JSR IAS ACADEMY

GENERAL SCIENCE

BIOLOGY

Physiology

Human Digestive System

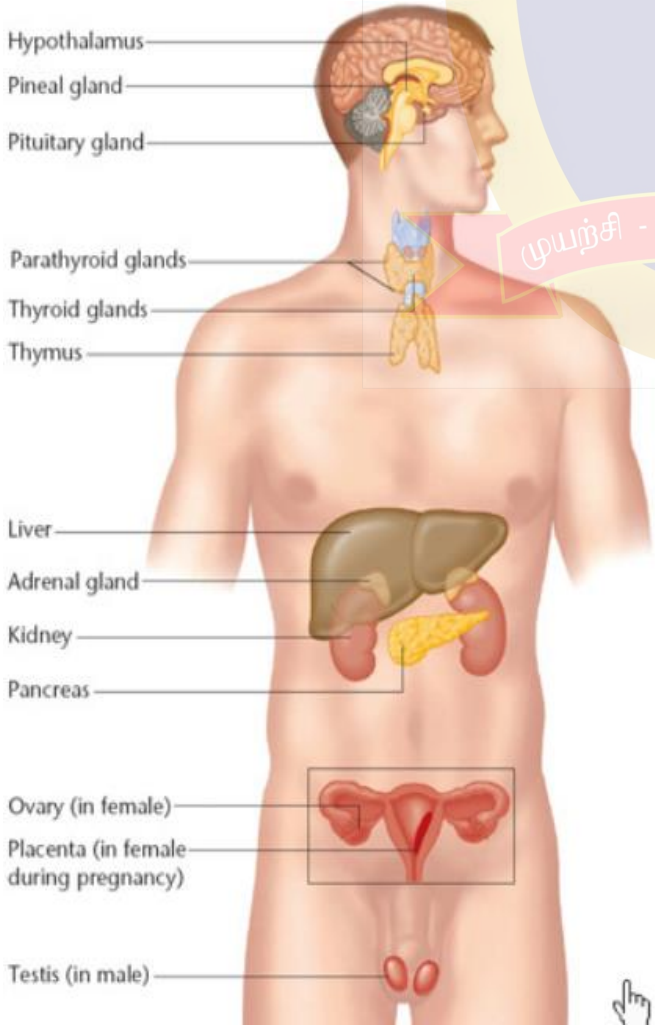
Human Endocrine Glands

- **Exocrine glands and endocrine glands** are two kinds of glands found in animals.
- Their secretions are called **hormones** which are produced in minute quantities.
- They act on specific organs which are referred as **target organs.**

Exocrine glands have specific ducts to carry their secretions **e.g. salivary glands, mammary glands, sweat glands.**

Endocrine glands present in human and other vertebrates are

a. Pituitary gland
b. Thyroid gland
c. Parathyroid gland
d. Pancreas (Islets of Langerhans)
e. Adrenal gland (Adrenal cortex and Adrenal medulla)
f. Gonads(Testes and Ovary)
g. Thymus gland



DO YOU KNOW?

The branch of biology which deals with the study of the endocrine glands and its physiology is known as '**Endocrinology**'. **Thomas Addison** is known as Father of Endocrinology. English physiologists **W. M. Bayliss** and **E. H. Starling** introduced the term ***hormone*** in 1909. They first discovered the hormone secretin.

Pituitary Gland

The pituitary gland or hypophysis is a **pea shaped** compact mass of cells located at the **base of the midbrain** attached to the hypothalamus by a pituitary stalk.

The pituitary gland is anatomically **composed of two lobes**

1. the anterior lobe **(adenohypophysis)**
2. the posterior lobe **(neurohypophysis).**

It regulates and controls other endocrine glands and so is called as the **"Master gland".**

Anterior lobe (Adenohypophysis) of pituitary

1. Growth Hormone
2. Thyroid stimulating Hormone
3. Adrenocorticotropic Hormone
4. Gonadotropic Hormone which comprises the **Follicle Stimulating Hormone and Luteinizing Hormone**
5. Prolactin

a. Growth hormone (GH)

- It stimulates the **growth of muscles, cartilage and long bones.**
- **Dwarfism:** It is caused by decreased secretion of growth hormone in children.
- **Gigantism:** Oversecretion of growth hormone leads to gigantism in children.
- **Acromegaly**: Excess secretion of growth hormone

b. Thyroid stimulating hormone (TSH)

TSH controls the growth of thyroid gland, coordinates its activities and hormone secretion.

c. Adrenocorticotropic hormone (ACTH)

It also influences protein synthesis in the adrenal cortex.

d. Gonadotropic hormones (GTH)

The gonadotropic hormones are **follicle stimulating hormone and luteinizing hormone** which are essential for the normal development of gonads.

