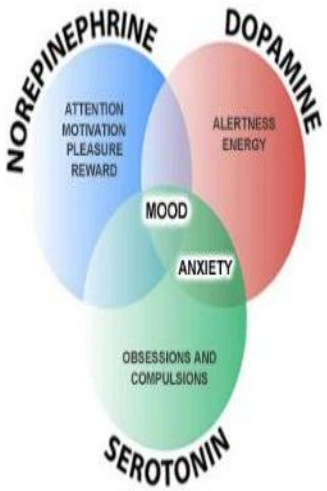
Neurotransmitters

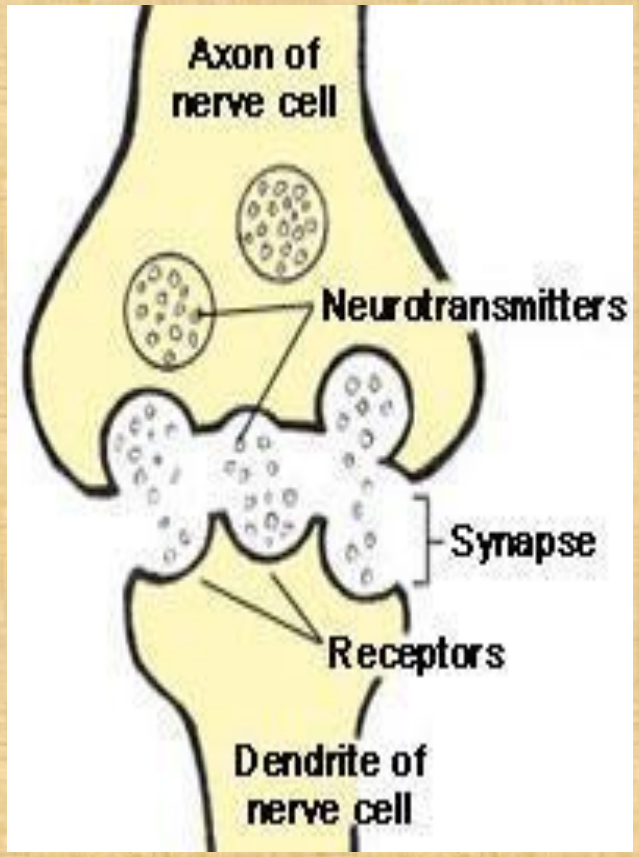
NEUROTRANSMITTERS

A **neurotransmitter** is **defined** as a chemical messenger that carries, boosts, and balances signals between neurons, or nerve cells, and other cells in the body. These chemical messengers can affect a wide variety of both **physical** and **psychological** functions including heart rate, sleep, appetite, mood, and fear. certain neurotransmitters are excitatory at some sites and inhibitory at other sites because different receptors molecules are involved.

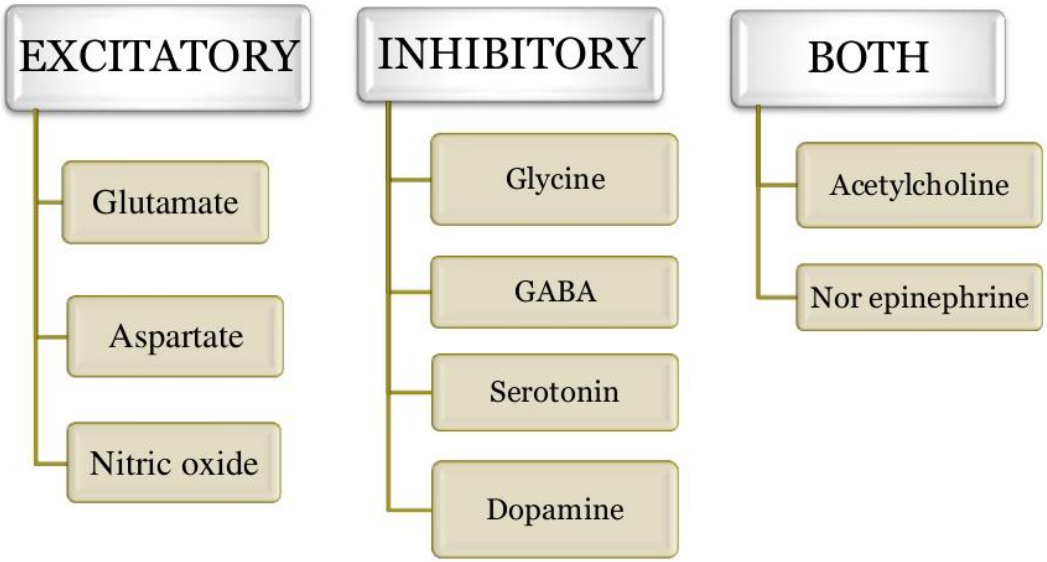
Neurotransmitters



Information is carried by biochemical substances called **neurotransmitters**. The terminal buttons and the dendrites of other neurons do not touch, but instead **pass** the information containing neurotransmitters through a synapse.



