



The Endocrine System

Homeostasis is achieved through the activity of the nervous and endocrine systems, which interact in the regulation of the body's activities. The nervous system is capable of rapid responses to stimuli. Slower responses, and long term adjustments of the body (growth, reproduction, and adaptation to stress), are achieved through endocrine control. The endocrine system comprises **endocrine glands** and their **hormones**. Endocrine glands are ductless glands that are distributed throughout the body. Under

appropriate stimulation (see below), they secrete **hormones**: chemical messengers that are carried in the blood to **target** cells, where they have a specific metabolic effect. After exerting their effect, hormones are broken down and excreted from the body. Although a hormone circulates in the blood, only the targets will respond. Hormones may be amino acids, peptides, proteins (often modified), fatty acids, or steroids. Some basic features of the human endocrine system are explained below.

Hypothalamus
Coordinates nervous and endocrine systems. Secretes *releasing hormones* which pass to the anterior pituitary gland and regulate the release of its hormones. Synthesises oxytocin and ADH, which are stored in, and released from, the posterior pituitary.

Pituitary Gland
Located below the hypothalamus, the pituitary is about the size of a pea. It is often called the "master gland" and secretes at least 9 hormones that regulate the activities of other endocrine glands.

Thyroid Gland
Secretes thyroxine, an iodine containing hormone needed for normal growth and development. Thyroxine stimulates metabolism and growth via protein synthesis.

Parathyroid Glands
Small glands on the surface of each of the lateral lobes of the thyroid. They secrete parathyroid hormone (PTH) which regulates calcium levels and promotes the release of calcium from bone. High levels of calcium in the blood inhibit PTH secretion.

Adrenal glands
The adrenal medulla produces adrenalin and noradrenalin, the hormones that are responsible for the fight or flight response. The adrenal cortex produces a number of steroid hormones, including aldosterone (sodium regulation) and cortisol (provides resistance to stress).

Pancreas
Apart from its exocrine role in digestion, the pancreas has specialised α and β endocrine cells which produce glucagon and insulin. Together, these control blood sugar levels.

Ovaries (in females)
At puberty the ovaries increase their production of *oestrogen* and *progesterone*. These hormones control and maintain female characteristics (*breast development* and *pelvic widening*), stimulate the *menstrual cycle*, maintain *pregnancy*, and prepare the mammary glands for lactation.

Testes (in males)
At puberty (the onset of sexual maturity) the testes of males produce *testosterone* in greater amounts. This hormone controls and maintains "maleness" (*muscular development* and *deepening voice*) and promotes the production of *sperm*.

The Three Ways in Which the Release of Hormones is Controlled

Presence of a Metabolite	Presence of a Hormone	Autonomic Nerves
The presence of a specific product of metabolism in the blood may stimulate hormone release. Example: Insulin release from the pancreas is stimulated by high glucose levels in the blood.	The presence of one hormone in the blood stimulates (or inhibits) the release of another hormone. Example: Releasing hormones from the hypothalamus regulate hormone release from the anterior pituitary.	Stimulation of an endocrine gland through autonomic nerves so that it releases its hormone into the circulation. Example: Release of adrenalin from the adrenal medulla in response to nerve impulses.

1. Explain the difference between a neurotransmitter and a hormone: _____

2. (a) Explain what is meant by a target tissue: _____

(b) Name a target tissue and explain how a (named) hormone controls its activity: _____

3. Complete the table below outlining some of the endocrine glands and hormones of the human endocrine system, and the functions these have in maintaining homeostasis. You may need to use your textbook to help you.

Endocrine Gland	Hormone Produced	Target	Homeostatic Function of Hormone
Parathyroid glands	Parathyroid hormone		
Anterior pituitary	Growth hormone		
Adrenal glands	Adrenalin		
Anterior pituitary	Prolactin		
Thyroid gland	Thyroxine		
Hypothalamus	Prolactin-releasing hormone		
Testes	Testosterone		
Ovaries	Progesterone		
β - cells of pancreas	Insulin		
Anterior pituitary	Luteinising hormone (LH)		
Pineal body	Melatonin		
Posterior pituitary	Antidiuretic hormone (ADH)		

4. The dotted arrows in the diagram opposite indicate the development of secondary sexual characteristics. For each gender, name the hormones involved in the development of these characteristics and state their role:
- (a) Male: _____

- (b) Female: _____

5. Briefly explain the three ways in which the release of hormones from endocrine glands may be regulated:
- (a) _____

- (b) _____

- (c) _____

6. In general terms, explain the role of negative feedback mechanisms in regulating hormone release. Use an example of a hormone to explain your answer:
- _____
- _____
- Example: _____

7. Explain why it is an advantage for hormones to be carried in the blood: _____

