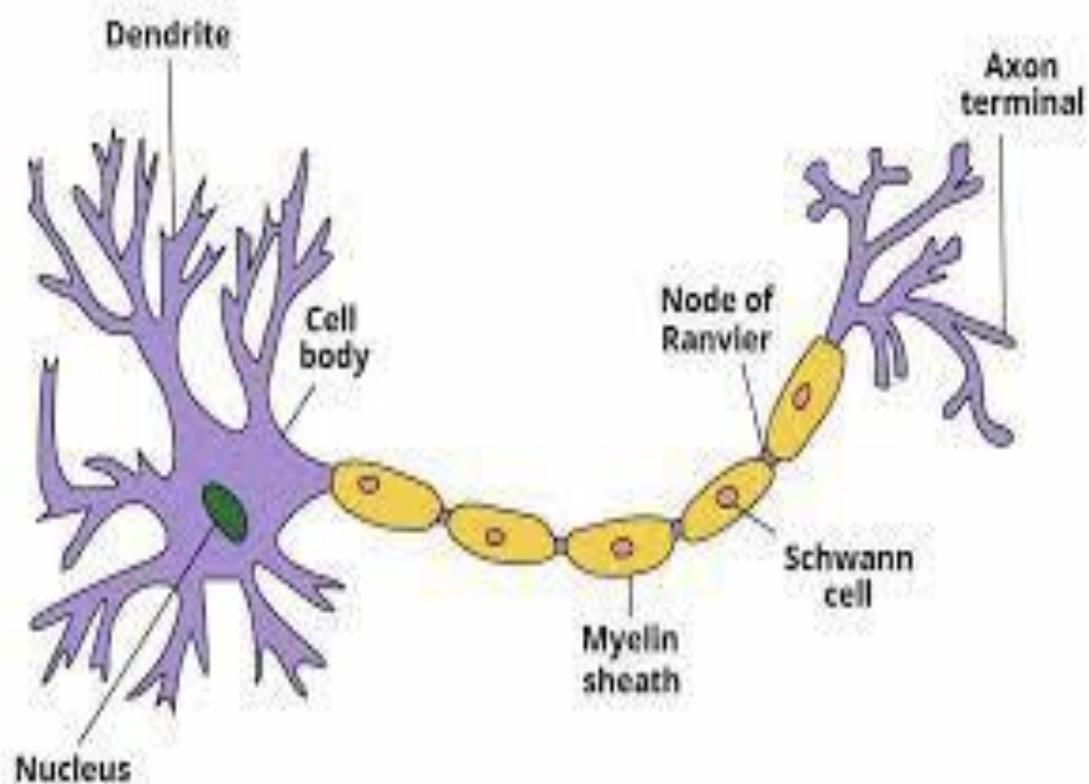


Central nervous system (CNS) drugs

Agents that act on the brain and spinal cord are used for medical and nonmedical purposes. Medical applications include relief of pain, suppression of seizures, production of anesthesia, and treatment of psychiatric disorders.

