Second Four

The Speed of Propagation

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2023- 2024

Speed of propagation

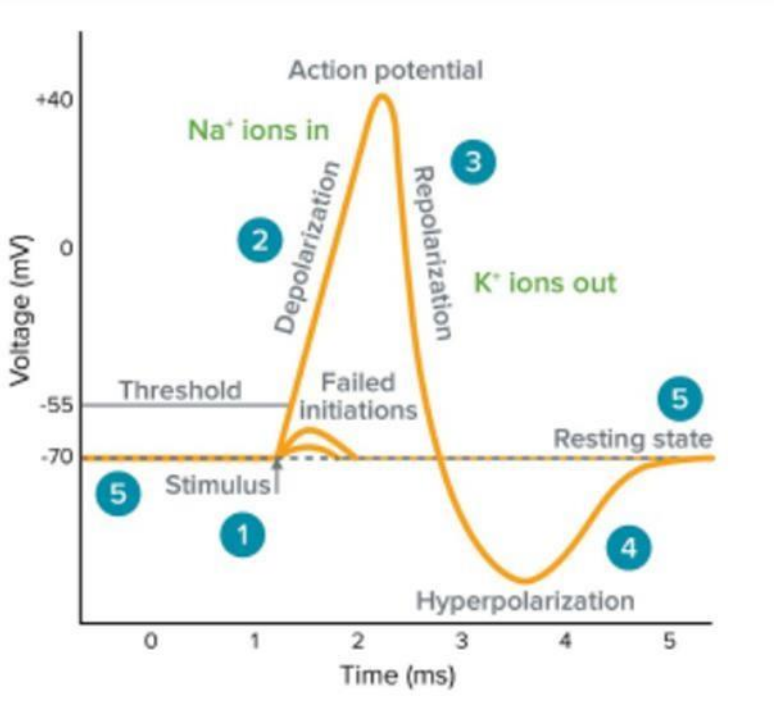
Nerve impulse propagates by jumping from one node of Ranvier to the next. This makes the process of nerve impulse faster as the nerve impulse does not travel the entire length of the axon (this happens in case of continuous conduction). The nerve impulse travels at a speed of 100 m/s in saltatory conduction.

Mechanism of Generated Action Potential :

1- Stimulus starts the rapid change in voltage or action potential. In patch-clamp mode, sufficient current must be administered to the cell in order to raise the voltage above the threshold voltage to start membrane depolarization .

2- Depolarization is caused by a rapid rise in membrane potential opening of sodium channels in the cellular membrane, resulting in a large influx of sodium ions .

3- Membrane Repolarization results from rapid sodium channel inactivation as well as a large efflux of potassium ions resulting from activated potassium channels .



4- Hyperpolarization is a lowered membrane potential caused by the efflux of potassium ions and closing of the potassium channels .

5- Resting state is when membrane potential returns to the resting voltage that occurred before the stimulus occurred .

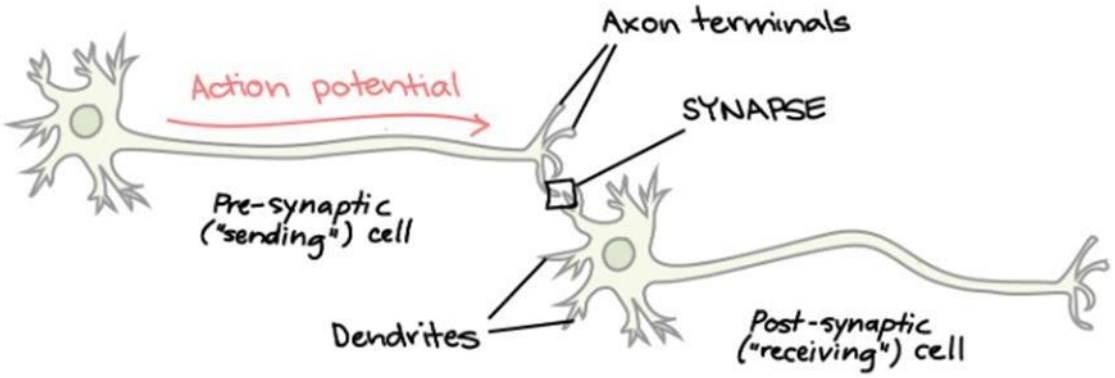
When the nerve impulse reaches the end of the axon, there are some chemicals released from the neurotransmitters. They diffuse across the synaptic gap, which is the small space present between the axon and the receptors. Nerve impulses can be transmitted either by the electrical synapse or the chemical synapse.

