

Grade 12 Life Sciences: Nervous System & Homeostasis Study Guide

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1. The Neuron

- Dendrites: receive signals from other neurons
- Cell body (soma): contains nucleus; integrates signals
- Axon: carries impulse away from cell body
- Myelin sheath: insulates axon; speeds up impulse; produced by Schwann cells
- Nodes of Ranvier: gaps in myelin; impulse jumps between nodes (saltatory conduction)
- Axon terminals: releases neurotransmitters into synapse

2. The Nerve Impulse (Action Potential)

- Resting potential: -70 mV inside; Na⁺ outside, K⁺ inside
- Depolarisation: Na⁺ channels open; Na⁺ rushes IN -> inside becomes positive
- Repolarisation: Na⁺ channels close; K⁺ channels open; K⁺ rushes OUT
- Hyperpolarisation: K⁺ channels slow to close; brief undershoot below resting
- Refractory period: neuron cannot fire again immediately; ensures one-way propagation

3. The Synapse

Junction between two neurons (or neuron and effector).

Electrical signal -> chemical signal -> electrical signal:

- Action potential reaches axon terminal
- Ca²⁺ enters; vesicles fuse with presynaptic membrane
- Neurotransmitter (e.g. acetylcholine) released into synaptic cleft
- Binds to receptors on postsynaptic membrane -> new impulse (or inhibition)
- Neurotransmitter broken down by enzymes (e.g. acetylcholinesterase) OR reabsorbed

4. CNS & PNS

- CNS: brain + spinal cord (integration and control)
- PNS: all nerves outside CNS; somatic (voluntary) and autonomic (involuntary)
- Autonomic: sympathetic ("fight or flight") and parasympathetic ("rest and digest")
- Reflex arc: receptor -> sensory neuron -> interneuron (in spinal cord) -> motor neuron -> effector

5. Homeostasis

Thermoregulation

- Too hot: vasodilation (more blood to skin -> more heat loss), sweating, reduced metabolic rate
- Too cold: vasoconstriction (less blood to skin), shivering (heat from muscle), goose bumps, increased metabolic rate

Osmoregulation (kidneys)

- Filtration: blood filtered at glomerulus -> glomerular filtrate in Bowmans capsule
- Reabsorption: glucose, amino acids, water, Na⁺ reabsorbed in tubules
- Secretion: toxins, excess H⁺ secreted into tubule
- ADH: antidiuretic hormone; increases water reabsorption in collecting duct
- More ADH -> more concentrated urine; less ADH -> more dilute urine

TIP Negative feedback: the response REVERSES the stimulus. Positive feedback: the response ENHANCES the stimulus (e.g. childbirth contractions). Most homeostatic mechanisms use negative feedback.