



ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

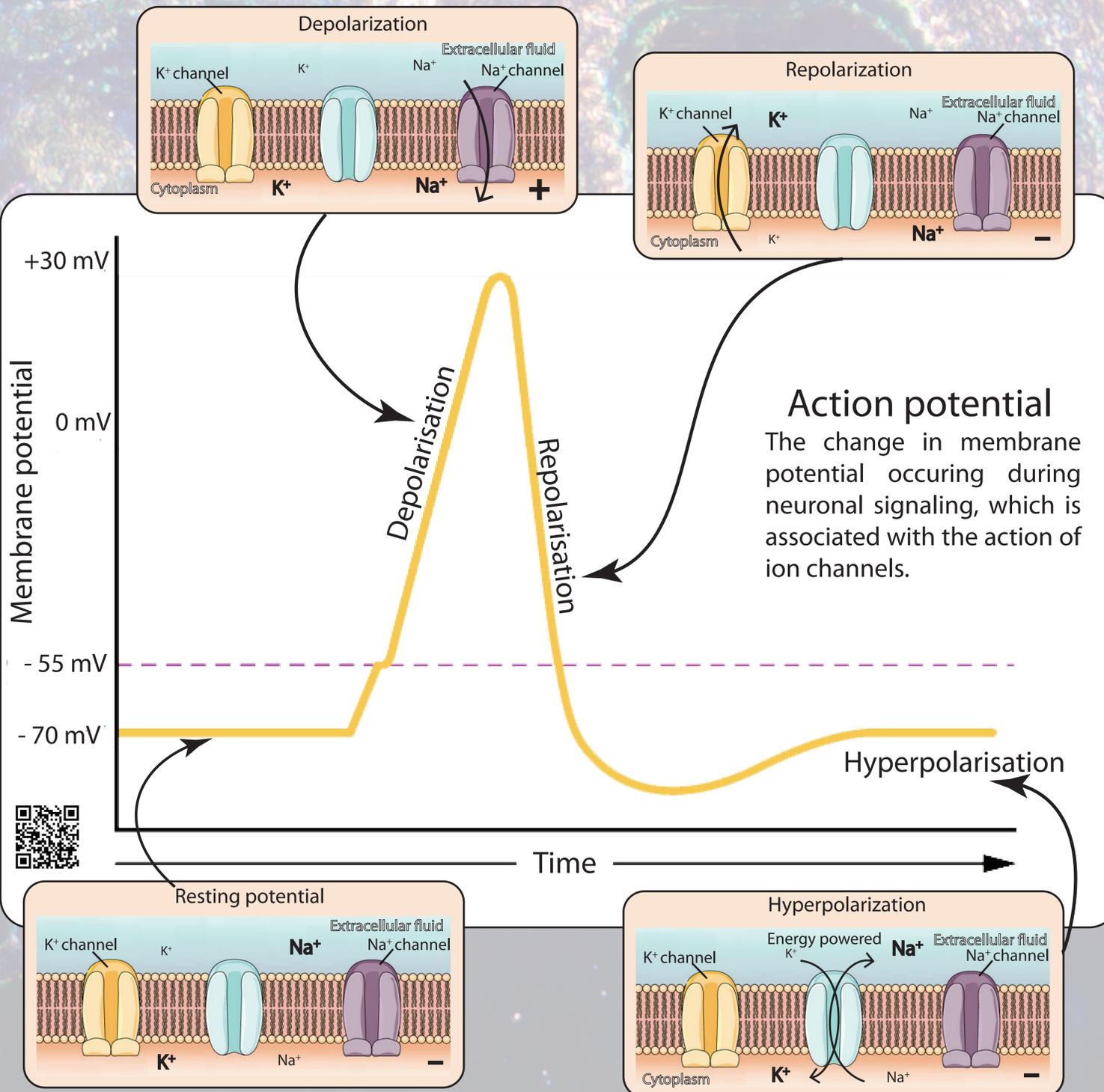
Working Together for a World Free of Chemical Weapons

Ion channels of the Nervous System

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Nerve agents and neurotoxins (such as botulinum toxin and saxitoxin) affect life processes by disrupting chemical signalling between nerve cells (neurons). Neurological signalling processes involve ion channels. Those are proteins that enable the transport of ions (specifically K^+ , Na^+ , Ca^{2+} , Cl^-) across cellular membranes. The direction of ion flow is driven by concentration gradients, with the ions flowing from higher to lower concentration.

Type of ion channel	Mechanism
Ligand gated	Activated by the binding of a ligand. In the nervous system, neurotransmitters such as acetylcholine or glutamate often serve as binding ligands.
Voltage-gated	Activated when the membrane potential exceeds or falls behind a triggering threshold (see action potential chart).
Inwardly-rectifying/ tandem pore domain	Allows K^+ ions to flow into the cell while at negative membrane potential. This allows the cell to maintain the resting potential state.



Ion channels	Ion Flow	Effect when	
		Blocked	Overstimulated
Sodium Na^+	Voltage-gated	No signaling. Muscle: Paralysis Brain: Neurological shut-down	Constant excitation. Muscle: Contractions Brain: Neurological shut-down
	Ligand-gated		
Potassium K^+	Voltage-gated	No new signal sent. Muscle: Paralysis Brain: Neurological shut-down	No signaling. Muscle: Paralysis Brain: Neurological shut-down
	Ligand-gated		
	Inwardly-rectifying/ tandem pore domain		
Calcium Ca^{2+}	Voltage-gated	No signaling. Muscle: Paralysis Brain: Neurological shut-down	Constant excitation. Muscle: Contractions Brain: Neurological shut-down
	Ligand-gated		
Chloride Cl^-	Voltage-gated	No signaling. Muscle: Paralysis Brain: Neurological shut-down	Constant excitation. Muscle: Contractions Brain: Neurological shut-down
	Ligand-gated		



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