TYPES OF NEUROTRANSMITTERS



How They Work

In order for neurons to send messages throughout the body, they need to be able to communicate with one another to transmit signals. However, neurons are not simply connected to one another. At the end of each neuron is a tiny gap called a synapse and in order to communicate with the next cell, the signal needs to be able to cross this small space. This occurs through a process known as neurotransmission.

► Seven Processes in Neurotransmitter Action

1. Neurotransmitters are synthesized from precursors under the influence of enzymes

2. Stored in vesicles

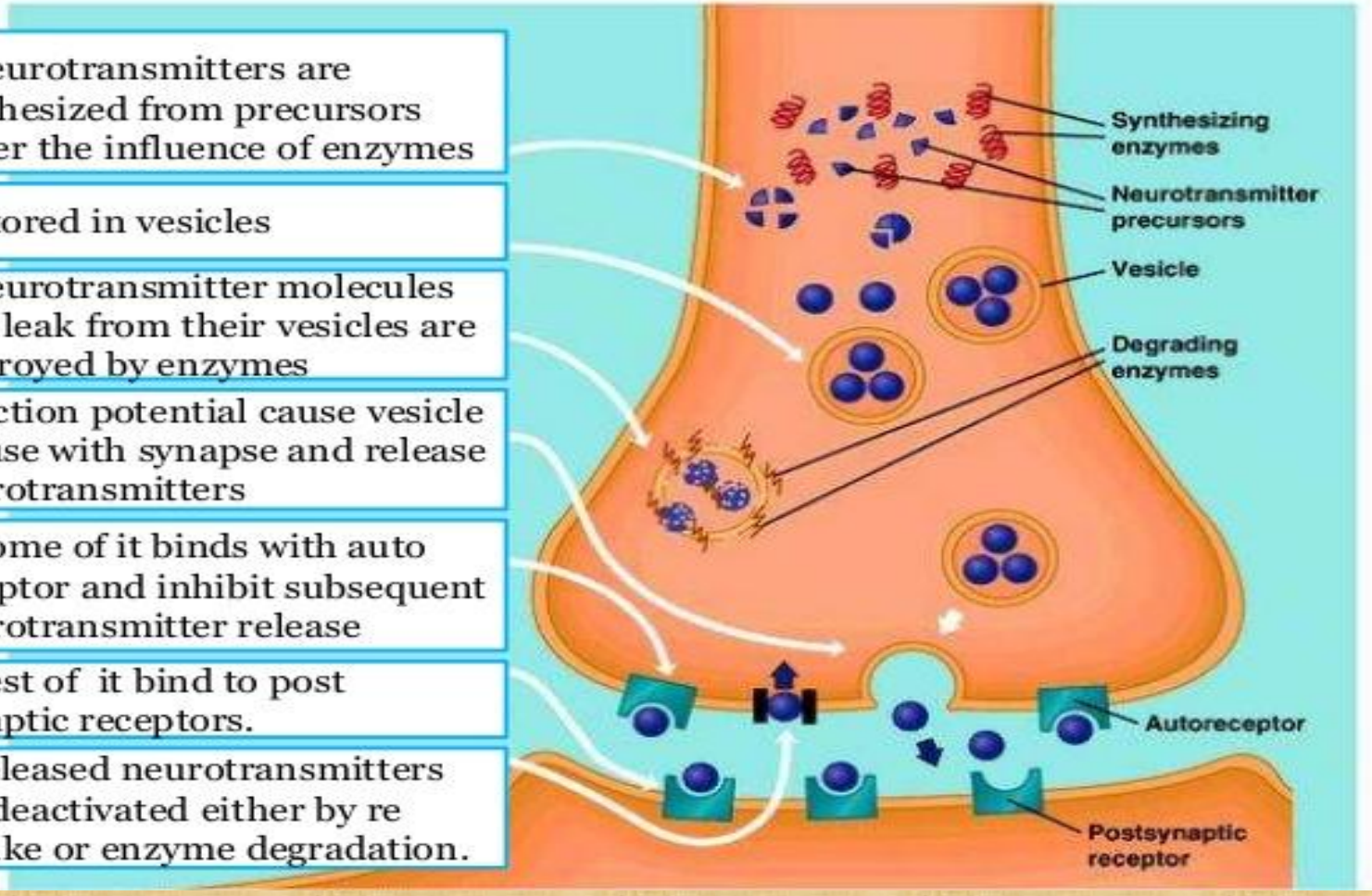
3. Neurotransmitter molecules that leak from their vesicles are destroyed by enzymes

