81: HYPOTHALAMUS and PITUITARY

In the next few lessons, we will take a closer look at some of the major endocrine glands. If you find these lessons on the endocrine system confusing, it’s not you, it’s the endocrine system. Organs such as the hypothalamus and pituitary bring together all of the other body systems in one way or another. That’s a guarantee that it’s going to be complicated. The main point in this lesson isn’t to memorize all this stuff, but to gain an appreciation for how all the body’s organs communicate with each other and work together. You’ll see lots of information from previous lessons here in this lesson!

The hypothalamus isn’t a minor brain part. It’s the hub where everything comes together. It receives information from both afferent (in-coming) nerves and from the blood. Most of the brain is out-of-touch with the rest of the body because of the Blood Brain Barrier (BBB) which keeps just about everything except food and oxygen from going into brain tissue. However, in the hypothalamus region we find places where that barrier is leaky. Receptor cells in this area need to sample the blood to find out what is currently in it. If there is too much or too little of something, hormone messengers will need to be sent out to correct the imbalance. The hypothalamus uses hormones to control a number of other organs. Often, these correction operations happen automatically, without us needing to do anything. Blood pressure and heart rate go up and down without any thought on our part. Other corrections need us to do something, in order to make the needed adjustment.

The hypothalamus connects our conscious, "thinking" brain to our chemical needs. It receives signals from many sensory cells in the body, so it is informed about things like body temperature, blood pressure, heart rate, level of glucose in the blood, saltiness of the blood, time of day, activity level of the immune system, any many other things. The hypothalamus also has connections to our rational brain— the parts that control our actions. The behaviors prompted by the hypothalamus are often are things that we "feel like " doing. When our body is hungry we "feel like" eating. When thirsty, we feel like drinking. We might even feel like having one food and not another. If we are very hungry, we may feel grouchy. We can feel like curling up in a blanket, or sitting in front of a fan. The hypothalamus prompts us to act a certain way, in order to maintain homeostasis.

The influence can go the other way around, too, with our behaviors or thoughts affecting our body chemistry. If we are in the midst of sad or upsetting circumstances, hormones may be affected. Anger can make our blood pressure go up. Scary sights or scary thoughts can make our heart rate go up. When a mother hears her baby cry, the hypothalamus and pituitary can cause the mammary glands to be activated. And so it goes both ways, with our chemistry affecting our behaviors, and our thoughts and behaviors affecting our body chemistry. The hypothalamus is right at the crossroads, where all this back and forth communication takes place.

The pituitary is almost like an extension of the hypothalamus. It hangs below it, connected by a thin "stalk." (In lesson 60 we noticed that the pituitary lies inside a protective "pocket" made of bone.) The pituitary has extensive networks of capillaries so it is well connected to the blood stream. Some hormones, like adrenalin, will need to go into the blood very quickly. Specialized neurons (called neuroendocrine cells) reach down from the hypothalamus into the pituitary and direct all its functions. The pituitary is divided into two parts: the front part (anterior) and the back part (posterior). Their functions are completely separate, so we will discuss them separately, as though they are two different glands.

The anterior pituitary makes peptide hormones that affect many other glands and organs. It’s stunning how much it controls, considering that it is only the size of a very small pea. It makes:

- ACTH (adrenocorticotropic hormone) which affects the adrenal glands. (More about this in a future lesson.)
- TSH (thyroid stimulating hormone) that tells the thyroid to secrete its hormones. (More about this in a future lesson.)
- GH (growth hormone) which does more than just make children get taller. Adults still need growth hormone because it also stimulates the immune system, helps bones to stay strong, affects how the liver processes glucose, helps to maintain the islets of Langerhans in the pancreas, affects the thyroid's hormones to function properly, helps us build muscle, promotes the breakdown of fats, and more.
- PROLACTIN, which causes female mammary glands to produce milk. ("Pro" means "for," and "lact" means "milk.")
- LH (luteinizing hormone) which makes the testes secrete testosterone and the ovaries secrete estrogen. Release of eggs (ovulation) in the ovaries is caused by a sudden increase in LH. (More on this in a future lesson.)
- FSH (follicle stimulating hormone) causes eggs to mature and sperm to be produced. (More about this in a future lesson.)

The posterior pituitary makes these peptide hormones:

- ADH (antidiuretic hormone) which affects the kidneys. ADH molecules stick to receptors in cells in the collecting ducts in the medulla of the kidneys and cause these cells to pull more aquaporin channels onto the inner sides of their membranes (the sides that form the inside lining of the duct). This increase in aquaporins allows more water to go out of the ducts and back into the kidney tissue. Basically, water gets recycled a lot more, and less urine is produced. AND, since the signals are being sent out by a part of the brain that is also in contact with the pineal gland (keeping track of night and day) and the thalamus (one of the parts that regulates consciousness), extra ADH is secreted while you are sleeping so that you makes less urine and hopefully don't need to get up in the middle of the night to go to the bathroom (at least not too often).
- OXYTOCIN which affects the smooth muscles in both male and female reproductive organs. (More on this in future lessons.)