FREE NOTES · NCERT + NEET LEVEL

Neural Control & Coordination

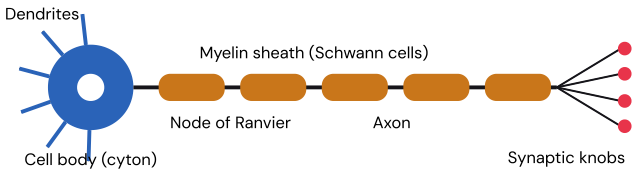
Neural system, neuron structure and types, generation and conduction of nerve impulse, synapse, central neural system (forebrain, midbrain, hindbrain).

01 Neural system
02 Neuron
03 Nerve impulse
04 Synapse
05 Brain: forebrain
06 Midbrain and hindbrain
07 Extra: ANS, reflex arc, sense organs
08 Important Q&A
09 Common mistakes
10 Practice (NEET style)
11 Quick revision

01 Neural system

- Hydra: network of neurons. Insects: brain + ganglia. Vertebrates: well-developed.
- Human: **CNS** (brain, spinal cord; information processing and control) and **PNS** (all other nerves). PNS fibres: afferent (tissues → CNS) and efferent (CNS → tissues).
- PNS: **somatic** (CNS → skeletal muscles) and **autonomic** (CNS → involuntary organs, smooth muscles): sympathetic and parasympathetic.
- Visceral nervous system = part of PNS with nerves, fibres, ganglia, plexuses for viscera.

02 Neuron

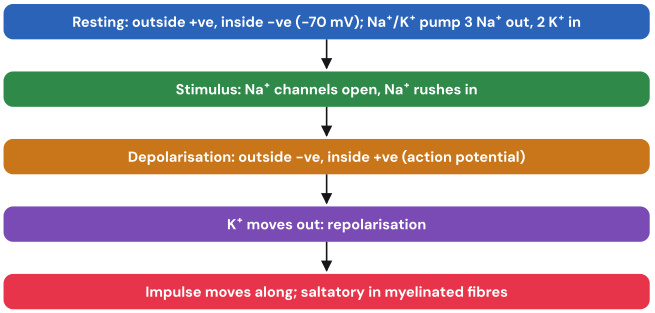


Structure of a myelinated neuron

- Cell body with cytoplasm, organelles and **Nissl's granules**; dendrites carry impulses towards cell body; axon carries away, ends in synaptic knobs with neurotransmitter vesicles.
- **Multipolar** (one axon, 2+ dendrites: cerebral cortex), **bipolar** (one axon, one dendrite: retina), **unipolar** (cell body with one axon: embryonic stage).
- **Myelinated** fibres: Schwann cells form myelin sheath; gaps = nodes of Ranvier (spinal and cranial nerves). **Non-myelinated**: Schwann cell without myelin (autonomic and somatic neural systems).

03 Nerve impulse

- Resting membrane: more permeable to K^+, nearly impermeable to Na^+ and impermeable to negatively charged proteins inside. Axoplasm: high K^+, low Na^+. ECF: high Na^+.
- **Polarised** state = resting potential; maintained by Na^+/K^+ pump (3 Na^+ out, 2 K^+ in).
- Stimulus ⇒ Na^+ influx ⇒ **action potential** (nerve impulse). Current flows to next site; process repeats.
- Rise in K^+ permeability restores resting potential.



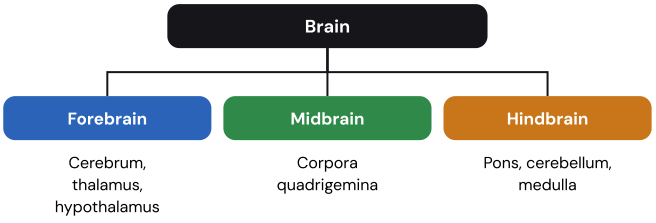
Generation of nerve impulse

04 Synapse

Feature	Electrical synapse	Chemical synapse
Gap	Membranes very close	Synaptic cleft between pre- and post-synaptic membranes
Transmission	Direct current flow; faster	Neurotransmitters (e.g. acetylcholine) released by exocytosis, bind receptors, open ion channels
Occurrence	Rare in our system	Common

New potential in post-synaptic neuron can be excitatory or inhibitory.

