LESSON ASSIGNMENT

LESSON 1
Anatomy and Physiology of the Endocrine System.

LESSON ASSIGNMENT
Paragraphs 1-1 through 1-9.

LESSON OBJECTIVES
After completing this lesson, you should be able to:

1-1. Define endocrine gland, hormone, target, and action.

1-2. Identify the composition and activities of hormones.

1-3. Identify the chief hormone(s) secreted by the glands of the endocrine system.

1-4. Identify the target and primary actions of the major hormones secreted by the endocrine system.

SUGGESTION
After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
1-1. GENERAL

The endocrine system is one of two major systems which control the body's activities. The endocrine system is composed of glands which secrete substances called hormones into the bloodstream. These hormones act as chemical messengers and float in the bloodstream to the body's organs, the target of the particular hormone. At the target, the hormone causes some action. The hormone either turns on a biochemical reaction or turns off a biochemical reaction.

a. The Endocrine System and the Nervous System. The endocrine system works with the nervous system to regulate and integrate the processes of the body such as growth, development, reproduction, response to stress, and change of food into energy and body tissue. The two systems work together like a giant super system. Some parts of the nervous system stimulate or prevent the release of hormones. Some hormones can stimulate or prevent the flow of nerve impulses.

b. Composition and Activities of Hormones. Hormones are composed of proteins, amino acids, or steroids. Although hormones affect many of the body's activities, hormone actions can be categorized into four broad areas:

![Diagram of endocrine system](image)

Figure 1-1. General location of major endocrine glands.
1-2. PINEAL GLAND

a. Description. The pineal gland is located just posterior to the third ventricle in the brain. The name was chosen because this gland resembles a pine cone. The pineal gland starts to calcify (becomes hard due to deposit of calcium salts) at about the time of puberty. These calcium deposits are referred to as brain salts.
b. **Hormones.** Scientists are not sure of the effect of the hormones secreted by the pineal gland. It is known that this gland causes animals to come into heat. Research indicates the following in regard to humans:

1. **Melatonin.** This hormone seems to be secreted on a day/night cycle with the highest production at night and the lowest production during the day. Its function is to prevent ovarian secretion.

2. **Serotonin.** This hormone seems to prevent extremes in the blood vessels of the brain. If blood vessels in the brain seem too small, serotonin dilates the vessels (makes them wider). The levels of this hormone are highest at noon and lowest at midnight.

3. **Glomerulotropin.** This hormone stimulates the secretion of adrenal aldosterone.

1-3. **PITUITARY GLAND**

a. **Description.** The pituitary gland is small weighing only about 600 mg; however, it is a key organ. The pituitary gland influences every structure and system in the body. Structurally and functionally, the pituitary gland is divided into two lobes: the anterior lobe and the posterior lobe.

b. **Anterior Lobe--Hormones.**

1. **Adrenocorticotropic hormone (ACTH).** This hormone is secreted by the anterior lobe of the pituitary gland. ACTH stimulates the adrenal cortex to produce steroid hormones. A primary action of ACTH is to promote and maintain normal growth and development of the adrenal cortex.

2. **Follicle-stimulating hormone (FSH).** FSH stimulates the normal growth cycle of the ovarian follicle in females. In males FSH stimulates the seminiferous tubules (tubes that convey semen) to produce spermatozoa.

3. **Growth hormone (GH).** This hormone promotes fat mobilization, prevents glucose from being used, and affects the rate of skeletal and visceral (internal organs) growth. Too much of this hormone can cause diabetes. Also, an excess of this hormone in early life can cause a child to become a giant. Too little of this hormone in early life can cause an infant to become a dwarf. Another name for GH is somatotropin.

4. **Interstitial cell stimulating hormone (ICSH).** ICSH stimulates testicular interstitial cells in the male to produce androgen, a substance that stimulates the development of male sex characteristics. This hormone in the male is the same as the luteinizing hormone in the female which is essential for ovulation (discharge of an ovum from the mature follicle of the ovary).
Luteinizing hormone (LH). LH promotes the maturation of the ovarian follicle; secretion of progesterone; ovarian follicle to release the ovum; and the conversion of the ruptured follicle into the corpus luteum (the scar tissue which forms the ruptured follicle).

Pituitary growth hormone (PGH). PGH is a growth hormone. Also known as the somatotrophic hormone (STH), this hormone turns on body cells to grow. The principal function is to increase the rate of growth of body cells and to maintain their size once growth is attained. The growth hormone also increases the rate of protein synthesis and promotes a process called fat catabolism. Fat catabolism causes cells to switch from burning carbohydrates to burning fats for energy.

c. Posterior Lobe--Hormones.

Antidiuretic hormone (ADH). This hormone has a potent antidiuretic action. ADH makes the collecting duct of the kidney permeable to water and allows reabsorption of water and concentration of urine in the kidney.

