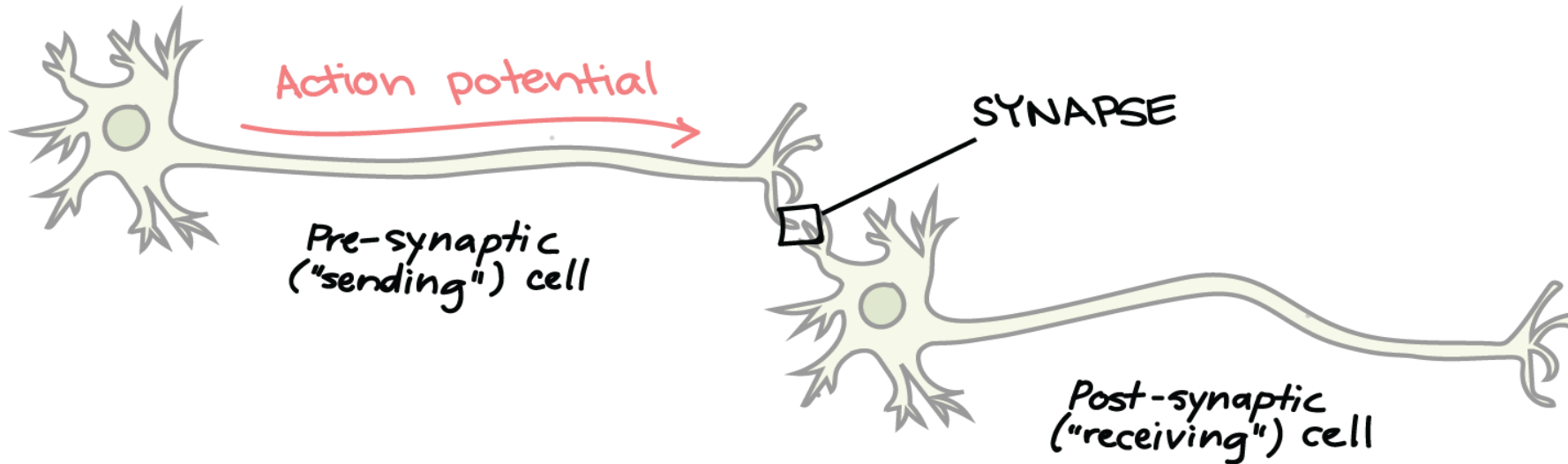


Synapse & Synaptic transmission

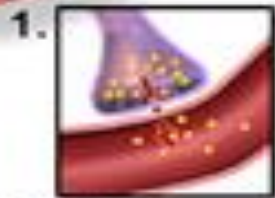
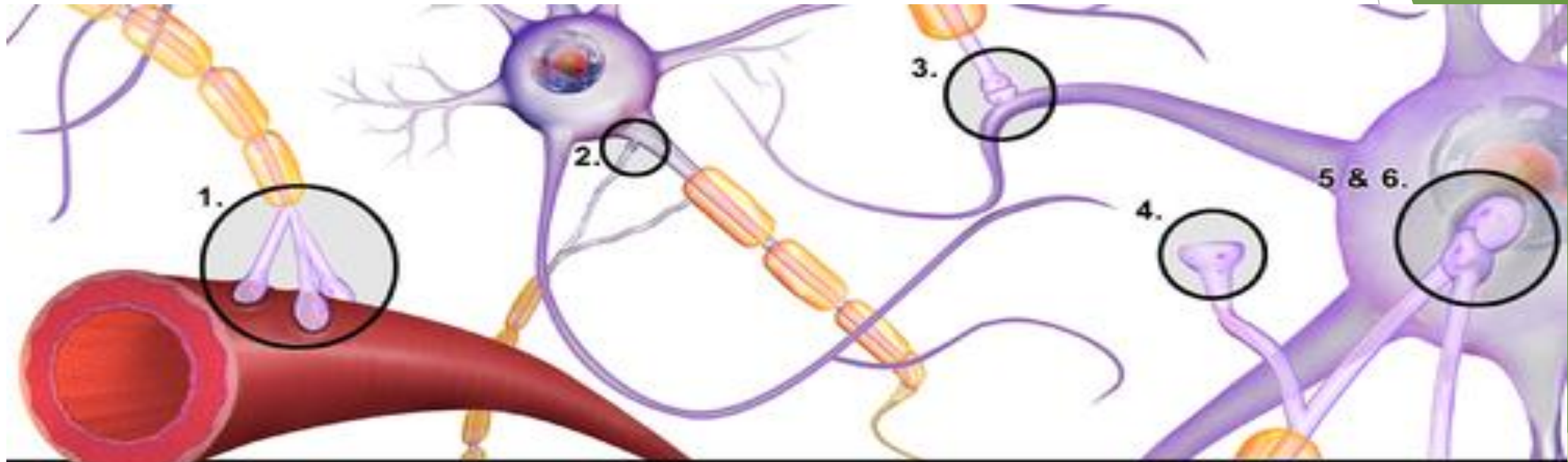
Prepared by-
Soumita Das

