10 Endocrine Glands — "The Producers of Chemical Messengers"

Syllabus : *Endocrine System : General study of the following glands : Adrenal, Pancreas, Thyroid and Pituitary. Difference in Endocrine and Exocrine glands.*

Scope of syllabus : Correct location and shape of the gland in the human body should be discussed along with the hormones they secrete (Pancreas : insulin and glucagon to be taught; Thyroid : only thyroxin to be taught). Effects of hypo-secretion and hyper-secretion of hormones must be discussed. The term tropic hormones should be explained in the study of pituitary. Brief idea of feedback mechanism must be given.

Endocrine glands are such glands which secrete hormones. Hormones are extremely important secretions for the regulation of body activities. The full set of endocrine glands in the body includes numerous glands, but the syllabus specifies only a few of them as mentioned above.

10.1 NEED FOR THE REGULATION OF BODY ACTIVITIES

The activities in our body are highly complex and they need to be so regulated that every activity takes place ***at a proper time and in a correct sequence***. For example, the gastric juice, bile and pancreatic juice should be poured into the food canal only when there is food in it. Though this kind of regulation is done to some extent by the nervous system (Chapter 9), it is also brought about by ***chemical regulators*** called ***hormones*** (*horma:* to stir up // to excite // to put into action).

Seven major differences in the action of the nervous system and of hormones in the regulatory mechanism in our body are listed in Table 10.1 below:

Hormones are secretions from specific cells or glands in the body, and are carried to all parts by the blood, but their effect is produced in one or more specific parts (**target** organ or cells) only.

Most hormones are secreted by special glands, the **endocrine glands** (*endo*: inside, *crine:* separate) meaning "secrete internally", also called ductless glands because their ***secretions are poured directly into the blood*** and not through any special duct.

Certain hormones are also produced from some such glands or body parts which otherwise have a different primary function; for example, the stomach & duodenum.

Table 10.1 : Differences between hormonal control and nervous control

Hormonal control	Nervous control
1. Usually **slow**.	1. Immediate/**Rapid**.
2. Transmitted **chemically** through blood.	2. Transmitted **electro-chemically** through the nerve fibres and chemically across synapses.
3. Affects **different organs** (**widespread** in body).	3. Affects only the particular muscles or the gland (**local**).
4. Effect is **short term** or **long-lasting**.	4. Effect **only short-lived**.
5. **Can affect growth.**	5. **Cannot affect growth.**
6. Can bring about specific chemical changes and **regulates metabolism.**	6. Does not influence chemical changes and **cannot regulate metabolism.**
7. **Cannot be modified** by learning from previous experience.	7. **Can be modified** to some extent by learning from previous experience.

Endocrine system. Endocrine system consists of several glands/glandular cells which bring about the overall common function of chemical coordination in the body. Almost all endocrine glands act in a coordinated manner. They activate each other and work as a system of organs called **endocrine system**. A system is defined as a group of organs performing an overall **common** function.

10.2 GENERAL PROPERTIES OF HORMONES

1. Hormones are secreted from their source **directly into the blood** (and not into lymph).
2. They **regulate** the physiological processes **by chemical means**. They affect the enzyme systems of the body.
3. They **act on target organs or cells** usually away from their source.
4. Hormones produced in one species usually show **similar influence in other species**.
5. They are produced in **very small quantities** and are **biologically very active**. For example, adrenaline is active even in a concentration of 1 part in 300,000,000 parts.
6. Chemically, some hormones are **peptides (proteins such as insulin)** which are water soluble, some are **amines** (derived from **amino acids such as adrenaline**) again water-soluble and some are **steroids** derived from cholesterol such as testosterone which are lipid-soluble.
7. Their **excess** (hypersecretion/oversecretion) **or deficiency** (hyposecretion/undersecretion), both may **lead to serious consequences**.
8. Hormones are **not stored** in the body and are excreted from the system.

Hormone is a secretion from some glandular part of the body, which is poured into blood and which acts on the target organs or cells of the same individual, bringing about coordination between distant parts of the body.

? PROGRESS CHECK

1. Fill in the blanks by selecting the appropriate alternative from those given in brackets.
   (i) Regulation of activities inside the body are brought about by ..... and ..... systems. **(nervous/digestive/endocrine)**
   (ii) Hormones are secreted directly into the ..... **(organs/lymph/blood)**.
   (iii) Chemically, some hormones are ....., some steroids, some ..... **(proteins/amines/carbohydrates)**.
   (iv) Both ..... or deficiency of hormones lead to serious consequences **(excess/absence)**.
   (v) Hormones produced in one species usually show ..... influence in other species. **(similar/different)**.
2. Give the characteristics of hormones pertaining to
   (i) Site of action .....
   (ii) Chemical nature .....
   (iii) Manner of transportation. .....

10.3 ENDOCRINE GLANDS

The principal endocrine (hormone-producing) glands in the human body have been shown in Fig. 10.1.

These are enumerated below (only the ones in bold face are included in the syllabus):

1. **Adrenal**
2. **Pancreas**
3. **Thyroid**
4. **Pituitary**
5. Parathyroid
6. Thymus
7. Gonads

We shall try to explain the major functions of each endocrine gland.

