Anatomy and physiology

The endocrine system

The endocrine system

The endocrine system works closely with the nervous system to control and coordinate the body's activities. It consists of the **Endocrine glands** and the **hormones.**

Hormones are often referred to as 'chemical messengers', which the glands secrete and/or store. They communicate between:

a. Two endocrine glands to stimulate one gland to release a hormone.

b. An endocrine gland and a target organ.

Each gland is rich in capillaries, which cluster around the glands so that hormones can be easily secreted and pass into the bloodstream.

Hormones attach to plasma proteins in the blood and are transported around the body to their target organs. Hormones may affect a number of target organs.

Hormones

Hormones affect many physiological functions including:

- growth
- metabolism
- appetite
- puberty
- fertility

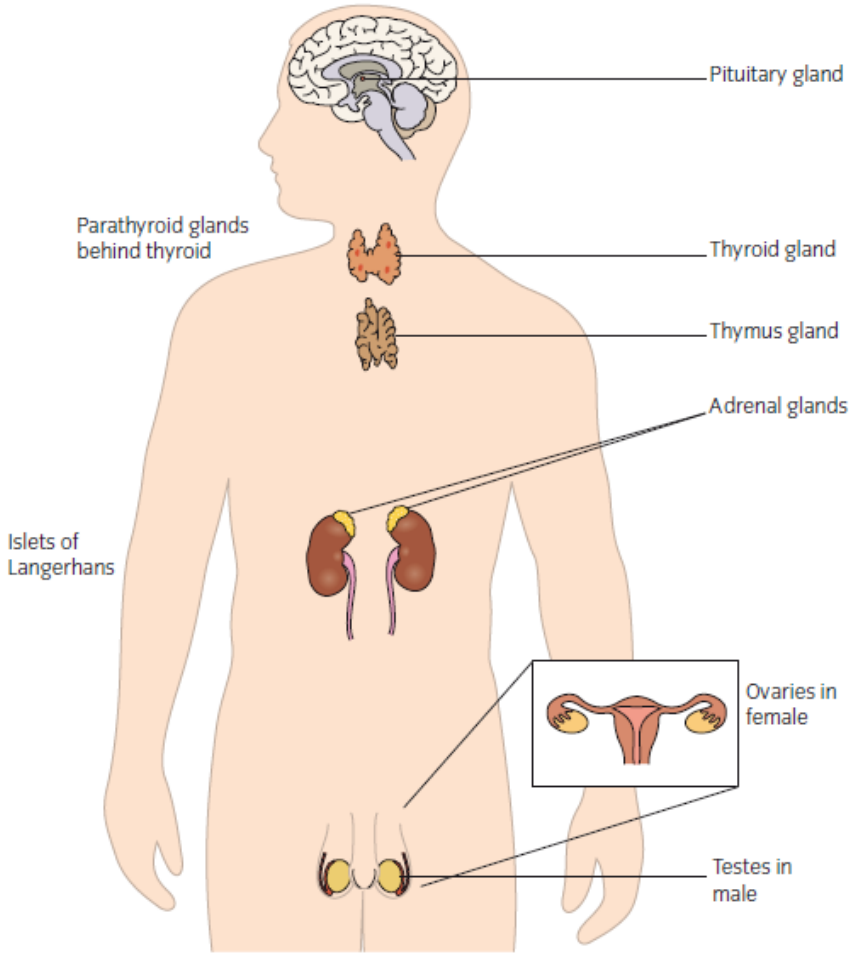
The endocrine system – supply and demand

The amount of hormone released by an endocrine gland is determined by the need for the hormone at any given time.

The body is normally regulated so that hormones are not over or under produced (homeostasis).

There are times when the regulating mechanism does not operate properly and hormonal levels may become too high, too low or not secreted at all. When this happens endocrine disorders occur.

