Nerve Impulse: Nerve impulse is an electrochemical phenomenon which includes:

1. Electrical, The movement of active potential by stimuli from stimulation point on the long nerve fiber. This is like electrical flows through a cable when voltage is applied.

2. Chemical, neurotransmitter is released by regulated exocytosis of synaptic vesicles when the action potential reached it to stimulate the adjacent cells.

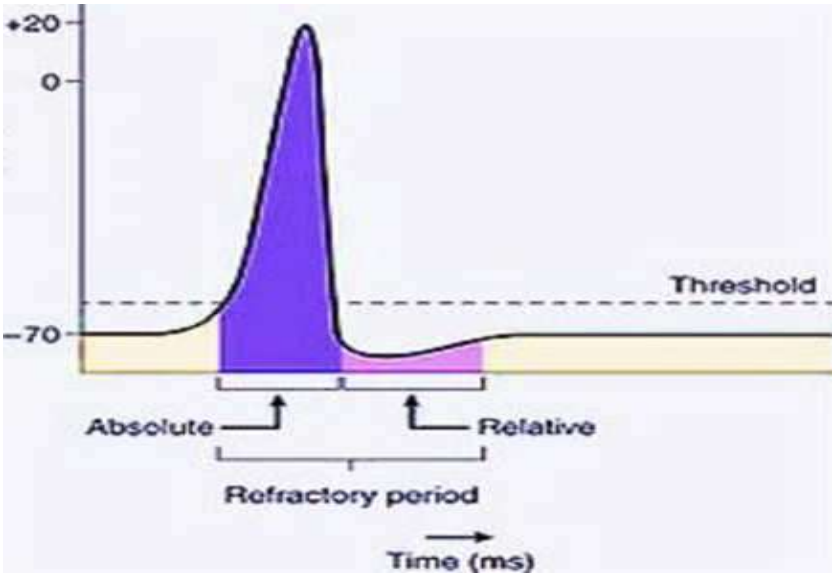
Nerve impulse characteristics are:

1. **All or None Low:**

Action potential producing depends on intensity of stimulus and duration of stimulation. All stimuli, which have threshold intensity and enough duration of stimulation, are success to produce action potential. But none, which its intensity is less than threshold, can produce action potential whatever its duration.

2. **Refractory period:**

During an action potential, the cell remains unresponsive to further stimuli. In **absolute refractory period**, from firing point to repolarization period no other action potential can be triggered, even by extremely strong stimuli, since Na^+ channels in depolarized membranes cannot be activated. This is flowed by **a relative refractory** period during which only action potentials of smaller amplitudes and rates or rise can be generated, even by strong stimuli. The refractory period ends once the membrane potential returns to its resting value.



3. **Impulse conduction**:

The start of an action potential is accompanied by a brief influx of Na+ into the nerve fiber. The cell membrane that previously was inside negative now becomes positive, thus a longitudinal potential difference with respect to adjacent, still unstimulated nerve segments. This is followed by a passive electrotonic withdrawal of charge from the adjacent segment of the nerve fiber, causing its depolarization. If it exceeds threshold, another action potential is created in the adjacent segment dissipates.

4. **Velocity of conduction: The conduction velocity depends on:**

a. Myelination: the conduction velocity of such myelinated nerve fiber is much higher than that of unmyelinated nerve fibers.

b. Diameter: the conduction velocity increases with the diameter of nerve fiber.

Classification of nerve fiber according its conduction velocity:

A) **Type-A-nerve fiber**:

Its conduction velocity is very high (2-80m/s) because it is myelinated and big diameter (1-16pm). It is called fast fiber such as somatic nerve fiber which pressure and touch sensation. It is can triggered the nerve impulse under anesthesia because of myeline sheath, but cannot triggered the nerve impulse under pressure because of the big diameter which cause the paralysis عجز او شلل.

B) **Type-B-nerve fiber:**

Their conduction velocity is less than types-A (3-15m/s) because it is myelinated but smaller diameter (3 pm). It is called moderate fiber such as visceral nerve fibers which pressure and touch sensation like type A.

C) Type-C-nerve fiber:

Its conduction velocity is very low (0.25-1.5m/s) because it is unmyelinated and small diameter (0.5-1.5pm).it is called slow fibers such as all nerve fiber which pain and temperature sensation. It is cannot triggered the nerve impulse under anesthesia, because it is unmyelinated; and under pressure, because of the small diameter.

