



ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

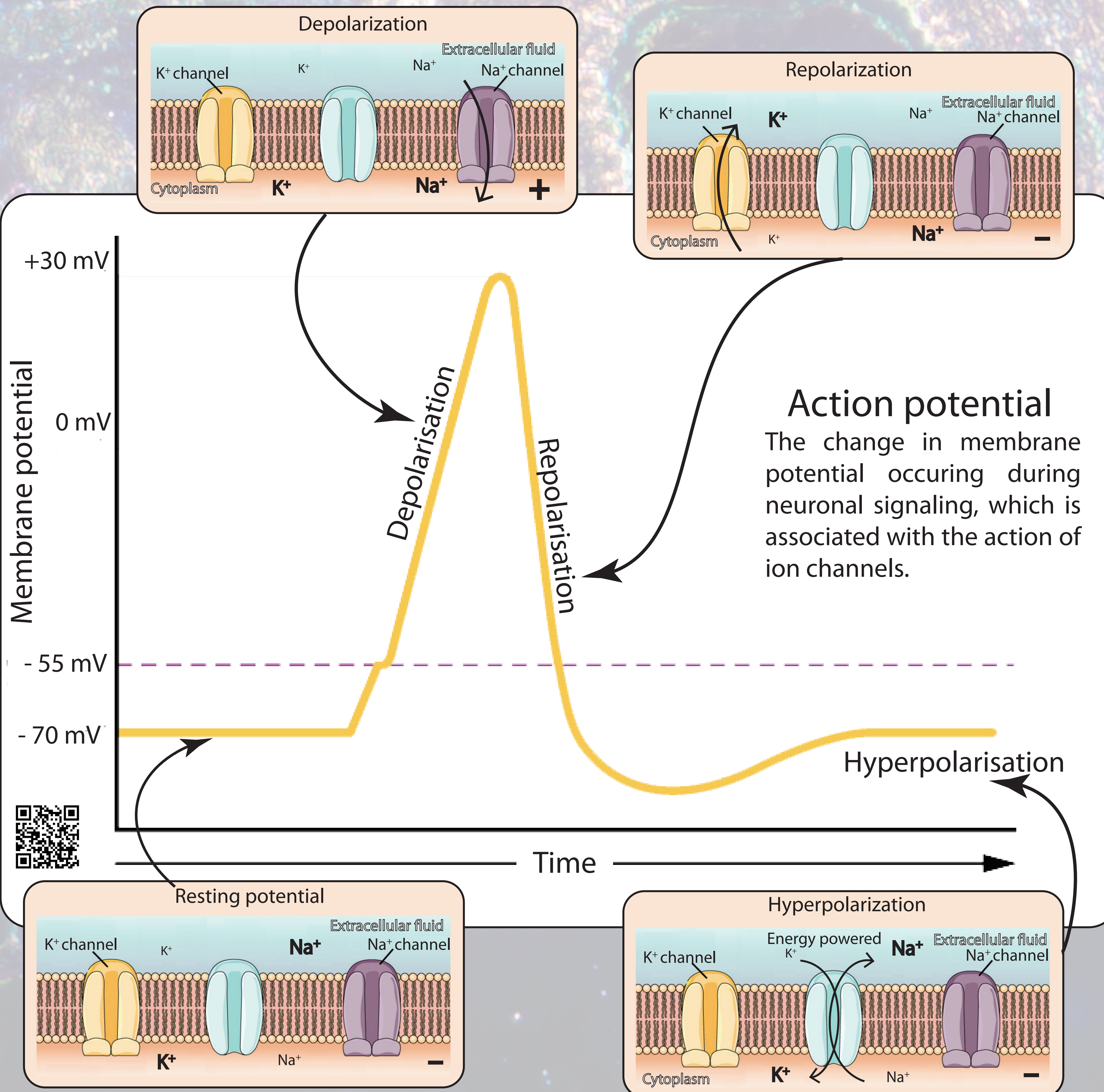
Working Together for a World Free of Chemical Weapons

Ion channels of the Nervous System

Edoxie E. Allier-Gagneur and Jonathan E. Forman

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 | | |



@opcw
@opcw_st



/opcwonline



/opcwonline



/company/opcw



/opcw