TOPIC "COMMUNICATION BETWEEN NEURON"

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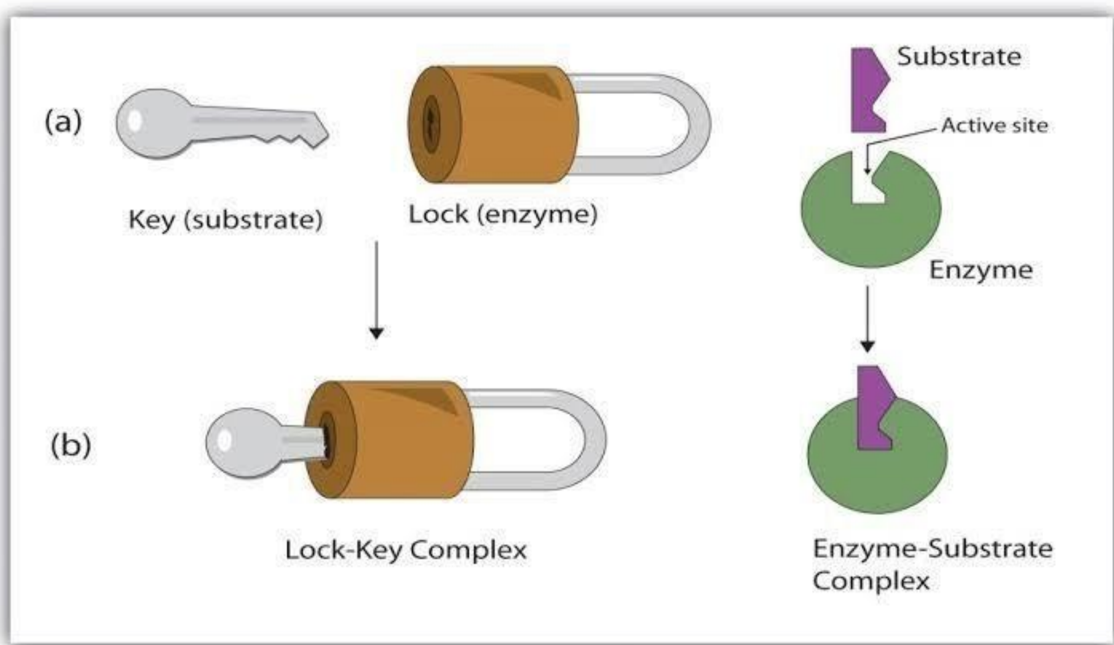
Communication between Neurons

THE primary means of communication between neurons is SYNAPTIC TRANSMISSION, the transmission of messages from one neuron to another through a synapse. These messages are carried by neurotransmitters, released by terminal buttons. These chemicals diffuse across the fluid filled gap between the terminal buttons and the membranes of neurons with which they form synapses. Neurotransmitters produce POSTSYNAPTIC POTENTIALS brief depolarization or hyperpolarization, that increase or decrease the rate of firing of the axon of the postsynaptic neuron.

LOCK AND KEY MODEL

Neurortransmitters exert their effects on cells by attaching to a particular region of a receptor molecule called the **BINDIND SITE**. A molecule of the chemical fits into the binding site the way a key fits into a lock. The shape of the binding site and the shape of the molecule of the neurotransmitter are complementary. A chemical that attaches to a binding site is called a **Ligand ,** from ligare, to bind. "Neurotransmitters are natural ligands produced and released by neurons. But other chemicals found in nature can serve as ligands too.