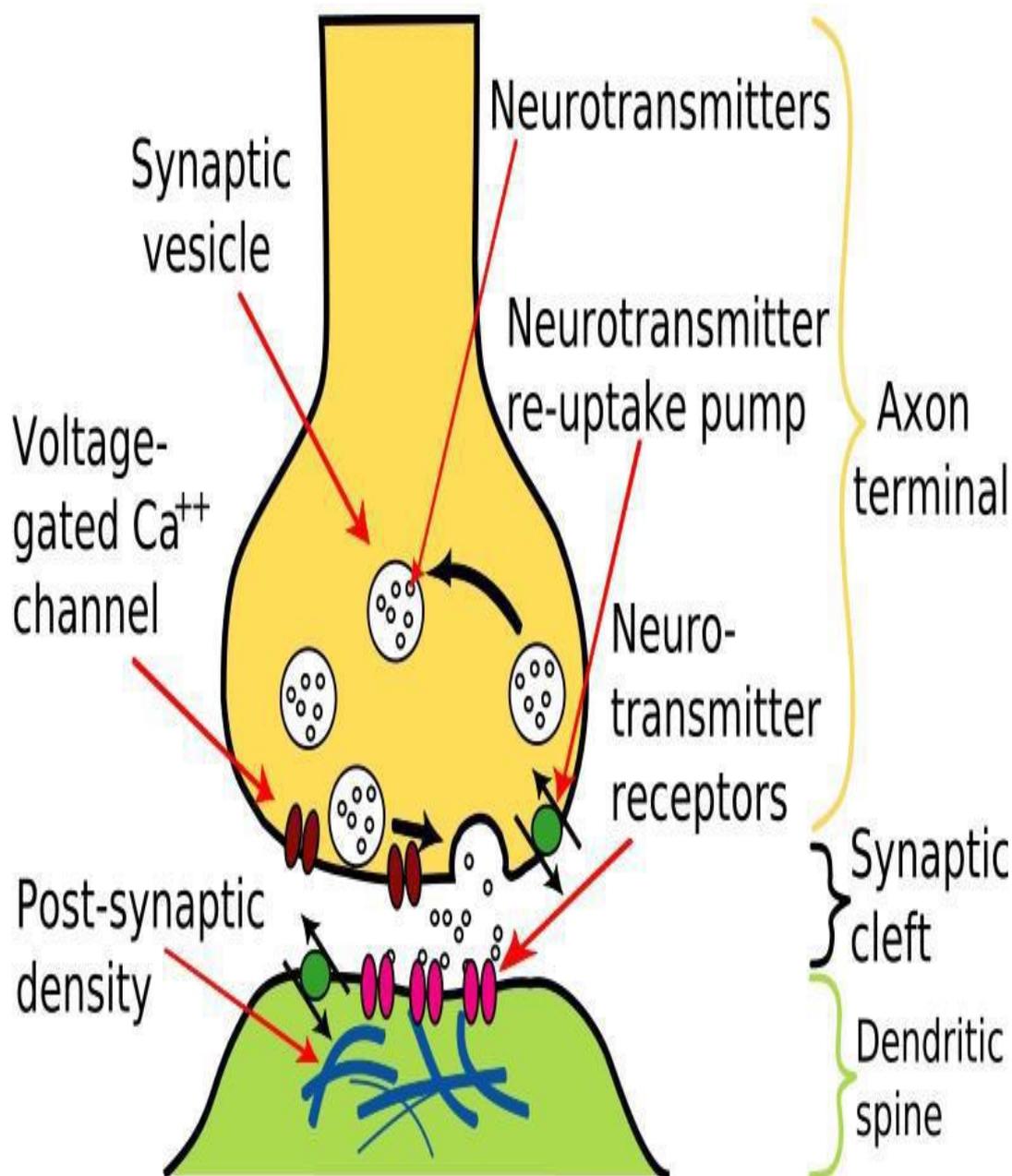
Neuron... Structure and Function:

- Neurons are **electrically excitable** cells composed, in general, of one or more dendrites, a single soma, a single axon, and one or more axon terminals.
- **Dendrites** are designed to capture the **neurotransmitters** released by the presynaptic neuron and have a high concentration of **ligand-gated ion channels**.
- **The axon** is characterized by having a very high concentration of **voltage-activated sodium channels**



Synapse: The site of transmission of electric nerve impulses between two nerve cells (neurons) or between a neuron and a gland or muscle cell (effector).

When an action potential arrives at the end of the pre-synaptic axon(top), it causes the release of **neurotransmitter** molecules that open ion channels in the post-synaptic neuron (bottom).



2 types of neurotransmitters:

1. Inhibitory neurotransmitters:

1-Glycine 2- Serotonin 3- Dopamine 4-GABA

2. Excitatory neurotransmitters:

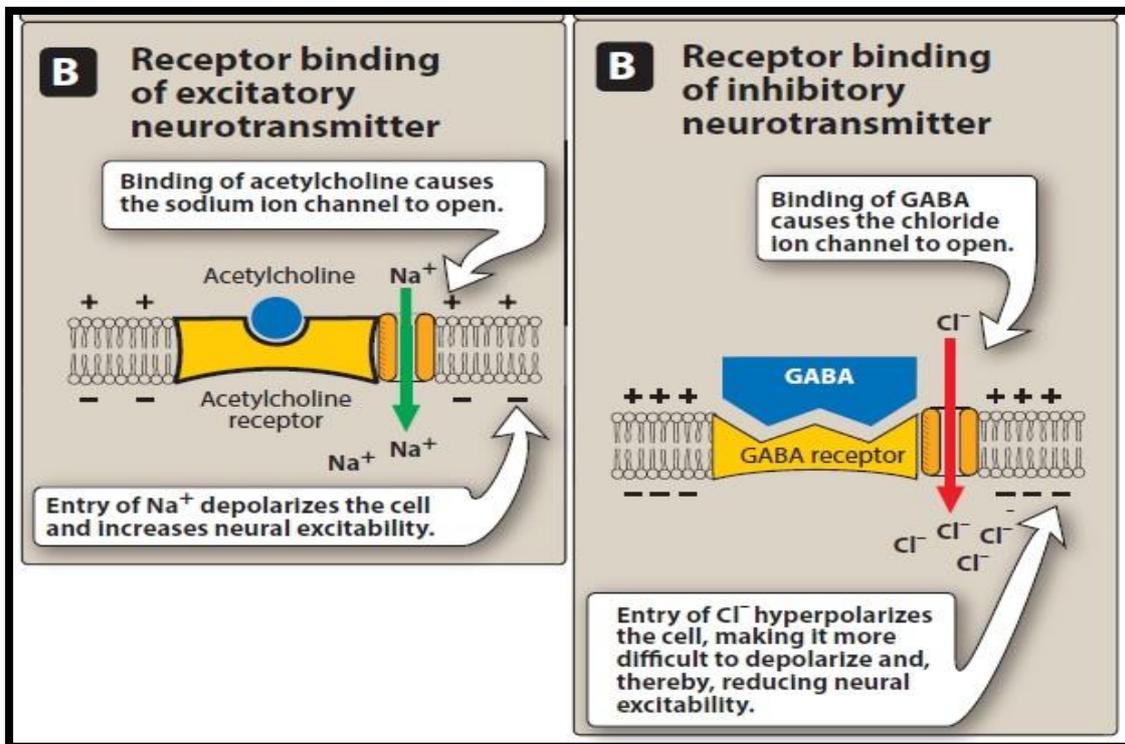
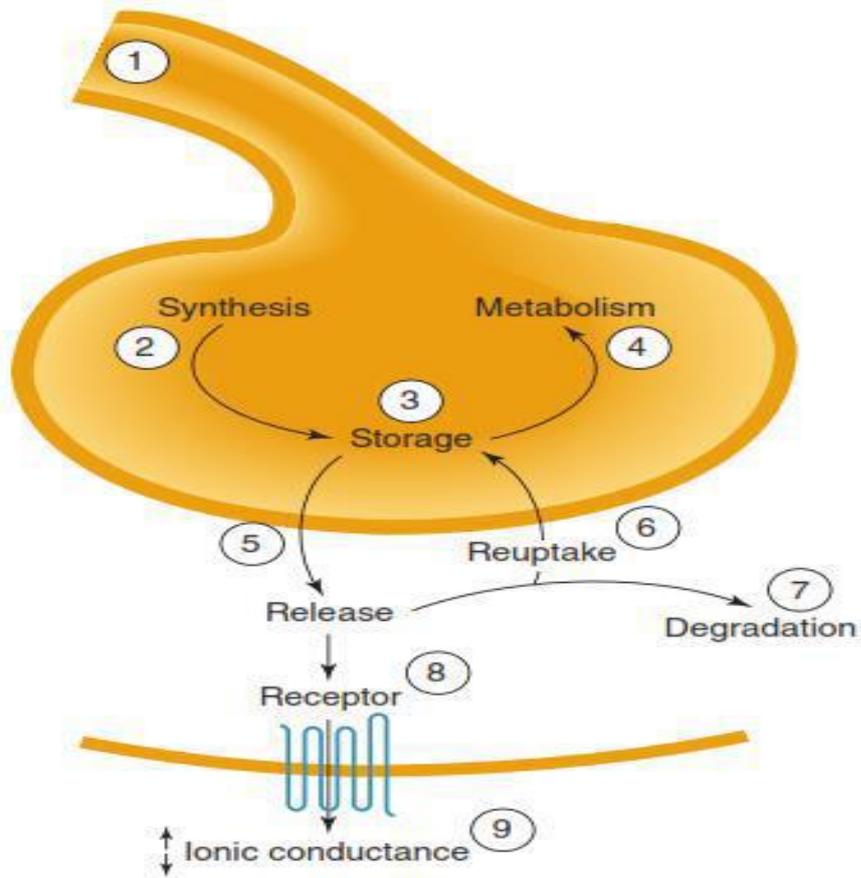
1-Glutamate 2-Aspartate 3-Nitric oxide

Ach and Norepinephrine act both **excitatory and inhibitory**.