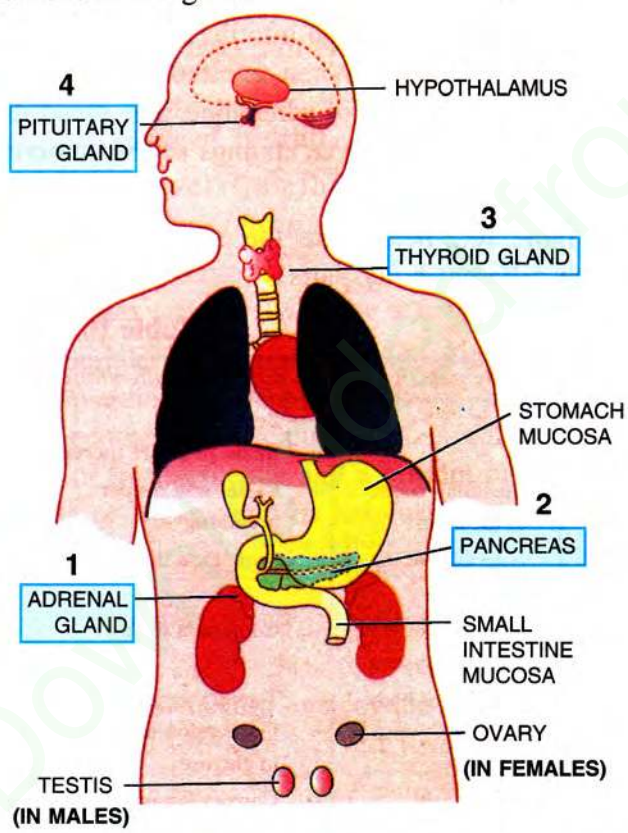


Fig. 10.1 : The principal endocrine glands. (Both sexes have the same endocrine glands except the sex glands *i.e.* ovaries in female and testes in male). The syllabus specifies only four (the ones in boxes 1-4)

1. ADRENAL GLANDS

The adrenal glands are like caps above the kidneys (*ad:* near, *renal:* kidney). Each adrenal gland consists of two parts — (i) a central *medulla* and (ii) a peripheral *cortex*.

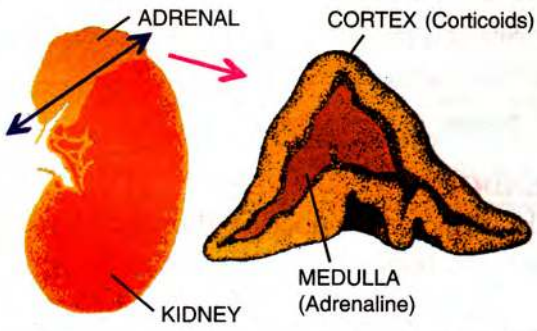


Fig. 10.2 : Position of adrenal on kidney, and its two parts in cross section which secrete respective hormones.

(i) Adrenal medulla secretes **adrenaline** (also called epinephrine and noradrenaline). Adrenaline is a hormone, which prepares the body to meet any emergency situation, for **"fight"** *i.e.* to face danger or for **"flight"**, to run away from it. Extra energy and strength is provided to the body in that situation. Extra hormone is released into the blood at the time of emotional stress. When **excited** or **angry** our adrenals produce a lot of adrenaline. The gland itself is stimulated by the nerve endings of the autonomic nervous system.

Table 10.2 below lists the effects of adrenaline on the different body parts.

FUNCTIONS OF ADRENALINE—THE EMERGENCY HORMONE

- It **increases heart** beat accompanied by an increase in blood pressure.
- It **increases blood supply to the muscles** while decreasing it to skin and visceral organs.
- **More glucose is released** into the blood by the liver (like putting more fuel into the engine). [The final dash to win a raoe is under the influence of adrenaline].

(ii) Adrenal cortex secretes many hormones but the best known hormone is **cortisone** (which suppresses inflammation).

The cortical hormones are categorised as :

a. Mineralocorticoids : regulates mineral metabolism, specially Na^+ and K^+ ions.

b. Glucocorticoids : regulates carbohydrate, protein and fat metabolism.

In general, the cortical hormones

- Increase blood glucose concentration.
- influence fat and protein metabolism.
- regulate salt and water balance in the body.
- adapt the body to "stresses" such as extreme heat or cold, burns, infections, *etc.*
- Certain cortical hormones behave like sex hormones. They are both male as well as female hormones in both sexes. An overgrowth of cortex in young children leads to a premature sexual maturity.

Table 10.2 : Responses to Adrenaline

	Body part	*Effects of adrenaline*	*Biological advantage*	*Effect or sensation*
1.	Heart	**Beats faster** **Blood pressure increases**	Sends more glucose and oxygen to the muscles	**Thumping heart**
2.	Breathing centre of the brain	**Faster and deeper breathing**	Increased oxygenation of the blood; rapid removal of carbon dioxide	**Panting**
3.	Arterioles of the skin	**Constricts them**	Less blood going to the skin means more is available to the muscles	**Person turns pale**
4.	Arterioles of the digestive system	**Constricts them**	Less blood for the digestive system, allows more to reach the muscles	**Dry mouth**
5.	Muscles of body	**Tenses them**	Ready for immediate action	**Tense feeling; shivering**
6.	Liver	**Conversion of glycogen to glucose**	Glucose available in blood for energy production	**No sensation**
7.	Fat deposit	**Conversion of fats into fatty acids**	Fatty acids available in blood, for muscle contraction	

In addition, adrenaline also increases clotting capacity of the blood, **dilates pupil of the eye**, stimulates uterine contraction during labour (delivery of baby), stimulates muscle of the hair follicles. (These functions are in general the same as those of the sympathetic autonomic nervous system).