Synapse is the junctional region where one neuron ends and the other begins.

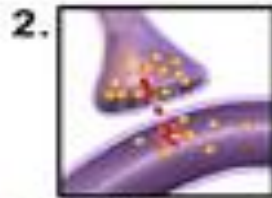


A single axon can have multiple branches, allowing it to make synapses on various postsynaptic cells. Similarly, a single neuron can receive thousands of synaptic inputs from many different presynaptic—sending—neurons.

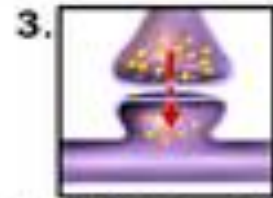
Anatomical Classification : according to the nature of connections



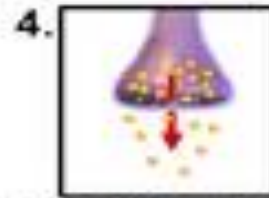
Axosecretory
Axon terminal secretes directly into bloodstream



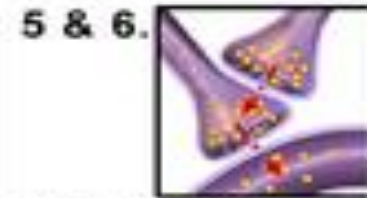
Axoaxonic
Axon terminal secretes into another axon



Axodendritic
Axon terminal ends on a dendrite spine



Axoextracellular
Axon with no connection secretes into extracellular fluid



Axosomatic
Axon terminal ends on soma
Axosynaptic
Axon terminal ends on another axon terminal

▶ Axoaxonic - pre -synaptic axon terminal secretes into another axon of postsynaptic cells.

e.g. - in the **thalamic reticular formation**)

