University of Al-Mustaqbal
College of Science
Department of Medical Physics

Neurophysics

Fourth Stage

The Speed of Propagation

Fourth Licture

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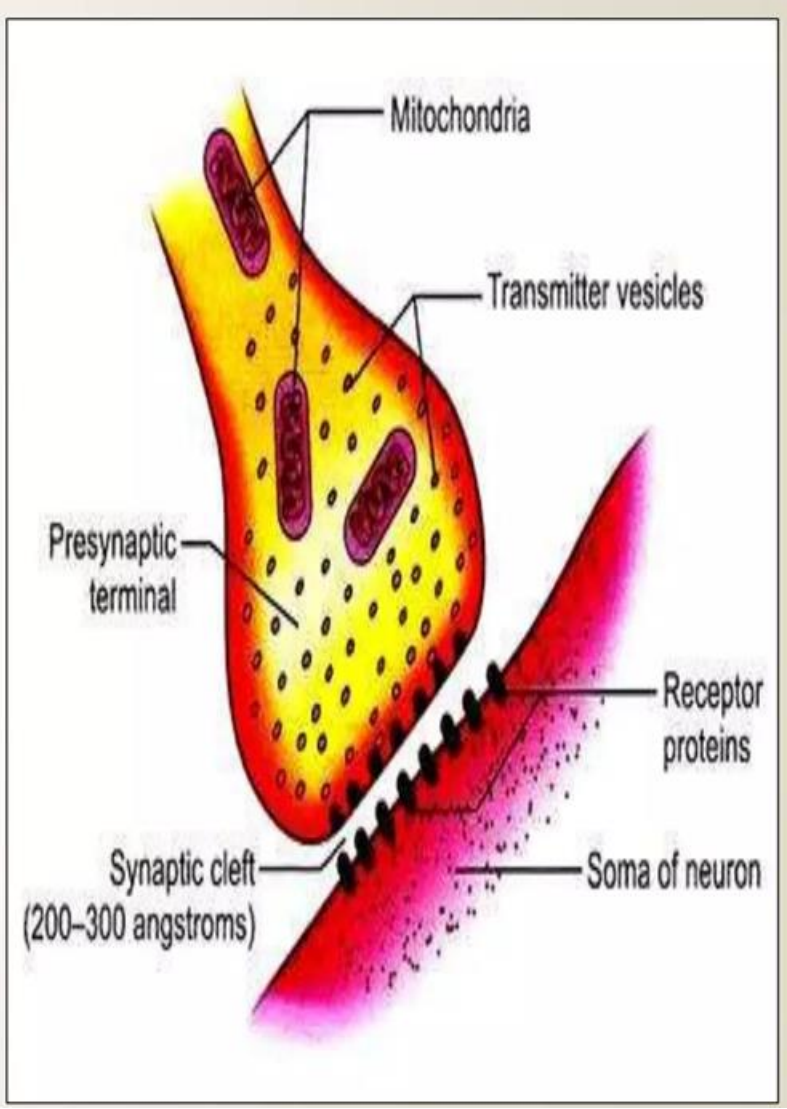
SYNAPSE

Synapse can be defined as functional junction between parts of two different neurons. There is no anatomical continuity between two neurons involved in the formation of synapse. At level of synapse, impulse gets conducted from one neuron to another due to release of neurotransmitters, like Acetyl Choline, noradrenaline, serotonin, etc.



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. Some synapses are purely electrical and make direct electrical connections between neurons. However, most synapses are chemical synapses. Transmission of nerve impulses across chemical synapses is more complex. The synapses, which require release of some chemical substance (neurotransmitter) during synaptic transmission, are termed as chemical synapses. In human body, almost all synapses are chemical type, rarely also consists of electrical type. Presynaptic region is mostly contributed by axon and postsynaptic region may be contributed by dendrite or soma (cell body) or axon of another neuron.

Properties of Synapse:

1. One-way conduction (unidirectional conduction): In chemical synapse, since neurotransmitter is present only in presynaptic region, impulse gets conducted from pre- to postsynaptic region only and not vice versa.

2. Synaptic delay is for neurotransmitter to:

a.Get released from synaptic vesicles when action potential has reached presynaptic region.

b. Pass through synaptic cleft.

c. Act on postsynaptic region to bring about production of action potential in postsynaptic region.