Women with beard & Men with breasts!

If there is an overgrowth of adrenal cortex in a mature woman, she develops certain male characteristics, such as, a beard, moustaches and deep male voice. The condition is known as **adrenal virilism** (Latin *Virilism* : maleness).

If the overgrowth occurs in mature men, they may develop some feminine characteristics, such as, enlargement of breasts.

Hyposecretion from adrenal cortex causes Addison's disease. Symptoms are loss of energy, skin pigmentation, loss of weight, nausea, hypoglycemia (low blood sugar), sensitivity to cold and pain, increased susceptibility to infections, etc.

Hypersecretion of adrenal cortex causes Cushing's syndrome. Symptoms are obesity, hyperglycemia (higher blood sugar), osteoporosis, weakness, salt and water retention.

2. PANCREAS

Pancreas is both a duct gland as well as a ductless gland. As a duct gland, its secretion (pancreatic juice) is poured into the duodenum for digestion. As a ductless gland, it has special groups of hormone-secreting cells called **Islets of Langerhans**, which are scattered in the entire gland (*islets :* little islands) (Fig. 10.3). The islet cells produce three hormones — *insulin*, *glucagon* and *somatostatin* from three different kinds of cells called beta, alpha and delta cells respectively. (*Note : Somatostatin from Delta cells is excluded from syllabus*).

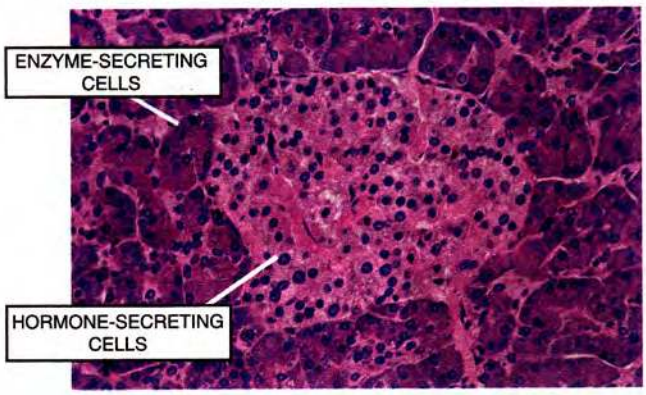


Fig. 10.3 : Section of pancreas tissue showing one islet (× 250)

(1) Insulin secreted by beta cells checks rise of sugar level in blood. This it does in two principal ways:

(i) It promotes **glucose utilisation** by the body cells.

(ii) It stimulates **deposition of extra glucose** of the blood as glycogen in liver and muscles.

Abnormalities in insulin — shortage and excess.

Insufficient secretion of insulin causes **diabetes** (more correctly **diabetes mellitus** or ***hyperglycemia*).** The word *"mellitus"* means honey, referring to the passage of sugar (glucose) in urine. A diabetic person:

- has **high concentration of sugar in blood** (hyperglycemia — *hyper* : excess, *glyce* : sugar (glucose), *emia* : blood.
- excretes a **great deal of urine** loaded **with sugar**.
- feels **thirsty** because of the loss of water through too much urination.
- **loses weight** and becomes weaker and weaker. In certain cases, the person loses eye sight or vision.

The usual treatment by administering insulin is not a cure, but only a method of supplying the hormone which is not being produced by the pancreas.

Over-secretion of insulin

- Sugar level in the blood is lowered (hypoglycemia, *hypo* : below) and
- Brain may enter a state of coma if the level becomes too low even for a few minutes.

A similar thing may happen to a diabetic patient if an overdose of insulin is given — the patient may become unconscious. This is called **insulin shock** or hypoglycemia and a prompt bite of sweet biscuits or sugar candy is helpful.

Caution in answering a question.

It is **wrong** to say "insulin converts glucose to glycogen."

Instead, "insulin enables the cells to absorb glucose and use it or convert it into glycogen."

(2) Glucagon is secreted from alpha cells. It stimulates the breakdown of glycogen in the liver to glucose, thus it raises sugar level in the blood.

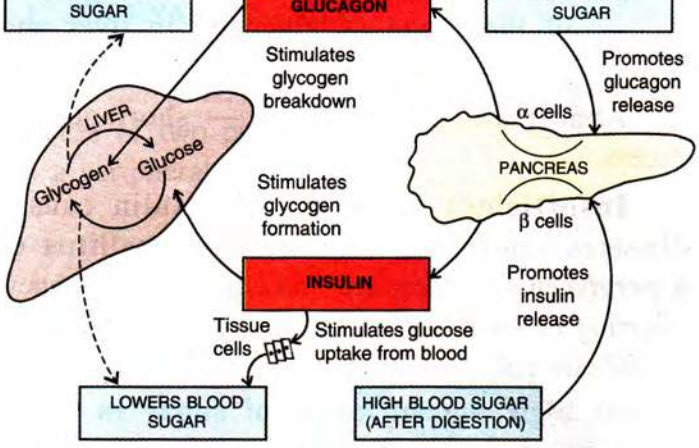


Fig. 10.4 : The role of pancreatic hormones (insulin and glucagon) in regulating blood sugar (glucose) level

HORMONES OF ISLETS OF LANGERHANS
(in Pancreas)

1. ***Insulin*** *(from beta cells)*
   - *Promotes glucose uptake by body cells*
   - *Stimulates deposition of extra glucose (as glycogen) in liver and muscles*

