter 21: Neural Control and Coordination

LONG ANSWER TYPE QUESTIONS

Question 1

Explain the process of the transport and release of a neurotransmitter with the help of a labelled diagram showing a complete neuron, axon terminal and synapse.

Solution:



Process of Neurotransmitter Transport and Release:

1. Synthesis and Storage:

Neurotransmitters are synthesized in the cell body or axon terminal

Stored in synaptic vesicles within the axon terminal

2. Action Potential Arrival:

When an action potential reaches the axon terminal, voltage-gated Ca^{2+} channels open

Ca^{2+} influx triggers vesicle fusion with presynaptic membrane

3. Exocytosis:

Synaptic vesicles fuse with the membrane and release neurotransmitters into the synaptic cleft

Neurotransmitters diffuse across the synaptic cleft

4. Receptor Binding:

Neurotransmitters bind to specific receptors on the postsynaptic membrane

This binding causes ion channels to open or close

5. Termination:

Neurotransmitters are removed by reuptake pumps, enzymatic breakdown, or diffusion

Synaptic vesicles are recycled for future use

Enhanced Explanation: The diagram shows the complete pathway from neuron to synapse, illustrating how electrical signals are converted to chemical signals and back to electrical signals, enabling communication between neurons.

Question 2

Name the parts of human forebrain indicating their respective functions.

Solution:

Human Forebrain Components:

A. Cerebrum (divided into 4 lobes):

1. Frontal Lobe:

Functions: Speech production (Broca's area), reasoning, planning, problem-solving, movement control, personality, working memory

2. Parietal Lobe:

Functions: Sensory processing, spatial awareness, perception of stimuli, integration of sensory information, body orientation

3. Occipital Lobe:

Functions: Visual processing, interpretation of visual information, visual memory

4. Temporal Lobe:

Functions: Auditory processing, language comprehension (Wernicke's area), memory formation, emotional processing

B. Thalamus:

Functions: Relay station for sensory information, regulation of consciousness and sleep, sensory integration

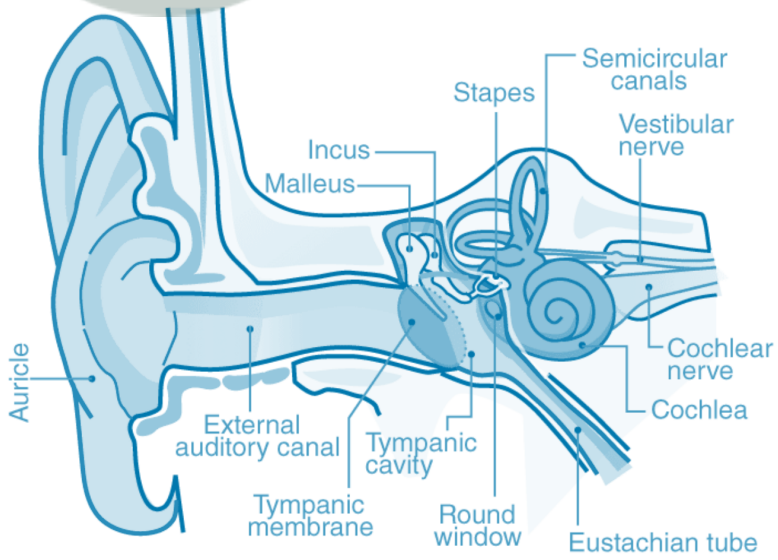
C. Hypothalamus:

Functions: Temperature regulation, hormone production, control of pituitary gland, hunger and thirst regulation, circadian rhythms, emotional responses

Enhanced Explanation: The forebrain is the most developed part of the human brain, responsible for higher-order thinking, consciousness, and complex behaviors that distinguish humans from other animals.

Question 3

Explain the structure of the middle and internal ear with the help of a diagram.



Solution:

MIDDLE EAR STRUCTURE:

Components:

Three Ossicles (arranged in chain):

Malleus (hammer): Attached to tympanic membrane

Incus (anvil): Connects malleus to stapes

Stapes (stirrup): Attached to oval window of cochlea

Eustachian Tube: Connects middle ear to pharynx for pressure equalization

Tympanic Cavity: Air-filled space containing the ossicles

INTERNAL EAR STRUCTURE:

A. Bony Labyrinth:

Hard outer shell containing perilymph fluid

Includes cochlea, vestibule, and semicircular canals

B. Membranous Labyrinth:

Soft inner structure containing endolymph fluid

Suspended within the bony labyrinth

Components:

1. Cochlea:

Scala vestibuli: Upper chamber filled with perilymph

Scala media: Middle chamber containing organ of Corti and endolymph

Scala tympani: Lower chamber filled with perilymph

Organ of Corti: Contains hair cells for hearing

2. Vestibular System:

Semicircular canals: Three perpendicular canals detecting rotational movement

Utricle and Saccule: Detect linear acceleration and gravity

Enhanced Explanation: The middle ear amplifies sound vibrations through the ossicular chain, while the inner ear converts these mechanical vibrations into electrical signals for hearing and maintains balance through the vestibular system. The fluid-filled chambers of the inner ear are crucial for proper function of both hearing and balance mechanisms.