Ratna Sagar

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Education, Our Mission

As per the latest ICSE syllabus 2022

Ratna Sagar
Education, Our Mission!

Revised and Updated

LIVING SCIENCE BIOLOGY

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10

EDUCATION, OUR MISSION

ICSE
Living Science
Biology

Class 10

Chapter 12 Endocrine System

LEARNING OBJECTIVES

Adjusting to changes – Homeostasis

- **What are hormones?**

Endocrine glands

- **Adrenal glands**
- **Thyroid gland**
- **Pancreas**
- **Pituitary – The Master Gland**

Feedback mechanism of hormone secretion

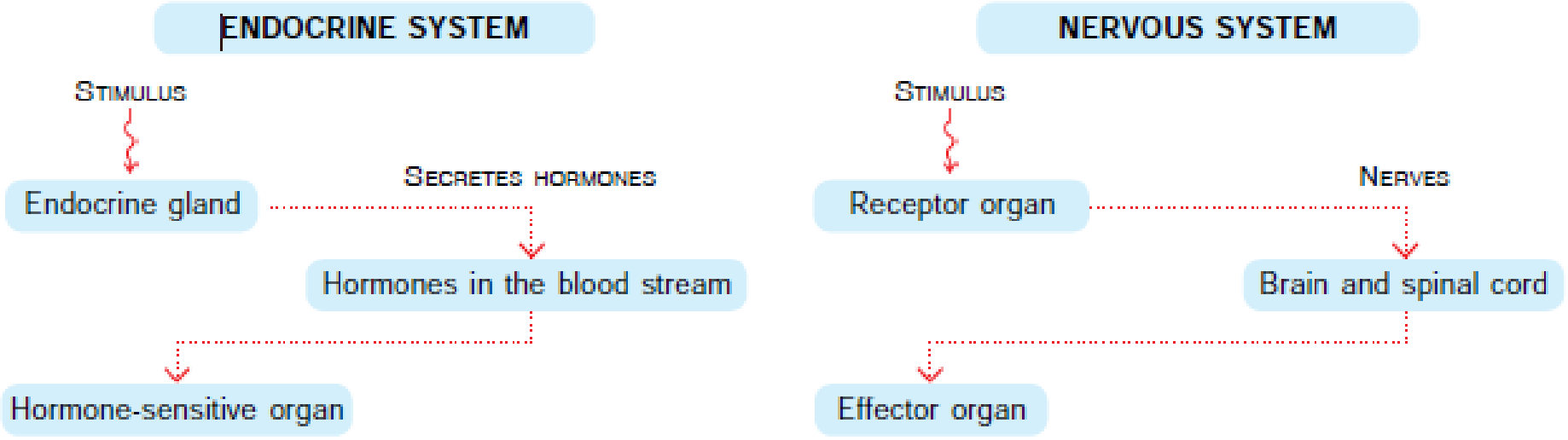
Which are the two regulatory systems involved in control and coordination of our body?

There are two regulatory systems involved in control and coordination of our body namely, nervous system and endocrine system.

Adjusting To Changes – Homeostasis

The activities in our body occur in a coordinated manner and have to be regulated at a proper time. If any step in the coordination misses out, then our body is severely affected. The capacity of an organism to adjust itself to cope with the external changes and maintain a steady state of functioning is called **homeostasis**.

Differences between the functioning of the endocrine system and the nervous system



Note: Refer to Table 12.1 for the Differences between nervous control and hormonal control

What are hormones?

Hormones are chemical secretions secreted by specific endocrine glands which are carried by blood to the target organ elsewhere in the body to stimulate a specific activity. Thus, hormones are special chemicals that regulate the physiological or biochemical processes.

