Endocrine system: An Overview

Dr. Garima Hore,
SA.C.T-I,
Department of Zoology,
Dr. Kanailal Bhattacharyya College.

Endocrine system: An Introduction

- Communication among various regions of the body also is essential for enabling the organism to respond appropriately to any changes in the internal and external environments.

- Two systems help ensure communication: the nervous system and the hormonal (i.e., **neuroendocrine**) system.

- The nervous system acts through electrical impulses and neurotransmitters to cause muscle contraction and glandular secretion.

- The endocrine system acts through chemical messengers called hormones that influence growth, development, and metabolic activities.

There are two major categories of glands in the body – **exocrine** and **endocrine**.

Exocrine Glands:
Exocrine glands have **ducts** that carry their **secretory** product to a surface. These glands include the **sweat**, **sebaceous**, and **mammary glands** and, the glands that **secrete digestive enzymes**.

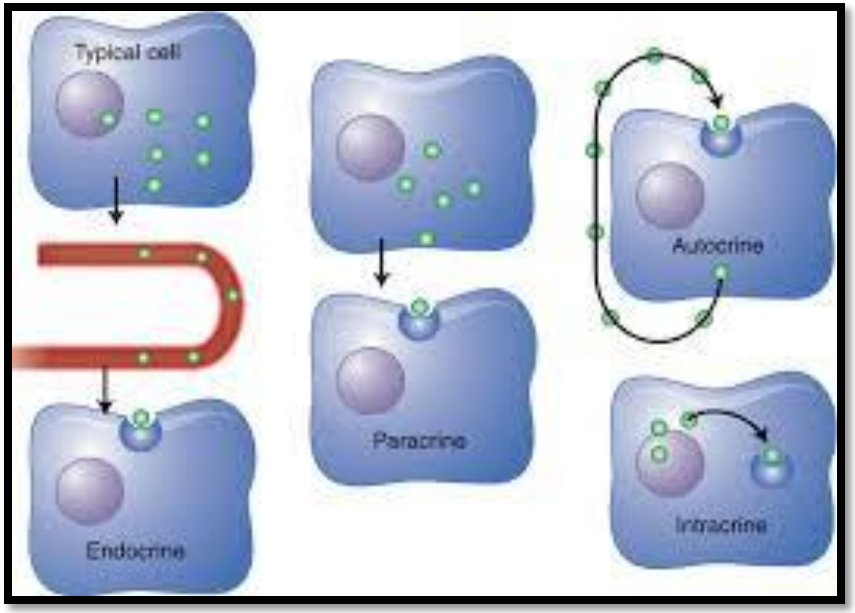
Endocrine Glands:
The **endocrine** glands **do not have ducts** to carry their product to a surface. They are called **ductless glands**. The word endocrine is derived from the Greek terms "**endo**," meaning **within**, and "**krine**," meaning to separate or **secrete**. The secretory products of endocrine glands are called hormones and are secreted directly into the blood and then carried throughout the body where they influence only those cells that have receptor sites for that hormone.

Hormones- chemical messengers

Communication in the endocrine system is made possible by hormones, biologically active chemical substances that are secreted from ductless glands in the body and circulate through the bloodstream to act on target cells or organs.

The actions of hormones in the endocrine system allow for the exquisite regulation of energy production and metabolism, somatic growth and development, reproduction, and responses to internal and external stimuli.

Hormone action can be classified into endocrine, paracrine, and autocrine actions.