For all the above events to be brought about, sometime is required. This is known as synaptic delay, which is normally about 0.5 msec at every synapse.

TYPES OF SYNAPTIC CONNECTIONS

A.BASED ON FUNCTION

1.CHEMICAL

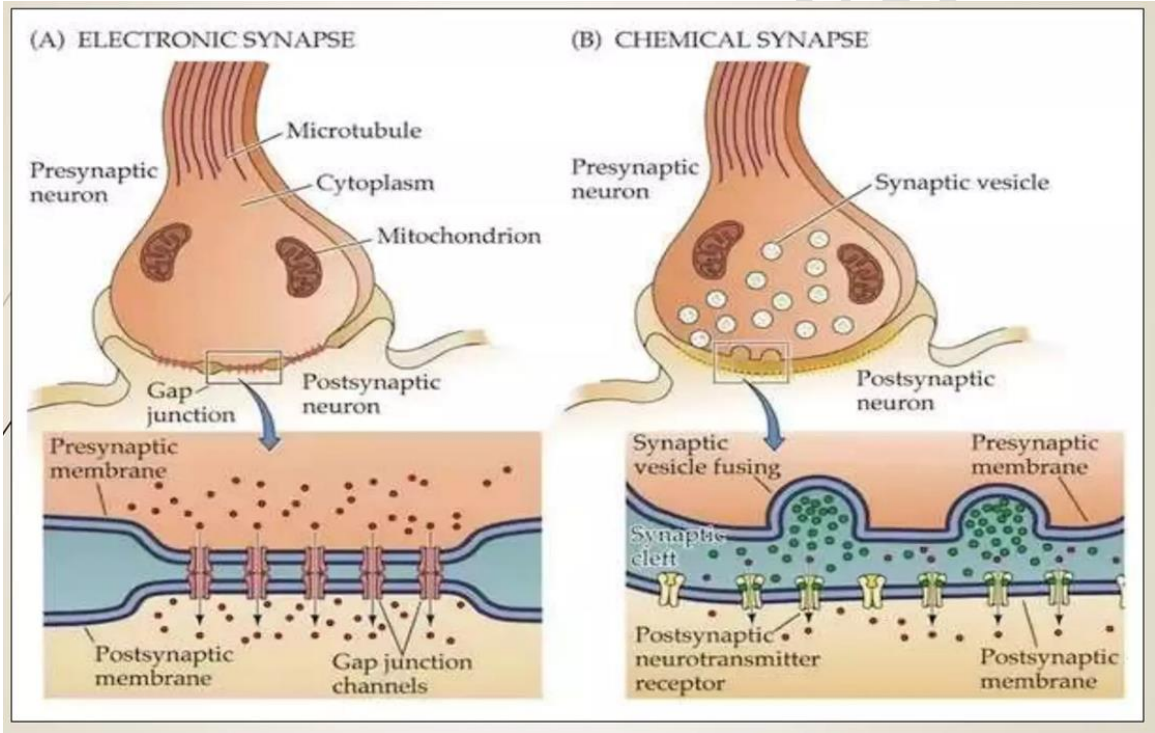
2.ELECTRICAL

B.BASED ON STRUCTURE

1. AXODENDRITIC

2.AXOSOMATIC

3.AXOAXONIC



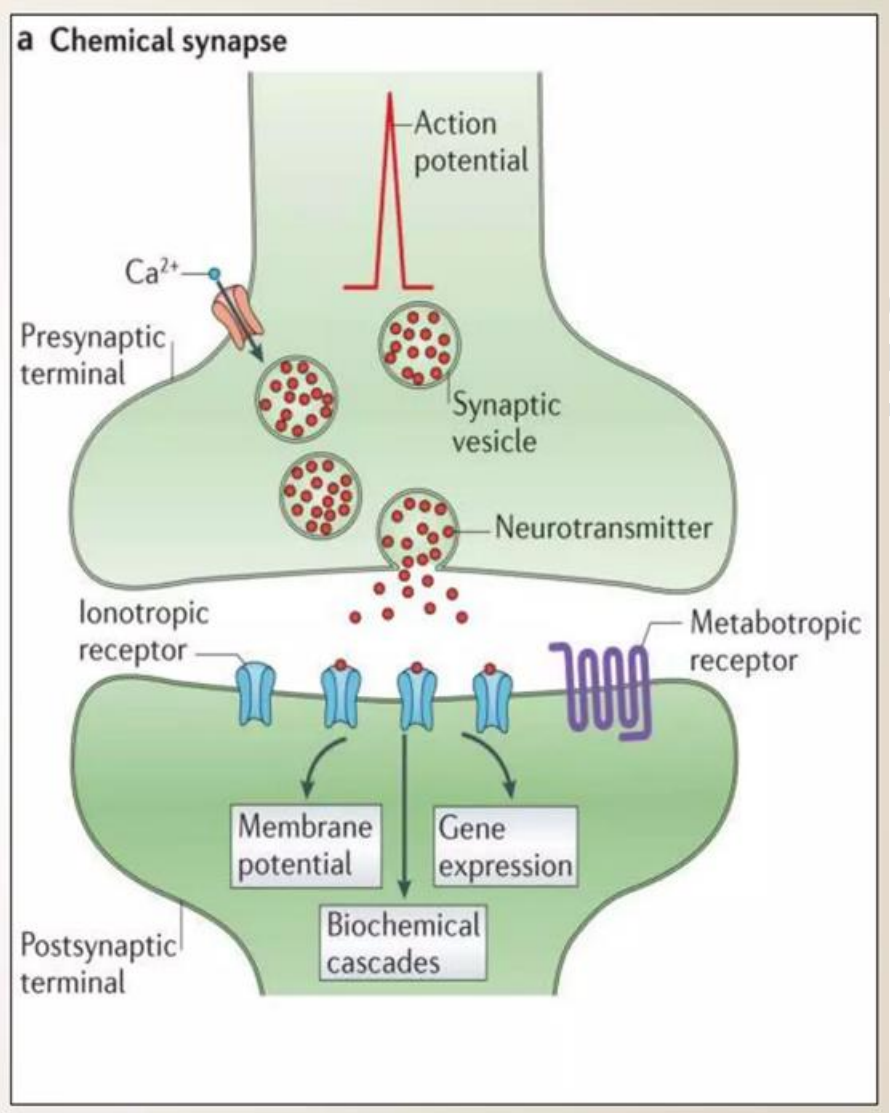
Chemical synapse