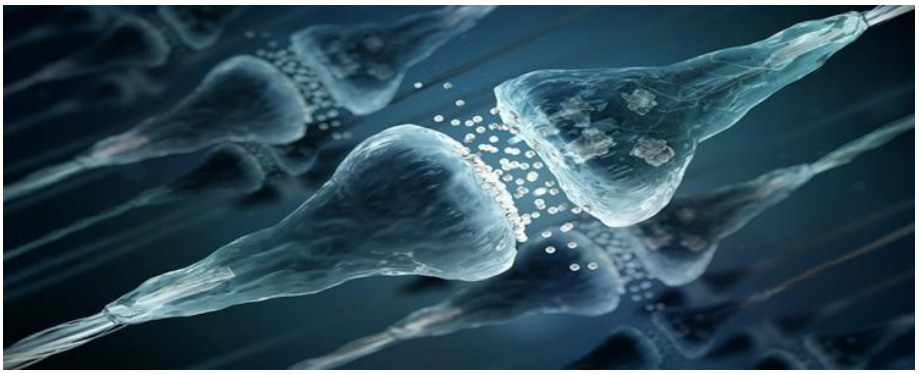
The place where an axon terminal meets another cell is called a synapse. This is where the transmission of a nerve impulse to another cell occurs. The cell that sends the nerve impulse is called the presynaptic cell, and the cell that receives the nerve impulse is called the postsynaptic cell.

The Synapse :

Neurons essentially communicate with each other through synapses. When signals have traveled through neurons to the endpoint, they cannot simply continue onto the next neuron

Neurons do not touch each other, but where the neuron does come close to another neuron, a synapse is formed between the two .





The junction between the axon terminal of one neuron and the dendrite terminal of the other neuron is called a synapse. A small gap called the synaptic cleft separates it .

There are two types of synapses :

1- Electrical synapse .

2- Chemical synapse .

Properties of synapse :

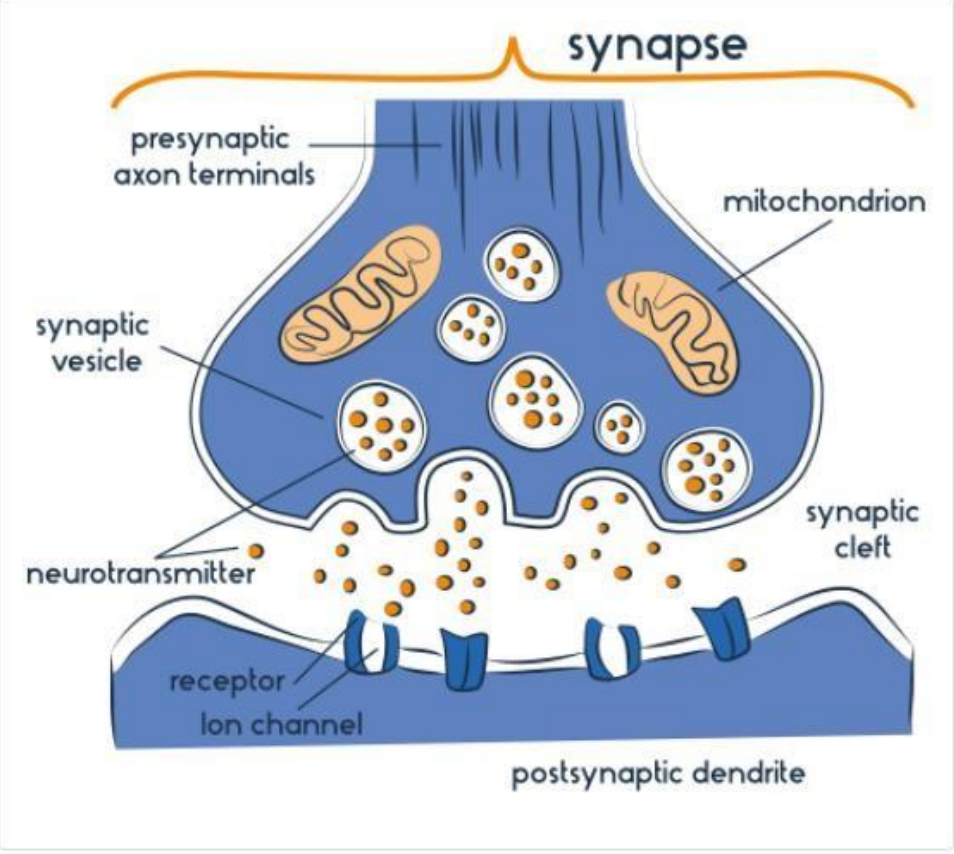
Synapses also have the ability to communicate a change in the message being passed on. Postsynaptic neurons can also send communications back to the presynaptic neurons telling them to change how often or much a neurotransmitter is released.

