Endocrine System

- Homeostasis is the regulation of equilibrium in the body, making sure that the body is in a state of balance so that all organs can function appropriately.
- Intercellular communication (communication between cells) is an extremely important aspect of the endocrine system.
- There is a messenger molecule that is the sender and a protein that acts as a receptor, like a mailbox. The messenger molecule gets to the receptor through one of a few different methods and passes on the signal. One example of the ways a signal can get to a receptor is called direct communication.

The endocrine system's role is to coordinate the functions of the body. It is made up of organs and glands that secrete hormones to regulate functions and communicate to the tissues. There are several methods used to transport the hormones to where they need to go.

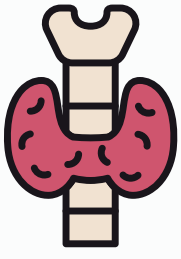
- Direct communication occurs between a local group of cells. This method uses gap junctions, which tunnel from one cell to another and pass through the cytosol of one cell into another.

Hormones are chemical substances that can demand an action from a particular cell type. The hormones are the messengers that bind to a receptor at the target cell.

- Exocytosis is when the message gets sent out of a cell (one example is paracrines). The message is packaged in a vesicle and is sent out into the interstitial fluid. Then it diffuses through the fluid to get to its target.
- Synaptic communication uses axons and neurons in the nervous system to send messages. Action potentials and axons can transfer signals across long distances. The neurotransmitter is the substance that diffuses across the synapse to its target.
- The endocrine system not only uses exocytosis and synaptic communication, it also uses the circulatory system.
- The circulatory system circulates the message around the body. It is not fast or efficient. The hormones often travel to several places in the body before reaching the receptor.

Endocrine System

- The endocrine system is composed of glands and specialized groups of cells, so the system is scattered all across the body.
- Endocrine glands release things inside the body, while exocrine glands release through a duct. So these only secrete substances onto surfaces, such as through pores in the skin, or on the surface of the digestive tract.
- Hormones have several roles, including making new proteins (transcription and translation), increasing/decreasing protein synthesis, and altering the activity of existing proteins.
- Upregulation is the increase of the number of receptors on a cell, while downregulation is a decrease of the number of receptors on a cell. This makes the target more or less sensitive to the hormone. If there are more receptors, then more of the hormone will be able to bind to the cell. That promotes stronger communication.
- Amino acid derivatives – amino acids are the building parts of proteins.
  - Thyroxine is a thyroid hormone.
  - The catecholamines are epinephrine, norepinephrine, and dopamine.
  - Melatonin helps us sleep.
  - Peptides are chains of amino acids. You can also add glycoproteins (also known as sugar)
  - Lipid derivatives are different types of fats/lipids. Not all lipids are fats. Lipids are hydrophobic (which means they hate water. hydro = water, phobic = fear). Lipids are primarily carbons and hydrogens.



TSH – THYROID STIMULATING HORMONE

LH – LUTEINIZING HORMONE

FSH – FOLLICLE STIMULATING HORMONE

- Examples of eicosanoids are prostaglandins and leukotrienes. These are chemical messages in our immune system that react to allergies, allergic reactions, and pain. The presence of any prostaglandins indicate pain. The presence of too many eicosanoids causes allergic reactions and allergies. Aspirin decreases the amount of prostaglandins in the body.

Endocrine System

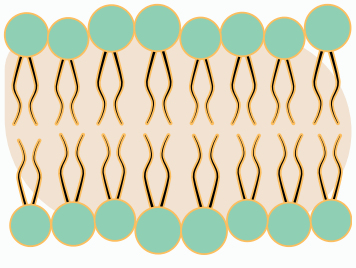
- Steroid hormones are secreted by the adrenal glands (the adrenal cortex), the testes, and ovaries. They are considered sex hormones because they emphasize the unique features of males and females.

Steroid hormones are estrogen, testosterone, and corticosteroids.

The receptors of a cell are typically on the membrane. In fact, the membrane itself can be a receptor.

- There is a big difference between fat- and water-soluble hormones. Fat-soluble hormones can diffuse through the membrane of the cell to bind with the receptors inside the cell. Water-soluble hormones cannot diffuse through the membrane of a cell. They have to bind to the receptors on the cell membrane. Examples of water-soluble hormones are catecholamines, peptides, and eicosanoids. These never enter the cell.

