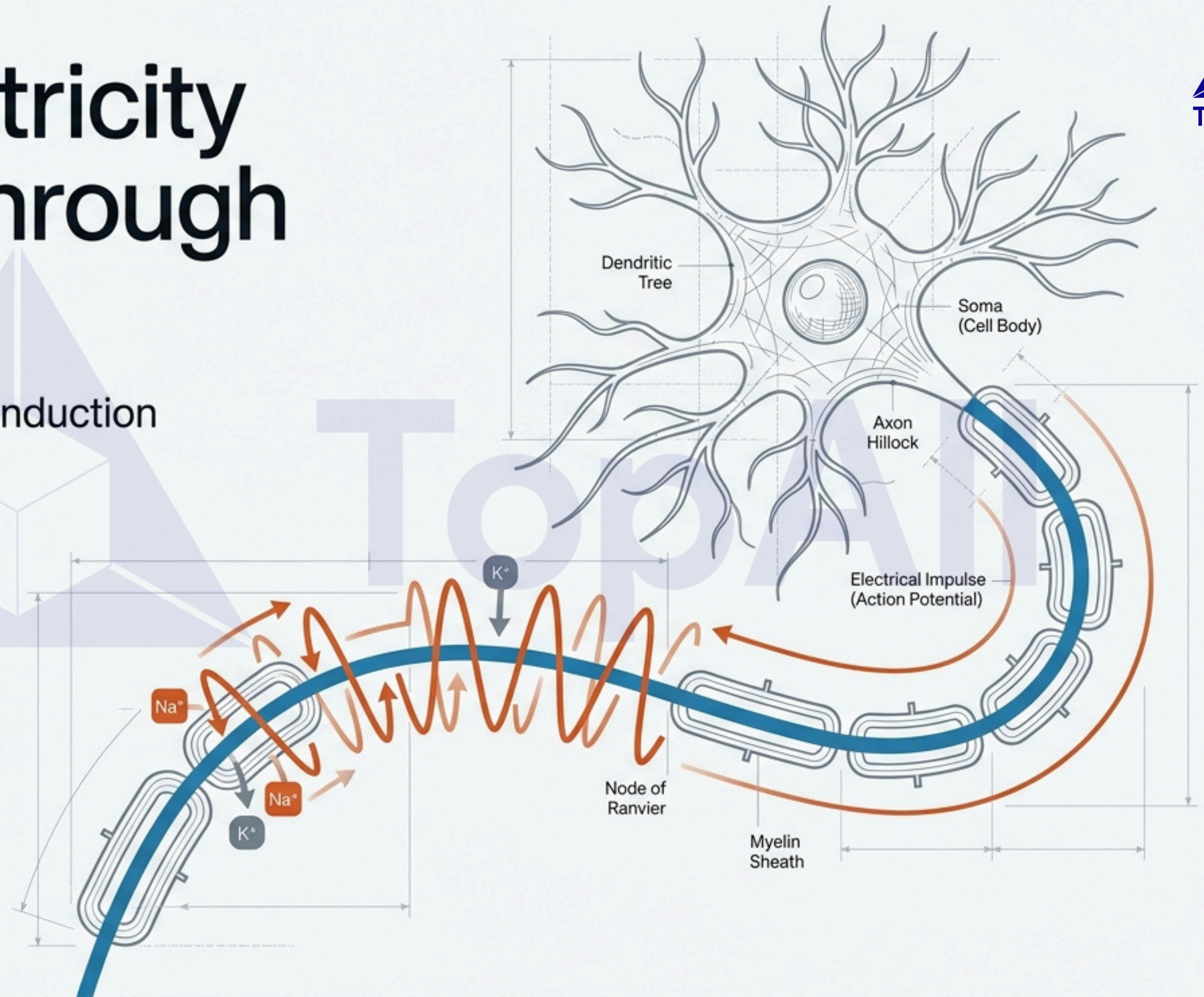


How Electricity Travels Through an Axon

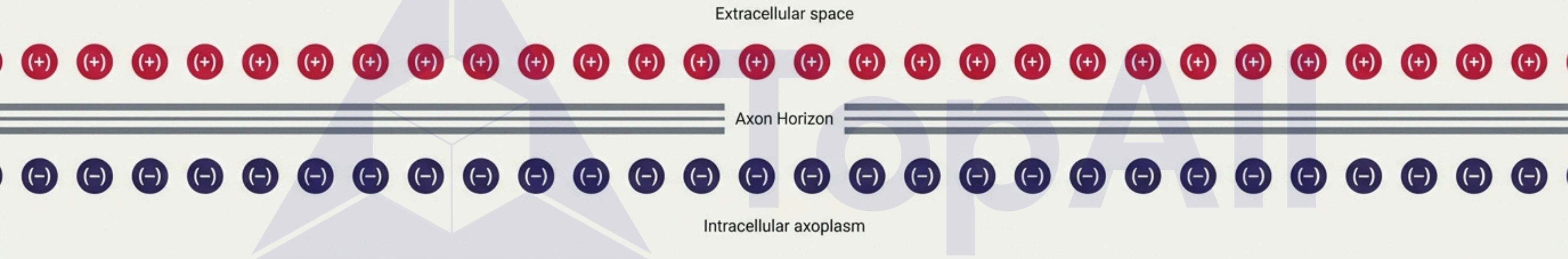
The Generation and Conduction of a Nerve Impulse



Section
18.3.1

The Polarised Resting Membrane

When a neuron is resting (not conducting an impulse), the axonal membrane is electrically polarised. The outer surface carries a net positive charge, while the inner surface carries a net negative charge.



Key Concept

Neurons are highly excitable cells. The polarised resting state acts exactly like a charged battery, storing potential energy and waiting for a stimulus.

Decoding the Resting Potential



Membrane State Matrix		
Property	Extracellular Fluid (Outside)	Axoplasm (Inside)