   Deficiency *causes diabetes mellitus (sugar diabetes)*

   Excess *causes nerve cell starvation & brain coma.*
2. ***Glucagon*** *(from alpha cells)* – *Stimulates liver to convert glycogen into glucose*
3. ***Somatostatin*** *(from delta cells)* (Not in syllabus) – *Inhibits secretion of insulin and glucagon.*

? PROGRESS CHECK

1. Mention against the three types of cells of the islets of Langerhans, the name of the hormone they secrete.
   (i) Alpha cells .....
   (ii) Beta cells .....
   (iii) Delta cells .....
2. Mention the two principal ways in which insulin acts :
   (i) .....
   (ii) .....
3. Name the following conditions :
   (i) Passage of much glucose in urine .....
   (ii) Overdose of insulin makes the diabetic patient unconscious .....
4. List any three symptoms of diabetes mellitus.
   (i) .....
   (ii) .....
   (iii) .....
5. List any two effects of adrenaline
   (i) .....
   (ii) .....
6. Name the two categories of hormones secreted by adrenal cortex.
   (i) .....
   (ii) .....

3. THYROID

The thyroid is a bilobed (butterfly-shaped) structure (Fig. 10.5) situated in front of the neck just below the larynx. The two lobes are joined by a narrow isthmus (interconnection). It secretes two hormones **thyroxine** and **calcitonin.** [*Note : Calcitonin is not included in the syllabus*].

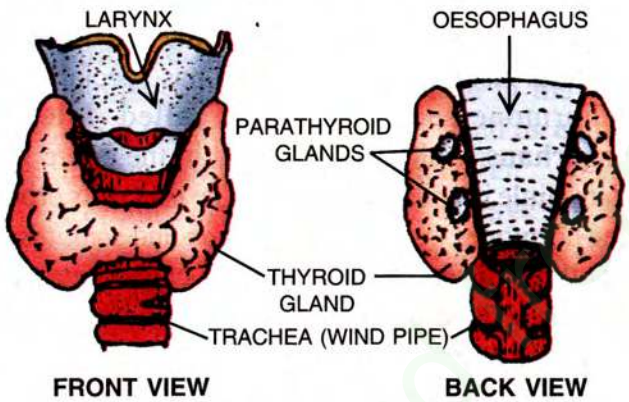


Fig. 10.5 : Thyroid gland

Thyroxine regulates the basal metabolism, *i.e.*, the rate of cellular oxidation resulting in heat production at rest. An increase in the secretion increases metabolism and a decrease in secretion lowers it. It also influences the general growth of the body, ossification of bones, body temperature, mental development, etc.

A. Undersecretion (Hypothyroidism) : Insufficient secretion of thyroxine may lead to three conditions – **simple goitre, cretinism** and **myxoedema**.

(i) **Simple goitre** is the enlargement of the thyroid and is visible as a **swelling in the neck** (Fig. 10.6). This is due to insufficient quantity of iodine in food. This condition is common in

is deficient in soil and hence in the food grown there.

Fig. 10.6 A person suffering from simple goitre

Thyroid deficiencies are common in many parts of India. Use of iodised salt (containing iodine) in food is recommended because iodine is the active ingredient in the production of thyroxine.

(ii) **Cretinism** is a condition which affects the growth of children showing **dwarfism** and **mental retardation**. This is due to defective development, or early atrophy (degeneration) of the thyroid.

(iii) **Myxoedema** is a condition that affects an adult if his thyroid does not function properly; in this condition, the person becomes **sluggish** with **swelling of the face and hands**.

B. Oversecretion (Hyperthyroidism) : Excess of thyroxine secretion may also cause a kind of goitre called **exophthalmic goitre** (*exo :* outward, *ophthalmos :* eye).

A person having the problem of oversecretion shows

- a marked increase in metabolic rate,
- rapid heart beat,
- shortness of breath;
- eyes are protruded, and
- forms a goitre in the neck.

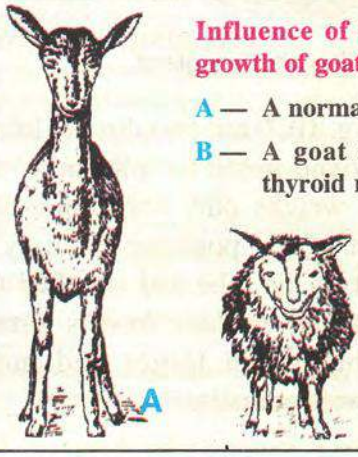
IMPROPER FUNCTIONING OF THYROID

Hypothyroidism (undersecretion)

1. ***Simple goitre*** *— enlargement of thyroid.*
2. ***Cretinism*** *— dwarfism and mental retardation.*
3. ***Myxoedema*** *— swelling of face and hands, sluggishness.*

Hyperthyroidism (oversecretion)

1. ***Exophthalmic goitre*** *— protruding eyes, increased metabolism, shortness of breath, restlessness.*



Influence of thyroid gland on the growth of goats.

A — A normal 4-month old goat;

B — A goat of the same age with thyroid removed.