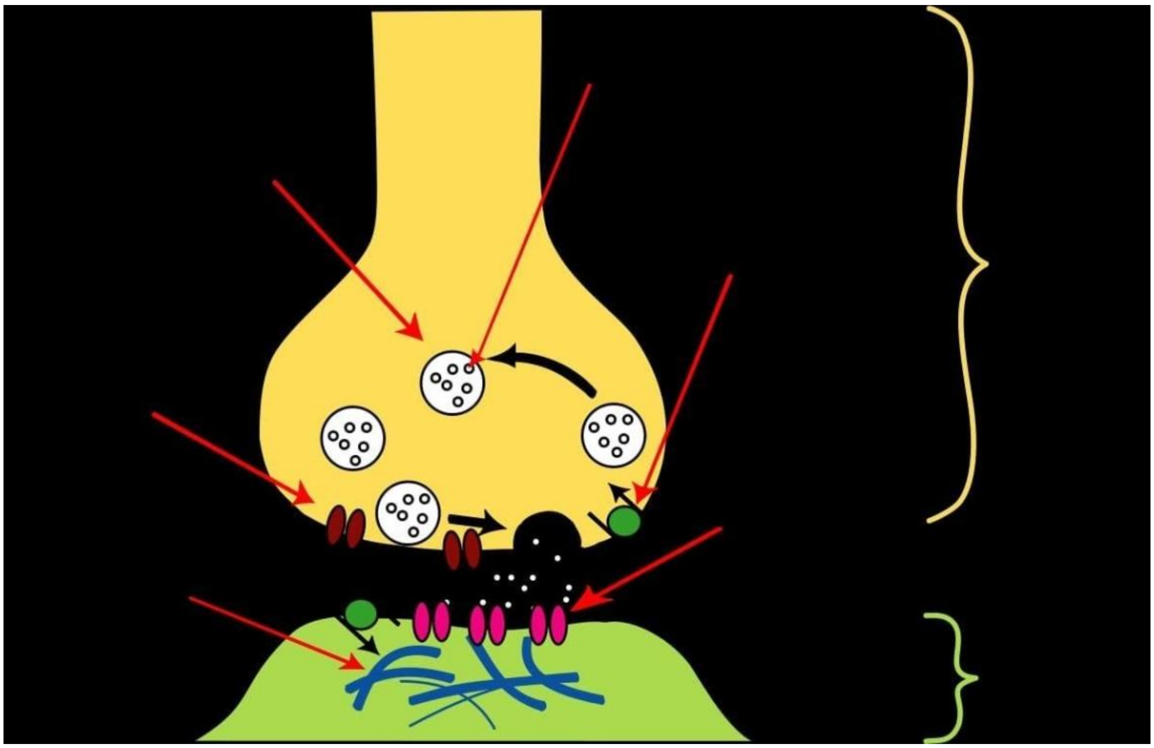


Structure of synapses

Synapses are junctions between the terminal buttons at the ends of the axonal branches of one neuron and the membrane of another. Synapses can occur in three places: dendrites, soma, axons. These synapses are referred to as **axosomatic axodendritic, axoaxonic.**

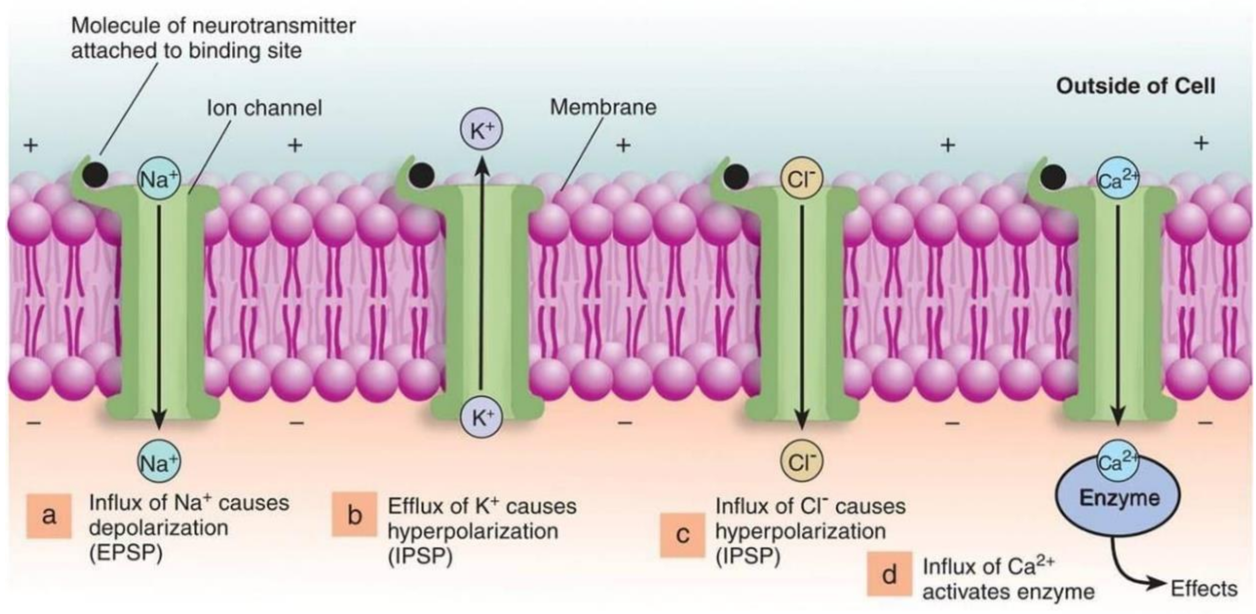
Axodendritic synapses: It can occur on the smooth surface of a dendrite or on dendritic spines ,small protrusions that stud the dendrites of several types of large neurons in the brain.

The **presynaptic membrane** located at the end of the terminal button faces the **postsynaptic membrane** located on the neuron that receives the message . These two membranes face each other across the synaptic cleft, a gap that varies in size from synapse to synapse.



