

NERVOUS SYSTEM

(Anatomy & Physiology)

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Introduction

The nervous system is the body's master control network, responsible for receiving sensory input, processing information, and coordinating responses.

It consists of the :

- Central Nervous System (**CNS**): it has brain and spinal cord and
- Peripheral Nervous System (**PNS**): it has cranial nerves and spinal nerves.
- Automatic Nervous System(**ANS**): it has Sympathetic Nervous System and Parasympathetic Nervous System

- Nervous system works through specialized cells called neurons that communicate via electrical and chemical signals.
- This system regulates everything from basic reflexes to complex cognitive functions.

✓ MCQ Points:

- ◆ Nervous system is divided into CNS and PNS
 - ◆ Basic functions: Sensory input → Integration → Motor output
 - ◆ Neurons communicate via electrical and chemical signals
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I. NEURON STRUCTURE & FUNCTION

1. Neuron Components

Cell body (Soma):

- Contains **Nissl granules (clusters of rough ER and ribosomes for protein synthesis)**
- Large nucleus with prominent nucleolus

Dendrites: Short, branched extensions that receive signals

Axon (A for Axon & Away): Long fiber carrying impulses **away** from cell body

Myelin sheath: Insulating layer formed by:

- Schwann cells (PNS): Wrap around single axons, aid regeneration
- Oligodendrocytes (CNS): Myelinate multiple axons
- **Nodes of Ranvier: Gaps in myelin sheath** enabling saltatory conduction

✓ **MCQ Points:**

- ◆ Nissl granules are made of rough ER and ribosomes
- ◆ Schwann cells are found only in PNS
- ◆ Axon carries impulse away from cell body

2. Nerve Impulse Transmission

Resting potential: -70mV (maintained by Na^+/K^+ pump)

#(It can be from -70mV to -110mV)

#(For some questions, exact answer can be -70mV or -90mV, so select answer nicely)

Action potential:

- **Depolarization:** Na^+ influx $\rightarrow$ +30mV
- **Repolarization:** K^+ efflux $\rightarrow$ -70mV

Synaptic transmission: Neurotransmitters cross synapse

✓ MCQ Points:

- ◆ Resting membrane potential is -70mV
 - ◆ Depolarization occurs due to Na^+ influx
 - ◆ Repolarization occurs due to K^+ efflux
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II. CENTRAL NERVOUS SYSTEM (CNS)

1. Brain Development (Embryonic Divisions)

Prosencephalon (Forebrain):

- Telencephalon → Cerebrum
- Diencephalon → Thalamus, Hypothalamus, Epithalamus (pineal gland)

Mesencephalon (Midbrain): Visual/auditory reflexes

Metencephalon (Hindbrain): Pons + Cerebellum

Myelencephalon: Medulla oblongata

✓ MCQ Points:

- ◆ Prosencephalon forms cerebrum and diencephalon
- ◆ Myelencephalon forms medulla oblongata
- ◆ Metencephalon forms pons and cerebellum

2. Meninges & CSF

Layers (DAP Mnemonic):

1. **Dura mater:** Tough outer layer
2. **Arachnoid mater:** Web-like middle layer

3. **Pia mater:** Delicate inner layer

CSF: Produced in choroid plexus; cushions brain (shock absorber)

✓ **MCQ Points:**

- ◆ Dura mater is the outermost meningeal layer
- ◆ CSF is produced by choroid plexus
- ◆ CSF acts as a shock absorber

Brain Regions & Functions:

A. Cerebrum Lobes (FM PaST Over ToAd)

a. Frontal:

Function: **Motor control**

Memory and Intelligence, Reasoning

b.Parietal: Pain, **S**ensation Touch, Temperature

c.Occipital: **V**ision

d.Temporal: (**A**uditory, Memory)

✓ MCQ Points:

- ◆ Frontal lobe controls motor functions
- ◆ Occipital lobe is for vision
- ◆ Temporal lobe is involved in hearing and memory

B. Diencephalon

- **Thalamus: Sensory relay station**
- **Hypothalamus (SEAT² Mnemonic):**

S- Sexual behavior

S- Sleep

E- Emotions

E- Endocrine control

A-Appetite

A-Autonomic functions

T- Temperature

T- Thirst

Epithalamus: Pineal gland (melatonin secretion)

