

Tutorial 6: The Action Potential

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Tutorial 6 describes the membrane and ions events associated with each phase of the action potential. This process underlies the transmission of information along the axon of a neuron. Figure 6 illustrates the primary phases of evolution and resolution of an action potential. The complete cycle of events from the onset of action potential to the return to resting membrane potential takes approximately 2.5 milliseconds.

Advanced

While considerable detail concerning the ionic events underlying action potentials exists, little attention has been paid to the molecular context in which these events occur until recently (Waxman, 1999). The complete picture of cell signaling needs to ultimately include this context. For example, the electrolytic changes associated with protein interactions that occur with the opening and closing of ion channels certainly affect the electrostatic profile of the neuronal membrane. Three types of potentials are now under study by neurobiologists (Olivotto, Arcangeli, Carla & Wanke, 1996):

1. the potential created across the layer of water that adheres to the membrane surfaces; molecular inducers of cell differentiation affect this potential,
2. the potential across the Gouy-Chapman sublayer of the bi-lipid membrane structure, and
3. the resting potential.

References

Olivotto, M., Arcangeli, A., Carla, M. & Wanke, E. (1999). Electric fields at the plasma membrane level: a neglected element in the mechanisms of cell signalling. *Bioessays*, 18(6), 495-504.

Waxman, S.G. (1999). The molecular basis for electrogenic computation in the brain: you can't step in the same river twice. *Molecular Psychiatry*, 4(3), 222-228.

Suggestions for further study

SUGGESTED READINGS:

Keynes, R.D. (1979, March). Ion channels in the nerve-cell membrane. *Scientific American*, 240(3), 126-132, 134-135.

Neher, E. & Sakmann, B. (1992, March). The patch clamp technique. *Scientific American*, 266(3), 28-35.

Regan, D. (1979, December). Electrical responses evoked from the human brain. *Scientific American*, 241(6), 134-146.

RELATED LINKS:

<http://psych.hanover.edu/Krantz/neural/actionpotential.html>

(Physical Factors Underlying the Action Potential)

Krantz - Psychology Tutorials

<http://phys-main.umsmed.edu/studlabs/VSMLABS/ACTPOT.HTM#TOP>

(Graduate Level Material on Membrane and Action Potentials with Lab)

T.M. Dwyer

<http://www.sfn.org/briefings/nmda.html>

(NMDA Receptors)

from Society for Neuroscience - *Brain Briefings*, 1994.

NMDA receptor blockers and the prevention of neuronal damage due to stroke, epilepsy, Huntington's Disease, and AIDS.