The location of the endocrine glands

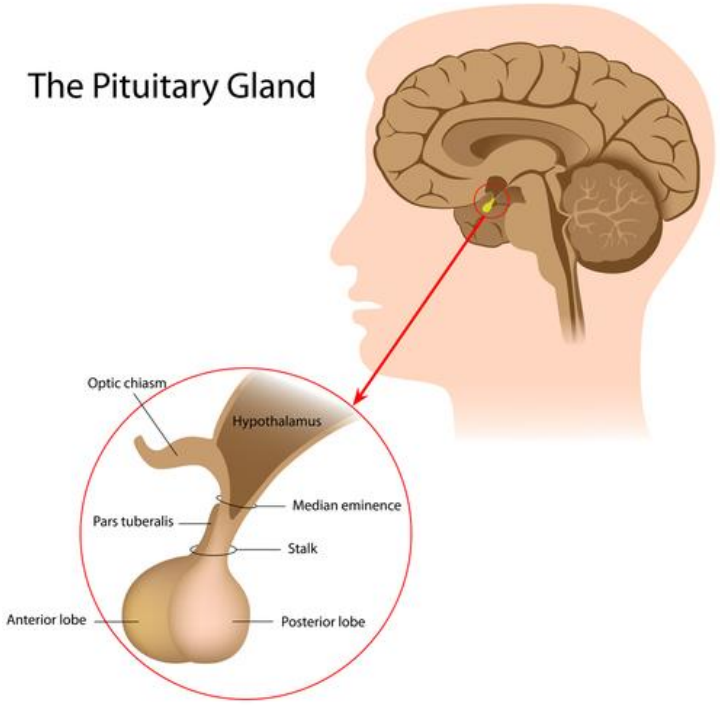


The endocrine glands – pituitary gland

- This gland is the size of a pea and sits in a hollow in the base of the skull, beneath the brain and behind the nose.
- Attached to the hypothalamus which controls its activity.
- It has two parts:
  - **Anterior** – connects to the brain by blood vessels and consists of gland cells.
  - **Posterior** – part of brain and secretes directly into the bloodstream under the command of the brain.

The pituitary gland

Often referred to as the master gland, as it produces hormones that control the function of other endocrine glands.



The endocrine glands – the anterior pituitary

Hormone	Action
Growth Hormone (GH) also known as Human Growth Hormone (HGH and somatotropin	Promotes growth in children. In adults it maintains normal body structure and metabolism. Increased by sleep, stress, exercise, low glucose levels in the blood.
Prolactin/luteotropic hormone (LTH)	Stimulates the breast to produce milk at the time of giving birth and maintains milk supply (also produced in other areas of the body).
Thyroid-stimulating Hormone (TSH)	Controls production of thyroxine and triiodothyronine from the thyroid gland.

The endocrine glands – the anterior pituitary

Hormone	Action
Follicle stimulating hormone (FSH)	Gonadotrophic hormone. Essential for development during puberty. Targets sexual organs, oestrogen and maturation of ovarian follicles in females and sperm production in males.
Luteinising hormone (LH)	Gonadotrophic hormone. Stimulates the ovarian follicles in the ovary week 1–2 of the menstrual cycle and for ovulation to occur. Stimulates corpus luteum to produce progesterone. Stimulates cells in testes to produce testosterone in the male.

The endocrine glands – the anterior pituitary

Hormone	Action
Adrenocorticotrophic hormone (ACTH)	High levels are secreted in the morning and fall during the day (diurnal rhythm). Targets cortex of suprarenal glands to secrete cortisol. Increases production of chemicals that trigger some other hormones, including adrenaline.