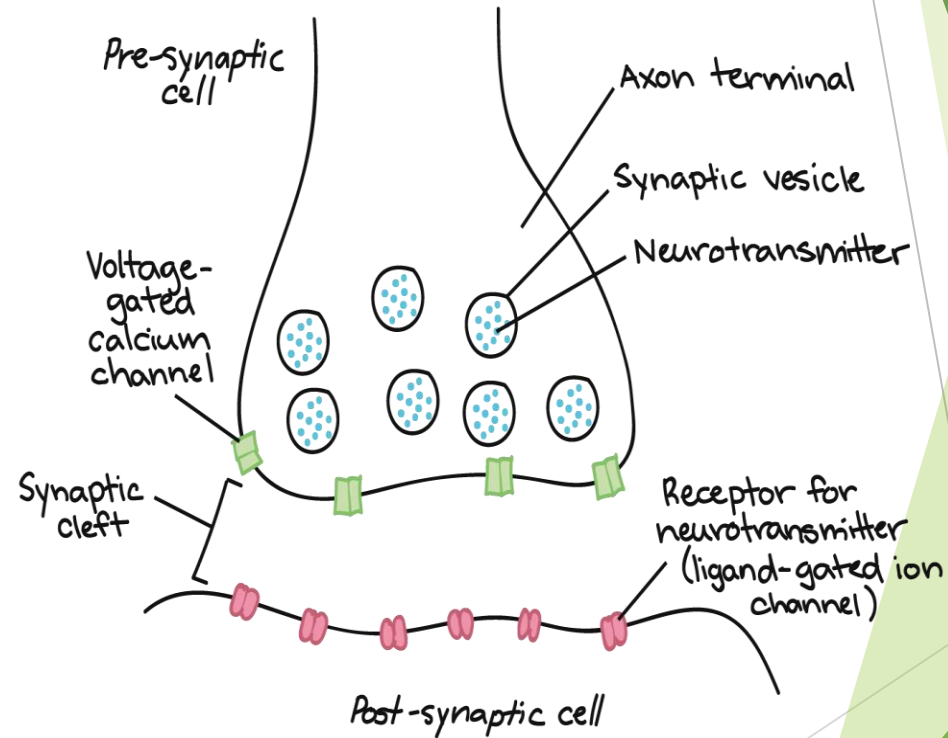
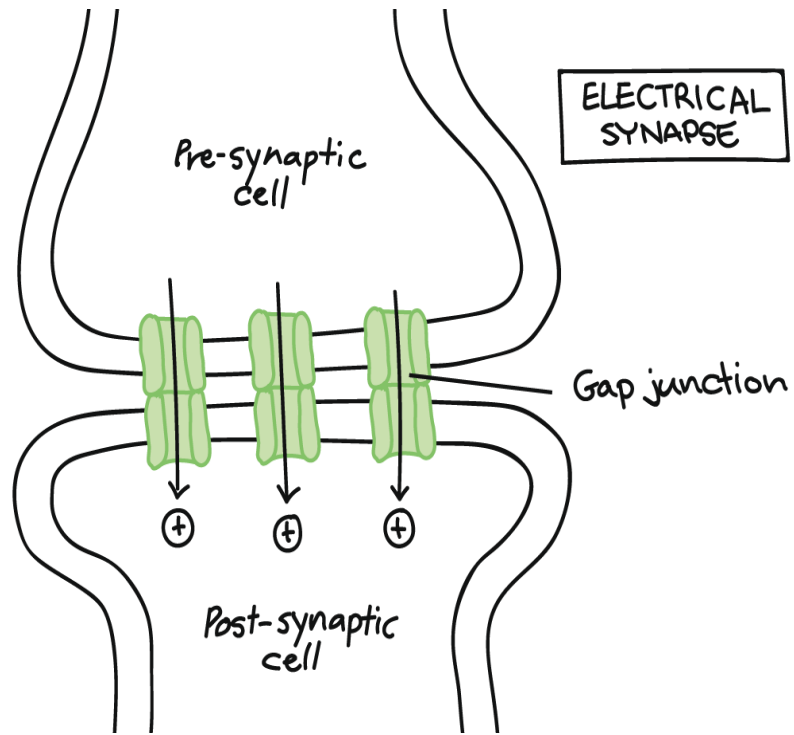
▶ Axodendritic - pre -synaptic axon terminal secretes into dendrites of postsynaptic cells.

e.g. - cerebellum where **climbing fibers** form this type of synapse with the dendrite of **purkinje cell**.

▶ Axosomatic - pre synaptic terminal of the axon ends in the cell body (soma) of the post synaptic neuron.

e.g. - in the cerebellum synaptic connection between the **basket cells and purkinje cell**.

Physiological classification:- depending upon the process of transmission of impulse



Electrical synapse

Chemical synapse

Chemical synapse

- ▶ Transmission is carried out by neurotransmitter
- ▶ Conduct information only in one direction
- ▶ More vulnerable to fatigue on repeated stimulation
- ▶ Slower than the velocity of nerve conduction resulting in the synaptic delay.

Electrical synapse

- ▶ Transmission occurs through gap junctions
- ▶ Conduct information in both direction
- ▶ Same as the velocity of nerve conduction.
- ▶ E.g. within the retina and olfactory bulb.

Conjoint synapse:- refers to a synapse where both the chemical and electrical transmission co exist

Synaptic Delay

- ▶ the time necessary for the conduction of a signal across a synapse; the interval between the arrival of a nerve impulse at the ending of a presynaptic fiber and the start of the postsynaptic potential. In synapses with a chemical transmission mechanism a synaptic delay lasts from 0.3-0.5 milliseconds to several milliseconds. During most of this period mediators are released by presynaptic endings under the influence of nerve impulses. Synaptic delay is practically absent in synapses with electrotonic transmission.