Due to this, we can say that the synapses are able to communicate bi-directionally, A synapse is a combination of :

1- Presynaptic endings – which contain the neurotransmitters (chemical messengers) .

2- Synaptic clefts – which is the gap between the two neurons .

3- Postsynaptic endings – which contains the sites for receptors (molecules which receives signals for a cell) .



Electrical and Chemical Synaptic Transmission.

Synapses can be either chemical or electrical and are essential to the functioning of neural activity.

Neuroscientists understand that synapses play a vital role in a variety of cognitive functions, including learning and memory formation .

Electrical synapses are different from chemical synapses as there is a direct physical connection between the presynaptic and the postsynaptic neuron.

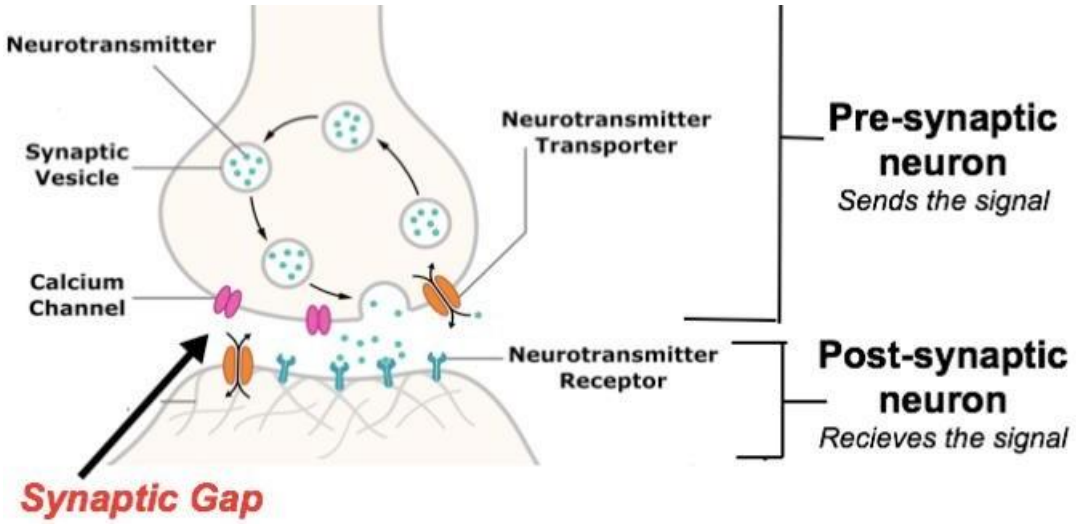
This connection takes the form of something called a gap junction, which is essentially a channel which allows ions to flow directly from the presynaptic cell to the postsynaptic cell .

Chemical Synapses	Electrical Synapses
1- Gap between cells is about 20 nanometers	1- Gap between cells is about 3.5 nanometers
2- Speed of transmission is several milliseconds	2- Speed of transmission is nearly instantaneous
3- Can be excitatory or inhibitory	3- Excitatory only
4- No loss of signal strength	4- Signal strength diminishes over time

Signal Transmission Across a Synapse :

1- When an impulse reaches the far end (called the synaptic terminal), the impulse must travel from the presynaptic neuron to the postsynaptic neuron .

2- Chemical messengers called neurotransmitters carry the neural signal from one neuron to the next neuron or effector .



Electrical Nature of Nerves :

1- Across the surface or membrane of every neuron is an electrical potential (voltage) difference due to the presence of more negative ions on the inside of the membrane than on the outside. The neuron is said to be polarized.

2- The inside of the cell is typically 60 to 90 m V more negative than the outside. This potential difference is called the resting potential of the neuron.

3- When the neuron is stimulated, a large momentary change in the resting potential occurs at the point of stimulation.

4- Qualitatively, the resting potential of a nerve exists because the membrane is impermeable to the large A- (protein) ions while it can be permeable to the K+, Na+, and Cl- ions.

5- Neurons use electrical signals to communicate with other neurons, muscles and glands.

6- When microelectrodes are placed on either side of the membrane of an inactive neuron, measurements from a voltmeter indicate an electrical potential difference of -70mV (millivolts) .

7- The charge of the inside of the neuron cell is negative in relation to the outside .This charge separation across the membrane is known as the