

# NEET Revision Notes

## Biology

### Chemical Coordination and Integration

#### Introduction

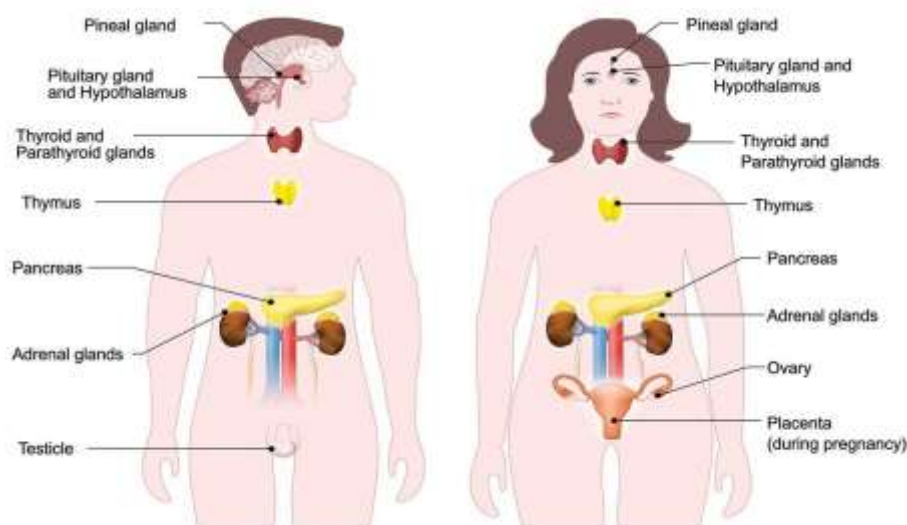
The brain system and the endocrine system work together to control and coordinate behaviour in animals. Because nerve fibres do not innervate all of the body's cells, the endocrine system is needed to coordinate processes.

#### Endocrine Glands

- Ductless glands are endocrine glands. They secrete directly into the bloodstream, which is subsequently delivered to specific target organs to trigger a metabolic shift.
- Hormones are substances secreted by the endocrine glands.
- Hormones are non-nutrient molecules produced in trace amounts that operate as intercellular messengers.

#### Human Endocrine System

- Endocrine glands and hormone-producing tissues/cells can be found throughout the body.
- Hormones are produced in minute amounts by the gastrointestinal tract, kidney, liver, and heart to control and coordinate the operation of their respective organs.

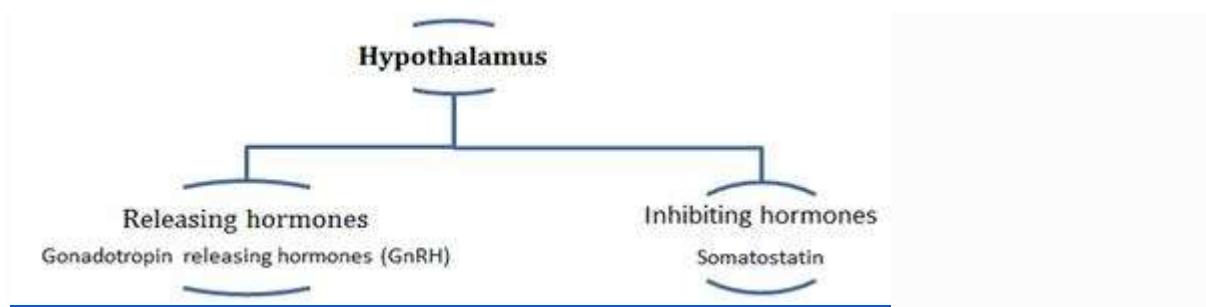


*Image: Different glands and their location*

## Hypothalamus

The hypothalamus contains nuclei, which are groupings of neurosecretory cells that create hormones. Hypothalamic hormones control the synthesis and production of pituitary hormones.

### Hypothalamus produces two types of Hormones:



*Image: Types of hormones released by Hypothalamus*

- Releasing or stimulating hormones like Gonadotropin-releasing hormone (GnRH), stimulate the pituitary gland to secrete its hormones whereas the inhibiting hormones like Somatostatin, inhibit pituitary gland to release its hormones.
- The hormones secreted by the hypothalamus travel through the portal circulatory system to the anterior pituitary, where they regulate its function.
- The hypothalamus has direct control over the posterior pituitary.

## Pituitary Gland

- The pituitary gland is located in the sella turcica, which is a bone hollow. A stalk connects it to the hypothalamus.
- Excess Growth Hormone secretion promotes excessive body growth, resulting in gigantism, and inadequate secretion causes stunted growth, resulting in dwarfism.
- Prolactin promotes mammary gland development and milk production.
- Thyroid Stimulating Hormone (TSH) increases thyroid hormone synthesis and release.
- The gonads are stimulated by Luteinizing hormone (LH) and Follicle-stimulating Hormone (FSH). LH increases androgen hormone production and secretion from the testis in males. LH causes completely formed ovum to ovulate from the ovary in females.