4. Action potential cause vesicle to fuse with synapse and release neurotransmitters

5. Some of it binds with auto receptor and inhibit subsequent neurotransmitter release

6. Rest of it bind to post synaptic receptors.

7. Released neurotransmitters are deactivated either by re uptake or enzyme degradation.



Acetylcholine

- it is particularly prevalent in an area of the forebrain called the **hippocampus,** which plays a **key role in the formation of new memories**. (eichenbaum,2000).
- This neurotransmitter plays a prominent role in Alzheimer's disease, a devastating memory disorders.
- neurons in the forebrain that produces acetylcholine tend to degenerate in Alzheimer's patients. the less acetylcholine is produced, the more serious the memory loss.

- it is also released at every synapse between a motor neuron and a skeletal muscle fibre, causing the muscle contraction.
- certain drugs that affect acetylcholine can produce muscle paralysis. for eg. botulinum toxin, which forms from bacteria in improperly canned foods, blocks the release of acetylcholine and can cause death by paralyzing the muscles used in breathing.
- it also helps in regulating sleep cycle and alertness.

Norepinephrine

- Norepinephrine or noradrenaline is produced mainly by neurons in the brainstem, causing alertness and arousal.
- any drug that causes norepinephrine to increase or decrease in the brain is correlated with an increase or decrease in the individual's mood level.
- cocaine and amphetamines prolong the action of norepinephrine by slowing down its reuptake. because of this delay, the receiving neurons are activated for a longer period, which causes these drugs stimulating psychological effects.
- in contrast, lithium speeds up the reuptake of norepinephrine,causing a person’s mood level to be depressed.

Dopamine

- Dopamine is chemically very similar to norepinephrine.
- it is involved in the regulation of motivation and emotional pleasure.
- in recent years, addiction researchers have shown that dopamine is involved especially in regulating the **incentives salience of a reward** (Schultz, 2002)- in other words: how much we want something.
- too much dopamine in some areas of the brain may cause schizophrenia, and too little in other areas may lead to Parkinson's disease.
- Drugs used to treat schizophrenia, such as chlorpromazine or clozapine, block the receptors for dopamine.
- in contrast, L-Dopa, a drug commonly prescribed to treat parkinson's disease, increase dopamine in the brain.

Serotonin

Like Norepinephrine, serotonin plays an important role in mood regulation.

low levels of serotonin have been associated with feelings of depression.

serotonin reuptake inhibitors are antidepressants that increase serotonin levels in the brain by blocking its uptake.

Prozac, Zoloft and Paxil, drugs that are commonly prescribed to treat depression, are serotonin reuptake inhibitors.

because serotonin is also important in the regulation of sleep and appetite, it is also used to treat the eating disorder bulimia.

Glutamate

- the excitatory neurotransmitter glutamate is present in more neurons of the central nervous system than any other transmitter.
- Glutamate is excitatory because it depolarizes neurons upon which it is released.
- of the three or more subtypes of glutamate receptors, one in particular the NMDA receptor, is thought to affect learning and memory (Madden 2002).
- Disruptions in glutamate neurotransmission have been implicated in schizophrenia.

GABA

- Another prominent amino acid neurotransmitter is gamma aminobutyric acid (GABA).
- this substance is a major inhibitory transmitter; in fact most synapses in the brain use GABA.
- the drug Picrotoxin, which blocks GABA receptors, produces convulsions because muscle movement cannot be controlled by the brain without GABA's inhibiting influence.
- the tranquilizing effects of certain antianxiety drugs, the benzodiazepines, are a result of GABA's inhibitory action.