Follicle stimulating hormone (FSH)

- **In male,** it stimulates **the germinal epithelium of testes for formation of sperms.**
- **In female** it initiates **the growth of ovarian follicles and its development in ovary.**

Luteinizing hormone (LH)

- **In male**, it promotes the **Leydig cells** of the testes to secrete male sex hormone **testosterone.**
- **In female**, production of female sex hormones **estrogen** and **progesterone.**

e. Prolactin (PRL)

- PRL is also called **lactogenic hormone**.
- This hormone initiates **development of mammary glands** during pregnancy
- **stimulates the production of milk** after child birth.

Posterior lobe (Neurohypophysis) of pituitary

The hormones secreted by the posterior pituitary are

1. Vasopressin or Antidiuretic hormone
2. Oxytocin

a. Vasopressin or Antidiuretic hormone (ADH)

- In kidney tubules **it increases reabsorption of water.**
- **It reduces loss of water** through urine and hence the name antidiuretic hormone.
- Deficiency of ADH reduces **reabsorption of water** and causes an increase in urine output **(polyuria).**
- This deficiency disorder is called **Diabetes insipidus.**

b. Oxytocin

- It helps in the **contraction of the smooth muscles of uterus** at the time of child birth
- **milk ejection from the mammary gland** after child birth.

Thyroid Gland

- The thyroid gland is **composed of two distinct lobes lying one on either side of the trachea.**
- The two lobes are connected by means of a narrow band of tissue known as **the isthmus.**
- This gland is **composed of glandular follicles and lined by cuboidal epithelium**.
- The follicles are **filled with colloid material called thyroglobulin.**
- An amino acid **tyrosine and iodine** are involved in the formation of thyroid hormone.

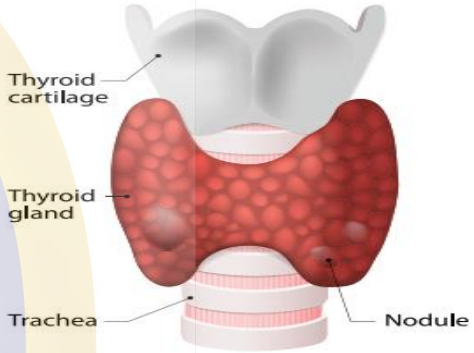


Figure 16.8 Thyroid Gland

The hormones secreted by the thyroid gland are

- Triiodothyronine (T3)
- Tetraiodothyronine or Thyroxine (T4)

Functions of thyroid hormones

- **Increases oxygen consumption** in tissues ‹
- Production of energy by **maintaining the Basal Metabolic Rate (BMR)** of the body. ‹
- **Helps to maintain normal body temperature.** ‹
- Influences the **activity of central nervous system.** ‹
- **Controls growth of the body, bone formation and development of gonads. ‹**
- Essential for normal physical, mental and personality development . It is also known as **personality hormone.**
- **Regulates carbohydrate, protein and fat metabolism**.

Edward C. Kendal in 1914 first crystallised thyroxine hormone. Charles Harrington and George Barger identified the molecular structure of thyroxine in 1927. Thyroid gland requires "120 µg" of iodine everyday for the production of thyroxine.

Thyroid Dysfunction

Hypothyroidism

It is caused due to **the decreased secretion of the thyroid hormones.** The abnormal conditions are simple **goitre, cretinism and myxoedema.**

Hyperthyroidism

It is caused due to the **excess secretion of the thyroid hormones** which leads to **Grave's disease**. **(Exopthalmia)**

Parathyroid Gland

The parathyroid glands are **four small oval bodies** that are situated on the posterior surface of the thyroid lobes.

