

# Control and Co-ordination

## Subtopics

- Introduction
- Nervous Co-ordination in Lower Animals
- Neural Tissue
- Synapse
- Transmission of Nerve Impulse
- Human Nervous System
- Sensory Receptors
- Disorders of Nervous System
- Chemical Co-ordination
- Endocrine System
- Major Endocrine Glands

Note: The topics, 'Reflex action' and 'chart 9.15 Types of Reflex action' are not a part of 9.5 - Human Nervous System, as per reduced syllabus 2020-21]

### Nervous system

The nervous system is the control system and network of communication for the body. It is made up of brain, nerves and spinal cord. The nerves control everything we do, they carry messages and tell us to move, breathe, think and feel.



## Quick Review

### Eye

- Organ of sight (Photoreceptors).
- Wall of eyeball is made up of three layers: Sclera, choroid and retina
- Choroid can be divided into 3 regions: Choroid proper, Ciliary body, Iris

### Sensory Receptors

### HUMAN NERVOUS SYSTEM

- The Human Nervous System is ectodermal in origin and composed of Neurons and Neuroglia cells.
- Neuron → Structural and functional unit of nervous system.

### Ear

- Organ of hearing (Phonoreceptor).
- It is made up of 3 parts:
  - **External ear** → Pinna + Auditory canal + Tympanic membrane (ear drum).
  - **Middle ear** → Ear ossicles.
  - **Internal ear** (Labyrinth) → Outer bony labyrinth + Inner membranous labyrinth.
  - **Bony labyrinth** → Upper scala vestibuli + Lower scala tympani.
  - **Membranous labyrinth** → Coiled cochlea + Reissner's membrane + Basilar membrane.
  - **Vestibular apparatus** → Sensory part for balancing the body.
  - **Organ of Corti** → Hearing apparatus containing hair cells which act as auditory receptors attached to the basilar membrane.

### Central Nervous System (CNS)

#### Spinal Cord

- Forms of extension of the medulla oblongata of the brain
- Main pathway for conduction of sensory and motor nerve impulses.

#### Brain

The study of all aspects of the brain is called encephalology.

### Peripheral Nervous System (PNS)

#### Cranial Nerves

- Arising from or terminating into the brain.
- 12 pairs of cranial nerves in human beings.

#### Spinal Nerves

- Arising from spinal cord.
- 31 pairs of spinal nerves in human beings.
- Cervical → 8; Thoracic → 12; Lumbar → 5; Sacral → 5; Coccygeal → 1

### Autonomic Nervous System (ANS)

#### Sympathetic

- Formed by 22 pairs of sympathetic ganglia.
- Secretes adrenaline or nor adrenaline as emergency hormones.

#### Parasympathetic

- Consists of nerve fibres.
- Releases Acetylcholine which acts as neurotransmitter as well as inhibitor of visceral organs.



## Brain

### Forebrain (Prosencephalon)

- Made up of Olfactory lobes, Cerebrum and Diencephalon.
- **Olfactory lobes** → Sense of smell.
- **Cerebrum** (Largest part of brain) → Outer cortex + Inner medulla.
- **4 lobes of cerebral hemisphere** → Frontal, Parietal, Occipital, Temporal.
- **Diencephalon** → Epithalamus + Thalamus + Hypothalamus.

### Midbrain (Mesencephalon)

- Acts as co-ordination centre between forebrain and hindbrain.
- **2 parts** → Corpora quadrigemina + Crura cerebri.

### Hindbrain (Rhombencephalon)

- Posterior region of the brain.
- Made up of Cerebellum + Pons varolii + Medulla oblongata.
- **Cerebellum** (2<sup>nd</sup> largest part of brain) → Primary centre for control of equilibrium, posture, balancing and orientation.
- **Pons Varolii** → Reflex centre for breathing.
- **Medulla Oblongata** → Respiratory and Circulatory centre.

### Hypothalamus

- Situated at the base of forebrain.
- Major control centre of Autonomic Nervous System and Endocrine System
- Regulates the activities of pituitary gland.

### Pituitary Gland

Also known as hypophysis gland  
It controls almost all other endocrine glands, hence earlier it was called the master endocrine gland.

### Adenohypophysis

- It is the Anterior lobe of the pituitary.
- **Hormones released** → Thyroid Stimulating Hormone (TSH); Somatotrophic Hormone (STH); Adenocorticotrophic hormone (ACTH); Prolactin (PL); Follicle Stimulating Hormone (FSH); Luteinizing hormone (LH).

### Neurohypophysis

- It is the Posterior lobe of the pituitary.
- **Hormones released** → Antidiuretic hormone (ADH); Oxytocin;

### HUMAN ENDOCRINE SYSTEM

Consists of endocrine glands that secrete their secretions (hormones).

### Kidney

Juxtaglomerular cells of kidney produces two hormones:

- **Erythropoietin** → Stimulates erythropoiesis in bone marrow.
- **Renin** → Converts Angiotensin I to Angiotensin II which brings about vasoconstriction.

### Heart

- Atrial wall of heart secretes Atrial Natriuretic Factor (ANF).
- It maintains blood pressure.

### Gastrointestinal Tract

- The gastrointestinal mucosa, certain cells are endocrine in function  
Hormones secreted are gastrin, secretin, CCK, Enterogastrone

### Gonads

- Testis → (Leydig cells) → Testosterone.
- Ovaries → Estrogen, Progesterone

### Thyroid Gland

- Largest endocrine gland in the body.
- **Hormones released** → Thyroxine ( $T_4$ ); Triiodothyronine ( $T_3$ ); Calcitonin.

### Parathyroid Gland

- 4 oval parathyroid glands are present on the dorsal side of thyroid gland.
- Secretes Parathyroid hormone (PTH) which increases  $Ca^{2+}$  levels in blood.

### Thymus

- Located on dorsal side of heart and aorta.
- **Temporary endocrine gland** → degenerates in old individuals.
- **Release Thymosins** → Provides cell-mediated and humoral immunity.

### Adrenal Glands

- Also called suprarenal glands since they are located superior to kidneys.
- **Hormones secreted:**
- **Adrenal Cortex** → Mineralocorticoids (Aldosterone); Glucocorticoids (Cortisol); Sex corticoids (Androgens + Estrogens)
- **Adrenal Medulla** → Adrenaline; Noradrenaline

### Pancreas

- Pancreas has 3 types of endocrine cells.
- **$\alpha$  cells** → Secrete Glucagon
- **$\beta$  cells** → Secrete Insulin
- **$\delta$  cells** → Secrete Somatostatin
- **PP cells** → Secrete pancreatic polypeptide