- Guanine nucleotide-binding proteins (G-proteins) are proteins that transmit the messages from the hormones. Second messengers are ions and molecules that bring the signals from water-soluble hormones to the molecules in the nucleus. This is how the water-soluble signals are effective.



- Steroid hormones can diffuse directly through the cell membrane, which means they are fat-soluble. However, their impact is determined by the number of receptors in the cell. The more receptors, the stronger the response to the steroid. If there are zero receptors, there is strong downregulation.

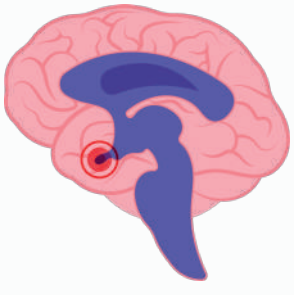
Endocrine System

- Hormones can influence each other if multiple are released and trying to bind at the same time. Permissive effects are when a hormone needs permission from another hormone in order to bind to the receptors or when it needs another hormone in order to perform a specific function.
- Synergistic/additive – when hormones A and B are together, they have greater effects.
- Antagonist – trying to stop something else or trying to impede something else. For example, hormone A is trying to do something, and hormone B is actively trying to decrease or stop what hormone A is doing.
- The secretion of hormones is regulated in several ways. Neural stimuli will cause hormones to be released when the endocrine glands are stimulated. This can be caused by the sympathetic nervous system when fight-or-flight has been activated.

HORMONAL EFFECTS – SOME OF THE HORMONES RELEASED ARE DUE TO THE PRESENCE OF OTHER HORMONES. IF THERE IS TOO MUCH OF ONE HORMONE, THEN ANOTHER ONE WILL BE RELEASED TO MINIMIZE THE DAMAGE. THIS IS AN EXAMPLE OF ANTAGONISTIC HORMONES.

An increase/decrease of hormones can also be triggered by chemical changes in body fluids. This is an important factor in maintaining homeostasis in the body.

- Many of the hormones being released are due to negative feedback. Negative feedback is the process by which the body regulates the functions of the body. It informs the brain when levels of hormones need to be changed. Negative feedback is an important part of homeostasis.
- The hypothalamus is located in the brain. This is the main controlling system for the sympathetic and parasympathetic nervous systems. It carries out lots of housekeeping functions. For instance, it regulates body temperature, thirst, hunger, sexual drive, and emotions. It also controls the release of many hormones, some that are released directly from the hypothalamus, and others that it stimulates the pituitary gland to release.



Endocrine System

Mometrix TEST PREPARATION

Hormones of the Hypothalamus:

- Antidiuretic hormone regulates water levels in the body and signals the kidneys to release less water in urine. It also increases blood pressure by constricting blood vessels.
- Corticotropin helps maintain and regulate the body's immune system and metabolism. This hormone is involved in the body's response to stress.
- Gonadotropin prompts the pituitary gland to excrete hormones that tell the reproductive organs to function.
- Oxytocin – also known as the love hormone – is involved in sexual interest and arousal, emotional attachments, sleep, and feelings of trust and dependence. One cool fact is that this hormone causes contractions during labor.
- Thyrotropin Releasing Hormone – regulates the thyroid gland through the releasing of TSH (thyroid-stimulating hormone) from the pituitary.
- Orexin and ghrelin increase your appetite
- Leptin decreases your appetite. This works by suppressing orexin and ghrelin.

The pituitary gland is the little chickpea-shaped gland underneath the hypothalamus. It is composed of the posterior and the anterior pituitary. The pituitary gland is connected to the hypothalamus through a hypophyseal portal system. There are two sets of capillaries that will bring messages from the hypothalamus to the pituitary.

Anterior Pituitary Hormones:

- Prolactin is a hormone that affects the mammary glands. It increases milk production.
- Melanocyte Stimulating Hormone is the prompter that makes melanin. Melanin darkens your skin when exposed to sunlight.
- Human Growth Hormone is the hormone that affects growth. We continue to produce this throughout our entire lifetime. It helps with the maintenance of our muscles and bones.
- Thyroid Stimulating Hormone is released to let the thyroid release its own hormones.
- Follicle Stimulating Hormones and Luteinizing Hormones affect the gonads.
- Adrenocorticotropic Hormones affect the adrenal glands and allow them to release their own hormones.