Characteristics of hormones

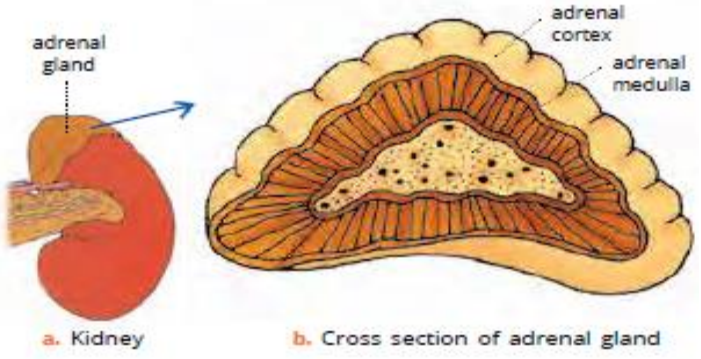
- ❖ Hormones are regulatory chemicals which are secreted by endocrine glands directly into the blood.
- ❖ They are **produced in very minute quantity**.
- ❖ They are **biologically very active** and they are slower than nervous control.
- ❖ They **act only on target organs or cells** located away from their sources. Thus, they are produced by one organ but act on some other organ.
- ❖ They **regulate** the physiological process of the body by bringing about **chemical changes**. Thus, they **bring about metabolic regulation** in the body.
- ❖ They are destroyed soon after their action and thus, they are **not stored** in the body.

Endocrine glands

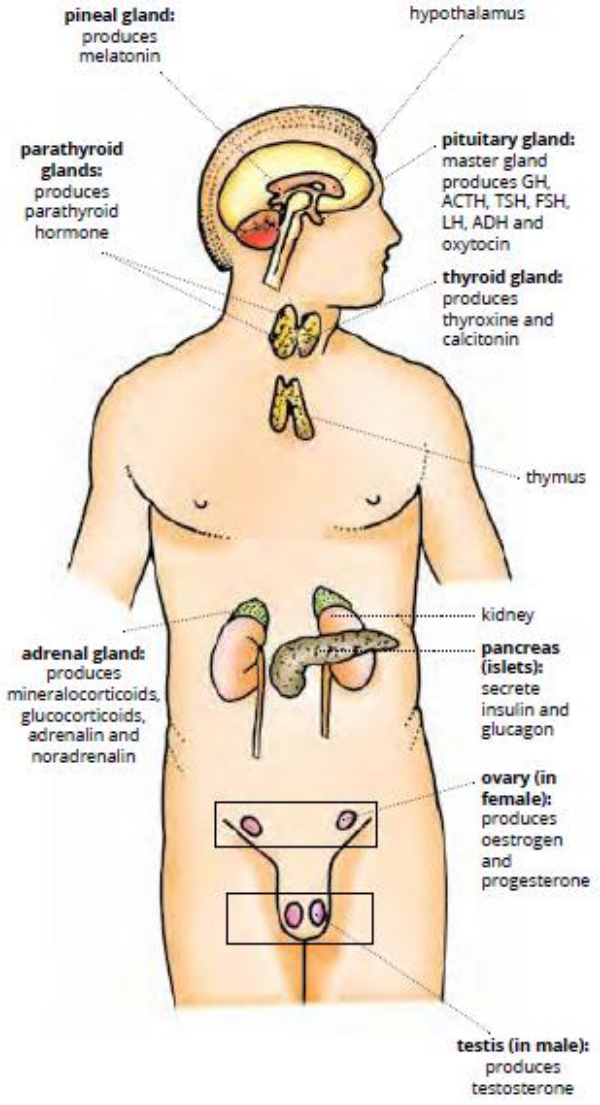
Major endocrine glands in our body are as follows:
1. Adrenals **2.** Thyroid gland **3.** Pancreas (pancreatic islets clusters) **4.** Pituitary gland (anterior and posterior) **5.** Parathyroid glands (four in humans) **6.** Thymus gland **7.** Pineal gland **8.** Gonads

Adrenal glands

In our body, two adrenal glands are present, one on top of each kidney, hence, they are also called **suprarenal glands**. Each adrenal gland has following two parts:
1. Adrenal cortex (on the outer periphery)
2. Adrenal medulla (inside central part)



a. Position of adrenal glands on kidney
b. Cross section of adrenal showing two main parts – cortex and medulla



Location of endocrine glands in our body

1. Adrenal cortex

Adrenal cortex secretes two main hormones – glucocorticoids and mineralocorticoids.

a. Glucocorticoids: Glucocorticoids are group of hormones such as cortisol, corticosterone and cortisone. Of the three, cortisol is the major hormone.