- Oxytocin aids in uterine contraction and milk ejection from the mammary glands during childbirth.
- Vasopressin promotes water and electrolyte absorption in the kidney.
- MSH modulates skin pigmentation by acting on melanocytes.

### **Pineal Gland:**

The pineal Gland is located on the dorsal side of the forebrain and releases the hormone melatonin, which aids in the regulation of body diurnal rhythms such as sleep, waking cycle, and body temperature.

### **Thyroid gland:**

- The thyroid gland is made up of two lobes on either side of the trachea that are joined by an isthmus.
- The thyroid gland's key responsibility is to secrete two hormones: triiodothyronine (T3) hormone and thyroxine hormone (T4). T3 and T4 hormones both play critical roles in the body, affecting nearly every tissue.
- **T4 hormone (Thyroxine or Tetraiodothyronine):** Thyroxine is a hormone that the thyroid gland secretes into the bloodstream. It then moves to organs such as the kidneys and liver, where it is transformed into its active form triiodothyronine.
- **T3 (Triiodothyronine) hormone:** A thyroid hormone that influences physiological functions including growth, development, metabolism, and so on.
- Iodine is required for thyroid hormone production. Hypothyroidism is caused by an iodine deficiency (Goitre).
- Hypothyroidism during pregnancy might result in a baby's growth being delayed and mental impairment.
- The basal metabolic rate is regulated by thyroid hormones. They assist in the production of red blood cells.
- They regulate glucose, protein, and fat metabolism. Thyrocalcitonin hormone controls calcium levels in the blood.

### **Parathyroid gland:**

- The parathyroid gland, which is located on the rear side of the thyroid gland, produces the peptide hormone parathyroid hormone (PTH).



- The calcium ion concentration in the blood is regulated by PTH. It also aids calcium absorption from the renal tubules and the gastrointestinal system.
- The parathyroid gland secretes parathyroid hormone, which regulates blood calcium levels. It is released into the bloodstream in response to low blood calcium levels and induces the release of calcium ions from the bones, thereby keeping blood calcium levels stable.

### **Thymus:**

- The thymus is found on the dorsal side of the heart, near the aorta. Thymosins, a peptide hormone released by this gland, aid in the development of T-lymphocytes for cell-mediated immunity.
- It also encourages the generation of antibodies that protect the humerus.

### **Adrenal gland:**

- The anterior region of each kidney located the adrenal gland, which is made up of two types of tissues: the central adrenal medulla and the outer adrenal cortex.
- Adrenaline and noradrenaline hormone, sometimes known as catecholamines, are secreted by the adrenal medulla.
- Emergency hormones are another name for these hormones. Alertness, pupil dilation, sweating, heart rate, rate of respiration, and glycogenolysis are all increased by these hormones.
- Glucocorticoids and mineralocorticoids are produced by the adrenal cortex. Gluconeogenesis is aided by glucocorticoids.
- Mineralocorticoids are hormones that regulate the body's water and electrolyte levels.

### **The pancreas:**

- Pancreas is both an endocrine and an exocrine gland. The "Islets of Langerhans," which contain  $\alpha$ -cells and  $\beta$ -cells, make up the endocrine pancreas. The hormone glucagon is secreted by  $\alpha$ -cells, and insulin is secreted by  $\beta$ -cells. Both hormones have a role in keeping blood sugar levels in check.
- Glucagon is a peptide hormone that increases blood sugar by stimulating glycogenolysis (hyperglycemia).

- Insulin is a peptide hormone that regulates glucose homeostasis in the body. It causes glucose to flow quickly from the bloodstream to hepatocytes and adipocytes, resulting in lower blood glucose levels (hypoglycemia).

### **Testes:**

- They serve as both a major sex organ and endocrine glands. Androgens, primarily testosterone, are produced by Leydig cells or interstitial cells, which regulate the maturation of primary sex organs and spermatogenesis.

