**Neurotransmitters** are the chemicals which allow the transmission of signals from one neuron to the next across synapses. They and their close relatives are produced by glands such as the pituitary and the adrenal glands.

**Amino acids involved as neurotransmitters**

**Inhibitory neurotransmitter**= mood regulation, sleep, appetite control, and calmness, responsible for calming the mind and body, inducing sleep

* Tryptophan=Serotonin=Melatonin
	+ Serotonin is an inhibitory neurotransmitter that has been found to be intimately involved in emotion and mood.  Too little serotonin has been shown to lead to depression, problems with anger control, obsessive-compulsive disorder, and suicide.  Too little also leads to an increased appetite for carbohydrates (starchy foods) and trouble sleeping, which are also associated with depression and other emotional disorders.  It has also been tied to migraines, irritable bowel syndrome, and fibromyalgia
* Glutamine=L-Glutamate=GABA
	+ GABA acts like a brake to the excitatory neurotransmitters that lead to anxiety.  People with too little GABA tend to suffer from anxiety disorders
	+ GABA is lacking in certain parts of the brain, epilepsy results.
* Glycine, Taurine

**Excitatory Neurotransmitters**= Learning, memory, mental clarity, focus, concentration, energy, and motivation. Norepinephrine is strongly associated with bringing our nervous systems into "high alert."  It is prevalent in the sympathetic nervous system, and it increases our heart rate and our blood pressure.  Our adrenal glands release it into the blood stream, along with its close relative epinephrine (aka adrenalin).

* Tyrosine=L-Dopa=Dopamine=Norepinephrine=Epinephrine
	+ Dopamine is strongly associated with reward mechanisms in the brain.  Drugs like cocaine, opium, heroin, and alcohol increase the levels of dopamine, as does nicotine.
	+ schizophrenia has been shown to involve excessive amounts of dopamine
	+ too little dopamine in the motor areas of the brain are responsible for Parkinson's disease
	+ low dopamine = social anxiety
* Phenylalanine= makes PEA phenylethylamine
* Glutamate
	+ Glutamate is an excitatory relative of GABA.  It is the most common neurotransmitter in the central nervous system - as much as half of all neurons in the brain - and is especially important in regards to memory
	+ ALS, more commonly known as Lou Gehrig's disease, results from excessive glutamate production
* Histidine= Histamine
* **Acetylcholine** responsible for much of the stimulation of muscles, including the muscles of the gastro-intestinal system.  It is also found in sensory neurons and in the autonomic nervous system, and has a part in scheduling REM (dream) sleep. \*90% loss of acetylcholine in the brains of people suffering from Alzheimer's

**Amino acids involved in brain activity or in process of making neurotransmitters**

* Asparagine=decreases mood swings, Leucine=natural pain killer, Lysine=anxiolytic due to effects on serotonin in GI tract, Methionine=precursor to SAMe, Proline=precursor to glutamic acid and GABA
* Serine=involved in synthesis of tryptophan, Valine, Alanine, Glutathione, Isoleucine, Theanine

When the balance between the excitatory and inhibitory systems is lost, it creates a situation of a neurotransmitter-related condition developing.   A healthy nervous system is characterized by meeting two basic criteria.  **Number one**, it must have sufficient supplies of the necessary neurotransmitters (Amino acids).  **Secondly,** the excitatory and inhibitory systems must work together so that it delivers signals appropriately. Many neurotransmitter-related conditions are believed to be the result of insufficient neurotransmitter supplies**. Neurotransmitters define our moods, actions, and health.** Organs throughout the body are connected to the brain via a vast network of neurons.  The brain uses neurotransmitters to tell the heart to beat, the lungs to breathe, and the intestines to digest this is known as the **autonomic nervous system**.  **Some of the most significant clinical issues linked to neurotransmitter imbalances are:  anxiousness, appetite control, attention issues, developmental delays, behavioral problems, low mood, fatigue, libido, women's issues, headaches, mood disorders, sleep disorders, weight issues, and many more.**