PROGRESS CHECK

Fill in the blanks with the correct alternative from those given for each :

(i) Thyroid is located close to ..... **(larynx/kidney).**

(ii) Cretinism is caused due to ..... of thyroxin **(undersecretion/oversecretion)**

(iii) Oversecretion of thyroxin causes ..... goitre. **(simple/exophthalmic)**

(iv) The condition showing swelling on face and hands and sluggishness due to hypothyroidism is called ..... **(cretinism/myxoedema)**

(v) The hormone concerned with facing dangers is ..... **(thyroxine/cortisone/adrenalin)**

(vi) Cortex and medulla are the two regions of .... **(thyroid/adrenal)**

(vii) One of the effects of increased secretion of adrenaline is ..... **(Dry mouth/slowing of heart beat/face flushed with blood)**

4. PITUITARY

The pituitary gland is a small projection (about the size of a pea) which hangs from the base of the mid-brain below hypothalamus (Fig. 9.6 page 111). It is popularly called the ***master gland*** because it seems to control practically all other endocrine glands.

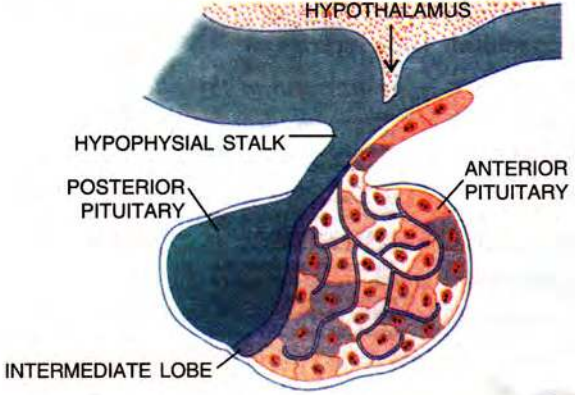


Fig. 10.7 : The pituitary gland

Pituitary gland (Fig. 10.7) has two distinct lobes, the **anterior pituitary** and **posterior pituitary** (the entire pituitary gland weighs only about **one-half gram).** The front part of the posterior pituitary is different from the rest of the lobe and is called the intermediate lobe. The *intermediate lobe* is almost absent in humans but much larger and more functional in some lower animals.

A. HORMONES FROM ANTERIOR PITUITARY

Some important hormones produced by the **anterior lobe** are as follows:

1. **Growth hormone** (GH) is essential for normal growth. It is also called ***somatotropin*** (*somatic:* body, *tropic:* stimulating).
   - The **deficiency** of GH in **childhood** results in **dwarfism**. [A **dwarf**, though fully developed, retains body proportions of a child.]

Fig. 10.8 : These two fully-grown men are victims of malfunctioning of the pituitary gland.

   - The **oversecretion in childhood** results in **gigantism**; the long bones lengthen beyond normal and human giants upto 2.7 metres in height are produced (Fig. 10.8).
   - If ***oversecretion*** of the growth hormone suddenly occurs ***in an adult***, there is an extra growth of bones in the face (particularly the jaws) and in the hands and feet. The person develops a large nose and thick lips. This condition is called **acromegaly** (*acro:* height/extremity, *megaly:* large).
2. **Thyroid stimulating hormone** (TSH) activates thyroid to secrete thyroxin.
3. **Gonad stimulating (Gonadotropic) hormones** regulate the activities of the testes and ovaries.
4. **Adrenocorticotropic hormone (ACTH)** regulates the activity of adrenal cortex.

The term **tropic hormones** refers to such hormones which *stimulate other endocrine glands* to produce their specific hormone such as gonadotropic hormones secreted by anterior pituitary and also stimulate gonads to produce certain hormones. **"Tropic"** means ***influencing the activity*** of the named organ such as *thyrotropic* (for thyroid), adrenocorticotropic (for adrenal cortex), etc.

B. HORMONES FROM POSTERIOR PITUITARY

The **posterior lobe** produces two hormones named vasopressin and oxytocin.

1. **Antidiuretic hormone** (ADH), also called **vasopressin**, constricts blood vessels with rise in blood pressure. It also acts on the kidney increasing reabsorption of water from the kidney tubules.
   - Deficiency of ADH causes **diabetes insipidus** (water diabetes) in which urination is frequent and copious, resulting in loss of water from the body and the person becomes thirsty.

REMEMBER

"Diabetes" means passing out excessive amounts of urine. **The two types of "diabetes" :** In ***diabetes mellitus***, the urine contains sugar caused due to insufficient insulin, but in ***diabetes insipidus***, there is no sugar in urine. *"Insipid"* means tasteless (blank) referring to the absence of sugar in urine and *"melli"* means honey/sweet.

2. **Oxytocin** (Gk. *oxys* : sharp/quick, *tokos* : childbirth) stimulates vigorous contractions of the uterus in a pregnant mother, leading to the birth of the baby. Also, stimulates milk ejection.

Table 10.3 : Hormones of pituitary gland and their actions

Source	Hormones and their action	
ANTERIOR PITUITARY	**GROWTH HORMONE (GH)**	***Promotes growth of whole body, particularly of the skeleton*** Deficiency (–) In childhood = ***Dwarfism*** Excess : (+) In childhood = ***Gigantism*** In adult = ***Acromegaly***
	TROPIC HORMONES (Stimulate certain other endocrine glands)	***THYROID STIMULATING HORMONE (TSH)*** ***(Stimulates thyroid to secrete thyroxine)***
		ADRENOCORTICOTROPIC HORMONE (ACTH) (Stimulates adrenal cortex)
		GONADOTROPIC HORMONES ***(Regulate the activities of Gonads-testes and ovaries)*** ***These are mainly of three types*** (i) ***Follicle-Stimulating Hormone (FSH)*** *Stimulates egg formation in females and sperm formation in males* (ii) ***Luteinizing Hormone (LH)*** *Stimulates the formation of corpus luteum to produce the female hormone progesterone, and the testes to produce the male hormone testosterone* (iii) ***Prolactin*** - *Milk secretion*
POSTERIOR PITUITARY	**ANTIDIURETIC HORMONE (ADH)** or **Vasopressin**	***Increases reabsorption of water from kidney tubules*** *Deficiency :* ***Diabetes insipidus (water diabetes)***
	OXYTOCIN	***Uterus contractions during child birth, stimulates milk ejection***

Table 10.3 summarises all the main hormones secreted by the pituitary and their action.