Dominant Cation	High Na ⁺ 	High K ⁺ 
Other Key Elements	Low K ⁺	 Low Na ⁺ , High concentration of negatively charged proteins
Membrane Permeability	Nearly impermeable to Na ⁺	Comparatively more permeable to K ⁺ ; Impermeable to negative proteins
Net Charge	Positive (+)	Negative (-)

Definition: The electrical potential difference across this specific resting plasma membrane configuration is called the **Resting Potential**.



You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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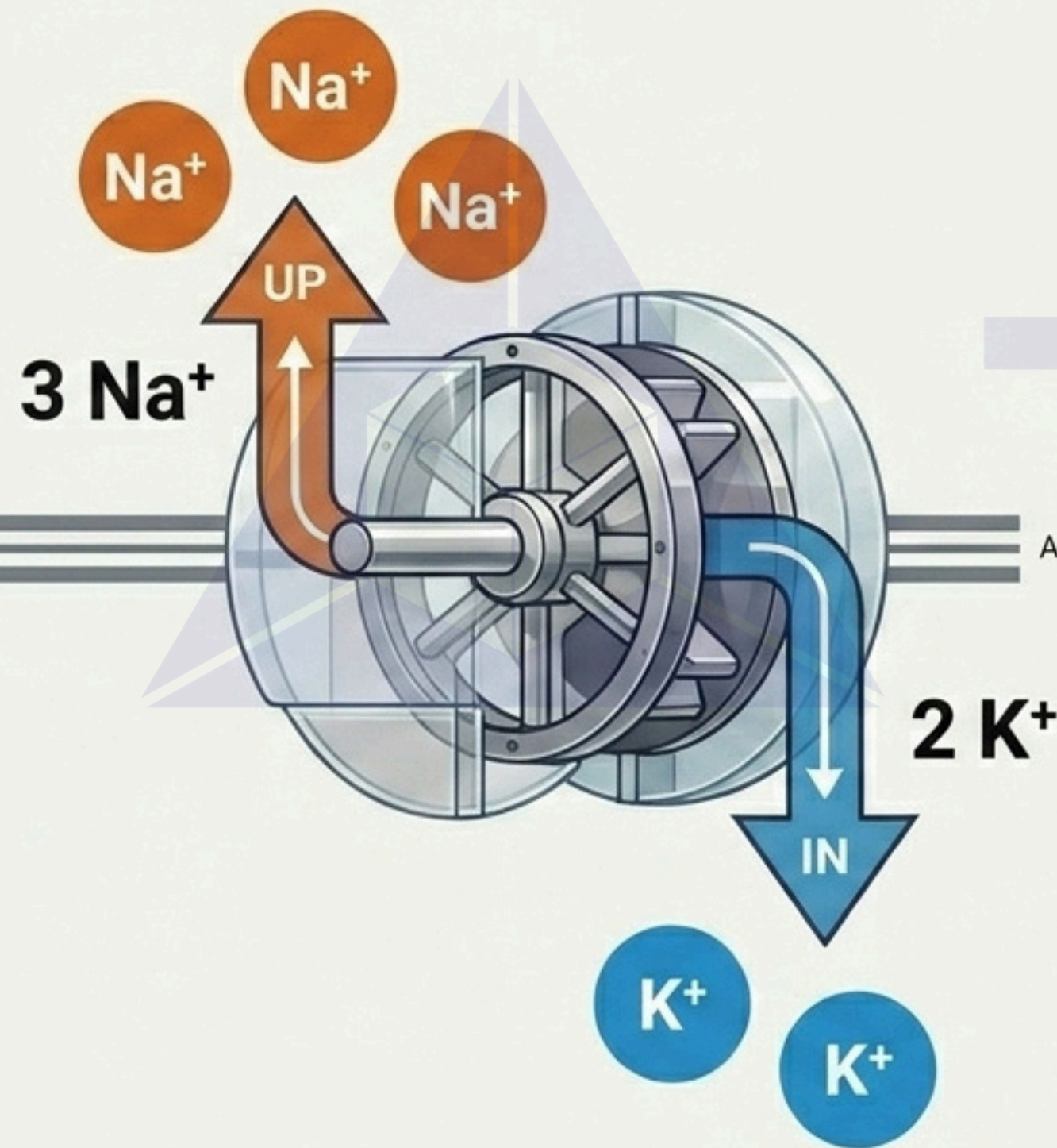
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The Sodium-Potassium Pump: Active Transport