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| **Alanine (NE)*** Blood sugar regulation
* Metabolism of glucose, tryptophan and B6
* Providing energy for your muscle tissue, brain, and central nervous system. It helps with the breakdown of glucose for energy and stabilizes glucose levels during exercise.
* used in the production of neurotransmitters
* Strengthens the immune system by producing antibodies and stimulates lymphocyte production.
 | **Arginine (NE)*** Cell division, Wound healing
* Precursor to NO / It plays an important role in **expanding blood vessels to facilitate the blood flow.** (Nitric oxide, which is required to expand blood vessels, is made from arginine.)
* T- lymphocyte proliferation/ enhance immunological function plays an important role in cell division, the healing of wounds, removing ammonia from the body, immune function
* It is an amino acid that is useful in eliminating excessive ammonia from the body.
* **release of growth hormones** considered necessary for muscle growth and tissue repair, decreasing healing time
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|   **Asparagine (NE)*** Metabolic function of cells in nerve and brain tissue
* Equilibrium of nervous system-decreases mood swings. Located close to the TCA cycle (place of energy generation) together with aspartic acid.
 | **Aspartic acid (NE)*** Increases stamina
* Aids in the removal of ammonia
* DNA and RNA metabolism
* enhances immunoglobulin production and antibodies
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| **Carnitine**—* Is necessary for heart muscle functioning, lowers cholesterol and triglycerides
* removes waste from cells
* enhances energy, transports fat directly to cells for energy which means less fat is stored in the body
 | **Cysteine (NE)*** Metal ion binding
* Builds up WBCs
* Carotene for hair and skin.
* **acts as an antioxidant** and protects against radiation and pollution it will slow the ageing process, deactivate free radicals, and neutralize toxins
* Cysteine is involved in the formation of one of the most potent detoxifiers in the body, **glutathione** in the lungs, liver, kidneys, and bone marrow
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| **Citrulline** * A precursor to arginine and is involved in the formation of urea in the liver
* Citrulline supports the body in optimizing blood flow through its conversion to l-arginine and then nitric oxide (NO). Arginine is a contributing member of the various amino acids found in the urea cycle, which is responsible for detoxifying ammonia
 | **Creatine** * Found in the skeletal tissue
* It allows peak athletic performance and longer endurance; an increase lean muscle mass, and lowers lactate and ammonia levels
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| **GABA (gamma-aminobutyric acid)** * Found in almost every region of brain, and is formed through the activity of the enzyme glutamic acid decarboxylase (GAD)
* **GABA serves as a inhibitory neurotransmitter to** block the transmission of an impulse from one cell to another in the central nervous system is a non-essential amino acid formed from glutamic acid with the help of vitamin B6
 | **Glutamic acid (NE)*** Neurotransmitter, and is an active neurotransmitter substance and is important for memory and learning.
* help to **prevent seizures**
* considered to be nature's "brain food" because it improves mental capacities;
* Prostate health
* Helps to prevent ammonia intoxication,
* speed the healing of ulcers
* relieves fatigue
* helps control alcoholism, schizophrenia
* decreases craving for sugar
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| **Glutamine (NE)*** Cellular energy
* Removes excess ammonia
* Strengthens the immune system.
* used as an energy source for the intestine and is an indispensable component to maintain its normal function
* enhance liver function
* **Glutamine in an amino acid that is a major precursor for the neurotransmitter, GABA**, or gamma amino butyric acid, and is especially important when the body is subjected to stressful situations. It has been stated that **when there is no GABA, there is no calm and no sleep because the brain will not "turn off"**
 | **Glutathione** * Found in the brain, kidneys, liver, and heart
* It is an antioxidant it assists white blood cells in protecting the lungs, helps treat asthma
* Helps carbohydrate metabolism.
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| **Glycine (NE)*** Inhibitory neurotransmitter Improves sleep quality
* It is used to produce glutathione and porphyrin
* is used for muscular tissue, DNA and RNA creation and converting glucose into energy and helps trigger the release of oxygen which is required for making new cells
* It prevents muscular degeneration by increasing levels of Creatine
* It is also important for the digestive system
* It is important for the manufacturing of hormones
* responsible for a strong immune system component of hemoglobin
 | **Histidine (E)*** Enhances absorption of calcium
* Vasodilatation Sexual arousal and behavior
* Produces gastric enzymes
* Histidine is used to form histamine a neurological compound released during allergic responses
* It is used for growth and for the repair of tissue, as well as the preservation of the myelin sheaths that protect nerve cells
* Histidine is required for the fabrication of both red and white blood cells and helps to protect the body from damage caused by radiation and in heavy metals detoxification.
* Histidine is found abundantly in hemoglobin
* It has been used in the treatment of rheumatoid arthritis, allergic diseases, ulcers & anemia
* A deficiency of Histidine can cause poor hearing
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| **Hydroxyproline** * Derived from the amino acid proline and is used almost exclusively in structural proteins including collagen, connective tissue in mammals, and in plant cell walls
 | **Isoleucine (E)****BCAA*** Formation of hemoglobin
* Regulates blood sugar and energy levels
* necessary for hemoglobin formation
* Builds proteins and enzymes, stimulates the brain, promotes muscle recovery after physical exercise
* used to make hemoglobin