General Mechanisms of the Drugs that act on the CNS:

Most drugs that affect the central nervous system (CNS) act by altering some step in the neurotransmission process. Drugs affecting the CNS may act presynaptically by influencing the **production, storage, release, or termination of the action of neurotransmitters**. Other agents may **activate** or **block postsynaptic** receptors.

In the CNS, receptors at most synapses are coupled to ion channels. The binding of the neurotransmitter to the postsynaptic membrane receptors results in a rapid but transient opening of ion channels. Open channels allow specific ions inside and outside the cell membrane to flow down their concentration gradients. The resulting change in the ionic composition across the membrane of the neuron alters the postsynaptic potential, producing either **depolarization (excitatory)** or **hyperpolarization (inhibitory)** of the postsynaptic membrane, depending on the specific ions and the direction of their movement.



(Excitatory and inhibitory action)

Drugs that act in the CNS:

- Centrally acting analgesics (Narcotic analgesics).
- CNS depressants, sedatives, and hypnotics.
- General and Local anesthetics.
- Anti-depressant drugs, Anti-psychotic drugs.
- Anti-Parkinson drugs and anti-epileptic drugs.
- CNS stimulants.

1. CNS depressant

A. Sedative-hypnotic drugs

The sedative-hypnotics are used primarily for two common disorders:

- Anxiety.
- Insomnia.

Sedative: Drugs that calm or quiet the patient and reduce anxiety without inducing normal sleep.

Hypnotics: Drugs that initiate and maintain normal sleep without loss of consciousness.

Classification of sedative-hypnotic drugs:

1. Benzodiazepines

- E.g.: Diazepam (**Valium**), Midazolam, Lorazepam.
- **M.O.A:**

A. The targets for benzodiazepine actions are the (**GABA**) receptors (GABA is the major inhibitory neurotransmitter in the central nervous system (CNS)).

B. triggers an opening of the central ion channel, allowing chloride through the pore).

C. The influx of chloride ions causes **hyperpolarization** of the neuron and inhibits the formation of action potentials.

- Therapeutic actions of benzodiazepines:

- Hypnotic (sleep-inducing).
- Anxiolytic (anti-anxiety).
- Anticonvulsant.
- Seizures (epilepticus).

ANALGESIC DRUGS

Analgesia: refers to the absence of pain **without** the loss of consciousness.

Opioid: is any drug, **natural**, **semi-synthetic**, or **synthetic** that has actions similar to those of morphine. Opioids are drugs of choice for moderate to severe pain that cannot be controlled with other classes of analgesics.

Opioid Analgesics: Powerful pain relievers. Originate from the **opium poppy (plant)**. Opioid analgesics are the most effective analgesics and are used in the management of severe pain.

Opioid receptors: Three main classes of opioid receptors, designated as **mu, kappa, and delta**. From the pharmacologic perspective, mu receptors are the most important. This is because opioid analgesics act primarily through activation of mu receptors, although they also produce weak activation of kappa receptors

Can be classified by similarities in their chemical structure, by their mechanism of action, or by their efficacy into:

- 1) **Opioid Agonists with Moderate Efficacy** (e.g., codeine, oxycodone)
- 2) **Opioid Agonists with High Efficacy** (e.g., hydromorphone, meperidine, methadone, morphine)
- 3) **Opioids with Mixed Agonist-Antagonist Effects** (e.g., butorphanol, nalbuphine, pentazocine)
- 4) **Other Analgesics** (tramadol)
- 5) **Opioid Antagonists:** naloxone, naltrexone.

- **Mechanism of action:** Stimulate opiate receptors in the brain. They relieve pain by mimicking the action of endogenous opioid peptides, primarily at mu receptors, or both mu and kappa receptors.
- **Opioid antagonists** may be used to reverse the symptoms of opioid toxicity or overdose, such as sedation and respiratory depression.

- **Therapeutic actions of opioids:** (morphine)
 - 1) **Analgesia.**
 - 2) **Depression of cough reflex:** Both morphine and codeine have antitussive properties.
 - 3) **GI tract:** Morphine relieves diarrhea by decreasing the motility and increasing the tone of the intestinal circular smooth muscle.