❖ regulate the **metabolism of proteins**, **fats** (lipids) and **carbohydrates** in the body;

❖ regulate the **blood-sugar level** and ensure energy supply to the body;

❖ **adapt the body to external stress** such as severe heat or cold, infections and burns, etc.

❖ certain cortical hormones act as sex hormone causing premature sexual maturity in children.

b. Mineralocorticoids (Aldosterone) : Aldosterone is major mineralocorticoid secreted by adrenal cortex.

❖ **controls mineral metabolism by reabsorption of sodium** in urinary tubules and **maintains Na+ and K+ ratio** in the extracellular and intracellular fluids;

❖ **regulates salt-water balance** in the body.

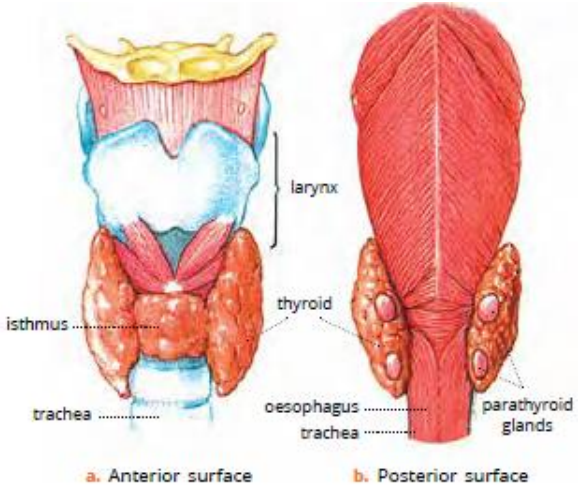
2. Adrenal medulla

Adrenal medulla secretes two major hormones – **adrenalin** (also known as epinephrine) and **noradrenalin** (norepinephrine). Adrenalin accounts for almost 80 per cent of the total secretion of the adrenal medulla. Both adrenalin and noradrenalin, together control emotions, fear, anger, blood pressure, heartbeat, respiration and relaxation of smooth muscles.

Adrenalin is also known as emergency hormone as it **prepares body for fight or flight situation**.

Thyroid Gland

The **thyroid gland** is a large endocrine gland located in front of the neck region just below the larynx. It has two lateral lobes one on either side of trachea. The two lobes are connected by a narrow mass of tissue called **isthmus**. The thyroid gland has a rich blood supply. Thus, thyroid gland can deliver large amount of hormones in a short period of time, if necessary.



a. Thyroxine

❖ It regulates basal metabolism by stimulating rate of cellular oxidation resulting into energy production and maintenance of body temperature.

❖ It regulates general growth of the body, ossification of bones and mental development.

❖ It regulates activities of the nervous system.

Undersecretion of thyroxine (Hypothyroidism)

Undersecretion of thyroxine may cause,

Simple goitre: In this condition, the **thyroid gland of adults enlarges** and becomes visible as a **swelling in the neck**

ii. Cretinism (in children): This is caused due to defective development or early atrophy (degeneration) of thyroid gland. **This condition is observed in children.** Children suffering from cretinism have stunted growth (dwarfism), short club-like fingers, deformed bones and teeth. Their abdomen becomes pot-bellied, and skin becomes rough, dry with scanty hair growth. Mental retardation of various degrees is also observed.

iii. Myxoedema (in adults): The hypothyroidism in adults causes myxoedema. In this condition, facial tissues swell and look puffy. Other symptoms include slow heart rate, low body temperature, sensitivity to cold, dry hair and skin, muscular weakness and general lethargy.

Oversecretion of thyroxine (hyperthyroidism)

Oversecretion of thyroxine may cause **exophthalmic goitre**. A person suffering from this disorder shows increased metabolic rate, rapid heartbeat, protruding eyes and short breathing rate.

b. Calcitonin (Not included in the syllabus)

Calcitonin is another hormone secreted by thyroid gland.

- ❖ It regulates calcium and phosphate levels in the blood.
- ❖ It facilitates absorption of calcium released by bones.