* Leucine & Isoleucine provide ingredients for the manufacturing of other essential biochemical components in the body, some of which are utilized for the production of energy, stimulants to the upper brain, and promote alertness
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| **Leucine (E)****BCAA*** Regulates blood sugar/Stimulates insulin release
* Recovery from trauma/surg natural painkiller
* Leucine – helps to maintain energy and muscle health, regulates blood sugar and plays a role in weight maintenance
* is used in the liver, but primarily in the muscle and fat
* It is used in the bio-synthesis of sterols in the body and has the ability to stimulate muscle growth and inhibit muscular degradation
 | **Lysine (E)*** Helps decrease HSV outbreaks
* Anxiolytic due to effects on serotonin in GI tract
* Causes cancerous cells to destroy themselves
* Boosts immune health
* plays a role in calcium absorption, forming collagen
* the production of hormones and enzymes – is important for proper growth
* an essential role in **the production of Carnitine, a nutrient responsible for converting fatty acids into energy and helping to lower cholesterol**
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| **Methionine (E)*** Precursor to SAMe
* Antioxidant
* Prevents plaque formation
* Boosts immune health Detox
* an essential amino acid which is used to produce various substances needed in the body – has important role in liver and kidney function, supplies sulphur to your hair and skin, helps to breakdown fats
* It helps lower cholesterol levels by increasing the liver's production of Lecithin
* It reduces liver fat, protects the kidneys, and acts as a natural chelating agent for heavy metals, regulates the formation of ammonia and creates ammonia-free urine which reduces bladder irritation
 | **Orthinine** * Assists in muscle growth and plays a crucial role in cell growth and repair
* L-ornithine is an important anti-aging amino acid that promotes growth. It is also a precursor of arginine. Arginine and ornithine are closely related. While arginine is incorporated into body proteins, ornithine is a tool used to make those proteins
* The amino acid ornithine works together with arginine and Carnitine to **promote natural growth hormone release** from the pituitary gland
* Ornithine metabolize excess body fat
* It is required for a properly functioning immune system and assists in ammonia detoxification. It is a central part of the urea cycle, which allows for the disposal of excess nitrogen
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| **Phenylalanine (E)*** The body changes this into tyrosine, another amino acid that is needed to make proteins, and neurotransmitters, including L-dopa, epinephrine, and norepinephrine, and thyroid hormones
* Phenylalanine is used by the brain to keep a person awake and alert, reduces hunger pangs and functions as an antidepressant and helps improve memory
 | **Proline (NE)*** Precursor to glutamic acid and GABA
* Component of collagen. It is **the main component of "collagen" which constitutes the skin and other tissues**
* It serves as a fast-acting energy source
* Tendon and joint health
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| **Serine (NE)*** DNA/RNA production
* Used in synthesis of tryptophan
* Increases absorption of Creatine
* Serine is involved in the formation of immunoglobulin’s and antibodies strengthening the body’s immune system
* Clotting factor
* It is used to produce phospholipids and glyceric acid
* A major role as a catalyst for many enzyme functions and synthesizes the fatty-acid based sheaths around nerve fibers
* Serine is a storage source of glucose by the liver and muscles
 | **Taurine*** Strengthens the heart muscle by increasing the force and effectiveness of heart muscle contractions
* It stabilizes irregular heart rhythms. It is also known to reduce cholesterol, triglycerides, and high blood pressure
* **Taurine as a Neurotransmitter** As a powerful inhibitory neurotransmitter, one of taurine's uses has been that of an anti-convulsion. These anti-convulsion effects come from its ability to stabilize nerve cell membranes, which prevents the erratic firing of nerve cells. Important in the control of epileptic seizures
* Taurine, along with sulfur, are necessary for the control of many biochemical changes that take place in the aging process and aid in the clearing of free radical wastes
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| **Theanine*** Involved in the **formation of the inhibitory neurotransmitter, gamma amino butyric acid (GABA).** GABA influences the levels of two other neurotransmitters, dopamine and serotonin, producing a relaxation effect
* The predominant amino acid in green tea and makes up 50% of the total free amino acids in the plant
 | **Threonine (E)*** Tooth enamel and collagen production
* It is an essential amino acid which is used to form active sites of enzymes
* Threonine may be beneficial in the treatment of Amyotrophic Lateral Sclerosis (ALS) and Multiple Sclerosis (MS).
* Threonine is an important constituent of collagen, elastin, and enamel protein
* It helps prevent fat build-up in the liver, Glucose-sparing effect, helps the digestive and intestinal tracts function smoothly, and assists metabolism and assimilation of nutrients. Immune support, Intestinal health.
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| **Tryptophan (E)** * Precursor to serotonin and niacin
* Supports Intestinal health. The **relaxing amino acid, supports restful sleep, and helps to protect your body from stress, anxiety and depression**
 | **Tyrosine (NE)*** Precursor to catecholamines
* Production of T3 and T4
* Supports the function of the thyroid, adrenal, and pituitary glands
* Is a factor in regulation endocrine hormonal function and structurally is a component in most of the proteins in the body.
* Tyrosine **transmits nerve impulses to the brain. It helps overcome depression, improves memory, increases mental alertness**
* Synthesis of melanin
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| **Valine (E)****BCAA*** Metabolize carbohydrates
* **Valine promotes mental vigor, muscle coordination, and calm emotions**
* Supports all round vitality, muscle coordination, maintains healthy levels of nitrogen in the body
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