PROGRESS CHECK

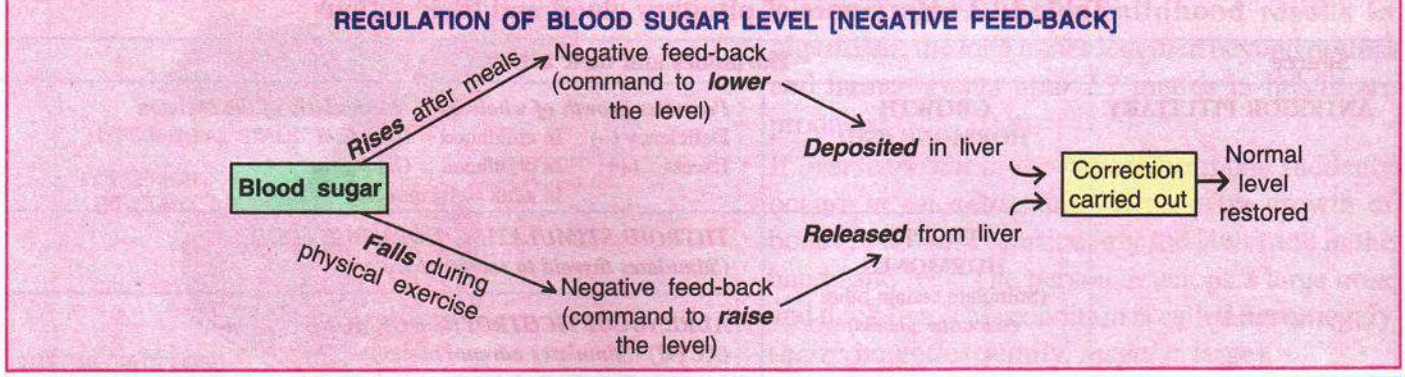
1. Mention if the following statements are true (T) or false (F). If false, rewrite the correct word (not words) striking out the single wrong one.
   (i) Pituitary is of the size of a lemon. T/F
   (ii) Pituitary has three lobes — anterior, posterior and intermediate. T/F
   (iii) Oversecretion of growth hormone in adult causes gigantism. T/F
   (iv) Vasopressin secreted by anterior lobe controls reabsorption of water form kidney tubules. T/F
2. Write the full forms of :
   (i) TSH .....
   (ii) LH .....
   (iii) ACTH .....
   (iv) ADH .....
3. What causes the following ?
   (i) Acromegaly .....
   (ii) Diabetes insipidus .....

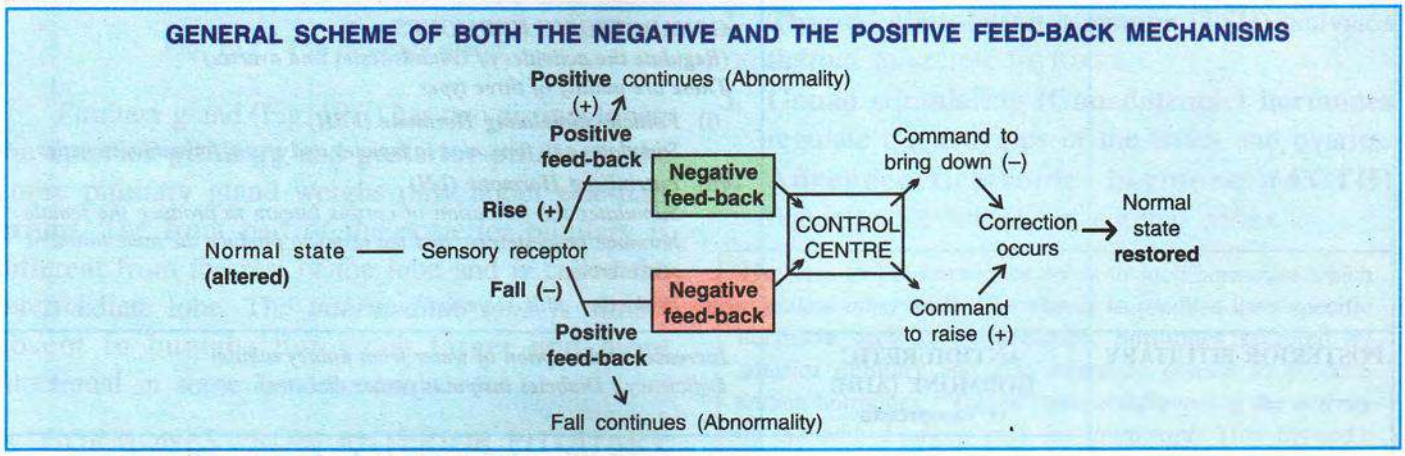
10.4 CONTROL OF HORMONAL SECRETIONS *[Feedback mechanism]*

[Commands like saying **"Too much, slow down"** or **"Too-little, speed up"**] – This is the feedback mechanism.