The endocrine glands – the hypothalamus – posterior pituitary gland

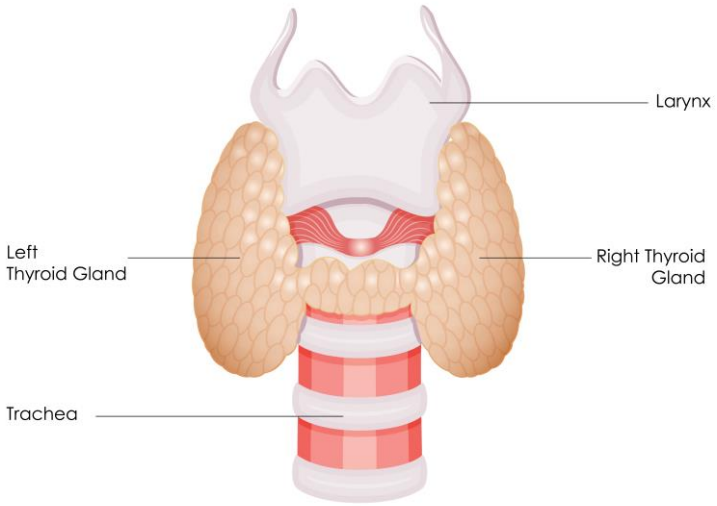
Hormone	Action
Antidiuretic hormone (ADH)/ vasopressin	Formed in the hypothalamus but released from the posterior pituitary. Regulates extracellular fluid and targets: 1. Kidneys to decrease urine production. 2. Arteries – vasoconstrictor.
Oxytocin	Formed in the hypothalamus but secreted via the posterior pituitary. Stimulates the uterus to contract at the end of pregnancy. During breastfeeding, promotes the movement of milk into the breast to be excreted. Plays a role in the movement of sperm in men.

The thyroid gland

Located in the front of the neck just below the larynx.

Has a distinct butterfly shape with two lobes – one on each side of the trachea.

Reliant on supplies of iodine in the diet to function effectively.



THYROID GLAND

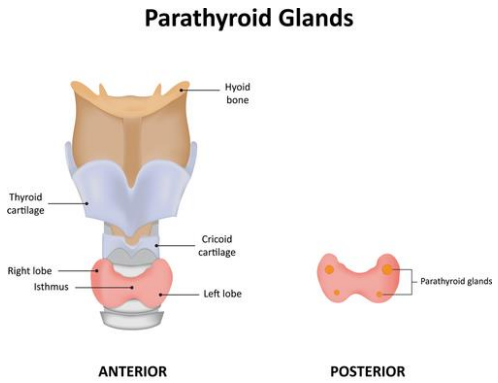
The endocrine glands – thyroid

Hormone	Action
Thyroxine and triiodothyronine	Regulates the metabolic rate, along with heart, digestive, muscle control, brain development and maintenance of bone.
Calcitonin	Plays a role in regulating calcium levels in the body. Still some uncertainly as to its exact role.

The endocrine glands – parathyriod

Located in the front of the neck, just below the larynx and just behind the thyroid gland.

There are four of these small pea-sized glands – two glands lie behind each wing of the thyroid.



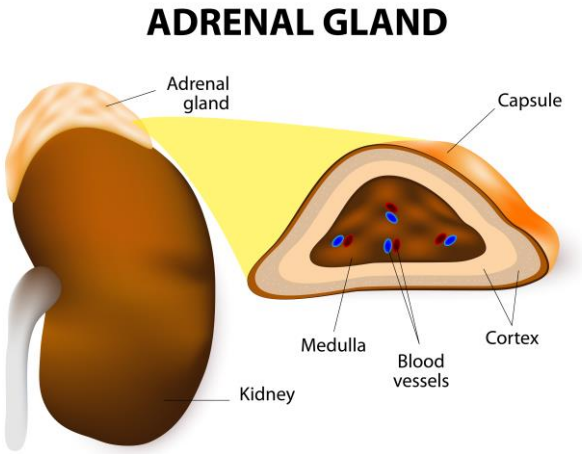
Hormone	Action
Parathormone (PTH) (parathyrin)	Targets: 1. Bones – regulates calcium from large stores in the bones into the bloodstream. 2. Kidneys – reduces loss of calcium by increasing absorption. Stimulates active Vitamin D production in the kidneys. 3. Its affects on vitamin D metabolism increases calcium absorption in the intestine from food.

The endocrine glands – the adrenals (suprarenal) glands

There is one adrenal gland on the top of each kidney.

Each gland has two parts:

- outer adrenal cortex
- inner adrenal medulla.