Classification by chemical nature of hormones

Hormones	Source	Example
Steroid hormones	Derived from cholesterol which belong to a chemical compounds known as steroids	sex hormones, adrenal cortex hormones
Amine hormones	Hormones derived from the modification of amino acids are referred to as amine hormones. Typically, the original structure of the amino acid is modified such that a COOH, or carboxyl, group is removed, whereas the NH^{3+}, or amine group remains. Amine hormones are synthesized from the amino acids tryptophan or tyrosine.	An example of a hormone derived from tryptophan is melatonin, while tyrosine derivatives include thyroid hormones and catecholamines
Peptide hormones	These hormones are made up of only few amino acid residues and they are usually present themselves in form of a linear chains	Oxytocin and vasopressin

Hormones	Source	Example
Protein hormones	These hormones are build up from large number of amino acid residues	Insulin, glucagon, somatotropins
Glycoprotein hormones	These are conjugated protein bound to carbohydrate which include galactose, mannose, fructose	luteinizing hormones follicle stimulating hormones, thyroid stimulating hormones
Eicosanoid hormones	Made up of small fatty acid derivatives with a variety of arachidonic acid	Prostaglandins

The major glands of the endocrine system include:

- **Hypothalamus**
- **Pituitary gland** (master gland)
- **Thyroid gland**
- **Parathyroid gland**
- **Pancreas**
- **Adrenal glands**
- **Ovary** (in females)
- **Testis** (in males)

The hypothalamus and pituitary glands are **neuroendocrine organs**.

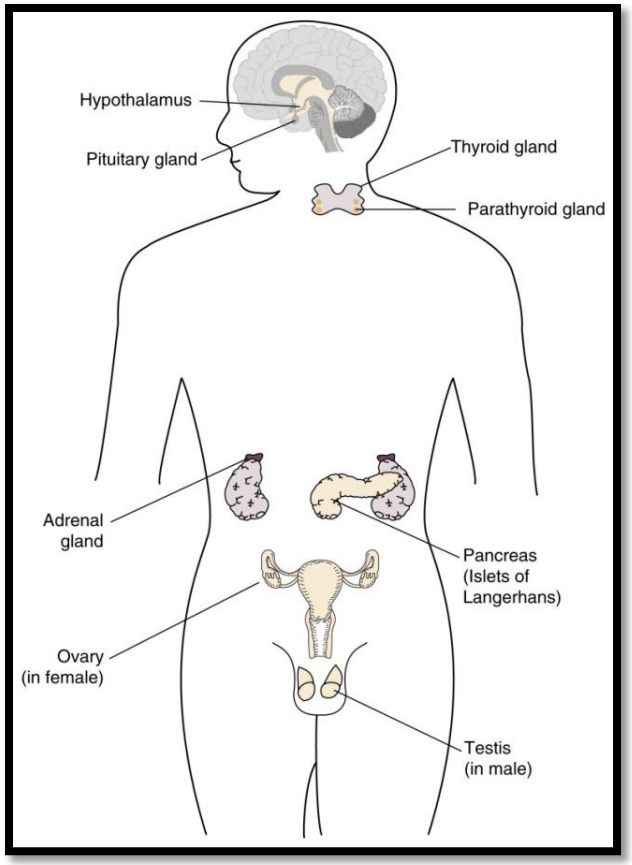


Fig. 1: Schematic representation of the location of the major hormone-producing (i.e., endocrine) organs in the body. (For the purposes of illustration, both male and female endocrine organs are presented here.)

Hormones Produced by the Major Hormone-Producing (i.e., Endocrine) Glands and Their Primary Functions

Endocrine Gland	Hormone	Primary Hormone Function
Hypothalamus	Corticotropin-releasing hormone (CRH)	Stimulates the pituitary to release adrenocorticotropic hormone (ACTH)
	Gonadotropin-releasing hormone (GnRH)	Stimulates the pituitary to release luteinizing hormone (LH) and follicle-stimulating hormone (FSH)
	Thyrotropin-releasing hormone (TRH)	Stimulates the pituitary to release thyroid-stimulating hormone (TSH)
	Growth hormone-releasing hormone(GHRH)	Stimulates the release of growth hormone (GH) from the pituitary
	Somatostatin	Inhibits the release of GH from the pituitary
	Dopamine	Inhibits the release of prolactin from the pituitary