A chemical synapse is a gap between two neurons where information passes chemically, in the form of neurotransmitter molecules.chemical synapses are:

1.slow

2.active (require ligand-gated channels) like Na- K channels

3.unidirectional



Electrical synapse

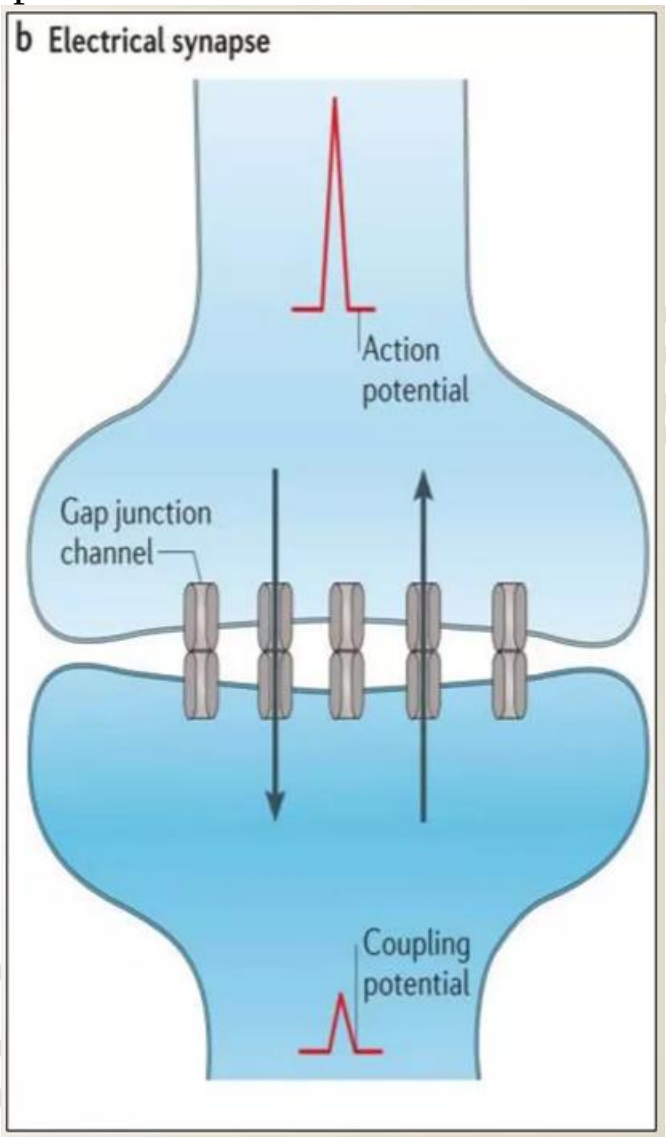
An electrical synapse is a gap which has channel proteins connecting the two neurons.