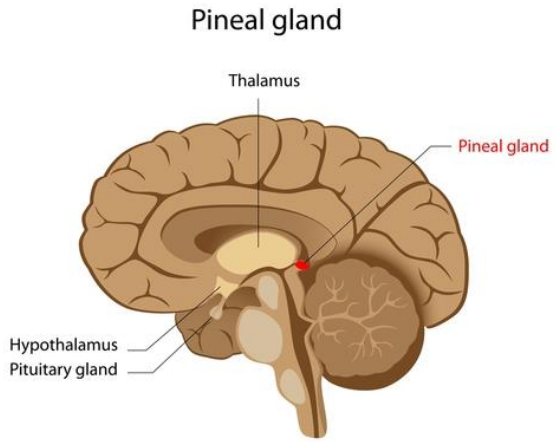
Hormone – from medulla	Action
Catecholamines, including adrenaline, noradrenaline, small amounts of dopamine.	Prepares the body for physical action (fight or flight) – physiological characteristics of stress response.

The endocrine glands – the adrenals

Hormone – from the cortex	Action
Mineralocorticoids – including aldosterone	Regulates salt, water levels and blood pressure
Glucocorticoids – cortisol	• Regulates metabolism • Involved in the stress response • Stimulates glucose production • Significant anti-inflammatory effects
Adrena – l androgens (dehydroepiandrosterone (DHEA) testosterone)	Early development of male sex organs and female during puberty

The endocrine glands – pineal gland

Located deep in the middle of the brain where the two halves meet. It sits above the thalamus.



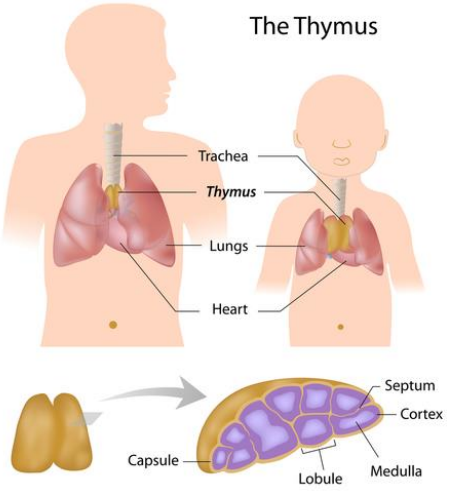
Hormone	Action
Melatonin	Also produced in other tissues in the body but the pineal gland is the major source. Peak levels occur during the night so known as sleep hormone – but not essential for sleep. In animals it regulates the body's seasonal biology; in humans this is not as clear but is believed to help circadian rhythms.

The endocrine glands – thymus

Located behind the sternum, between the lungs.

Predominantly active during puberty then atrophys.

Helps the body against autoimmunity and has a vital role in the lymphatic system.



Hormone	Action
Thymosin	Stimulates the production and development of T cells – a white blood cell that plays a crucial role in the immune system. By 75 years of age the thymus is little more than fatty tissue.

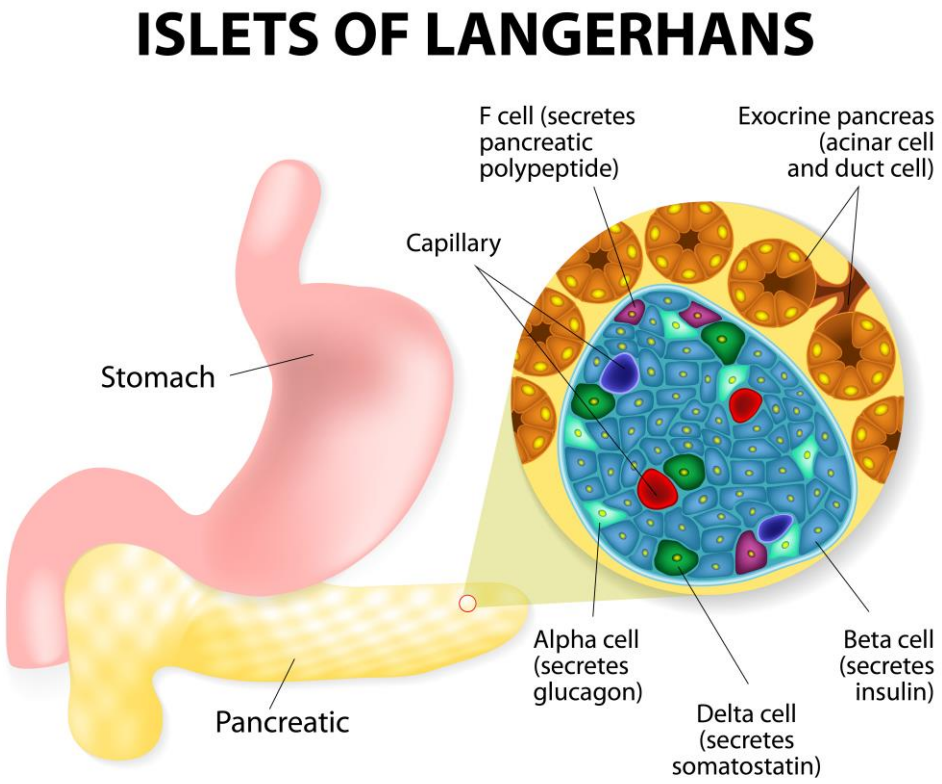
The endocrine glands – pancreas (Islets of Langerhans)