### **Ovaries:**

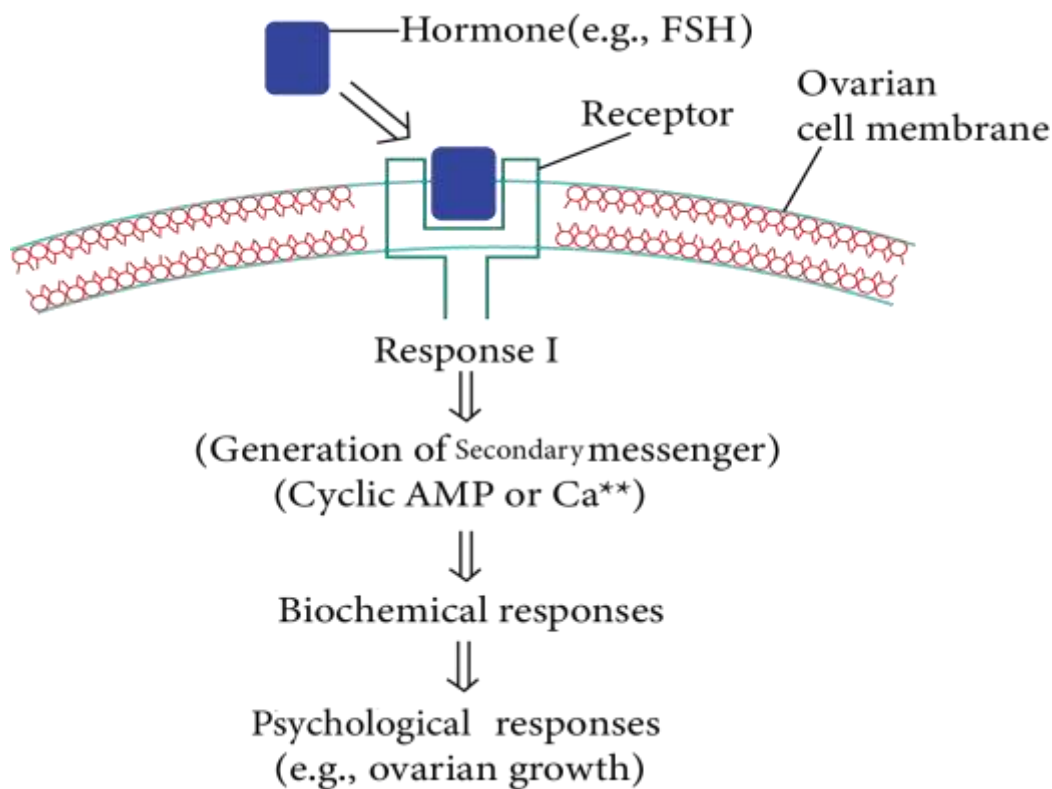
- Oestrogen and progesterone are two types of steroid hormones produced by the ovary. Growing ovarian follicles produce and secrete oestrogen.
- The ruptured ovum, known as the corpus luteum, secretes progesterone after ovulation.
- Estrogen has a wide range of effects, including the development of female secondary sex organs, the formation of ovarian follicles, and the regulation of female sexual behaviour.

### **Hormones of Heart, Kidney and Gastrointestinal Tract**

- The peptide hormone atrial natriuretic factor (ANF) is secreted by the atrial wall of the heart and lowers blood pressure.
- The kidney's juxtaglomerular cells produce the hormone erythropoietin, which stimulates erythropoiesis.

### **Four main peptide hormones are secreted by the gastrointestinal tract:**

1. Gastrin promotes hydrochloric acid and pepsinogen secretion.
2. Secretin increases the production of water and bicarbonate ions by the exocrine pancreas.
3. Cholecystokinin (CCK) promotes pancreatic enzyme and bile juice secretion.
4. GIP (gastric inhibitory peptide) is a peptide that reduces stomach secretion and motility.



*Image: Mechanism of Hormone action*

### Mechanism of Hormone Action

- Hormones exert their effects on target tissues via binding to hormone receptors, which are proteins found in the target tissue.
- Hormone receptor complexes are formed when hormones bind to their receptors. The target tissue changes as a result of this binding.

### On the basis of chemical nature, hormones are grouped as-

- Peptide, polypeptide and protein hormones- insulin, glucagon, pituitary hormone, hypothalamic hormones.
- Steroids- cortisol, testosterone, progesterone.
- Iodothyronines- thyroid hormones.
- Amino acid derivatives- epinephrine.
- Hormones that connect to membrane-bound receptors do not generally penetrate target cells, but instead produce second messengers that regulate cellular metabolism.
- Hormones (steroid hormones) that interact with intracellular receptors affect gene expression or chromosome function primarily through



interactions with the genome's hormone-receptor complex. Physiological and developmental impacts are the result of these biochemical processes.

**Points to remember:**

- Hormones are the special chemicals which provide chemical coordination, integration and regulation in the human body.
- Hormones regulate the metabolism, growth and development of our organs, the endocrine glands or certain cells.
- The endocrine system is composed of the hypothalamus, pituitary and pineal, thyroid, adrenal, pancreas, parathyroid, thymus and gonads (testis and ovary).
- The pituitary hormones regulate the growth and development of somatic tissues and the activities of peripheral endocrine glands.
- The pineal gland secretes melatonin, which plays a very important role in the regulation of the 24-hour (diurnal) rhythms of our body (e.g., rhythms of sleep and state of being awake, body temperature, etc.).
- The thyroid gland hormones play an important role in the regulation of the basal metabolic rate, development and maturation of the central neural system, erythropoiesis, metabolism of carbohydrates, proteins and fats, and menstrual cycle.
- The parathyroid glands secrete parathyroid hormone (PTH) which increases the blood Calcium levels and plays a major role in calcium homeostasis.