05 Brain: forebrain



Parts of human brain

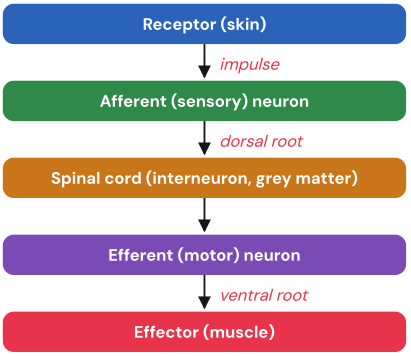
- Protected by skull and **cranial meninges**: dura mater (outer), arachnoid (middle, thin), pia mater (inner, touching brain).
- **Cerebrum**: two hemispheres joined by **corpus callosum**; cerebral cortex (grey matter, convolutions) has motor areas, sensory areas and association areas (intersensory associations, memory, communication). Fibres of tracts = white matter.
- **Thalamus**: major coordinating centre for sensory and motor signalling. **Hypothalamus**: controls body temperature, urge for eating and drinking; neurosecretory cells release hypothalamic hormones.
- **Limbic system** (amygdala, hippocampus etc. with hypothalamus): sexual behaviour, emotions (excitement, pleasure, rage, fear), motivation.

06 Midbrain and hindbrain

- **Midbrain**: between thalamus/hypothalamus and pons; **cerebral aqueduct** passes through it; dorsal part has four lobes = **corpora quadrigemina**.
- **Hindbrain**: **pons** (fibre tracts interconnecting regions), **cerebellum** (very convoluted surface, provides space for many more neurons; coordination and balance), **medulla oblongata** (connected to spinal cord; controls respiration, cardiovascular reflexes, gastric secretions).
- **Brain stem** = midbrain + pons + medulla; connects brain and spinal cord.

07 Extra: ANS, reflex arc, sense organs

Effect	Sympathetic ("fight or flight")	Parasympathetic ("rest and digest")
Pupil	Dilates	Constricts
Heart rate	Increases	Decreases
Saliva, digestion	Decrease	Increase
Bronchi	Dilate	Constrict
Neurotransmitter (end organ)	Noradrenaline	Acetylcholine



Reflex arc (knee-jerk type)

- Neurotransmitters: excitatory (acetylcholine, noradrenaline, glutamate) vs inhibitory (**GABA**, glycine). Dopamine, serotonin also act in brain.
- **CSF** made by choroid plexus; cushions brain. **Blood–brain barrier**: tight junctions + astrocytes.
- Embryonic brain: prosencephalon (forebrain) → telencephalon + diencephalon; mesencephalon (midbrain); rhombencephalon (hindbrain) → metencephalon (pons, cerebellum) + myelencephalon (medulla).
- Eye (old syllabus): cornea, iris, lens; retina with rods (dim light, rhodopsin) and cones (colour); fovea = sharpest vision; blind spot = no photoreceptors. Ear: pinna → auditory canal → tympanum → malleus, incus, stapes → cochlea (organ of Corti: hearing); vestibular apparatus (balance).

08 Important Q&A

Q1. Why is conduction faster in myelinated fibres?

Impulse jumps from node to node of Ranvier (saltatory conduction) instead of travelling along the whole membrane.

Q2. What is the resting membrane potential due to?

Unequal distribution of ions: more K^+ inside, more Na^+ outside, maintained by Na^+/K^+ pump; membrane more permeable to K^+.

Q3. Which part controls body temperature and hunger?

Hypothalamus.

09 Common mistakes

- Saying Na^+/K^+ pump moves 2 Na^+ out and 3 K^+ in (it is 3 Na^+ out, 2 K^+ in).
- Putting corpora quadrigemina in hindbrain (midbrain).
- Calling dura mater the innermost meninx (pia mater is).
- Thinking dendrites carry impulse away from cell body.

10 Practice (NEET style)

1. Bridge between two cerebral hemispheres?
2. Neuron type in retina?
3. Centre for respiration?
4. Gaps in myelin sheath?
5. Neurotransmitter at neuromuscular junction?

ANSWERS

1) Corpus callosum · 2) Bipolar · 3) Medulla oblongata · 4) Nodes of Ranvier · 5) Acetylcholine

11 Quick revision: 5 minutes before the exam

NEURON

- Dendrite → cyton → axon
- Multipolar cortex, bipolar retina
- Myelin by Schwann cells

IMPULSE

- Resting -70 mV, inside -ve
- Na^+ in = depolarisation
- 3 Na^+ out, 2 K^+ in

FOREBRAIN

- Corpus callosum
- Thalamus relay
- Hypothalamus temp, hunger

HINDBRAIN

- Cerebellum balance
- Medulla breathing, heart
- Brain stem = mid + pons + medulla

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.