Endocrine Gland	Hormone	Primary Hormone Function
Anterior pituitary gland	ACTH	Stimulates the release of hormones from the adrenal cortex
	LH	In women, stimulates the production of sex hormones (i.e., estrogens) in the ovaries as well as during ovulation; in men, stimulates testosterone production in the testes
	FSH	In women, stimulates follicle development; in men, stimulates sperm production
	TSH	Stimulates the release of thyroid hormone
	GH	Promotes the body's growth and development
	Prolactin	Controls milk production (i.e., lactation)
Posterior pituitary gland	Vasopressin	Helps control the body's water and electrolyte levels
	Oxytocin	Promotes uterine contraction during labor and activates milk ejection in nursing women

Endocrine Gland	Hormone	Primary Hormone Function
Adrenal cortex	Cortisol	Helps control carbohydrate, protein, and lipid metabolism; protects against stress
	Aldosterone	Helps control the body's water and electrolyte regulation
Testes	Testosterone	Stimulates development of the male reproductive organs, sperm production, and protein anabolism
Ovaries	Estrogen (produced by the follicle)	Stimulates development of the female reproductive organs
	Progesterone (produced by the corpus luteum)	Prepares uterus for pregnancy and mammary glands for lactation
Thyroid gland	Thyroid hormone (i.e., thyroxine [T4] and triiodothyronine [T3])	Controls metabolic processes in all cells
	Calcitonin	Helps control calcium metabolism (i.e., lowers calcium levels in the blood)
Parathyroid gland	Parathyroid hormone (PTH)	Helps control calcium metabolism (i.e., increases calcium levels in the blood)
Pancreas	Insulin	Helps control carbohydrate metabolism (i.e., lowers blood sugar levels)
	Glucagon	Helps control carbohydrate metabolism (i.e., increases blood sugar levels)

Feedback control – Regulation of hormonal activity

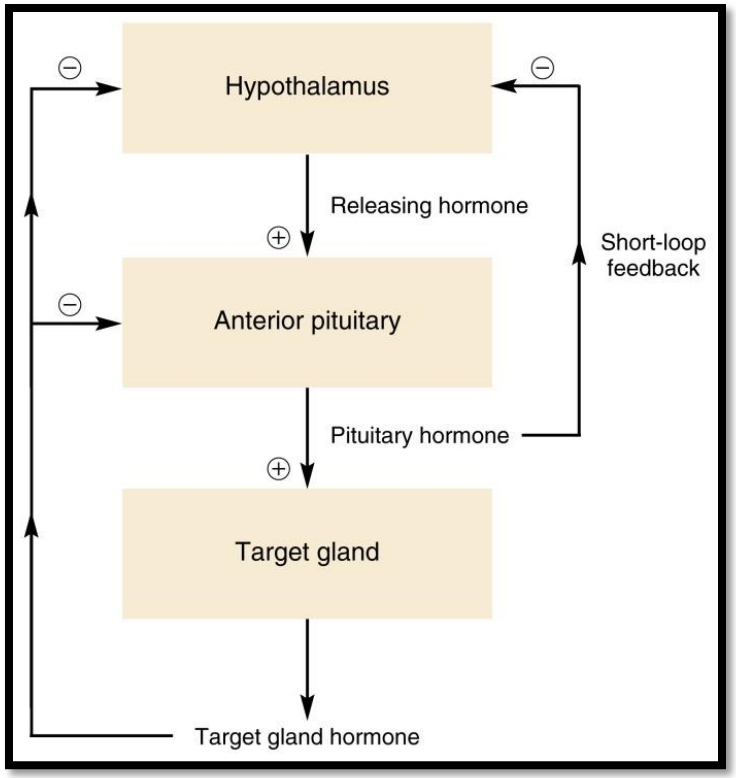


Fig.: Schematic representation of negative feedback mechanisms that control endocrine system activity. In many cases, the hormones released from the target gland act back on the pituitary and/or hypothalamus, repressing further hormone release from both organs and thereby shutting off the system. For a short-loop negative feedback mechanism, pituitary hormones act directly back on the hypothalamus, inhibiting the release of hypothalamic hormones