5. Compound action potential:

Synaptic transmission:

1. At the chemical synapse, the arrival of an action potential in the axon triggers the release of transmitter form the presynaptic axon terminals (presynaptic membrane)

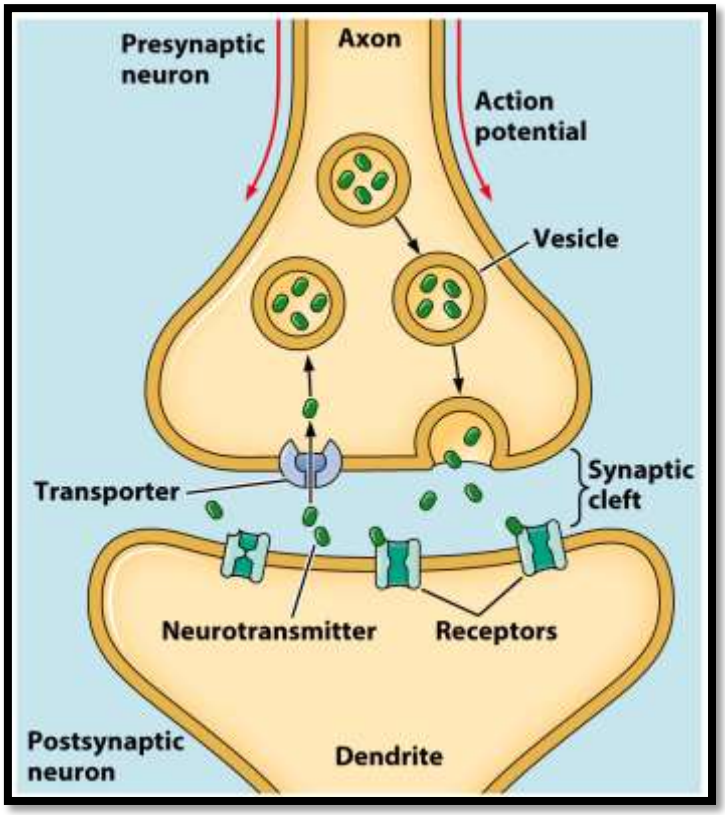
2. The transmitter then diffuses across the narrow synaptic cleft الشق العصبي to bind postsynaptic receptors in the postsynaptic membrane of a neuron or of glandular or muscle cell. Depending on the type of transmitter and receptor involved.

3. the effect on the postsynaptic membrane may either be excitatory or inhibitory. Excitatory neurotransmitters such as Acetyl choline (Ach) and Norepinephrine (NE) open Ca channels leading to an increase in the cytosolic Ca concentration, which increases the action potential.

4. Inhibitory neurotransmitters such as Glycine and Gamma Amino Butyric Acid (GABA) open K+ or Cl- channels, as a result, excitatory postsynaptic potential related depolarization is reduced and stimulation of postsynaptic neurons is inhibited.

A signal excitatory postsynaptic potential normally is not able to generate a postsynaptic (axonal) action potential, but requires the triggering of a large number of local depolarizations in the dendrites. Their depolarizations are transmitted electrotonically across the soma and summed on the axon hillock (spatial summation). Should the individual stimuli arrive at different times, the prior depolarization will not have dissipated before the next one arrives, and summation will make it easier

to reach threshold. This type of temporal summation therefore increases the excitability of the postsynaptic neuron.



Types of Neurotransmitters

NEUROTRANSMITTER CATEGORY	EXAMPLE(S)
Monoamines	Dopamine, epinephrine, norepinephrine, serotonin, melatonin
Amino acids	Glutamate, aspartate, GABA, glycine
Peptide neurotransmitters	Cholecystokinin, somatostatin, neuropeptide Y
Gases	Nitric oxide, carbon monoxide
Organic cation	Acetylcholine