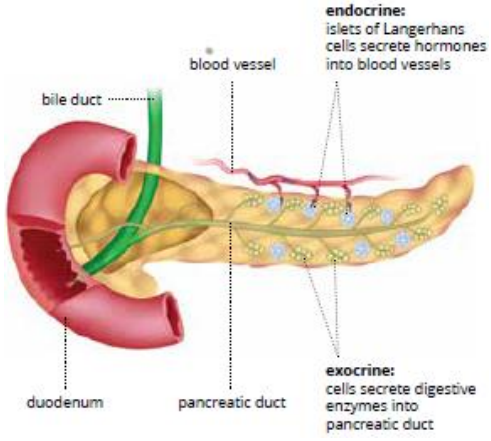
Pancreas

Pancreas is a compound gland located posterior to the stomach and attached to the duodenal loop in the abdominal region. It secretes both enzymes (digestive juices) as well as hormones. It has two parts:

1. an exocrine (duct) part, which produces digestive juices, and

2. endocrine (ductless) part, which secretes hormones.

Its endocrine part contains hormone-secreting cells called **islets of Langerhans**. The islets of Langerhans in pancreas contain **beta**, **alpha** and **delta cells** that secrete insulin, glucagon and somatostatin hormones, respectively.



Insulin

Insulin is secreted by **beta cells** of islets of Langerhans.

❖ It **regulates blood sugar level** by regulating **conversion of glucose into glycogen**. Whenever there is increase in blood glucose, insulin is secreted which induces absorption of glucose through cells. This glucose is burnt or stored as glycogen. This reduces the blood glucose level.

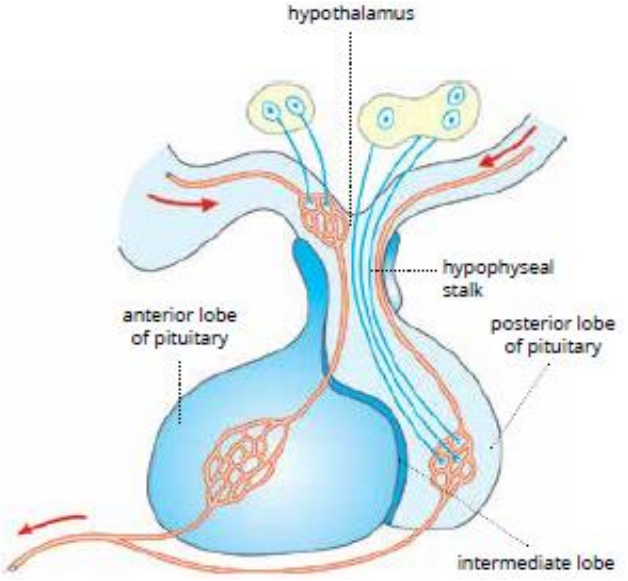
❖ It **stimulates deposition of extra glucose as glycogen** in the liver and muscles.

Pituitary – The Master Gland

It is popularly known as **master gland** because **it controls the functioning of all other endocrine glands**. Since most hormones secreted by pituitary stimulate other glands to produce their hormones, they are called **tropic hormones**. Thus tropic hormones are such hormones which stimulate other endocrine glands to secrete their own specific hormones. The pituitary is mainly divided into three lobes:

1. The anterior lobe **2.** The posterior lobe

3. The intermediate lobe (almost absent in humans)



Hormones of the anterior pituitary

The anterior pituitary releases at least six different hormones some of which are as under.

1. Growth hormone (GH) or somatotropic hormone (STH) or somatotropin

- ❖ It controls the overall development or growth of the body, muscles and bones.
- ❖ It increases the rate of protein synthesis.
- ❖ It also stimulates fat metabolism.

2. Thyroid stimulating hormone (TSH)

- ❖ It controls the growth and functioning of the thyroid gland.
- ❖ It **stimulates the thyroid gland to produce thyroxine.**

3. Adrenocorticotropic hormone (ACTH)

- ❖ It regulates the activity of adrenal cortex.