The body has mechanism to maintain a normal state. Whenever there is a change in this state there are "messages" through the body systems to "increase" if there is a fall below the normal, or to "decrease" if there is a rise above the normal. This kind of ordering for the opposite is **"negative feedback"**, to restore the normal state. Most feed-back mechanisms in our body are of this negative type. ***Example :*** Blood sugar level :

Positive feed-back mechanisms are very few. One example is that of uterine contractions during child birth. Normal state of uterus is uncontracted, one contraction instead of commanding to come to normal gives a message to continue to contract further (positive feed-back till delivery is completed).





10.5 THE HORMONES AT A GLANCE

Table 10.4 gives a consolidated general summary of the hormones from the four major endocrine glands, their actions and the disorders due to their undersecretion or oversecretion.

Table 10.4 Hormones from four major endocrine glands and their principal actions.

ENDOCRINE GLAND	HORMONES SECRETED	PRINCIPAL ACTIONS	DISORDERS	
			Undersecretion	Oversecretion
1. ADRENALS				
(i) Adrenal cortex	i. Mineralocorticosteroids (aldosterone)	Regulate plasma sodium and potassium concentrations,	Addison's disease	Adrenal virilism
	ii. Glucocorticoids (cortisol, corticosterone)	Regulate carbohydrate, lipid, and protein metabolism		
	iii. Sex corticoids (adrenal androgens)	Stimulate development of external sex characters in males		
(ii) Adrenal medulla	Adrenaline	Causes stimulation of sympathetic nervous system. Prepares body for any emergency.		
2. PANCREAS (Islets of Langerhans)				
(i) Beta cells	i. Insulin	Lowers blood sugar level	Diabetes mellitus	
(ii) Alpha cells	ii. Glucagon	Raises blood sugar level		
(iii) Delta cells	iii. Somatostatin *(not in syllabus)*	Inhibits the secretion of insulin and glucagon	—	—
3. THYROID	i. Thyroxine	Promotes tissue metabolism, growth and differentiation	Simple goitre, cretinism in children and myxoedema in adults	Exophthalmic goitre (Eye balls protrude, increased metabolism and restlessness)
	ii. Calcitonin *(not in syllabus)*	Promotes movement of calcium ions from blood to bones		

(Contd.)

4. PITUITARY				
(i) Anterior pituitary	i. Growth hormone (somatotropin; GH)	Body growth	dwarfism	Gigantism in childhood, acromegaly in adulthood
	ii. Prolactin	Promotes lactation (milk formation and secretion)		
	iii. Adreno-corticotropic hormone (ACTH)	Stimulates secretion from adrenal cortex		Pigmentation in Addison's disease
	iv. Thyroid-stimulating hormone (TSH)	Stimulates thyroxine secretion		
	v. Follicle stimulating hormone (FSH)	*In females*, growth of Graafian follicles and estrogen secretion *In males*, spermatogenesis.		
	vi. Luteinizing hormone (LH)	*In females*, ovulation, maintenance of corpus luteum and secretion of progesterone *In males*, testosterone secretion.		
(ii) Posterior pituitary	i. Vasopressin (ADH)	Increases reabsorption of water from kidneys, contraction of blood vessels causing rise in blood pressure	Diabetes insipidus	Elevation of blood pressure
	ii. Oxytocin	Causes contraction of uterine muscle during childbirth		

REVIEW QUESTIONS

A. MULTIPLE CHOICE TYPE

(Select the most appropriate option in each case)

1. A gland having endocrine as well as exocrine function is
   (a) pituitary (b) thyroid
   (c) pancreas (d) adrenal
2. Exophthalmic goitre is caused due to the overactivity of
   (a) thymus (b) thyroid
   (c) parathyroid (d) adrenal cortex.
3. The secretion of ADH (anti-diuretic hormone) is inhibited by
   (a) emotion and stress (b) nicotine
   (c) alcohol (d) morphine

B. VERY SHORT ANSWER TYPE

1. **Name** the following:
   (a) The three hormones produced by pancreas.
   (b) The hormone produced by adrenal medulla.
   (c) The condition caused by the oversecretion of insulin.
   (d) The hormone secreted by β (beta) cells of the islets of Langerhans.
   (e) The hormone which increases blood pressure.
   (f) The hormone causing more urine formation.
   (g) The hormone which stimulates the entire sympathetic nervous system.
2. **What** would a child suffer from, if there was hyposecretion from his thyroid ?
3. **Choose** the odd one out from each series
   (a) The glands – ***thyroid, adrenal, pituitary, prostate*** .....
   (b) The conditions – ***cretinism, myxoedema, goitre, scurvy*** .....
   (c) The hormones – ***insulin, glucagon, cretinism, thyroxine*** .....
   (d) The hormonal sources – ***adrenal cortex, adrenal medulla, cortisone, pituitary*** .....
4. **Identify** the odd one in each of the following and mention what the rest are :
   (a) Larynx; glucagon; testosterone; prolactin. .....
   .....
   (b) Adrenaline; penicillin; insulin; thyroxin .....
   .....
   (c) Stomach; ileum; liver; adrenaline .....
   .....
   (d) TSH; GH; ADH; insulin. .....
   (e) Iodine, cretinism, goitre, myxoedema. .....
   .....

5. **Match** the items of column I with those of column II.

Column I	Column II
1. 'β' (beta) cells of islets of Langerhans	(a) Condition due to undersecretion of thyroxine in adults.
2. Thyroid	(b) Glucocorticoids
3. Cretinism	(c) Exophthalmic goitre
4. Addison's disease	(d) Increases heart beat
5. Hypothyroidism	(e) Thyroxine
6. Myxoedema	(f) Adrenal cortex
7. Adrenaline	(g) Insulin
8. Cortisone	(h) Undersecretion of thyroxine in a child.