A) Synaptic knob

- Large number of mt
- Synaptic vesicles contains neurotransmitter
 - Circular- excitatory
 - Flat/elongated - inhibitory
- Microtubules for transport

B) Presynaptic membrane

C) Synaptic cleft - a gap between

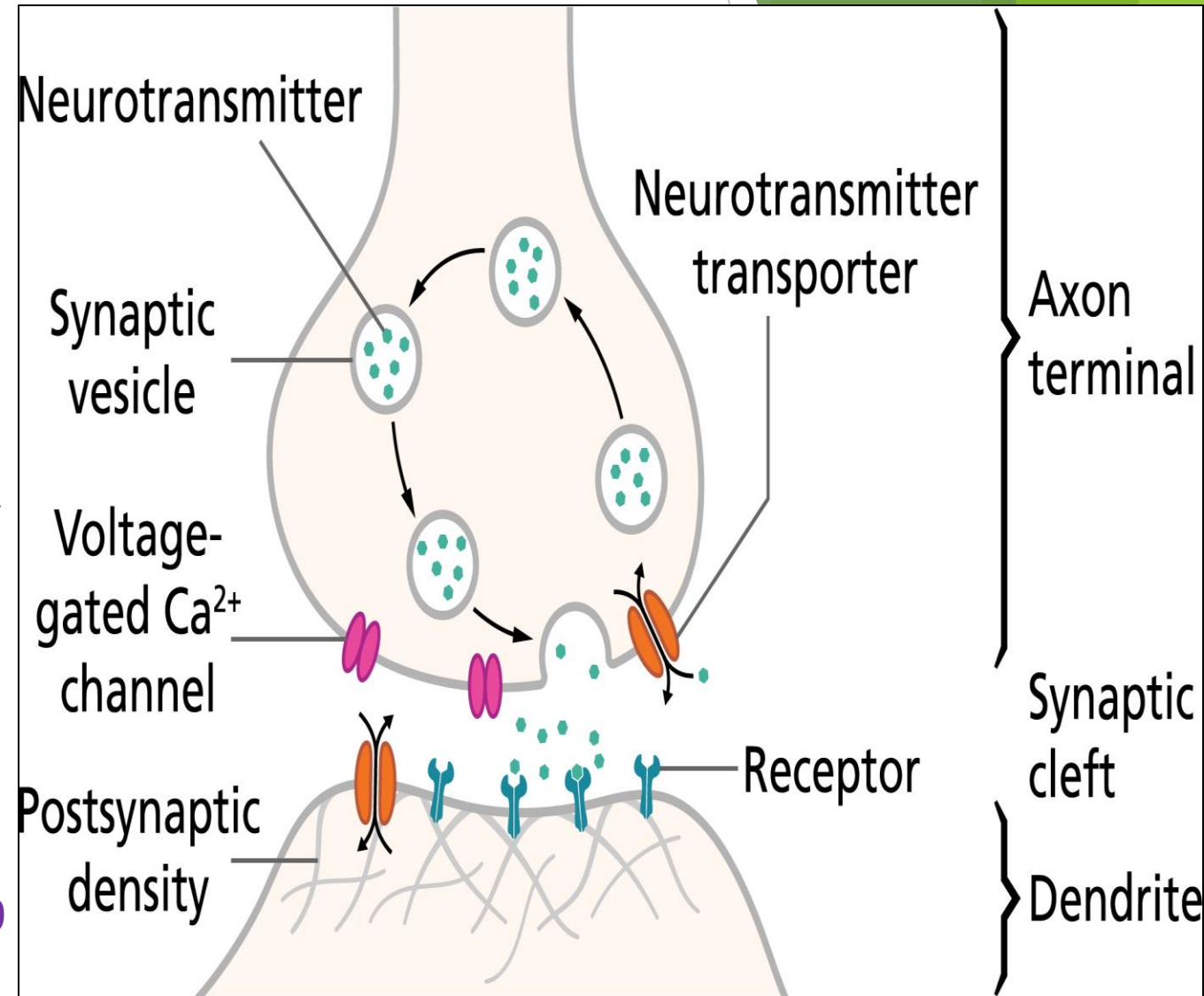
- 20-40 nm wide
- Filled with ECF containing glycoproteins
- Enzymes for destroy the neurotransmitter , after completing the transmission