Oxytocin. Oxytocin is formed in the base of the brain (hypothalamus) and stored in the posterior lobe of the pituitary gland. This hormone stimulates smooth muscle and causes strong contractions of the uterus and the ejection of milk from the breast.

NOTE: Oxytocin is not to be confused with the hormone prolactin which stimulates the production of milk.

1-4. THYROID GLAND

Description. The thyroid gland is located just below the larynx with a right and left lateral lobe on either side of the trachea. A mass of tissue called an isthmus lies in front of the trachea and connects the two lateral lobes of the thyroid gland. The thyroid gland weighs about 25 grams and receives a rich supply of blood (about 80 to 120 ml per minute).

Hormones. Thyroid hormones have three principal effects on the body. They regulate the body's metabolism rate; regulate the body's growth and development; and regulate the activity of the nervous system. To fulfill these functions, the thyroid gland releases these hormones; tetraiodothyronine (thyroxine or T₄) and triiodothyronine (T₃). Both of these hormones contain iodine. Iodine collects in the thyroid gland in the process of thyroid hormones being made.
1-5. PARATHYROID GLANDS

a. Description. The parathyroid glands are tiny bean-shaped glands embedded on either side of the thyroid gland. There are usually four parathyroid glands, but there may be more. The upper parathyroids are usually located at the point where the upper and middle third of the thyroid gland meet. The lower parathyroids are usually located in the branches of the inferior thyroid artery, but these parathyroids may be located in the chest.

b. Hormones. The parathyroid glands secrete the hormone parathormone. This hormone regulates the concentration of calcium and phosphorus in the blood. Parathormone also influences the passage of calcium and phosphorus among the bloodstream, bones, and urine.

1-6. ADRENAL GLANDS

a. Description. The adrenal glands are located above the kidneys. The adrenal cortex is the outer part of the gland, and the medulla is the inner portion of the gland.
b. **Hormones.** Glucocorticoids, mineralocorticoids, and small amounts of sex hormones are made and secreted by the adrenal cortex. All together, these hormones are called **corticosteroids.** Two **neurohormones** are produced by the adrenal medulla: epinephrine and norepinephrine.

(1) **Glucocorticoids.** The glucocorticoids secreted by the adrenal cortex aid protein, fat, and carbohydrate metabolism to help the body meet stress conditions. Glucocorticoids accelerate the breakdown of protein to amino acid which is changed to glucose in the liver. In this way, the amount of serum glucose in the body is increased. Glucocorticoids also help the body withstand stress from anxiety or severe injury because the hormone has an anti-inflammatory effect. Catecholamine hormones, a type of glucocorticoid hormone, are commonly known as the "fight or flight" hormones because these hormones give the body extra energy in stressful situations.
(2) **Mineralocorticoids.** Mineralocorticoids keep mineral salt metabolism in balance which, in turn, helps to maintain the body's electrolyte and fluid intracellular balance. **Aldosterone**, a mineralocorticoid, regulates the metabolism of sodium, chloride, and potassium. Aldosterone causes sodium to be absorbed into the blood which leads to water being reabsorbed in the farthest renal tubules. Proper levels of aldosterone also cause potassium to be excreted and aids in the maintenance of normal blood Ph.

1-7. **PANCREAS**

   a. **Description.**

   (1) **Functions.** The pancreas is a gland with two major functions, one an endocrine function and the other an exocrine function. As an endocrine organ, the pancreas produces the hormone insulin. As an exocrine organ, the pancreas produces a variety of enzymes (protein-digesting enzymes, fat-digesting enzymes, and carbohydrate-digesting enzymes).

   (2) **Composition.** The pancreas, located slightly behind and toward the top of the stomach, is composed of three parts: a head, body, and tail. The average length is about six inches, and the average weight is about three ounces. The endocrine portion of the pancreas is called the isles of Langerhans which are clusters of cells. Three kinds of cells are found here: alpha cells, beta cells, and delta cells.

   ![Figure 1-5. The pancreas.](image)

   b. **Hormones.** Alpha cells secrete the hormone glucagon which acts primarily on the liver. Alpha cells increase the body's blood sugar level by causing sugar to be removed from storage in the liver and transferred to the blood. Beta cells secrete insulin which affects most body cells. Insulin causes a decrease in blood sugar by increasing the ability for body cells to take up and use sugar. Beta cells promote storage of sugars and fats on body tissue and promote building of body protein. Delta cells secrete somatostatin, a hormone which inhibits growth.
1-8. GONADS

a. Description. The gonads are the sex glands. In the female, the gonads are the ovaries which are located in the pelvic cavity. In the male, the gonads are the testes which are located in the scrotum. These glands give the primary sex characteristics in the growth and development of the primary reproductive organs at puberty. These glands are also responsible for the secondary sex characteristics.

b. Hormones.

