SNS COLLEGE OF ALLIED HEALTH SCIENCES
SNS Kalvi Nagar, Coimbatore - 35
Affiliated to Dr MGR Medical University, Chennai

DEPARTMENT : PHYSICIAN ASSISTANT

COURSE NAME : NEUROLOGY

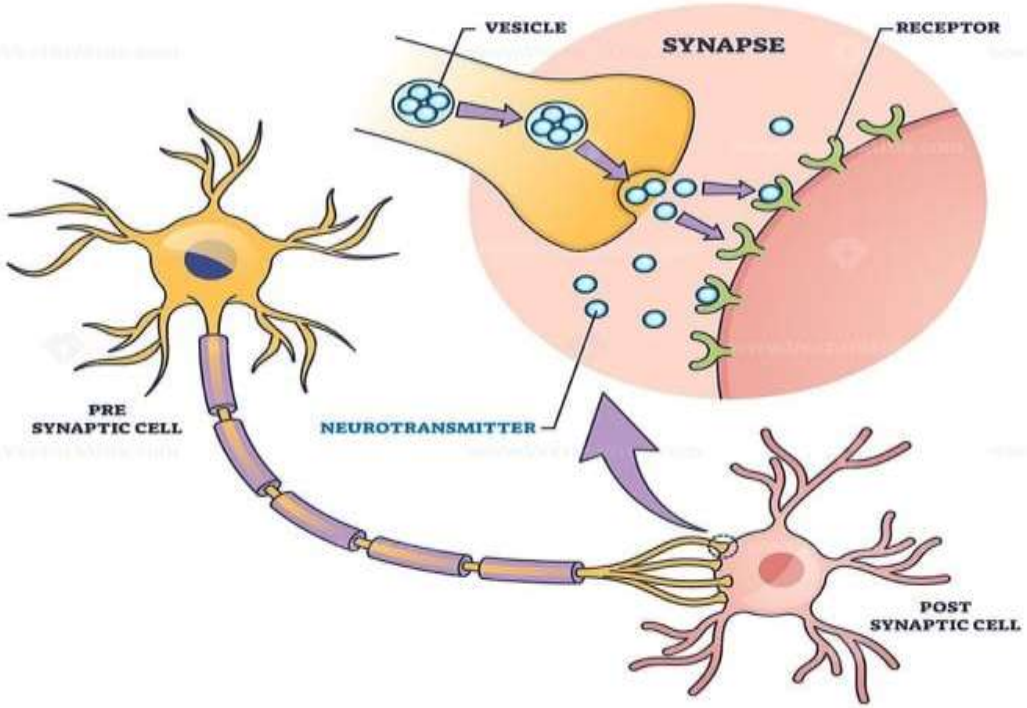
UNIT : NERVOUS SYSTEM

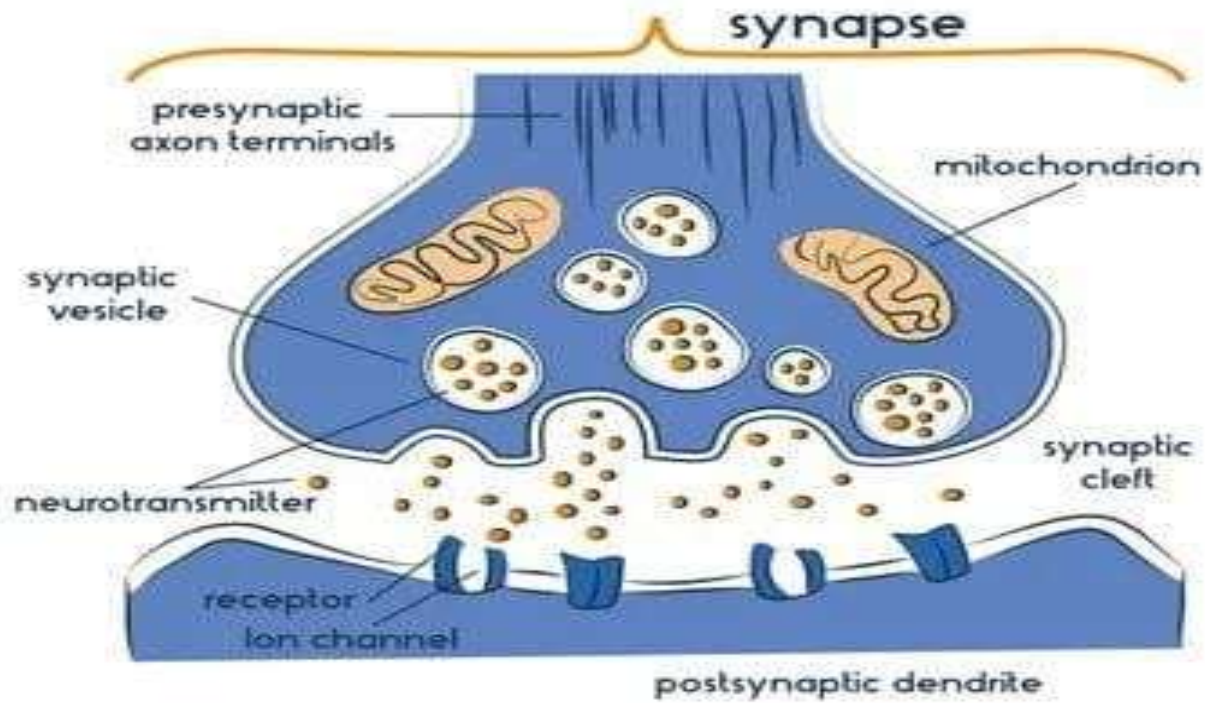
TOPIC : NEUROTRANSMITTERS - GENERAL PRINCIPLES AND COMMON TRANSMITTERS

NEUROTRANSMITTER

- Neurotransmitters are biochemical substances that transmit signals across synapses, which are the junctions between neurons or between neurons and other cells such as muscles or glands.
- These chemical messengers are fundamental to the communication within the nervous system and are responsible for regulating a vast array of physiological and behavioral processes.

NEUROTRANSMITTER




synapse
presynaptic
axon terminals
mitochondrion
synaptic
vesicle
synaptic
cleft
neurotransmitter
receptor
ion channel
postsynaptic dendrite

GENERAL PRINCIPLES

- **Synthesis:** Neurotransmitters are synthesized within the neuron's cell body or terminals. The synthesis process involves enzymatic reactions that convert precursor molecules, often derived from dietary sources, into neurotransmitters.
- For instance, acetylcholine (ACh) is synthesized from choline and acetyl coenzyme A (acetyl-CoA), while dopamine is synthesized from the amino acid tyrosine.

- **Storage:** Once synthesized, neurotransmitters are stored in synaptic vesicles, small membrane-bound compartments within the neuron's presynaptic terminals.

- These vesicles contain high concentrations of neurotransmitters, ensuring rapid and efficient release when needed.

- **Release:** When an action potential reaches the presynaptic terminal, it depolarizes the membrane, leading to the opening of voltage-gated calcium channels.