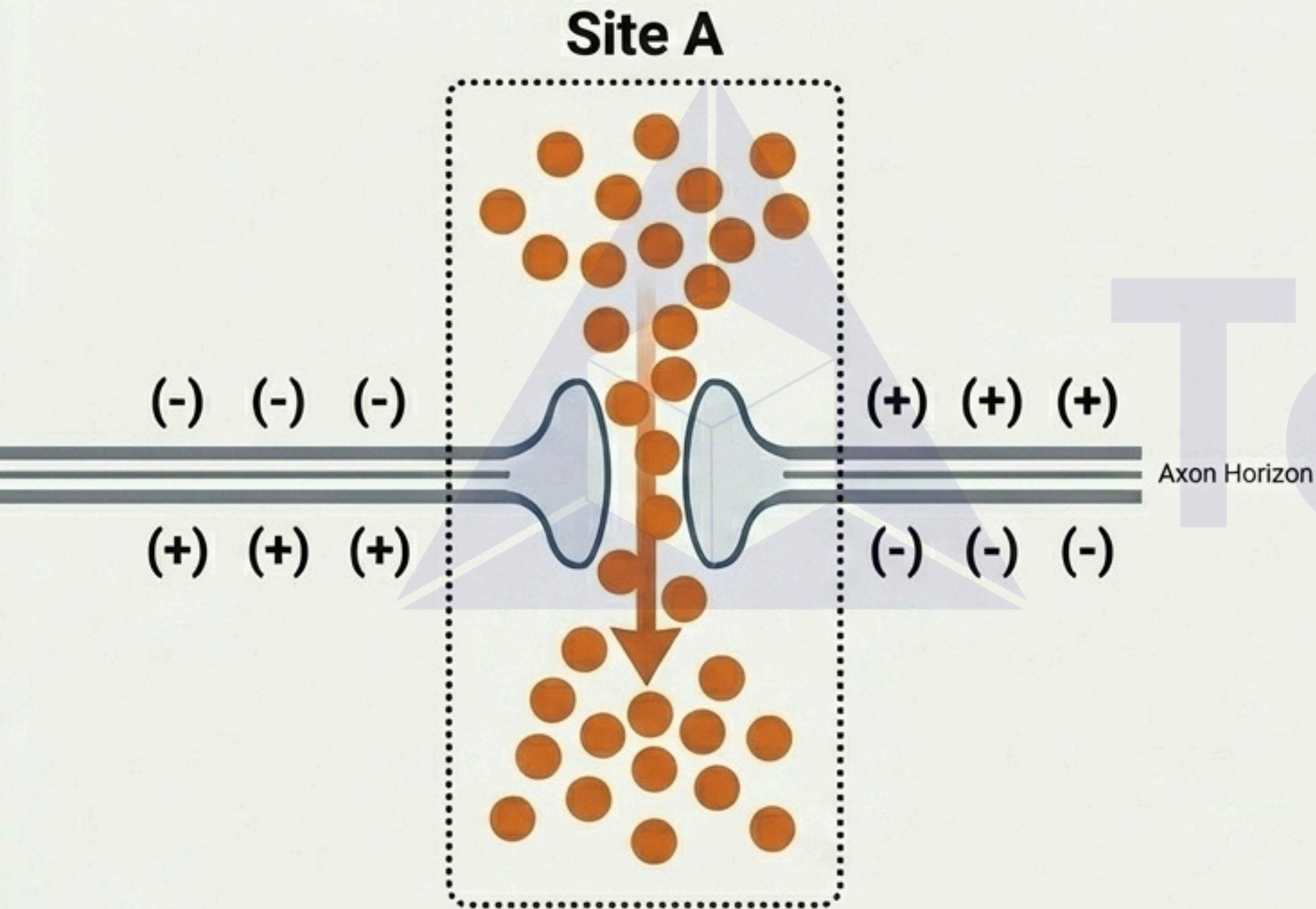
$$\left[\begin{array}{c} 3 \text{ Na}^+ \\ \text{OUT} \end{array} \right] + \left[\begin{array}{c} 2 \text{ K}^+ \\ \text{IN} \end{array} \right] = \text{Net +1 Positive Outside}$$