(1) Hormones in females. The ovaries, in the female, produce estrogen, progesterone, and relaxin. Estrogen is responsible for stimulating the development of the female sex organs and secondary sexual characteristics of voice pitch, broad pelvis, and hair pattern. Progesterone acts with estrogen to regulate menstruation. Relaxin causes the birth canal to widen.

(2) Hormones in males. The testes, in the male, produce the hormone testosterone. Testosterone is the principal male hormone and has a number of effects on the body. First, this hormone controls the development, growth, and maintenance of the male sex organs. Additionally, the hormone stimulates bone growth, sexual behavior, final maturation of sperm, and development of male secondary sex characteristics. Secondary male sex characteristics include the following:

(a) Muscular and skeletal development such as wide shoulders and narrow hips.

(b) Body hair patterns that include pubic hair, armpit hair and chest hair, facial hair, and hair recession at the temple.

(c) Enlargement of the thyroid cartilage of the larynx which produces the deepening of the male voice.

NOTE: Testosterone is also responsible for stimulating the descent of the testes just before a male is born.

1-9. CLOSING

The interworking of the endocrine system with all other systems is a remarkable and delicate balance. As you evaluate your patients, you will not be looking for diseases of the adrenal medulla or thyroid gland but the symptoms of what their malfunction will show. Keep in mind that your patient's body is a complex machine where every part affects another part.
Figure 1-6. Location of female gonads.

Figure 1-7. Female gonads.
Figure 1-8. Location of male gonads.

Figure 1-9. Male gonads.

Continue with Exercises

Return to Table of Contents
EXERCISES, LESSON 1

INSTRUCTIONS. The following exercises are to be answered by writing the answer in the space provided. After you have completed all the exercises, turn to the solution at the end of the exercises and check your answers.

1. The ____________ gland, located in front of the neck at the junction of the larynx and the trachea, secretes a hormone that aids in the regulation of the body's metabolic rate.

2. The ____________ glands, the smallest of the endocrine glands, secrete a hormone which regulates the concentration of calcium and phosphorus in the blood.

3. The ____________ secretes glucorticoids which help the body meet conditions of stress.

4. A small cone-shaped gland, the ____________ gland, is located inside the cranial cavity, secretes the hormone melatonin which seems to inhibit reproductive activities.

5. The alpha cells of the ____________ secrete glucagon, a hormone produced when the body's blood sugar gets too low.

6. ____________ cells secrete insulin (hypoglycemic hormones) which causes a decrease in blood sugar by increasing the body's ability to take up and use sugar.

7. The hormone somatostatin is produced by the ____________.
8. A principal effect of the _____________ gland is to regulate the body’s metabolic rate.

9. ______________ is the hormone which releases the milk formed by the glandular cells of the nursing female.

10. The adrenocorticotropic hormone (ACTH) has the primary action of __________

11. The ______________ hormone is secreted by the anterior lobe of the pituitary gland and stimulates the normal growth cycle of the ovarian follicle in females.

12. ______________ hormone is secreted by the posterior lobe of the pituitary gland. This hormone makes the collecting duct of the kidney permeable to water and allows concentration of water.

13. The hormone which promotes the maturation of the ovarian follicle as well as the secretion of progesterone is the ______________ hormone.

14. The hormone which works with estrogens to regulate menstruation is ________.

15. The hormone responsible for the secondary sex characteristics of voice pitch, broad pelvis, and hair pattern in women is ______________.

16. The hormone responsible for secondary sex characteristics in men is ______________
17. The gland responsible for animals coming into heat is the ____________ gland.

18. The mineralocorticoid (secreted by the adrenal glands) help maintain __________ balance and __________ balance.

19. The catecholamine hormones epinephrine and norepinephrine (secreted by the adrenal medulla) are commonly known as the __________________________ hormones because they give the body extra energy in stressful situations.

Check Your Answers on Next Page
SOLUTIONS TO EXERCISES, LESSON 1

1. Thyroid  (paras 1-4a, b)
2. Parathyroid (paras 1-5a, b)
3. Adrenal cortex   (para 1-6b)
4. Pineal   (paras 1-2a, 2b(1))
5. Pancreas   (para 1-7b)
6. Beta cells   (para 1-7b)
7. Delta cells   (para 1-7b)
8. Thyroid   (para 1-4b)
9. Oxytocin   (para 1-3c(2))
10. Promoting and maintaining normal growth and development of the adrenal cortex.  
    (para 1-3b(1))
11. Follicle-stimulating   (para 1-3b(2))
12. Antidiuretic   (para 1-3c(1))
13. Lutenizing   (para 1-3b(5))
14. Progesterone   (para 1-8b)
15. Estrogen   (para 1-8b)
16. Testosterone   (para 1-8b(2))
17. Pineal   (para 1-2b)
18. Electrolyte, fluid   (para 1-6b(2))
19. Fight or flight   (para 1-6b(1))

Return to Table of Contents