Resting Membrane Potential

A typical neuron at rest is more positive electrically outside than inside the cell membrane. **This net difference in charge between the inner and outer surface of a non-conducting neuron is called the resting membrane potential**.



Factors Involved In Resting Membrane Potential

Three major factors are involved;

(1) Sodium and potassium ions pump

Many kinds of ions are present in the nerve cell and the surrounding fluid. Sodium and potassium ions are the most important.

- **Sodium ions:** are tenfold higher in concentration outside than the membrane surface.
- **Potassium ions:** are twenty times more concentrated inside than outside.

(2) Negative Organic ions

The large negative organic ions such as proteins, organic acids etc. are much more inside the membrane than outside where they are only in negligible concentration. This makes the inside of the neuron membrane more negative.

(3) Leakage of K+ ions form neurons

The cell membrane is virtually impermeable to all ions except K+. As the membrane is slightly permeable to K+, some of it leaks out of the cell. The loss of this positive ion from the neuron by diffusion moves negative charge inside than outside the cell membrane of the neuron.

- **No conduction of nerve impulse** There is no conduction of nerve impulse.
- **Resting Membrane potential**

Normally, resting membrane potential is about -70 mv. The resting potential is measured in millivolts(m) A millivolt is 1/1,000 of volt.

Mechanism of Neuron Action

Changing the resting electrical potential across the plasma membrane is the key factor in the creation and conduction of a nerve impulse. A stimulus that is strong enough to initiate an impulse is called threshold stimulus.

1) Depolarization

Threshold stimulus is applied on the resting plasma membrane and the permeability to Na+ ions increases as the point. The inflow of positively charged Na+ ions causes the membrane potential to go from -70 mV towards 0.This loss in membrane polarity is called depolarization. When depolarization reaches a certain level, special Na" channels that are sensitive to changes in membrane potential quickly open. Thus more Na ions rush to the inside of the neuron.

2) Repolarization

Shortly after the Na+ ions move into the cell, the Na+ gates close. Now voltage gated K+ channels open. Now K+ ions rapidly diffuse outward. The movement of the K+ ions out of the cell causes the positive charge outside the cell again. Now the membrane becomes repolarized. This rebuilding of positive charge outside is called repolarization.

This series of membrane changes produce a similar cycle in an adjacent region of the membrane. The wave of depolarization moves down the axon as an action potential. Overall the transmission of an action potential along the neuron plasma membrane is a wave of depolarization and repolarization.

3) Hyperpolarization and Refractory period

After each action potential, there is an interval of time when it is more difficult for another action potential to occur. It is because the membrane has become hyperpolarized (more negative than -70 mV) due to the large number of K+ ions that rushed out. This brief period is called the refractory period. During this period, the resting potential is restored at the part of the membrane. Afterward, the neuron is repolarized. Now it is ready to transmit another impulse. The state of neurons in which more -ive charge is developed inside the membrane is called hyperpolarization.

Factors affecting the speed of nerve impulse

1) Diameter of axons

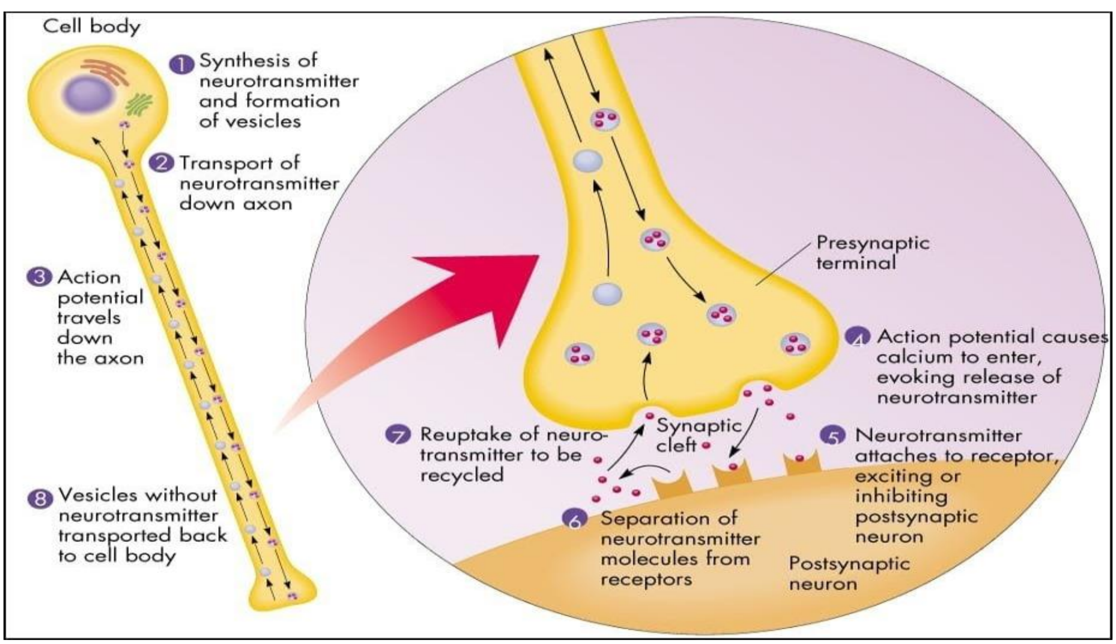
Increase of the diameter of the axon increases the speed of nerve impulse. Axons with a large diameter transmit impulses faster than smaller ones. Large diameter axons are common among many invertebrates(e.g, Crayfishes Earthworms.)

