CONCEPTUAL LIFE SCIENCE

THE ENDOCRINE SYSTEM

The endocrine glands do not have ducts. They will secrete their chemical messengers directly into the bloodstream. Glands that do have ducts are known as exocrine glands. Two examples are the salivary glands and the pancreas. A comparison of the major features of exocrine and endocrine glands are listed in Table XVI-1.

Table XVI-1. Exocrine vs. endocrine glands.

<table>
<thead>
<tr>
<th>Exocrine Glands</th>
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<tr>
<td>1. Exocrine glands release their secretions through a duct.</td>
<td>1. Endocrine glands release their secretions into the bloodstream.</td>
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<td>2. The secretions of exocrine glands are fluids such as tears (tear glands), saliva (salivary glands), bile (gall bladder) and pancreatic juice (pancreas).</td>
<td>2. The secretions of endocrine glands are hormones. Examples are insulin (pancreas), parathormone (parathyroid glands), and cortisone (adrenal glands).</td>
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<td>3. The results of the secretions of exocrine glands are found where the opening of the duct is located.</td>
<td>3. The effects of endocrine glands are directed either at target organs (such as the follicle stimulating hormone of the ovary) or are systemic (the hormone affects the entire body as in the case of growth hormone.)</td>
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Adrenal glands

The adrenal glands are located on top of the kidneys (suprarenal). They each have a cortex, the outer portion; and a medulla, the inner portion. The medulla of the adrenal gland produces adrenalin (epinephrin) and norepinephrin. Adrenalin causes the heart to beat faster in an emergency.

Hormones of the adrenal cortex

The hormones of the adrenal cortex are essential for life. These are two hormones, hydroxycortisone and cortisone, which are the regulators of carbohydrate metabolism. There are also two aldosterones that regulate mineral metabolism.

There are several hormones of the adrenal cortex that have sex-hormone function. These are similar in effect to those produced by the gonads. The androgens and the estrogens control the development of sex characteristics.
The pituitary gland

The pituitary is the master gland of the endocrine system. It is located in the head, just below the brain. It has two lobes, one in front of the other. The one in front is called the *anterior* lobe and the one behind is called the *posterior* lobe.

**Hormones of the posterior lobe**

The posterior lobe of the pituitary gland produces antidiuretic hormone (ADH) and oxytocin. ADH helps the body to conserve water by affecting the kidneys. Oxytocin causes contraction of the smooth muscle layers of the uterus during labor and helps in the production of milk.

**The anterior lobe of the pituitary gland**

The anterior lobe of the pituitary gland produces at least six secretions. These are responsible for important body functions. This lobe is under the influence of the hypothalamus.

**Follicle stimulating hormone (FSH)**

In females, FSH stimulates the follicle cells that surround the egg in the ovary. In males, FSH stimulates the production of sperm in the testes.

**Leutinizing hormone (LH)**

In females, LH stimulates the *corpus luteum* (meaning "yellow body," a structure in the ovary developing after the release of an egg). Each corpus luteum functions as an endocrine gland. They disappear unless pregnancy develops. In males, LH stimulates the interstitial cells that surround the sperm in the testes.

**Prolactin**

Prolactin controls secretion of milk by the mammary glands. It is produced only after birth. It is also known as *lactogenic* hormone.

**Adrenocortotropic hormone (ACTH)**

ACTH controls the adrenal cortex. It controls the cholesterol levels in the body. Cholesterol is used to make other hormones.
Thyrotropic hormone

Thyrotropic hormone stimulates the growth and function of the thyroid gland. The thyroid gland controls the metabolic activities of the body.

Growth hormone

Growth hormone exerts control over growth of the body. Genetics of the individual and nutrition, especially early in life, also contribute partially to growth and the individual's adult size.

Gonads

The gonads are the sexual glands. The female gonads are the ovaries. The male gonads are the testes. The gonads produce hormones that control sexual development of the individual.

Hormones involved in the menstrual cycle.

The menstrual cycle in females is regulated by four hormones. These hormones are:
- Follicle stimulating hormone
- Leutenizing hormone
- Estrogens
- Progesterone

Female sex hormones

The female sex hormones control the development of the egg and the menstrual cycle. The ovary produces estrogens. Of these estriodiol is most important. It cause the proliferation of cells in the lining (endometrium) of the uterus.

The corpus luteum produces progesterone. This hormone causes changes in the uterine lining that adapt it to receive a fertilized egg. It is also known as "pregnancy hormone."

The estrus cycle in animals

Estrus refers to the mating state in female animals, commonly called "heat." Female animals must be receptive in order to mate. They come into heat from one to several times per year. The foregoing does not apply to humans. Humans can engage in sexual activity without regard to the receptivity of the female reproductive system.
Male sex hormones

FSH stimulates the sperm cells and LH stimulates the interstitial cells. The interstitial cells produce testosterone, which is responsible for growth of male sex organs and is necessary for sperm maturation. It also influences the development of secondary sex characteristics.

Thyroid gland

The thyroid gland is a bilobed structure with a connection across the trachea, like a bow tie. It is the largest organ in the body that is entirely endocrine in function.

The thyroid gland produces the hormone thyroxin, which contains iodine. Thyroxin regulates the metabolic rate of the body.

Parathyroid glands

The parathyroid glands are the smallest endocrine glands. They are located on and associated with the thyroid gland. They produce parathormone, which regulates the metabolism of calcium and phosphorus.

Islets of Langerhans

The pancreas contains two tissue types. The islets of Langerhans are cells of the pancreatic tissue that is endocrine in nature and secrete insulin and glucagon into the bloodstream. The other pancreatic tissue is exocrine in nature and secretes pancreatic juice.

Insulin regulates glucose metabolism. The result of increased insulin in the blood is a lower blood glucose concentration. Glucagon balances the effects of insulin by raising the blood glucose levels.

Diabetes is a disease characterized by abnormal glucose levels brought on by insufficient insulin levels. There are two types. Type 1 diabetes, is an autoimmune disease. Somehow, the individual has developed antibodies of the immune system that are attacking the insulin-producing cells in the pancreas. They are gradually destroyed and the insulin levels in the bloodstream drop. This type is sometimes called insulin-dependent diabetes.

In type 2 diabetes, the blood glucose levels are above normal. This is because the body cells do not use insulin properly and the pancreas has difficulty producing enough insulin for the body. In this type of diabetes, the body cells become resistant to insulin. Type 2 diabetes is frequently diagnosed in adulthood.
Some other glands

While we are on the topic of glands, there are two other glands in the body that deserve mention. These are the pineal gland and the thymus. Neither of these is an endocrine gland. For lack of a better place, they are discussed here.

Pineal gland

The pineal gland secretes melatonin, which is a derivative of the amino acid tryptophan. Its function is poorly understood in humans, although it is known that the synthesis and release of melatonin is stimulated by darkness and inhibited by light.

In birds, it helps them to navigate by the Sun. It also causes them to roost at night. There is some evidence for a nervous system connection between the pineal gland and the eyes. In humans, there may be a connection between the pineal gland and SAD (seasonal affective disorder.)

Thymus

The thymus is located underneath the breastbone. It is the largest organ in the body that has an immune system function. It is the location for the maturation of T-lymphocytes.