4. Gonad stimulating (Gonadotropic) hormones

a. Follicle stimulating hormone (FSH)

- ❖ In males, it **stimulates** the process of **spermatogenesis**.
- ❖ In females, it **stimulates the follicle cells** in the ovaries to develop into mature eggs and also stimulates them to produce **oestrogen**.

b. Luteinizing hormone (LH)

❖ **In males**, it stimulates the **secretion of** male hormone, **testosterone**, which in turn influences the appearance of **secondary sexual characteristics**.

❖ **In females**, it stimulates **secretion of oestrogen and progesterone**, which in turn influence the process of **ovulation**, formation and maintenance of **corpus luteum** and appearance of **secondary sexual characteristics**.

5. Prolactin hormone (PRL)

❖ **In females**, it **enhances mammary glands development** and **milk production**.

❖ **In males**, it enhances the **production of testosterone**.

Hormones of the posterior pituitary

The posterior pituitary stores two hormones, antidiuretic hormone (ADH) also called vasopressin, and oxytocin. Both these hormones are produced and released by hypothalamus (and not by the pituitary as given in most books).

1. Antidiuretic hormone (ADH) or vasopressin

❖ It promotes **reabsorption of water from the kidney tubules**. Thus, it causes the kidney to form more and more concentrated urine.

❖ It **constricts blood vessels** with the rise in blood pressure.

2. Oxytocin

❖ It **stimulates vigorous contraction of the uterus** during labour, leading to the childbirth.

❖ It also causes the **release of milk** from the breast of a **nursing mother**.

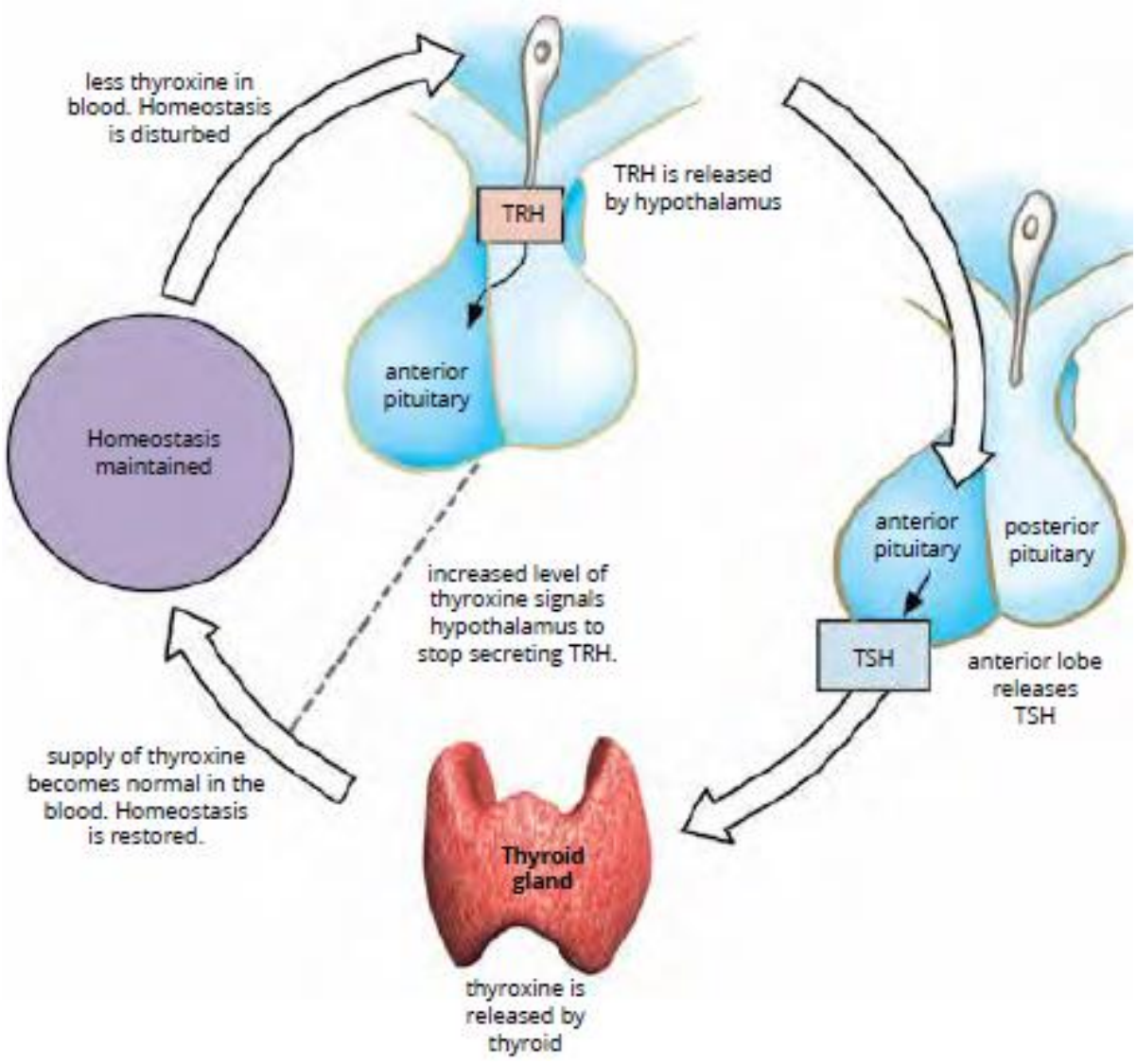
Hormone of intermediate lobe of pituitary