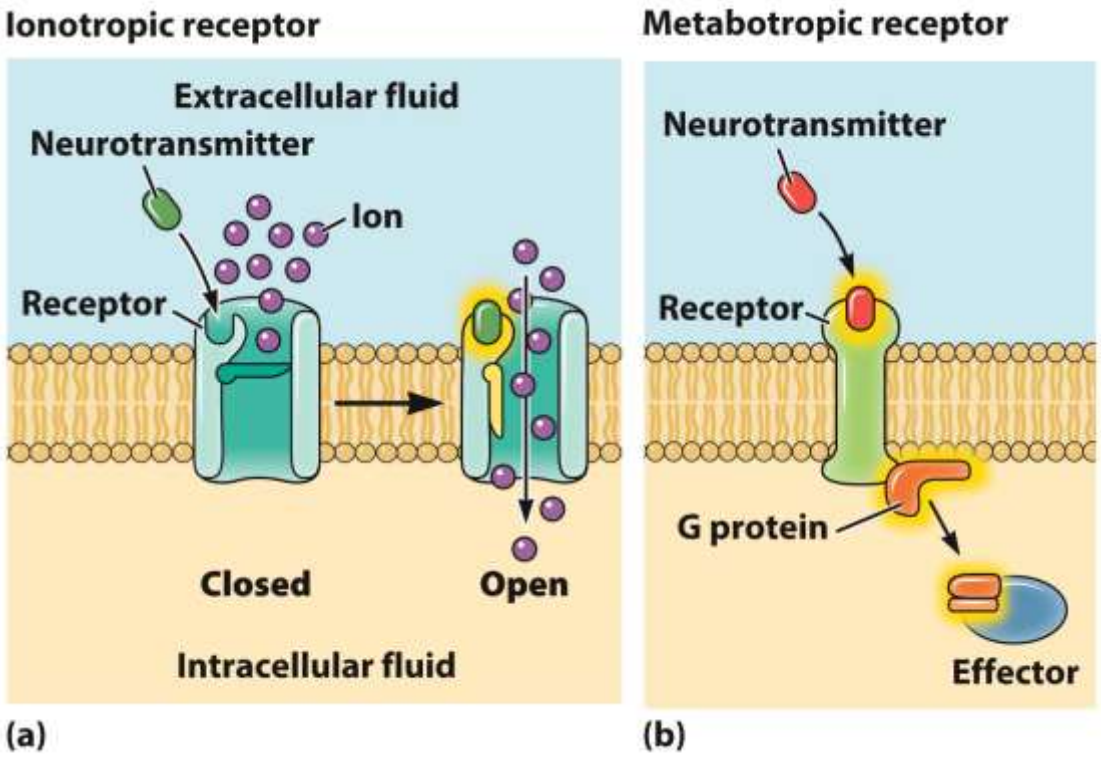
Receptors

-Specialized proteins in the cell membrane

-Neurotransmitters interact with receptors to affect the postsynaptic cell.

-Ionotropic receptors allow ions to flow across the membrane, changing the charge of the cell membrane.

-Metabotropic receptors relay information into the cell using a series of proteins.

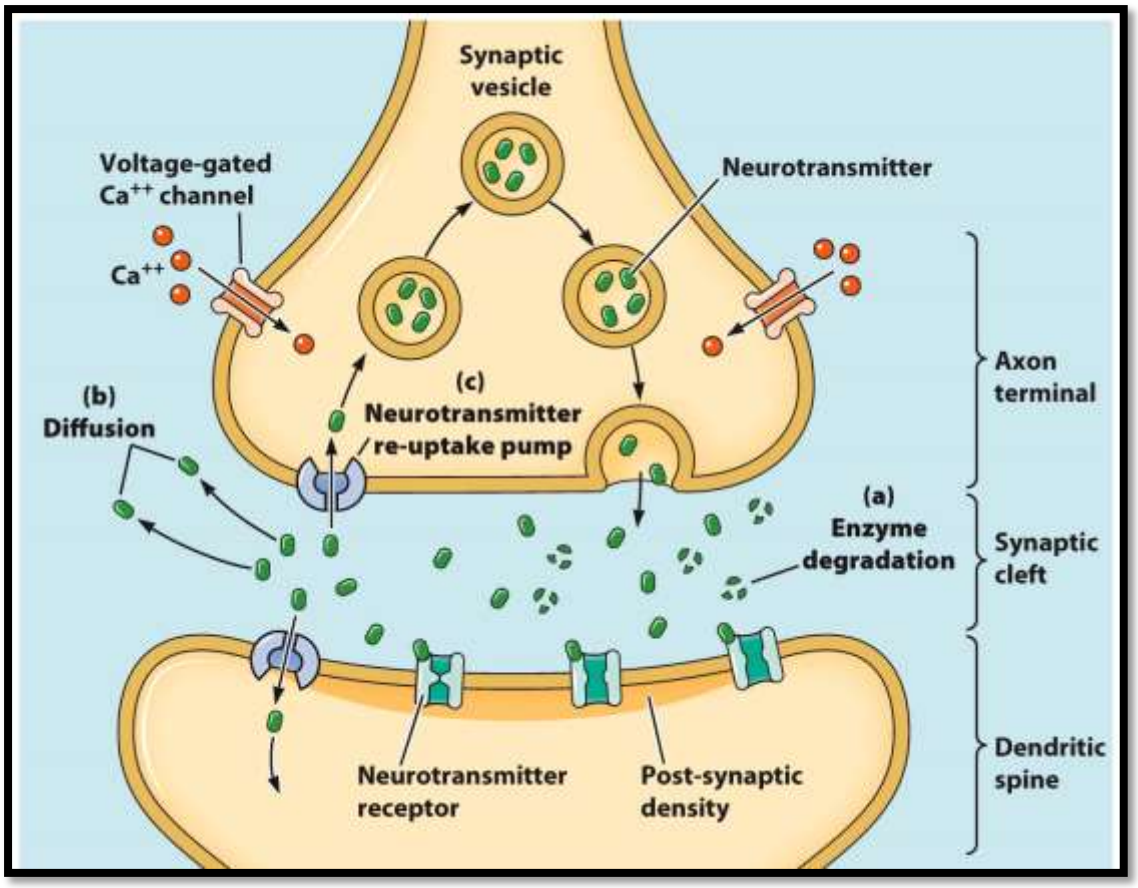


Neurotransmitters only bind to receptors for a short time and need a way to be removed.

Degradation: The neurotransmitter is broken apart.

Diffusion: The neurotransmitter moves down the concentration gradient and out of the synapse.

Reuptake: Neurotransmitter is transported back into the original cell.


Synaptic vesicle
Voltage-gated Ca++ channel
Ca++
Neurotransmitter
(b) Diffusion
(c) Neurotransmitter re-uptake pump
(a) Enzyme degradation
Axon terminal
Synaptic cleft
Dendritic spine
Neurotransmitter receptor
Post-synaptic density