Active Maintenance

The ionic gradients across the resting membrane do not happen passively. They are actively maintained by the sodium-potassium pump,

continuously at: naturally forcing sodium outwards and potassium inwards to sustain the polarized state.

The Stimulus: Depolarisation and Action Potential



1.

Stimulus Applied

Membrane at Site A suddenly becomes freely permeable to Na⁺.

2.

Rapid Influx

Na⁺ rushes into the axoplasm, destroying the previous balance.

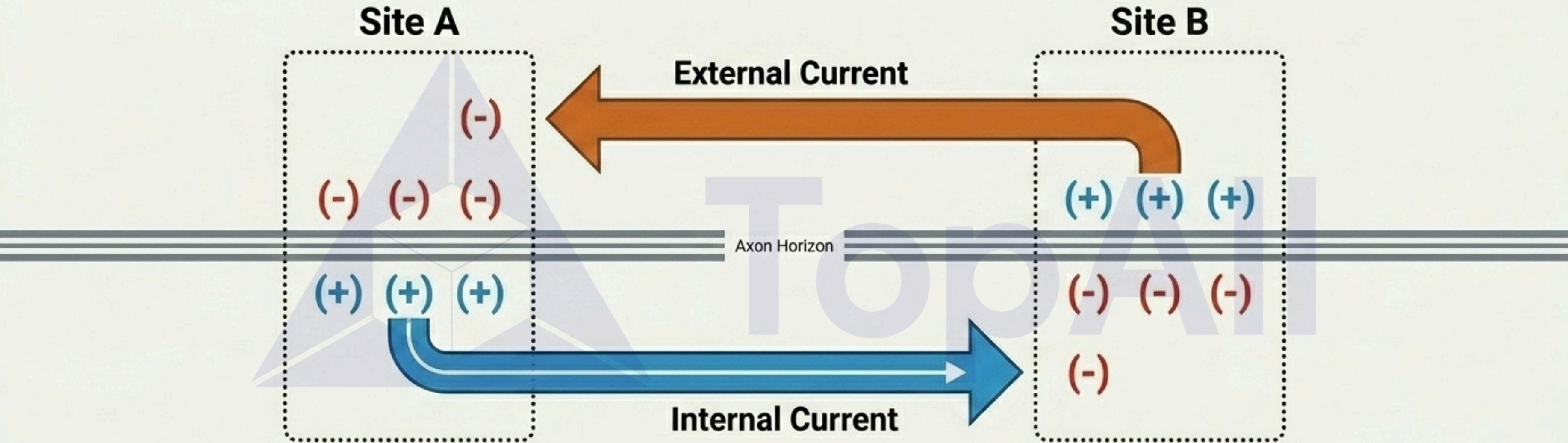
3.

Polarity Reversal

The outer surface becomes negatively charged, and the inner side becomes positively charged.

This localised reversal of polarity is **Depolarisation**. The electrical potential difference at Site A is the **Action Potential** (the nerve impulse).