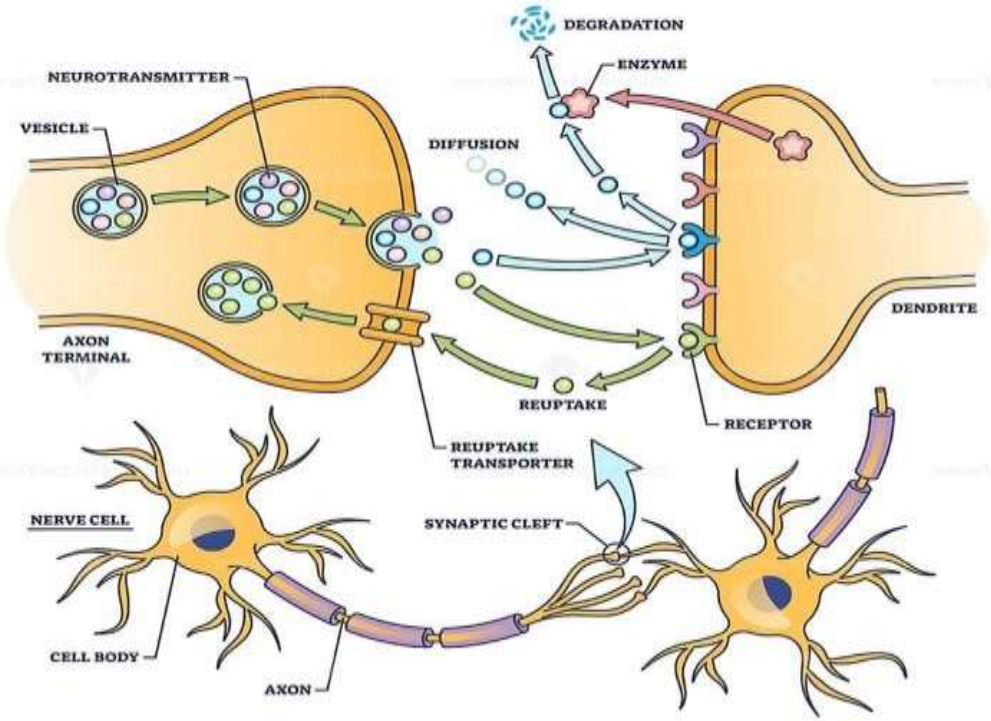
- The influx of calcium ions triggers the fusion of synaptic vesicles with the presynaptic membrane, a process known as exocytosis. As a result, neurotransmitters are released into the synaptic cleft.

- **Binding:** Neurotransmitters diffuse across the synaptic cleft and bind to specific receptors located on the postsynaptic membrane or on the membrane of target cells.
- The binding of neurotransmitters to receptors initiates a cascade of biochemical events within the postsynaptic neuron or target cell, leading to changes in membrane potential and cellular activity.

- **Response:** Neurotransmitter-receptor binding can either excite or inhibit the postsynaptic neuron or target cell, depending on the type of neurotransmitter and receptor involved.
- Excitatory neurotransmitters, such as glutamate, promote neuronal depolarization and action potential generation, whereas inhibitory neurotransmitters, such as gamma-aminobutyric acid (GABA).

- **Termination:** Neurotransmitter action is terminated to ensure precise signaling and prevent prolonged activation of postsynaptic receptors.
- This termination can occur through several mechanisms, including reuptake into the presynaptic neuron via specific transporter proteins, enzymatic degradation in the synaptic cleft by enzymes such as acetylcholinesterase (AChE), or diffusion away from the synapse.

NEUROTRANSMITTER



COMMON NEUROTRANSMITTERS

- **Acetylcholine (ACh):** ACh is involved in neuromuscular transmission, autonomic nervous system function, and cognitive processes. It plays a important role in muscle contraction, memory formation, and attention.
- **Glutamate:** Glutamate is the most abundant excitatory neurotransmitter in the central nervous system (CNS). It mediates fast synaptic transmission and is involved in synaptic plasticity, learning, and memory.

- **Gamma-aminobutyric acid (GABA):** GABA is the primary inhibitory neurotransmitter in the CNS.

- It acts to inhibit neuronal activity, thereby modulating neuronal excitability and maintaining the balance between excitation and inhibition in the brain.

- **Serotonin:** Serotonin is involved in the regulation of mood, appetite, sleep, and cognition.

- It modulates emotional states, anxiety, and aggression, and is targeted by antidepressant medications such as selective serotonin reuptake inhibitors (SSRIs).

- **Norepinephrine (NE) and Epinephrine (E):** NE and E are catecholamine neurotransmitters that play key roles in the sympathetic nervous system's "fight or flight" response.

- They regulate cardiovascular function, arousal, attention, and stress responses.

- **Endorphins:** Endorphins are endogenous opioid peptides that modulate pain perception and contribute to feelings of pleasure and euphoria.

- They are released in response to stress and physical exertion and are involved in the body's natural pain-relief mechanisms.

ASSESSMENT

- What is Neurotransmitter ?
- What all are the Common Neurotransmitters ?