D) Postsynaptic membrane

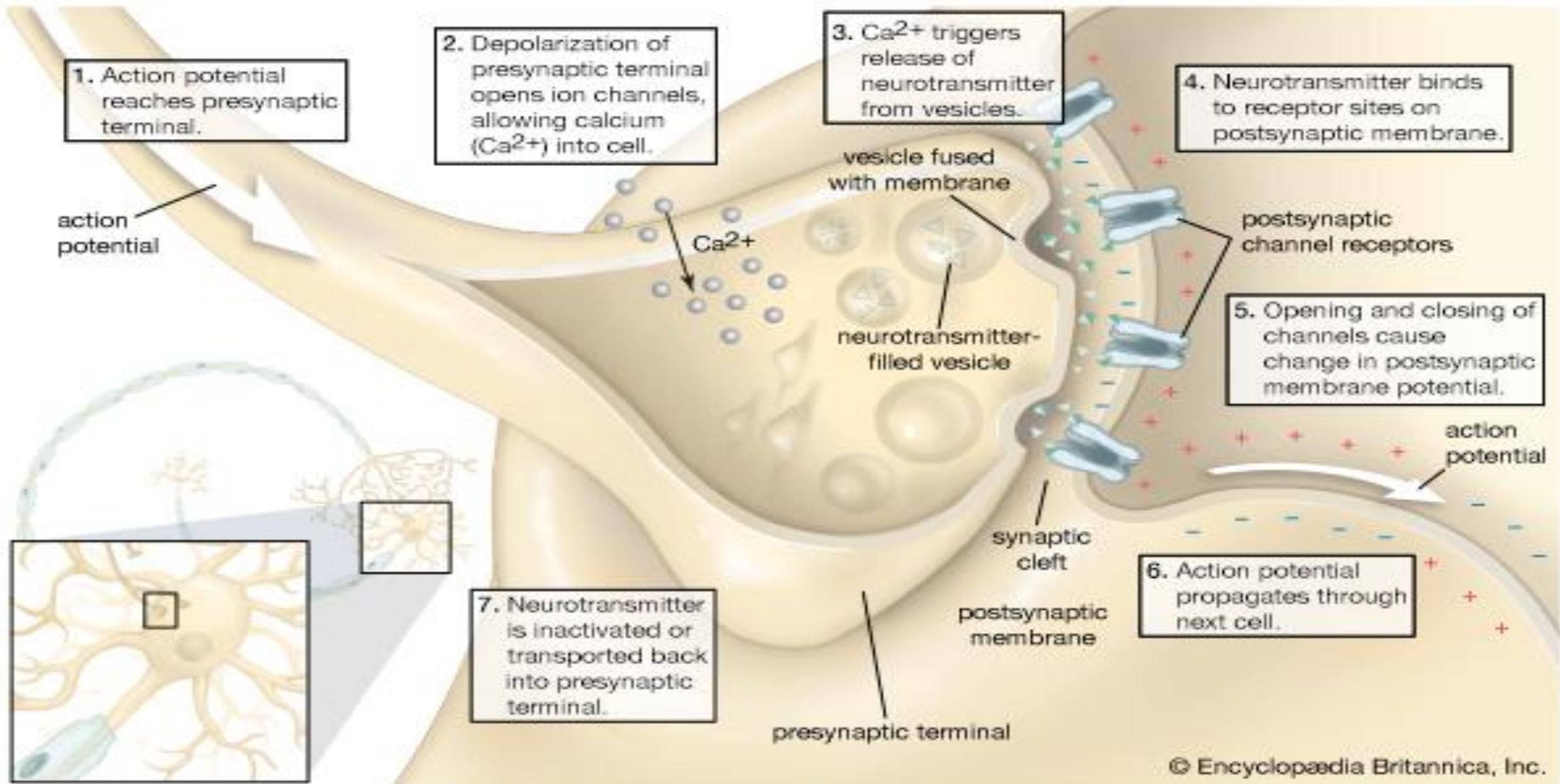
- Large number of receptor proteins
 - Ion channels
 - Enzymatic type of receptor proteins

Canaliculi(parallel intersynaptic filaments, 50 Angstrom)