✓ MCQ Points:

- ◆ Thalamus is the sensory relay station
- ◆ Hypothalamus regulates body temperature
- ◆ Pineal gland secretes melatonin

C. Brainstem (MOHR Mnemonic)

- **Medulla Oblongata:** Controls **H**eat rate & **R**espiration
- Pons: Sleep, breathing
- Midbrain: Visual/auditory reflexes

✓ MCQ Points:

- ◆ Medulla controls heart rate and respiration
- ◆ Pons regulates sleep and breathing
- ◆ Midbrain is involved in visual and auditory reflexes

D. Cerebellum: Balance, coordination

✓ MCQ Points:

- ◆ Cerebellum maintains balance and coordination
- ◆ Damage to cerebellum causes ataxia

4. Spinal Cord

Length: ~45 cm (ends at L1-L2 as conus medullaris)

Cauda equina: Nerve bundle resembling “horse’s tail”

Filum terminale: Fibrous extension anchoring spinal cord

✓ MCQ Points:

- ◆ Spinal cord ends at L1-L2 in adults
 - ◆ Cauda equina is a bundle of nerve roots
 - ◆ Filum terminale anchors the spinal cord
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PERIPHERAL NERVOUS SYSTEM (PNS)

a. Cranial Nerves (12 Pairs)

Mnemonic: “Old Ox Of Tokyo Touched A Fish And Got Very Sexy Horns”

1. Olfactory (I): Smell
2. Optic (II): Vision
3. Oculomotor (III): Eye movements
4. Trochlear (IV): *Smallest nerve*

5. Trigeminal (V):

Largest cranial nerve

Supplies face, teeth (“Dentist’s nerve”)

6. Abducens (VI): Eye movement

7. Facial (VII):

Facial expressions

Anterior 2/3 tongue taste

8. Auditory nerve (also known as Vestibulocochlear)(VIII): Hearing, balance

9. Glossopharyngeal (IX):

Posterior 1/3 tongue sensation

**10. Vagus (X): Longest nerve
(parasympathetic)**

11. Accessory (XI): Neck muscles

12. Hypoglossal (XII): Tongue movement

✓ MCQ Points:

- ◆ Trigeminal is the largest cranial nerve
- ◆ Trochlear is the smallest cranial nerve
- ◆ Vagus is the longest cranial nerve

b. Spinal Nerves (31 Pairs): Cervical (8), Thoracic (12), Lumbar (5), Sacral (5), Coccygeal (1)

✓ MCQ Points:

- ◆ There are 31 pairs of spinal nerves
- ◆ Cervical spinal nerves are 8 in number

AUTONOMIC NERVOUS SYSTEM (ANS)

A.Sympathetic (Fight/Flight)

Neurotransmitter: **Noradrenaline**

Effects:

- **↑ Heart rate, BP (↑ means increase)**
- **Dilates pupils**
- **Inhibits digestion**
- **Urination control: Relaxes bladder**

B.Parasympathetic (Rest/Digest)

Neurotransmitter: **Acetylcholine**

Effects:

↓ Heart rate(↓ means decrease)

Stimulates digestion

Urination control: Contracts bladder

✓ MCQ Points:

- ◆ Sympathetic system uses noradrenaline
 - ◆ Parasympathetic system uses acetylcholine
 - ◆ Sympathetic system is active during stress
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V. Disorders of Nervous System & Brain

1. Alzheimer's Disease – Memory loss, cognitive decline.

2. Parkinson's Disease – Tremors, rigidity, slow movement.

3. Epilepsy– Seizures, abnormal brain activity.

4. Stroke (CVA)– Brain blood flow blocked/ruptured.

5. Multiple Sclerosis (MS)– Myelin damage, nerve dysfunction.

6. Huntington's Disease – Uncontrolled movements, genetic disorder.

7. Migraine – Severe headache, light sensitivity.

8. Schizophrenia – Hallucinations, delusions, thought disorder.

9. Autism Spectrum Disorder (ASD) – Social, communication challenges.