

CONCEPT MAP

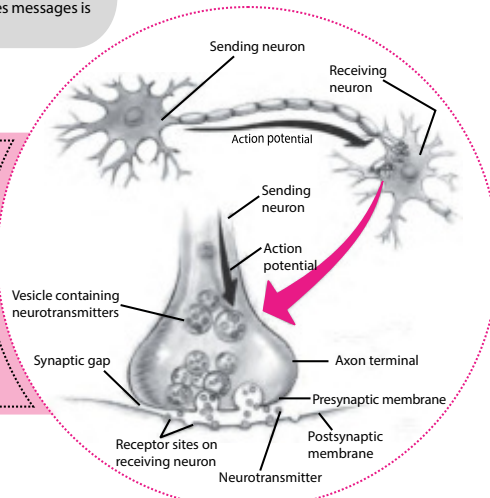
SYNAPSE

Synapse is an anatomically specialised junction between two neurons, where the axon (or some other portion) of one cell (neuron) terminates on the dendrites or some other portion of another cell. The term 'synapse' was first introduced by Charles Sherrington (1924). Transmission of nerve impulse takes place across a synapse between neurons or neurons and an effector. The neuron which sends messages is called presynaptic cell whereas the neuron which receives messages is postsynaptic neuron.

STRUCTURE OF SYNAPSE

Most of the synapses comprise the following structures:

- (i) **Synaptic knob** – Terminal bulbous ending of presynaptic axon which is devoid of neurofilaments but its cytoplasm contains:
 - (a) **Synaptic vesicles** – Small vesicles present in presynaptic cytoplasm that contain neurotransmitters (for excitation or inhibition), like acetylcholine, GABA, etc.
 - (b) **Mitochondria, ER and microtubules.**
 - (c) **Presynaptic membrane** – Nerve membrane which is in close approximation with membrane of postsynaptic cell.
- (ii) **Sub-synaptic and postsynaptic membrane** – The surface of the cell membrane involved in the synapse is called the sub-synaptic membrane and the remaining of the motor neuron cell membrane is called the postsynaptic membrane. Receptor sites for neurotransmitters are usually located on the sub-synaptic membrane.

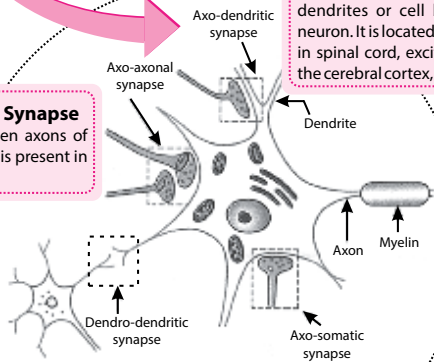


TYPES OF SYNAPSE

On the basis of proximity and location within nervous system

On the basis of physiology

Axo-axonal Synapse
Synapse between axons of two neurons. It is present in spinal cord.



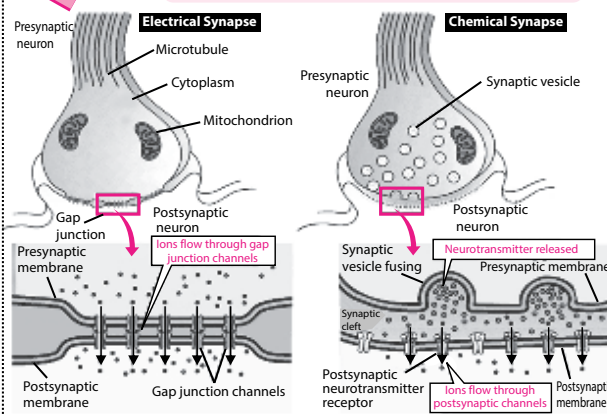
Axo-dendritic Synapse
Synapse between fine terminal branches of axon of one neuron and dendrites or cell body of another neuron. It is located in motor neurons in spinal cord, excitatory synapse in the cerebral cortex, etc.

Dendro-dendritic Synapse
Synapse between dendrites of two neurons, but is rare. It is present between mitral and granule cell in the bulb.

Axo-somatic Synapse
Synapse between axon of one neuron and soma of another neuron. It is present in motor neurons in spinal cord and autonomic ganglia.

Chemical Synapse

- Signals are transmitted across synaptic cleft in form of chemical messenger – a neurotransmitter, released from presynaptic axon terminal.
- Chemical synapse operates only in one direction, as neurotransmitter is stored on the presynaptic side of synaptic cleft, whereas receptors for neurotransmitters are on postsynaptic side.



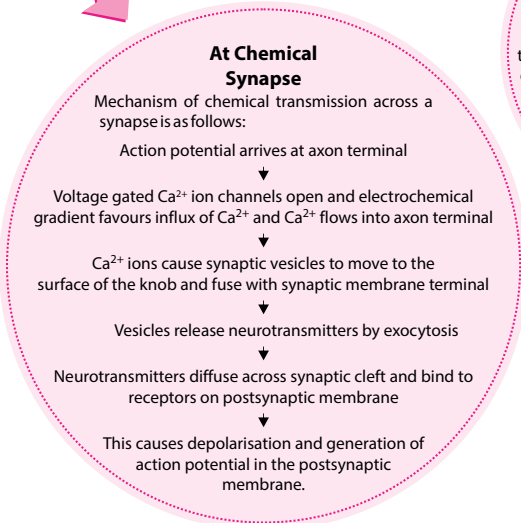
Electrical Synapse

- Here pre-and postsynaptic membrane are joined by gap junctions, through which ions can pass easily.
- Impulse transmission across electrical synapse is faster than chemical synapse because of the direct flow of electrical current from one neuron to another through gap junction,

MECHANISM OF IMPULSE CONDUCTION

PROPERTIES OF SYNAPSE

- **Convergence and Divergence** : Many presynaptic neurons **converge** on any single postsynaptic neuron, e.g., in spinal motor neurons, some inputs come from dorsal root, some from long descending spinal tracts and many from interconnecting neurons. The axons of most presynaptic neurons divide into many branches that **diverge** to end on many postsynaptic neurons.
- **Fatigue** : Repeated stimulation of presynaptic neuron leads to gradual decrease and finally disappearance of the postsynaptic response. This is due to exhaustion of chemical transmitter, as its synthesis is not as rapid as the release.
- **Synaptic Delay** : When an impulse reaches the presynaptic terminal, there is a gap of about 0.5 msec., before a response is obtained in postsynaptic neuron. This is due to the time taken by synaptic mediator to be released and to act on postsynaptic membrane.
- **Synaptic Plasticity** : Plasticity implies the capability of being easily moulded or changed. Synaptic conduction thus can be increased or decreased on the basis of past experience. These changes can be presynaptic or postsynaptic in location and play an important role in learning and memory.



At Electrical Synapse

- Gap junctions in electrical synapse allow the local currents resulting from arriving action potentials to flow directly across the junction from one neuron to the other.
- This depolarises the membrane of the second neuron to threshold, continuing the propagation of the action potential.