Structure of a axodendritic synapse :-



Chemical synaptic transmission

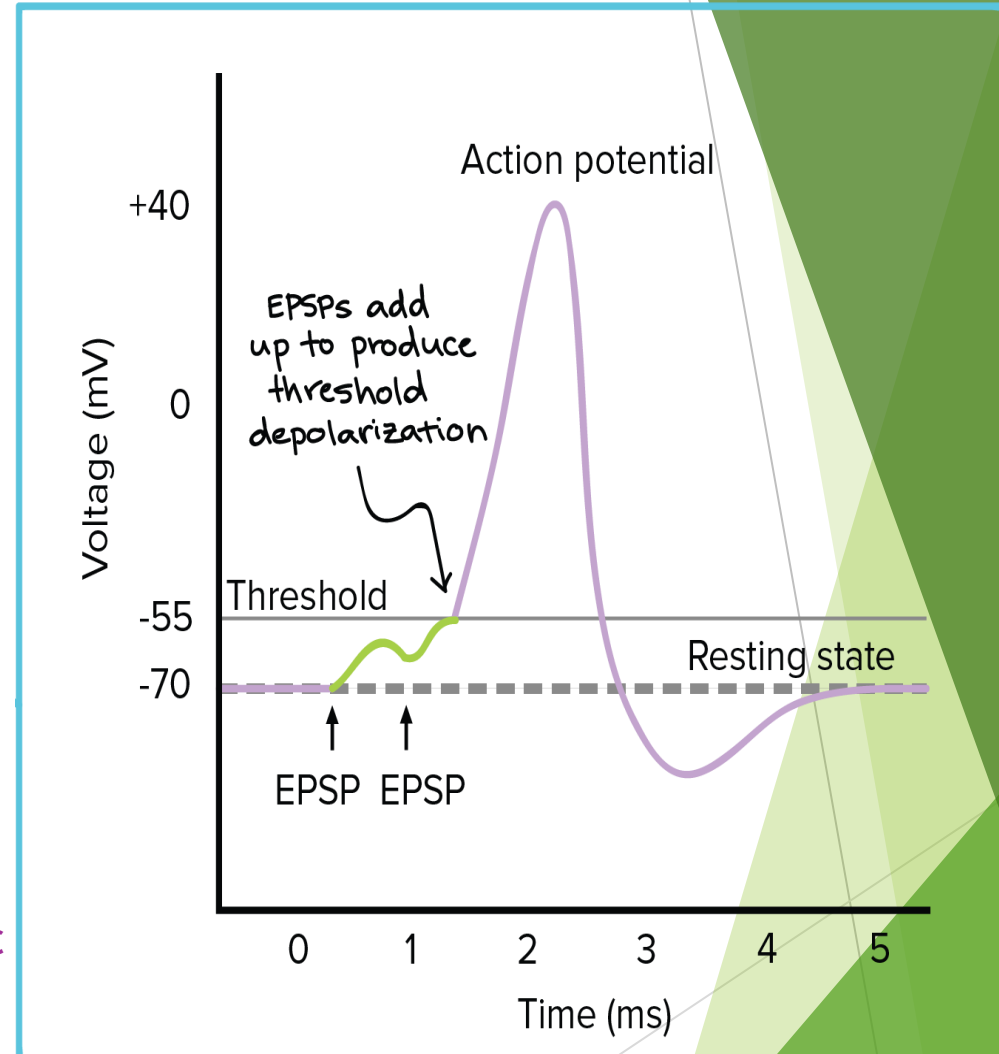


EPSP - Excitatory post synaptic potential

- ▶ Depolarization of postsynaptic membrane is produced by excitatory neurotransmitter. (e.g. glutamate)
- ▶ 8 mV

Ionic basis

- ▶ Neurotransmitter binds with specific receptor protein
- ▶ Open Na⁺ channels on the postsynaptic membrane
- ▶ Depolarize membrane and graded potential generated
- ▶ Summation
 - ▶ Temporal - Repeated stimuli at very short interval
 - ▶ Spatial - occurs when postsynaptic membrane receive impulses from a large number of presynaptic terminals simultaneously.
 - ▶ Both types occurs simultaneously - firing level - action potential



IPSP - inhibitory post synaptic potential

- ▶ Hyperpolarization of the postsynaptic membrane is produced by inhibitory neurotransmitter (e.g. glycine and GABA)

- ▶ - 2 mV

Ionic basis

- ▶ Causes opening of either K^+ or Cl^- channels in postsynaptic membrane

- ▶ Leads to diffusion of K^+ from neuron to ECF

or

- ▶ Cl^- ions diffuse to the interior of the neuron

- ▶ Spatial and temporal summation also occurs.

Inactivation of neurotransmitter from the synaptic cleft

- ▶ Diffusion of the transmitter out of the cleft
- ▶ Enzymatic degradation of the transmitter , e.g. dissociation of acetylcholine by acetylcholinesterase.
- ▶ Active transport back into the presynaptic terminal, e.g. active re-uptake of norepinephrine at sympathetic postganglionic nerve endings.

Thank you