Effects of Neurotransmitters

Neurotransmitter	Effect
Glutamate	Turns brain on; builds memory, regulates awareness, movement, sensation and mood.
GABA	Turns brain off; involved in sleep, sedation, relaxation, reducing anxiety, and decreasing muscle tension.
Endocannabinoids	Regulates pain, appetite, coordination, and learning.
Serotonin	Regulates mood, anxiety, appetite, sleep cycle, and body temperature.
Noradrenaline	Feelings of alertness, attention, concentration, raises blood pressure, lifts mood, can increase anxiety.
Dopamine	Creates feelings of motivation and drive, liking, attention, pleasure, and enjoyment of food.
Acetylcholine	Regulates sleep cycle and alertness, and builds memory.
Adenosine	Makes us feels tired and hungry.
Endorphins	Creates feelings of pleasure and reward, and reduces pain.
Substance P	Regulates pain and stress responses.
Cholecystokinin	Tells us when to eat, possibly involved in managing anxiety.

Excitatory Neurotransmitters

These types of neurotransmitters have excitatory effects on the neuron, meaning they increase the likelihood that the neuron will fire an action potential. some of the major exciattory neurotransmitters include epinephrine and norpineohrine.

Inhibitory Neurotransmitters

These types of neurotransmitters have inhibitory effects on the neuron. they decrease the likelihood that the neuron will fire an action potential. some of the major inhibitory neurotransmitters include serotonin and gamma aminobutyric acid (GABA)

Modulatory Neurotransmitters

These neurotransmitters, often referred to as neuromodulators, are capable of affecting a larger number of neurons at the same time. these neuromodulators also influence the effects of other chemical messengers.

Neurotransmitters Implicated in Drug Use and Addiction

Neuro- transmitter	Distribution in the Central Nervous System	Functions Affected	Drugs That Affect It
Dopamine	Midbrain, Ventral Tegmental Area (VTA),Cerebral cortex,Hypothalamus	Pleasure and reward,Movement Attention,Memory	Cocaine Methamphetamine Amphetamine In addition, virtually all drugs of abuse directly or indirectly augment dopamine in the reward pathway.
Serotonin	Midbrain VTA Cerebral cortex Hypothalamus	Mood Sleep Sexual desire Appetite	MDMA (ecstasy) LSD Cocaine
Norepinephrine	Midbrain VTA Cerebral cortex Hypothalamus	Sensory processing Movement Sleep Mood Memory Anxiety	Cocaine Methamphetamine Amphetamine
Endogenous opioids (endorphin and enkephalin)	Widely distributed in brain, but regions vary in type of receptors Spinal cord	Analgesia Sedation Rate of bodily functions (e.g., breathing) Mood	Heroin Morphine Prescription pain relievers (e.g., oxycodone)

Acetylcholine	**•Hippocampus •Cerebral cortex •Thalamus •Basal ganglia •Cerebellum**	**•Memory •Arousal •Attention •Mood**	**•Nicotine**
Endogenous cannabinoids (anandamide)	•Hippocampus •Cerebral cortex •Thalamus •Basal ganglia •Cerebellum	•Memory •Arousal •Attention •Mood	•Nicotine
Glutamate	•Widely distributed in brain	•Neuron activity (increased rate) •Learning •Cognition •Memory	•Ketamine •Phencyclidine •Alcohol
Gamma-aminobutyric acid (GABA)	•Widely distributed in brain	•Neuron activity (slowed) •Anxiety •Memory •Anesthesia	•Sedatives •Tranquilizers •Alcohol

What Happens When Neurotransmitters Do Not Work Right

As with many of the body's processes, things can sometimes go awry. It is perhaps not surprising that a system as vast and complex as the human nervous system would be susceptible to problems.
A few of the things that might go wrong include:

1. Neurons might not manufacture enough of a particular neurotransmitter.
2. Too much of a particular neurotransmitter may be released.
3. Too many neurotransmitters may be deactivated by enzymes.
4. Neurotransmitters may be reabsorbed too quickly.

Types of drugs

Agonist vs Antagonists: Some drugs are known as agonists and function by increasing the effects of specific neurotransmitters. other drugs and referred to as antagonists and act to block the effects of neurotransmission

HORMONES

VERSUS

NEUROTRANSMITTERS

ON THE TEAS

Hormones	Neurotransmitters
Hormones are relesed by endocrine glands	Neurotransmitters are released by nerve cells
Hormones travel through the blood to act on distant target cells	Neurotransmitters travel across the synpase to act on nearby cells
The effects of hormones can be slower to build but longer lasting	The effects of neurotransmitters can be fast to act but shorter lasting
Hormones are part of the endocrine system	Neurotransmitters are part of the nervous system

Prenursing Smarter

A Word From Very well

Neurotransmitters play a critical role in neural communication, influencing everything from involuntary movements to learning to mood. This system is both complex and highly interconnected. Neurotransmitters act in specific ways, but they can also be affected by disease, drugs, or even the actions of other chemical messengers.

THANK YOU