Nervous System

Autonomic NS & Voluntary vs Involuntary

- **Autonomic NS**: pair of nerve chains + **ganglia** (masses of nerve-cell bodies) on either side of the backbone; controls involuntary activities of internal organs
- Two **antagonistic** (opposite) systems: sympathetic + parasympathetic
- **Sympathetic** (in times of fear): dilates pupils, constricts skin vessels, accelerates heart rate
- **Parasympathetic**: constricts pupils, dilates blood vessels, slows heart rate
- **Voluntary actions**: done **knowingly** — switch on TV, pick up an apple
- **Involuntary actions**: done **unknowingly** — tears flush dust, hand jerks off hot iron; also called **reflexes**

CNS / PNS & Nerves

- Human NS = **Central NS (CNS)** — brain (in skull) + spinal cord (in vertebral column) — and **Peripheral NS (PNS)**
- **PNS** = nerves radiating from CNS to whole body; splits into **somatic** + **autonomic**
- **Nerve** = bundle of axons (nerve fibres) inside a tubular **medullary sheath** — insulation stops signals mixing
- 3 kinds of nerves: **sensory** only (optic), **motor** only (to eye muscles), **mixed** (tongue)

Coordination & NS Functions

- **Coordination** = interlinking of life processes (digestion, respiration, excretion) as per body's needs
- **Nervous coordination**: brought about by the **nervous system** — brain, spinal cord, nerves & sense organs
- **Chemical coordination**: brought about by chemical messengers called **hormones** released into the blood
- Keeps us **informed** of the outside world via the **5 sense organs**; enables **remembering, thinking & reasoning**
- Controls **voluntary** muscle activity (running, holding a book) & regulates **involuntary** activity (heartbeat, breathing) without conscious thought

The Neuron

- **Neuron** (nerve cell) = structural & functional unit of the nervous system
- **Cyton** (cell body) with nucleus; **dendrites** = cytoplasmic extensions of the cell body that receive impulses
- **Axon** = single long process (few mm – 1 m); ends in **terminal branches**; medullary/myelin sheath insulates axon & prevents impulses mixing between fibres
- 3 types: **sensory** (receptors → CNS), **motor** (CNS → muscles/glands), **association** (neuron → neuron)
- **Synapse** = tiny junction where one axon terminal meets the next dendrite — neurons don't actually touch
- A **neurotransmitter** carries the impulse across the synapse — impulses flow **one-way** only

Spinal Cord

- Extends from the **medulla** down inside the **vertebral column**; grey matter **INNER**, white matter **OUTER** (opposite of brain)
- Controls **reflexes below the neck**
- Conducts **sensory** messages (skin & muscles → brain) & **motor** commands (brain → muscles of trunk & limbs)

Reflex Action

- **Reflex action** = **quick, immediate, automatic** response to a stimulus — controlled by the **spinal cord** & peripheral NS (below the neck); brain NOT involved
- **Reflex arc** = shortest nerve pathway from receptor to effector that makes a reflex possible
- Pathway: **stimulus → receptor → sensory neuron → spinal cord (relay neuron) → motor neuron → effector → response**
- 5 terms, e.g. touching a hot iron: **stimulus** (environmental change — heat), **receptor** (sense organ — skin), **impulse** (electrical wave along the nerve), **effector** (muscle/gland — hand muscle), **response** (activity — hand withdrawn)
- **Natural (inborn)** reflexes: blink, cough, sneeze, vomit (protective); salivation, peristalsis (functional efficiency)
- **Conditioned (acquired)** reflexes: learnt via experience — typing, playing an instrument, mouth watering at favourite food

Somatic NS: Cranial & Spinal

- **Somatic NS**: connects CNS to organs, muscles & skin; carries sensory + motor info both ways
- **Cranial nerves**: **12 pairs**, emerge from the brain
- Cranial mix: sensory — **olfactory** (nose), **optic** (eyes), **auditory** (ears); motor — to eye muscles; mixed — face & tongue
- **Spinal nerves**: **31 pairs** from the spinal cord; typical one is **mixed** — sensory fibre (sense organ → CNS) + motor fibre (CNS → effector); serve voluntary & involuntary activity

The Brain

- Protected inside the **skull**; 3 main parts — cerebrum, cerebellum, medulla oblongata
- **Cerebrum**: largest (~9 billion neurons); L & R hemispheres; seat of **intelligence, consciousness, memory, will power**; initiates voluntary actions
- **Cerebellum**: below cerebrum; **body balance** + coordinates the **muscular movement** of voluntary actions; alcohol impairs it → poor coordination
- **Medulla oblongata**: lowest; controls **involuntary** — breathing, heartbeat, peristalsis; injury can be fatal
- **Grey matter** = cell bodies; **white matter** = axons — brain: grey OUTER, white INNER; spinal cord reverses this