Neural signalling

International Baccalaureate · IB Diploma · Biology · SL

Scope and prerequisites

This handout covers selected SL topics for the course first assessed in 2025; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

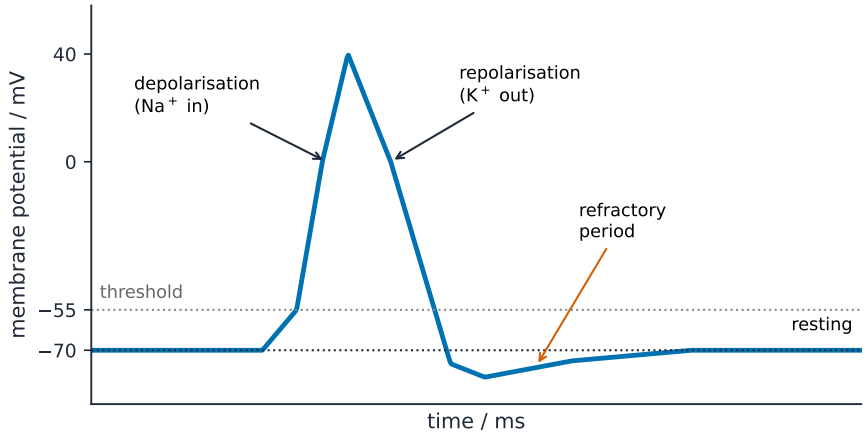
Neural signalling: impulses and synapses

What would explain this observation?

- A stronger stimulus can increase impulse frequency while each **action potential** remains a similar size.

Build the model

- An action potential is a brief change in membrane potential involving voltage-gated ion channels.
- Depolarization followed by repolarization propagates along a neuron.
- At a chemical **synapse** , transmitter release can alter the next cell membrane potential.
- action potential: A brief propagating change in membrane potential.
- synapse: A junction for communication between cells.



all-or-nothing: once threshold is reached, a full spike fires (no partial APs)

Past threshold, sodium in depolarizes; potassium out repolarizes; then a refractory period

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Choose evidence that can test it

- The all-or-none principle applies to an individual action potential.
- Stimulus information can be encoded by frequency and recruitment.
- Myelination permits saltatory conduction between nodes rather than making ions move freely through myelin.

In the lab: Interpret supplied voltage-time traces and compare time intervals. Identify threshold, rising phase and recovery before explaining ions. Use classroom models rather than electrical stimulation of people.

Work from known quantities

- Known: 30 impulses occur in 0.50 s.
- Frequency = count/time = 30/0.50 = 60 Hz.
- This is impulse frequency, not an estimate of propagation speed.

Your turn: 24 impulses occur in 0.40 s. Find impulse frequency.

■ **Check the conclusion and its limits**

- A neurotransmitter diffuses across the synaptic cleft; an action potential does not jump intact through the liquid gap.
- Excitatory input does not guarantee the postsynaptic cell reaches threshold.

Not true: A stronger stimulus always makes each action potential larger. Action potentials are all-or-none: once threshold is reached, the impulse has a fixed size set by the ion gradients. A stronger stimulus raises the frequency of impulses, not their amplitude.

Key:

- An action potential is a brief change in membrane potential involving voltage-gated ion channels.
- The all-or-none principle applies to an individual action potential.
- Watch for: A neurotransmitter diffuses across the synaptic cleft; an action potential does not jump intact through the liquid gap.

■ **Write from a frequency of 36 per second**

- 18 impulses occur in 0.50 s.
- Find the frequency. A stronger stimulus does not make each action potential larger.