Hypothalamic-Pituitary-Gonadal Axis

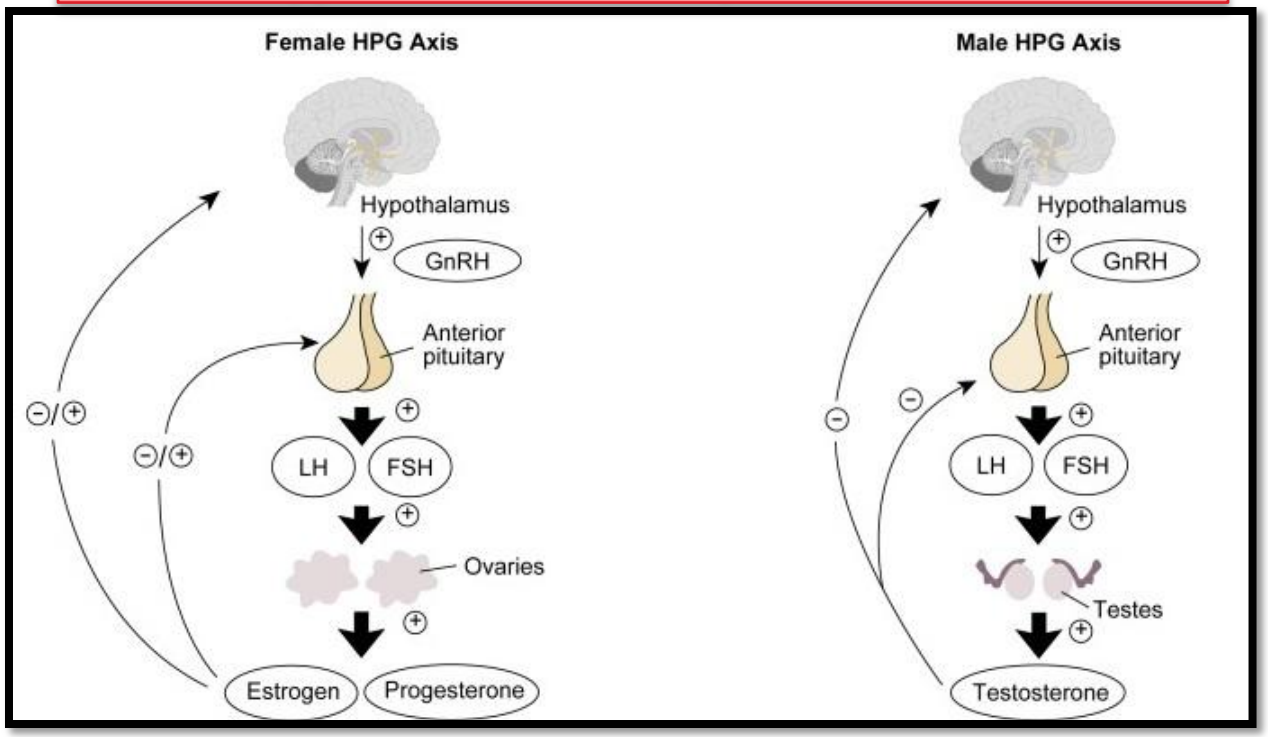


Fig.: Schematic representation of the female and male HPG axes. For each system, the hypothalamus secretes releasing hormones (GnRH) that act on the pituitary gland. In response to those stimuli, the pituitary gland releases gonadotropins (i.e., LH and FSH). LH and FSH in women stimulate the ovaries to produce estrogens and progesterone. Depending on the phase of the menstrual cycle, those hormones act back on the hypothalamus and pituitary gland in either a stimulatory or inhibitory manner. In men, LH stimulates the testes to release testosterone, which feeds back on the hypothalamus and pituitary.

THANK YOU