While electrical synapses are faster (electricity moves quicker than molecules, and you don't need receptors).You often find electrical synapses in systems requiring quick responses, like instincts and, are often found in all nervous systems, including the human brain.

1.very rapid (no synaptic delay)

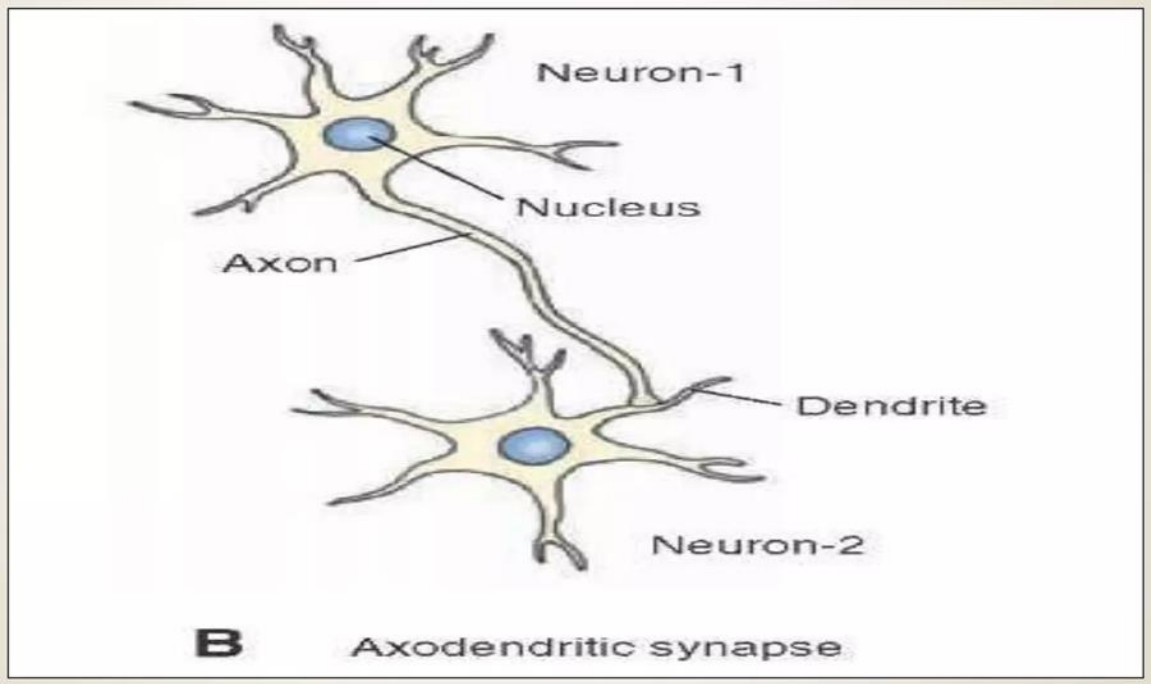
2.passive

3.Bidirectional -"post"synaptic cell can actually send messages to the "pre"synaptic cell