It secretes melanocyte stimulating hormone (MSH) which stimulate skin to secrete melanocyte (melanin pigment).

Feedback mechanism of hormone secretion

Thyroid stimulating hormone (TSH) and thyroxine regulate each other's level just like the requirement–supply kind of situation. Such a system of opposing effects leads to proper control and balance in a system. **The two opposing systems work in coordination and help the body to adjust its output accordingly**. The ultimate effect of such a feedback system is to maintain **homeostasis**.

Note: Summary of major hormones secreted in human body, their sources glands and principal functions are given in Table 12.3.



Feedback mechanism by pituitary to release TSH

The heart and kidneys also secrete hormones!

The heart secretes a hormone called atriopeptin which lowers the blood pressure and helps to maintain fluid balance in the body. Its target are the blood vessels and kidneys. Kidneys have been found to secrete the hormone erythropoietin which acts on the bone marrow and stimulates red blood cell production.

SUMMARY...

❖ Hormones are chemical messengers secreted by endocrine glands and carried by blood or lymph to a target organ elsewhere in the body to stimulate a specific physiological change.

❖ Hormones (i) are secreted in minute quantity, (ii) are specific chemical messengers, (iii) regulate physiological processes by chemical means, (iv) are secreted by ductless (endocrine) glands, (v) are poured directly into blood stream, and (vi) their action is very rapid and they act on a specific target.

❖Adrenal glands are also called suprarenal glands. Each adrenal gland has an outer region called cortex and an inner region called medulla.

● Adrenal cortex secretes glucocorticoids and mineralocorticoids.

● Glucocorticoids regulate metabolism of proteins, fats and carbohydrates in the body and regulate blood sugar level.

● Mineralocorticoids (aldosterone) control reabsorption of sodium in kidney tubules.

● Adrenal medulla secretes adrenalin and noradrenalin hormones. Both these hormones together control emotions, fear, anger, blood pressure and heartbeat rate and are called emergency hormone.

❖ Thyroid gland is situated in the neck region. It secretes two hormones – thyroxine and calcitonin.

❖ Pancreas produces insulin from beta cells and glucagon from alpha cells of islets of Langerhans.

❖ Pituitary gland has three lobes – anterior lobe, posterior lobe and intermediate lobe.

❖ Anterior pituitary secretes six main hormones –

- Growth hormone (GH)
- Adrenocorticotropic hormone (ACTH)
- Thyroid stimulating hormone (TSH)
- Follicle stimulating hormone (FSH)
- Luteinizing hormone (LH)
- Prolactin (PRL)

❖ Posterior pituitary stores two hormones – antidiuretic hormone (ADH) and oxytocin.

❖ Hormone production is regulated by a feedback mechanism.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