Electrical Synapse

An electrical synapse is an alternative to the chemical synapses found throughout the nervous system. Electrical synapses are found typically in cardiac and smooth muscle cells. They are characterized by the connection of the cytoplasm of a presynaptic and postsynaptic cell through channels. Presynaptic sodium floods through the gap junction, an intercellular connection. This sodium influx in the postsynaptic cell causes action potential generation, just as if the sodium flooded in through traditional voltage-gated channels. Two differences between electrical and chemical synapses are that signals can be transmitted in either direction with electrical synapses, whereas chemical synapses can only transmit action potentials in one direction. Additionally, transmission of the signal is much faster because of the short distance in between cells and because action potential generation does not depend on a neurotransmitter crossing the synaptic cleft and binding to a receptor.

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Characteristics

Cardiac and Smooth Muscle Location

Heart-muscle with vascular intestine Smoothie

Electrical synapses are found typically in cardiac and smooth muscle cells.

Fast Transmission

Fast-rabbit

Transmission is also faster because sodium can influx faster, through connected cytoplasm, than neurotransmitter can cross the synaptic cleft and bind to receptors.

Bidirectional

Bidirectional-bike

With electrical synapses, the action potential can travel in either direction (either cell can be presynaptic or postsynaptic). This is impossible in cells with chemical synapses because the signal has to travel from the dendrites to the nerve terminal.

Presynaptic Na+ Floods Through Gap Junction

Priest Salt-shaker Flood through Gap in teeth

Presynaptic sodium floods through the gap junction, an intercellular connection that allows for molecules and ions to travel between the cytoplasm of the presynaptic and postsynaptic cells.

Na+ Influx Initiates Postsynaptic Action Potential

Salt-shaker hits button and Initiates P-spring release

Sodium influx in the postsynaptic cell generates an action potential, just like the one generated by sodium influx through voltage-gated sodium channels.