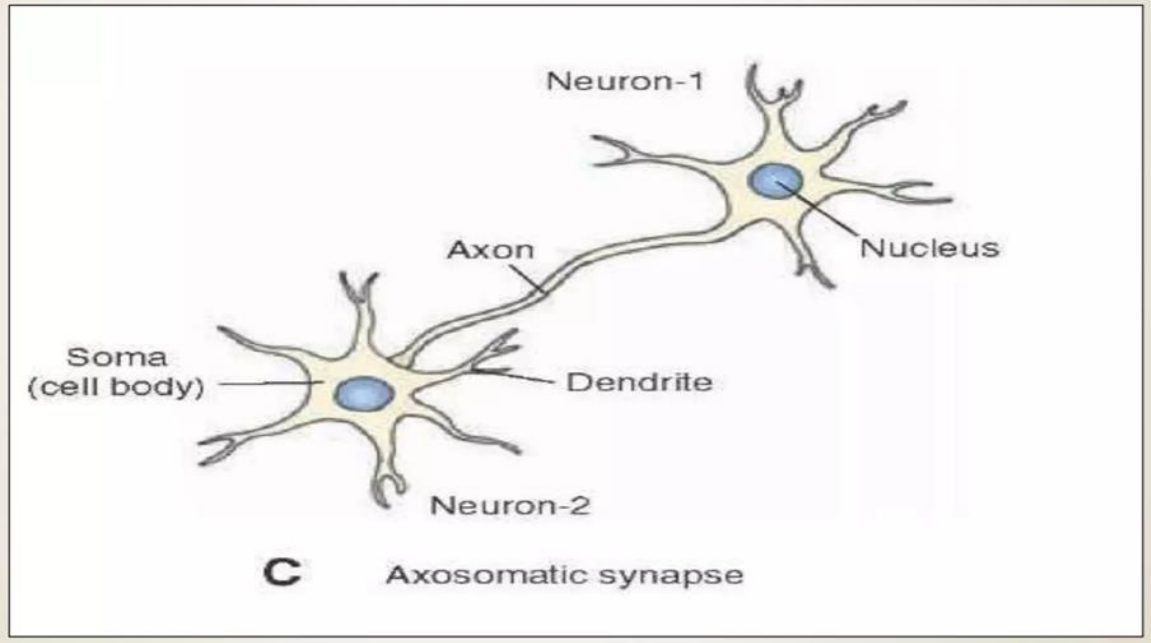
1.Axodendritic synapse

one between the axon of one neuron and the dendrites of another.

