

Endocrine System

Is a group of specialized organs and body tissues that produce, store, and secrete chemical substances known as hormones. As the body's chemical messengers, hormones transfer information and instructions from one set of cells to another. Because of the hormones they produce, endocrine organs have a great deal of influence over the body. Among their many jobs are regulating the body's growth and development, controlling the function of various tissues, supporting pregnancy and other reproductive functions, and regulating metabolism.

Endocrine organs are sometimes called ductless glands because they have no ducts connecting them to specific body parts. The hormones they secrete are released directly into the bloodstream. In contrast, the exocrine glands, such as the sweat glands or the salivary glands, release their secretions directly to target areas—for example, the skin or the inside of the mouth. Some of the body's glands are described as Endo-exocrine glands because they secrete hormones as well as other types of substances. Even some nonglandular tissues produce hormone-like substances—nerve cells produce chemical messengers called neurotransmitters, for example. The earliest reference to the endocrine system comes from ancient Greece, in about 400 BC. However, it was not until the 16th century that accurate anatomical descriptions of many of the endocrine organs were published. Research during the 20th century has vastly improved our

understanding of hormones and how they function in the body. Today, endocrinology, the study of the endocrine glands, is an important branch of modern medicine. Endocrinologists are medical doctors who specialize in researching and treating disorders and diseases of the endocrine system.

COMPONENTS OF THE ENDOCRINE SYSTEM

The primary glands that make up the human endocrine system are the hypothalamus, pituitary, thyroid, parathyroid, adrenal, pineal body, and reproductive glands—the ovary and testis. The pancreas, an organ often associated with the digestive system, is also considered part of the endocrine system. In addition, some nonendocrine organs are known to actively secrete hormones. These include the brain, heart, lungs, kidneys, liver, thymus, skin, and placenta. Almost all body cells can either produce or convert hormones, and some secrete hormones. For example, glucagon, a hormone that raises glucose levels in the blood when the body needs extra energy, is made in the pancreas but also in the wall of the gastrointestinal tract. However, it is the endocrine glands that are specialized for hormone production. They efficiently manufacture chemically complex hormones from simple chemical substances—for example, amino acids and carbohydrates—and they regulate their secretion more efficiently than any other tissues. The hypothalamus found deep within the brain, directly controls the pituitary gland. It is sometimes described as the

coordinator of the endocrine system. When information reaching the brain indicates that changes are needed somewhere in the body, nerve cells in the hypothalamus secrete body chemicals that either stimulate or suppress hormone secretions from the pituitary gland. Acting as liaison between the brain and the pituitary gland, the hypothalamus is the primary link between the endocrine and nervous systems. Located in a bony cavity just below the base of the brain is one of the endocrine system's most important members: the pituitary gland. Often described as the body's master gland, the pituitary secretes several hormones that regulate the function of the other endocrine glands.

Structurally, the pituitary gland is divided into two parts, the anterior and posterior lobes, each having separate functions. The anterior lobe regulates the activity of the thyroid and adrenal glands as well as the reproductive glands. It also regulates the body's growth and stimulates milk production in women who are breast-feeding. Hormones secreted by the anterior lobe include adrenocorticotrophic hormone thyrotrophic hormone luteinizing hormone follicle-stimulating hormone growth hormone and prolactin. The anterior lobe also secretes endorphins, chemicals that act on the nervous system to reduce sensitivity to pain.

The posterior lobe of the pituitary gland contains the nerve endings from the hypothalamus, which stimulate or suppress hormone production. This lobe secretes antidiuretic hormones, which control water

balance in the body, and oxytocin, which controls muscle contractions in the uterus. The thyroid gland, located in the neck, secretes hormones in response to stimulation by TSH from the pituitary gland. The thyroid secretes hormones—for example, thyroxine and triiodothyronine—which regulate growth and metabolism, and play a role in brain development during childhood.

The parathyroid glands are four small glands located at the Four Corners of the thyroid gland. The hormone they secrete, parathyroid hormone, regulates the level of calcium in the blood. Located on top of the kidneys, the adrenal glands have two distinct parts. The outer part, called the adrenal cortex, produces a variety of hormones called corticosteroids, which include cortisol. These hormones regulate salt and water balance in the body, prepare the body for stress, regulate metabolism, interact with the immune system, and influence sexual function. The inner part, the adrenal medulla, produces catecholamines, such as epinephrine, also called adrenaline, which increase the blood pressure and heart rate during times of stress.

The reproductive components of the endocrine system, called the gonads, secrete sex hormones in response to stimulation from the pituitary gland. Located in the pelvis, the female gonads, the ovaries, produce eggs. They also secrete a number of female sex hormones, including estrogen and progesterone, which control development of the reproductive

organs, stimulate the appearance of female secondary sex characteristics, and regulate menstruation and pregnancy.

Located in the scrotum, the male gonads, the testes, produce sperm and also secrete a number of male sex hormones, or androgens. The androgens, the most important of which is testosterone, regulate development of the reproductive organs, stimulate male secondary sex characteristics, and stimulate muscle growth.

The pancreas is positioned in the upper abdomen, just under the stomach. The major part of the pancreas called the exocrine pancreas, functions as an exocrine gland, secreting digestive enzymes into the gastrointestinal tract. Distributed through the pancreas are clusters of endocrine cells that secrete insulin, glucagon, and somastatin. These hormones all participate in regulating energy and metabolism in the body.

The pineal body, also called the pineal gland, is located in the middle of the brain. It secretes melatonin, a hormone that may help regulate the wake-sleep cycle. Research has shown that disturbances in the secretion of melatonin are responsible, in part, for the jet lag associated with long-distance air travel.

HOW THE ENDOCRINE SYSTEM

WORKS

Hormones from the endocrine organs are secreted directly into the bloodstream, where special proteins usually bind to them, helping to keep the hormones intact as they travel throughout the body. The

proteins also act as a reservoir, allowing only a small fraction of the hormone circulating in the blood to affect the target tissue. Specialized proteins in the target tissue, called receptors, bind with the hormones in the bloodstream, inducing chemical changes in response to the body's needs. Typically, only minute concentrations of a hormone are needed to achieve the desired effect. Too much or too little hormone can be harmful to the body, so hormone levels are regulated by a feedback mechanism. Feedback works something like a household thermostat. When the heat in a house falls, the thermostat responds by switching the furnace on, and when the temperature is too warm, the thermostat switches the furnace off. Usually, the change that a hormone produces also serves to regulate that hormone's secretion. For example, parathyroid hormone causes the body to increase the level of calcium in the blood. As calcium levels rise, the secretion of parathyroid hormone then decreases. This feedback mechanism allows for tight control over hormone levels, which is essential for ideal body function. Other mechanisms may also influence feedback relationships. For example, if an individual becomes ill, the adrenal glands increase the secretions of certain hormones that help the body deal with the stress of illness. The adrenal glands work in concert with the pituitary gland and the brain to increase the body's tolerance of these hormones in the blood, preventing the normal feedback mechanism

from decreasing secretion levels until the illness is gone.

Long-term changes in hormone levels can influence the endocrine glands themselves. For example, if hormone secretion is chronically low, the increased stimulation by the feedback mechanism leads to growth of the gland. This can occur in the thyroid if a person's diet has insufficient iodine, which is essential for thyroid hormone production. Constant stimulation from the pituitary gland to produce the needed hormone causes the thyroid to grow, eventually producing a medical condition known as goiter.