

Action Potential

Week
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Notes

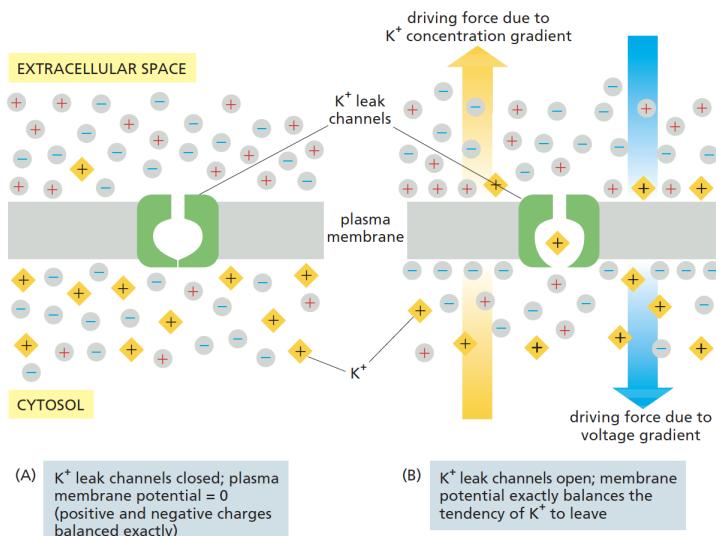
The Na+ K+ pump is an electrogenic transmembrane ATPase first discovered in 1957 and situated in the outer plasma membrane of the cells; on the cytosolic side.[\[1\]](#)[\[2\]](#) The Na+ K+ ATPase pumps 3 Na+ out of the cell and 2K+ that into the cell, for every single ATP consumed. The plasma membrane is a lipid bilayer that arranged asymmetrically, containing cholesterol, phospholipids, glycolipids, sphingolipid, and proteins within the membrane.[\[3\]](#)[\[4\]](#) The Na+K+-ATPase pump helps to maintain osmotic equilibrium and membrane potential in cells.

The sodium and potassium move against the concentration gradients. The Na+ K+-ATPase pump maintains the gradient of a higher concentration of sodium extracellularly and a higher level of potassium intracellularly. The sustained concentration gradient is crucial for physiological processes in many organs and has an ongoing role in stabilizing the resting membrane potential of the cell, regulating the cell volume, and cell signal transduction.[\[2\]](#) It plays a crucial role on other physiological processes, such as maintenance of filtering waste products in the nephrons (kidneys), sperm motility, and production of the neuronal action potential.[\[5\]](#) Furthermore, the physiologic consequences of inhibiting the Na+-K+ ATPase are useful and the target in many pharmacologic applications.

Na, K-ATPase is a crucial scaffolding protein that can interact with signaling proteins such as protein kinase C (PKC) and phosphoinositide 3-kinase (PI3K).[\[6\]](#)

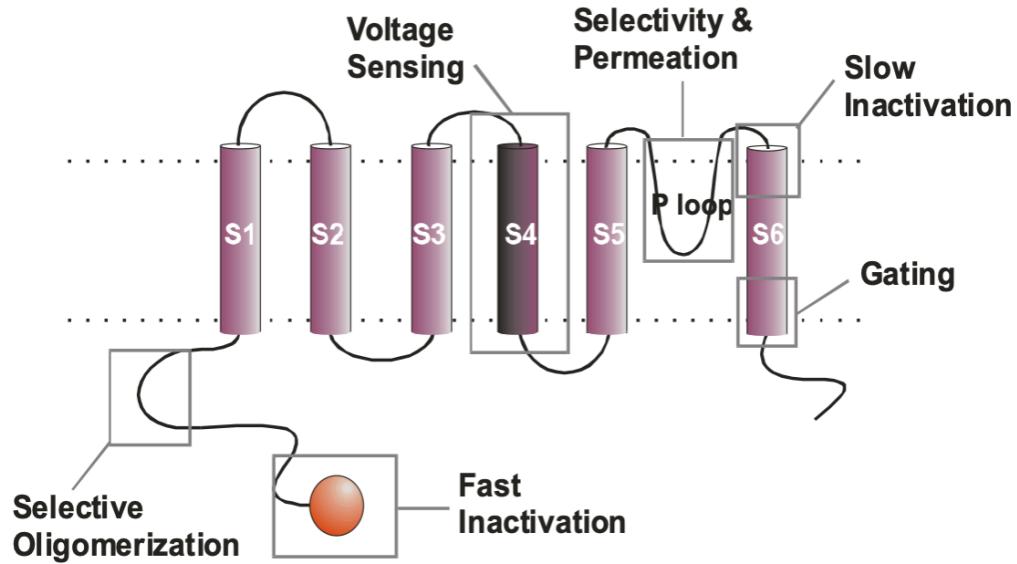
Figure 12–23 The K⁺ concentration gradient and K⁺ leak channels play major parts in generating the resting membrane potential across the plasma membrane in animal cells. (A) A hypothetical situation in which the K⁺ leak channels are closed and the membrane potential is zero. (B) As soon as the channels open, K⁺ will tend to leave the cell, moving down its concentration gradient. Assuming the membrane contains no open channels permeable to other ions, K⁺ will cross the membrane but negative ions will be unable to follow. The resulting charge imbalance gives rise to a membrane potential that tends to drive K⁺ back into the cell. At equilibrium, the effect of the K⁺ concentration gradient is exactly balanced by the effect of the membrane potential, and there is no net movement of K⁺ across the membrane.

The Na⁺ pump (not shown here) also contributes to the resting potential—both by helping to establish the K⁺ gradient and by pumping 3 Na⁺ ions out of the cell for every 2 K⁺ ions it pumps in (see Figure 12–11). Moving one more positively charged ion out of the cell with each pumping cycle helps to keep the inside of the cell more negative than the outside.



the electrochemical gradient for K⁺ is zero, even though there is still a much higher concentration of K⁺ inside the cell than out (Figure 12–23).

Structure-Function Relations in a Voltage-Dependent Channel



Tetrodotoxin is an extremely potent poison (toxin) found mainly in the liver and sex organs (gonads) of some fish, such as puffer fish, globefish, and toadfish (order Tetraodontiformes) and in some amphibian, octopus, and shellfish species.

This neurotoxin, reported as a threat to human health in Asian countries, has spread to the Pacific and Mediterranean, due to the increase of temperature waters worldwide. TTX, for which there is no known antidote, inhibits sodium channel producing heart failure in many cases and consequently death.