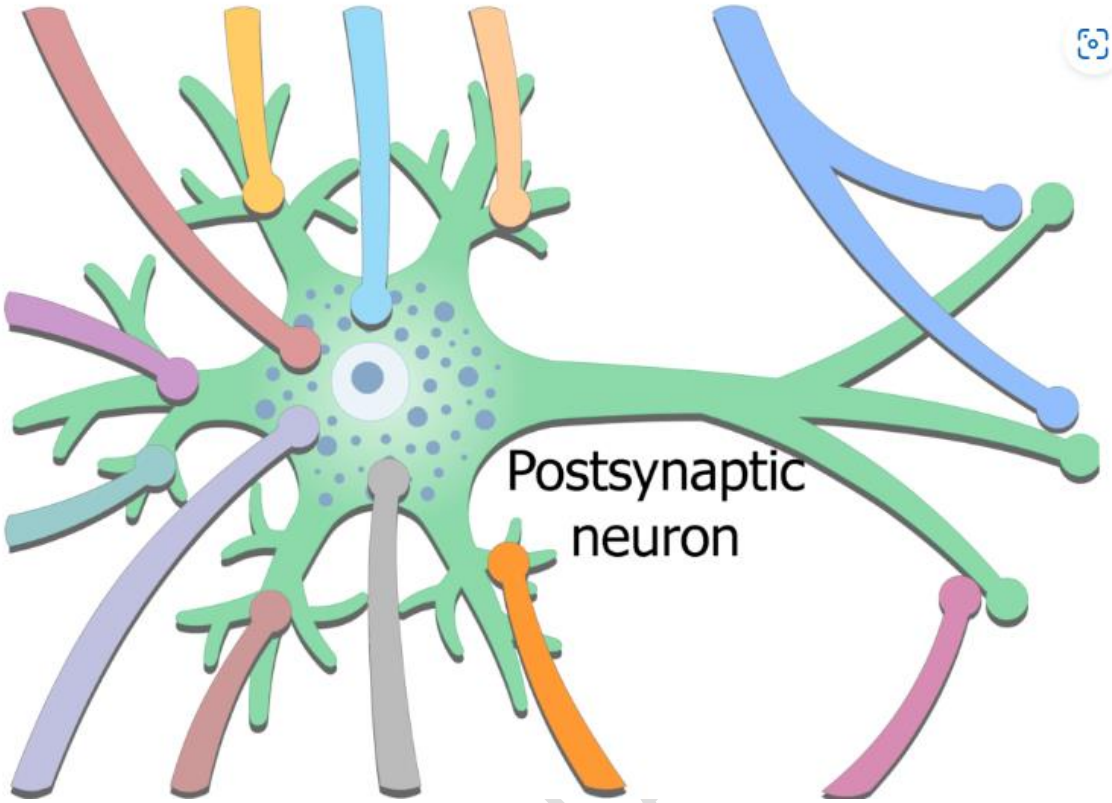


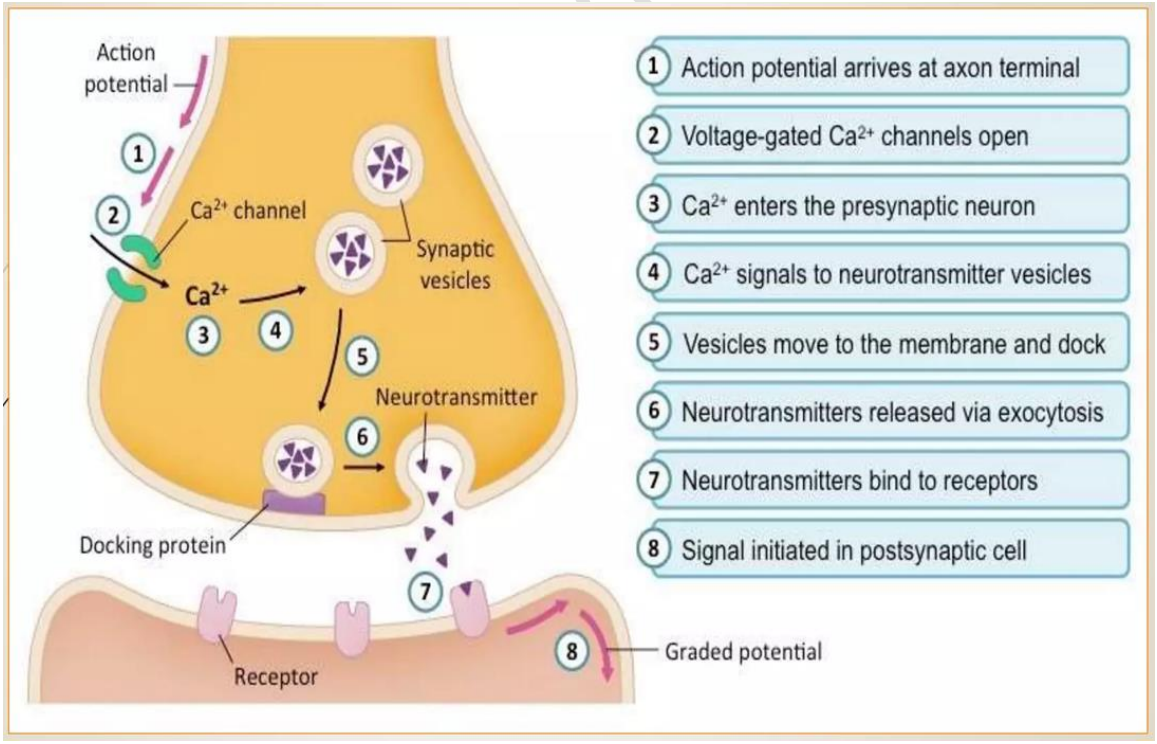
2.Axosomatic synapse

one between the axon of one neuron and the body of another.



3.Synapses can also form between the axon of a presynaptic neuron and the axon of a postsynaptic neuron. This third type of junction is called an axoaxonic synapse.


Postsynaptic
neuron


Action potential
1
2
Ca2+ channel
Ca2+
3
4
5
Synaptic vesicles
Neurotransmitter
6
Docking protein
7
8
Receptor
Graded potential
1 Action potential arrives at axon terminal
2 Voltage-gated Ca2+ channels open
3 Ca2+ enters the presynaptic neuron
4 Ca2+ signals to neurotransmitter vesicles
5 Vesicles move to the membrane and dock
6 Neurotransmitters released via exocytosis
7 Neurotransmitters bind to receptors
8 Signal initiated in postsynaptic cell