The chief cells of the **gland are mainly concerned with secretion of parathormone.**

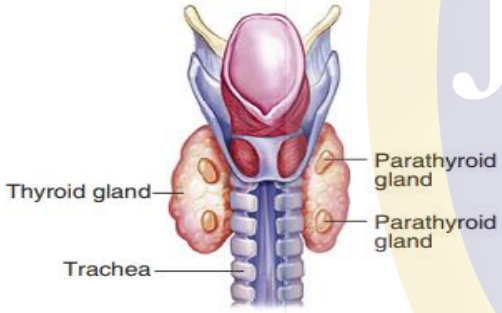


Figure 16.9 Parathyroid Gland

Functions of Parathormone

- The parathormone regulates **calcium and phosphorus metabolism in the body**.
- They act on bone, kidney and intestine **to maintain blood calcium levels**.

Parthyroid Dysfunction

- Removal of parathyroid glands during **thyroidectomy (removal of thyroid)** causes decreased secretion of parathormone.
- Muscle spasm known as **Tetany**

Pancreas (Islets of Langerhans)

- Pancreas is an elongated, **yellowish gland** situated in the loop of stomach and duodenum.
- It is **exocrine and endocrine in nature.**
- The exocrine pancreas **secretes pancreatic juice** which plays a role in digestion
- while, the endocrine portion is made up of **Islets of Langerhans.**

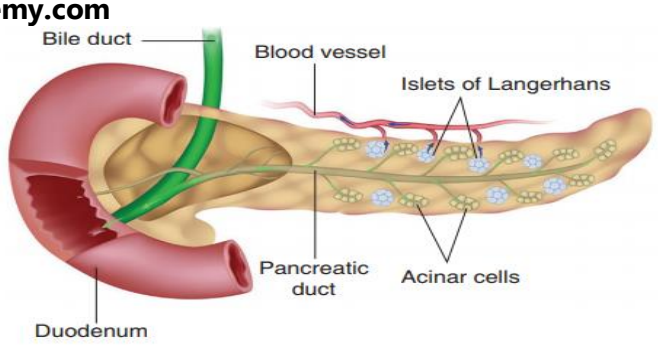


Figure 16.10 Pancreas

DO YOU KNOW?

Human insulin was first discovered by Fredrick Banting, Charles Best and MacLeod in 1921. Insulin was first used in treatment of diabetes on 11th January 1922.

The Islets of Langerhans

consists of two types of cells namely **alpha cells and beta cells.**

- The alpha cells secrete **glucagon**
- The beta cells secrete **insulin.**

Functions of Pancreatic hormones

Insulin

- helps in the **conversion of glucose into glycogen** which is stored in **liver and skeletal muscles**.
- It promotes **the transport of glucose into the cells.**
- It **decreases the concentration of glucose** in blood.

Glucagon

helps in the **breakdown of glycogen to glucose** in the liver.

It **increases blood glucose levels.**

Diabetes mellitus

The deficiency of insulin causes Diabetes mellitus.

Adrenal Gland

The adrenal glands are **located above each kidney.**

The outer part is the **adrenal cortex** and the inner part is the **adrenal medulla.**

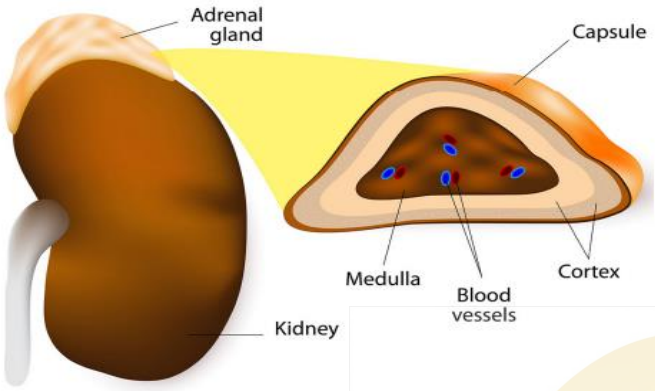


Figure 16.11 Adrenal Gland

Adrenal Cortex

The adrenal cortex **consists of three layers of cells.**

- zona glomerulosa,
- zona fasciculata and
- zona reticularis

Hormones of Adrenal Cortex The hormones secreted by the adrenal cortex are **corticosteroids.**

a. Glucocorticoids
b. Mineralocorticoids

Functions of adrenocortical hormones

Glucocorticoids

- The glucocorticoids secreted by the **zona fasciculata** are **cortisol and corticosterone**
- It stimulates the **formation of glucose from glycogen in the liver.**
- It is an **anti-inflammatory and anti-allergic agent.**

The **cortisol** hormones of adrenal cortex serves to maintain the body in living condition and recover it from the severe effects of stress reactions. Thus an increased output of cortisol is "life saving" in "shock conditions". It is also known as life-saving hormone.