Completing the Circuit: Current Flow from A to B



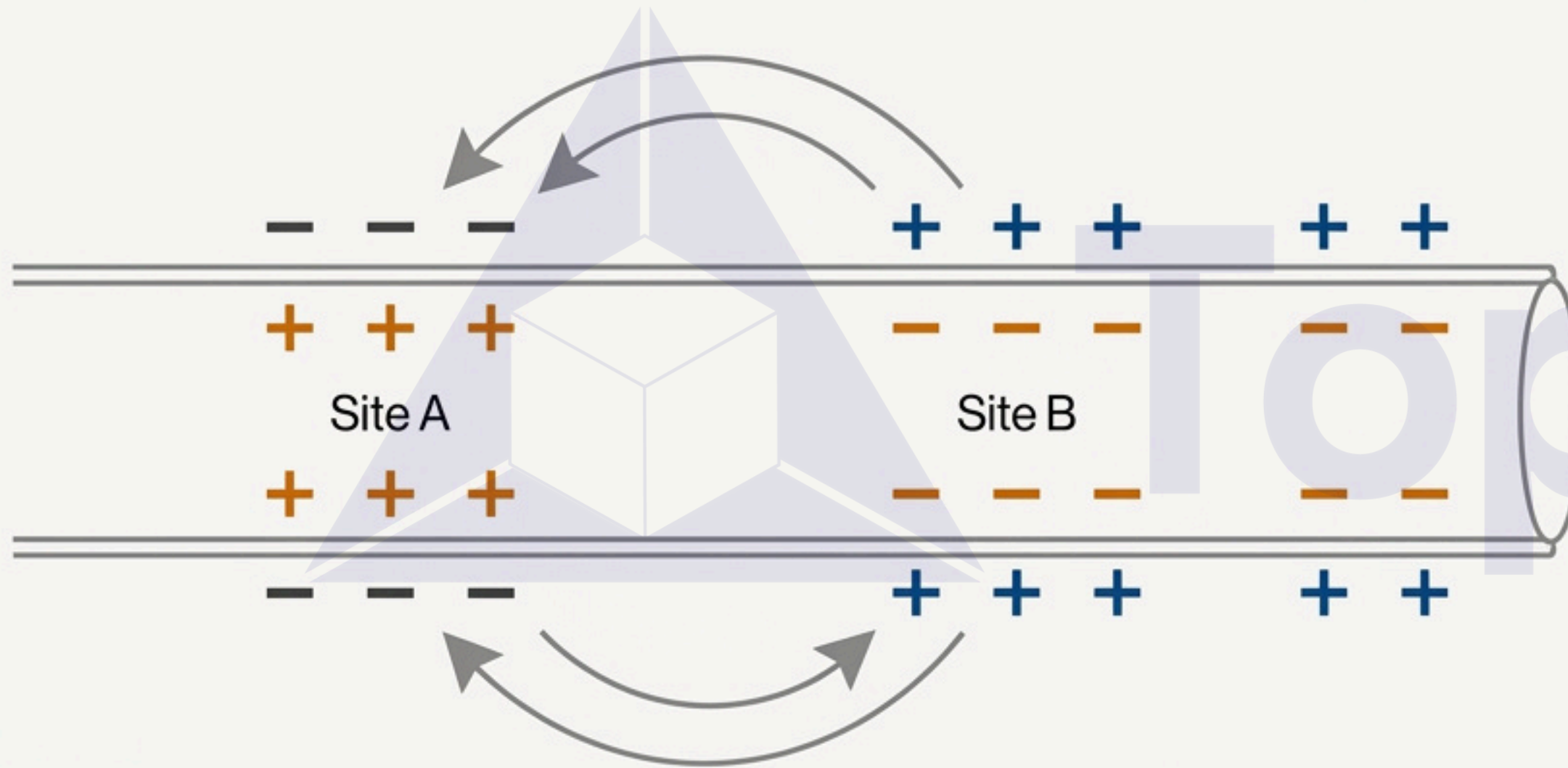
The Propagation Flow

Current flows on the inner surface from A to B, and on the outer surface from B back to A to complete the electrical circuit.

The Result

This flow reverses the polarity at Site B, generating a new action potential there. The impulse has successfully traveled forward.