Example

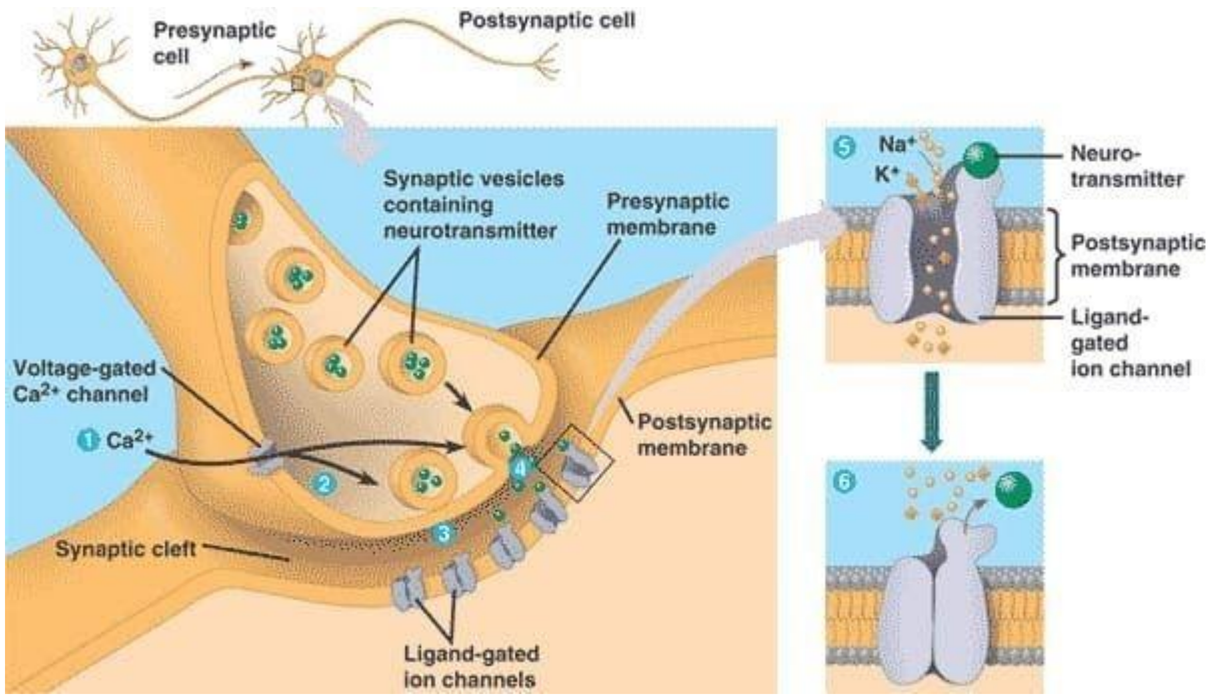
1) **The squids** have the largest diameter. The diameter of its axon is over 1 mm. The axons have a conduction velocity greater than 36 m/ second. The squid axons can easily escape from predators. A single action potential causes maximum contraction of the mantle muscle in squids, Mantle contraction rapidly expels water like a jet. Thus the squid moves away from the predator.
2) **Most vertebrate axons** have a diameter less than 10 . Some fishes and amphibians have large unmyelinated axons. Their diameter is 50. They extend from the brain. They pass down the spinal cord and activate skeletal muscles.

2) Addition Of myelin

Addition of myelin sheath also increases the speed of conduction of a nerve impulse. Myelin is an excellent insulator. Thus it stops the movement of ins across it. Therefore it increases the rate of conduction of nerve impulse. Action potentials are generated only at the neurofibril nodes. Thus action potential 'jumps; from one node to the next node. Therefore conduction along myelinated fibers is known as saltatory conduction. It takes less time for conduction of nerves, Myelin sheath allows rapid conduction of small neurons. Thus evolution of the nervous system in animals took place. It does not occupy large spaces.



Release of neurotransmitters



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