The pancreas is a large gland, about 15cm long, sitting alongside the stomach and small bowel. Both an exocrine and endocrine gland, it also plays an important role in digestion.

The Islets of Langerhans contain endocrine tissue. These are clusters of cells making up 1–2% of the pancreas.

Hormone	Action
Insulin	Released by beta cells. Controls how the body uses carbohydrate and fat. Regulates how cells in the muscles live and adipose tissue utilise glucose to provide energy. Insulin also has some other metabolic effects. Reduces the level of glucose in the blood.
Glucagon	Works in tandem with insulin. Raises the level of glucose in the blood.

The endocrine glands – pancreas

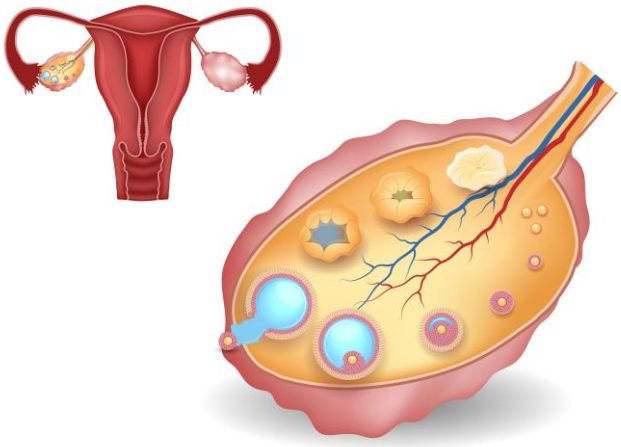


The endocrine glands – ovaries

Small oval organs about 4cm in size. They lie on either side of the uterus, held in place by ligaments – they are not attached to the fallopian tubes.

They produce ova and are part of the female reproductive system.

Hormone	Action
Oestrogen	Controls the development and function of the female sex organs. Controls the development of secondary characteristics.
Progesterone	Prepares the uterus for pregnancy and maintains pregnancy.

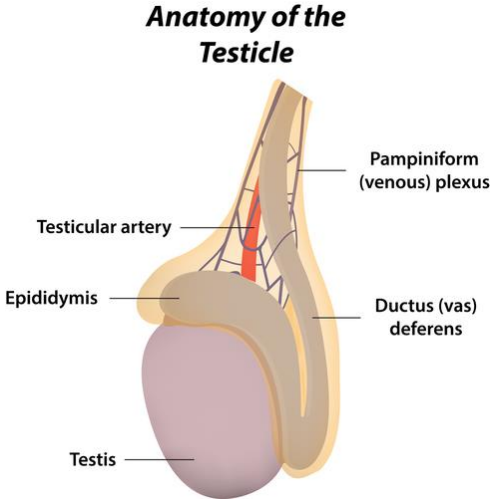


The endocrine glands – testes

The two male gonads lie in the scrotal sacs – one each side of the penis.

They form part of the male reproductive system.

Hormone	Action
Testosterone	Produces male sexual characteristics.
Androgen	Controls the development and function of the male sex organs. Controls the development of secondary sexual characteristics.



You and your hormones

Society of Endocrinology:

www.yourhormones.info