Mineralocorticoids

- The mineralocorticoids **secreted by zona glomerulosa** is **aldosterone**
- It helps to **reabsorb sodium ions** from the renal tubules.
- It causes **increased excretion of potassium ions**.
- It regulates **electrolyte balance, body fluid volume, osmotic pressure and blood pressure.**

Adrenal Medulla

Hormones of Adrenal Medulla It secretes two hormones namely

a. Epinephrine (Adrenaline)
b. Norepinephrine (Noradrenaline)

They are together called as **"Emergency hormones".**

It is produced during conditions of stress and emotion. Hence it is also referred as **"flight, fright and fight hormone"**.

Functions of adrenal medullary hormones Epinephrine (Adrenaline)

- It promotes the **conversion of glycogen to glucose in liver and muscles.**
- It **increases heart beat and blood pressure.**
- It **increases the rate of respiration** by dilation of bronchi and trachea
- It **causes dilation of the pupil in eye.**
- It **decreases blood flow through the skin.**

Norepinephrine (Noradrenalin)

Most of its actions are similar to those of epinephrine.

Reproductive Glands (Gonads)

The sex glands are of two types the **testes and the ovaries.**

- The testes are present in **male,**
- The ovaries are present in **female.**

Testes are composed of **seminiferous tubules, Leydig cells and Sertoli cells.**

Leydig cells form the endocrine part of the testes.

They secrete the male sex hormone called **testosterone.**

Functions of testosterone

- It **influences the process of spermatogenesis**.
- It is **responsible for the development of secondary sexual characters (distribution of hair on body and face, deep voice pattern, etc).**

Ovary

The ovaries are the female gonads **located in the pelvic cavity of the abdomen.**

They secrete the female sex hormones

a. Estrogen
b. Progesterone

Estrogen is produced by the **Graafian follicles** of the ovary

progesterone from the **corpus luteum**

Functions of estrogens

- It **initiates the process of oogenesis**
- It **stimulates the maturation of ovarian follicles** in the ovary
- It **promotes the development of secondary sexual characters** (breast development, high pitched voice etc).

Functions of progesterone

- It is **responsible for the premenstrual changes of the uterus.**
- It **prepares the uterus for the implantation of the embryo.**
- It **maintains pregnancy.**
- It **is essential for the formation of placenta.**

Thymus Gland

- Thymus is partly an **endocrine gland and partly a lymphoid gland.**
- It is located in the **upper part of the chest**
- Thymosin is the hormone secreted by **thymus.**

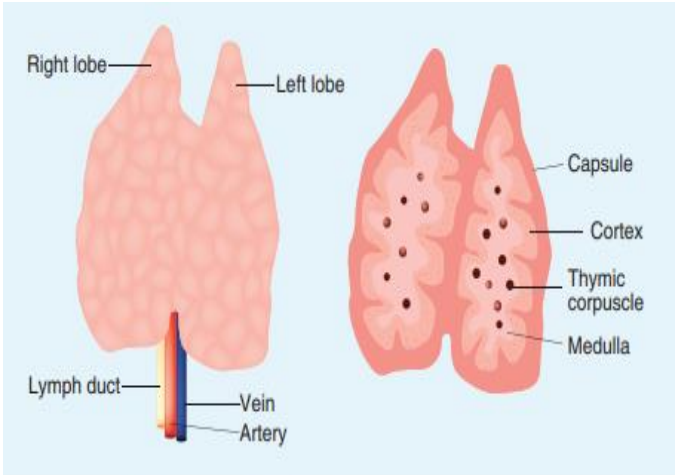


Figure 16.12 Thymus Gland

Functions of Thymosin

- It has **a stimulatory effect on the immune function**
- It **stimulates the production and differentiation of lymphocytes**.

Melatonin is a hormone produced by the pineal gland. It is known as a 'time messenger'. It signals night time information throughout the body.

Exposure to light at night, especially short-wavelength light, can decrease melatonin production interrupting sleep. Suppression of melatonin has been implicated in sleep disturbances and related metabolic disorders.