- Too much growth hormone can cause gigantism since it stimulates our body to grow.
- Dwarfism occurs when someone has too little growth hormone.
- Acromegaly is when you get more growth hormone after your plates have closed. This can cause overgrowth of bones and tissues. It can cause deformity.
- The posterior pituitary does not produce hormones. It gets all its hormones from the hypothalamus.
- The posterior pituitary releases oxytocin and antidiuretic hormone, which is involved in sex and water regulation.

Endocrine System

- The thyroid gland sits in front of the larynx. It is a butterfly-shaped gland that produces and releases hormones that regulate the metabolic rate, growth, and development. It also plays an important role in many other functions. The thyroid makes thyroxin T4 and T3 (the difference between the two is the number of iodines). These hormones increase the metabolic rate. In the follicle cells, they make something called thyroglobulin; it is the almost finished form of a hormone, but it's not one. Iodine plays an important part in T3, T4, and thyroglobulin.

A hormone made by the thyroid is calcitonin. Calcitonin plays a major role in calcium homeostasis by regulating the calcium levels in the blood. This promotes the addition of Ca^{+2} to bones (just converts the calcium in the blood into osseous tissue). This lowers the Ca levels in our blood.

- Calorigenic effect – A calorie is a unit of energy. This effect releases heat and helps maintain body temperature. On a cellular level, it helps with the production of Na+/K+ ATP. It also helps with the conditioning of the potassium pumps and increases the effects of catecholamines, such as epinephrine.

- Parathyroid glands are on the back of the thyroid. Most people have four of these glands, but you can have up to six. The parathyroid makes parathyroid hormone. This hormone increases your blood calcium by breaking your bones down a bit so that you can release that calcium into the bloodstream (simply by breaking the osseous tissue down). This also increases the calcium absorption of the kidneys and causes them to release calcitriol, which is an active form of vitamin D. This increases your Ca absorption by your gut.

The thymus gland secretes a variety of hormones called thymosins. These are involved in the maturation of lymphocytes, the slowing down of the aging process, and other things. The size of the gland is larger in juveniles, and it is much more active.

Endocrine System

Somatostatin is a growth hormone-inhibiting hormone made by delta cells. Pancreatic peptide is involved in regulating pancreatic secretions.

- Insulin stimulates cells to take up glucose and lower blood sugar. It is made by beta cells. Type 1 diabetes is when people don't make any insulin, while type 2 diabetes is when someone is producing insulin, but the cells aren't responding to it anymore. There is too much glucose because the cells have lowered the # of receptors for insulin.
- Adrenal glands are composed of two different parts: the adrenal cortex and the adrenal medulla.

- Gonads produce the sex hormones that are involved in sexual characteristics. They produce eggs and sperm. The female gonads are the ovaries, which are located in the pelvic region (one on either side of the uterus) and connected to the uterus by the fallopian tubes. The hormones involved in the female reproductive cycle, maintaining pregnancy, and lactation all originate here. The two primary types of female hormones are estrogen and progesterone. These help build the breasts, widen the hips, and distribute the body hair. It also helps with the endometrial lining of the fetus.
- The male gonads are the testes. These are outside the body in a sack called the scrotum because sperm need a lower temperature than the body. Testosterone is found in both males and females but is much more present in males. Testosterone is a hormone associated with sexual development and drive, building muscle mass, and establishing hair distribution.

There are three different hormones that come from the adrenal cortex:

Mineralocorticoids – the ion is typically a steroid. This class works on the water and salt balance. Aldosterone is a sub-part of mineralocorticoids. This hormone targets the kidneys and helps with compounds that need to stay in the body. Glucocorticoids are stress hormones. They provide everything so that your body can deal with stress. Androgens are the sex hormones. These can provide hormones once the ovaries aren't working as well in menopause. The adrenal medulla makes the epinephrine and norepinephrine. These hormones cause the fight-or-flight response and do the mobilization of glucose for ATP production.