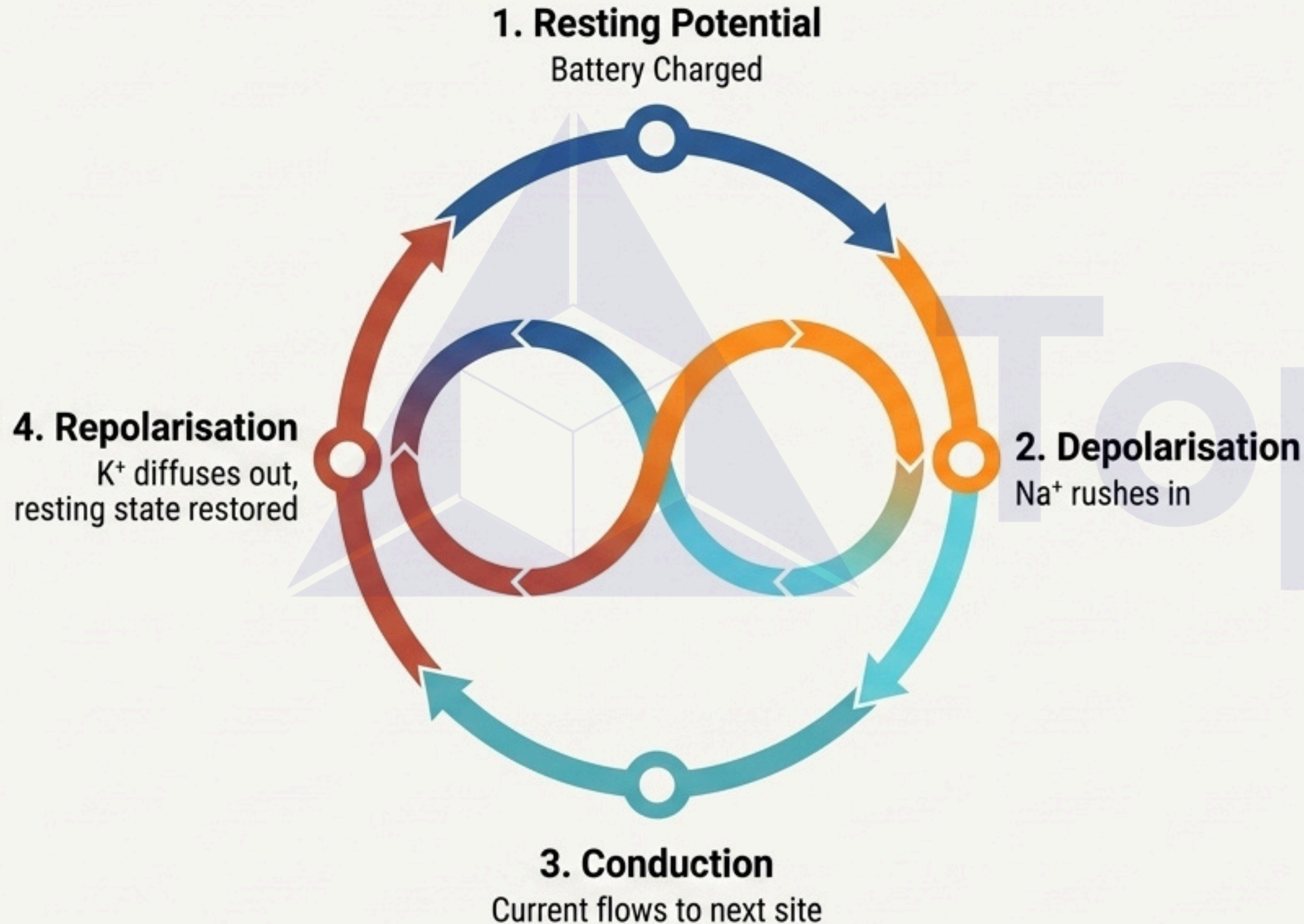
The Wave in Motion



The Reset Mechanism

The rise in Na⁺ permeability is extremely short-lived. Within a fraction of a second, permeability to K⁺ rises. K⁺ diffuses outside, instantly restoring the resting potential so the fibre is ready for the next stimulus.

Key Takeaway: The Self-Propagating Wave



The axon acts as an infinitely resetting biological wire.

An action potential is not a single moving object. It is a sequence of dominoes where falling down is immediately followed by standing back up. Each depolarized segment triggers the exact same event in the adjacent segment, while local pumps immediately restore the resting potential—ensuring a continuous, one-way electrochemical wave.



You've Learned the Theory.

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