6. **Match** the conditions in column A with the cause in column B

A (Condition)	B (Cause)
(a) Dwarfism and mental retardation.	(i) Shortage of glucose in blood.
(b) Diabetes mellitus	(ii) Oversecretion of growth hormone.
(c) Excess of glucose in blood.	(iii) Insulin shock.
(d) Gigantism	(iv) Oversecretion of thyroxine.
(e) Enlargement of breasts in adult males	(v) Hypothyroidism
(f) Exophthalmic goitre	(vi) Oversecretion of cortical hormones.

C. SHORT ANSWER TYPE

1. **Mention** which of the statements are ***true*** **(T)** and which are ***false*** **(F)**. Give reason in support of your answer.

(a) Adrenaline is often described as the emergency hormone. (T/F)

(b) There are two kinds of diabetes (mild and severe) related with two different hormones. (T/F)

(c) Simple goitre can be prevented by using iodised salt in food. (T/F)

(d) Pituitary is popularly called the master gland. (T/F)

(e) Hormones "obey" the commands like "enough, slow down or "two little, speed up". (T/F)

(f) Gigantism and dwarfism in humans basically depend on the quality and quantity of the food eaten during early growing age. (T/F)

2. **How** do endocrine glands differ from other glands ?

3. **Mention** any two differences between a hormone and an enzyme.

4. **Do you agree** with the statement – "All hormones are chemical signals"? Yes/No. Justify your answer.

5. **Why** is iodine as a nutrient, important to our body ?

6. If you stand to make your maiden speech before a large audience, your mouth dries up and heart rate increases. **What brings about** these changes?

7. If one adrenal gland is removed, the other one gets enlarged to some extent. **How do you explain** this change ?

8. **Name** the two kinds of diabetes ? **Mention** their symptoms and the causes.

9. People living in the low Himalayan hilly regions often suffer from goitre. **What could be** the possible reason for it ?

10. Given below is a table designed to give the names of the glands, the hormones produced, their chief functions, the effects of oversecretion and undersecretion in respect of thyroid, pituitary and pancreas. Fill up the blanks 1-13.

S.No.	Source Gland Cells	Hormone produced	Chief function	Effect of oversecretion	Effect of undersecretion
1.	(1)	Thyroxine	(2)	(3)	(4) .....
2.	Beta cells of Islets of Langerhans	(5)	Promotes glucose utilisation by the body cells	(6)	(7) .....
3.	(8)	Growth Hormone	(9)	(10)	Dwarfism
4.	(11)	Vasopressin	Increases reabsorption of water from kidney tubules	(12)	(13) .....

11. **Complete** the following table by filling in the blanks numbered 1 to 7

Gland	Hormone secreted	Effect on body
(1)	(2)	Regulates basal metabolism
Pancreas ("beta" cells)	(3)	Controls blood sugar.
(4)	(5)	Increases heart beat
(6)	Thyroid stimulating hormone	(7) .....

12. **Complete** the following table by filling in the blank spaces numbered 1 to 8.

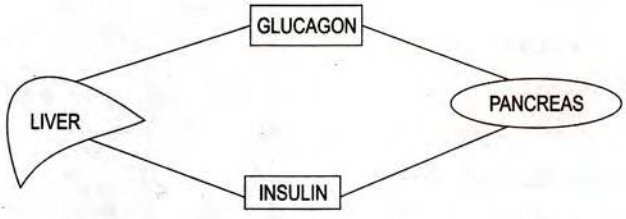
Gland	Secretions	Effect on body
(1)	Oestrogen	(2) .....
Alpha cells of Islets of Langerhans	(3)	(4) .....
(5)	(6)	Protruding eyes
(7)	(8)	Gigantism.

D. LONG ANSWER TYPE

1. **Compare** the hormonal response with the nervous response with respect to their speed, transmission and the general nature of changes brought about.
2. **Mention** three important differences between the action of hormones and that of nerves in the regulatory mechanism of our body.

E. STRUCTURED/APPLICATION/SKILL TYPE

1. Study the diagram given below and then answer the questions that follow:

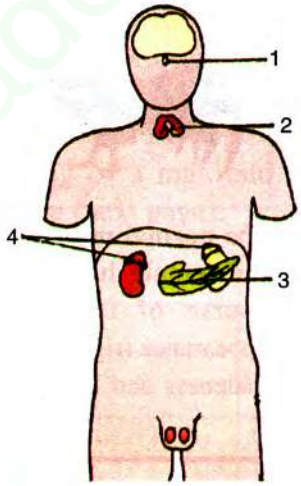


(a) **Name** the cells of the pancreas that produce (l) glucagon (2) insulin.
(b) **State** the main function of (1) glucagon and (2) insulin.
(c) **Why** is the pancreas referred to as an exo-endocrine gland?
(d) **Why** is insulin not given orally but is injected into the body?
(e) **What** is the technical term for the cells of the pancreas that produce endocrine hormones?
(f) **Where** in the body is the pancreas located?

2. Given alongside is a portion from the human body showing some important structure in ventral (front) view.

(a) **Where** is this portion located in the body ?
(b) **Name** the structures numbered 1-3.
(c) **State** one main function of each of the structures named above.
(d) Is there any duct to carry the secretions from the structure numbered 2? If so, give its name.

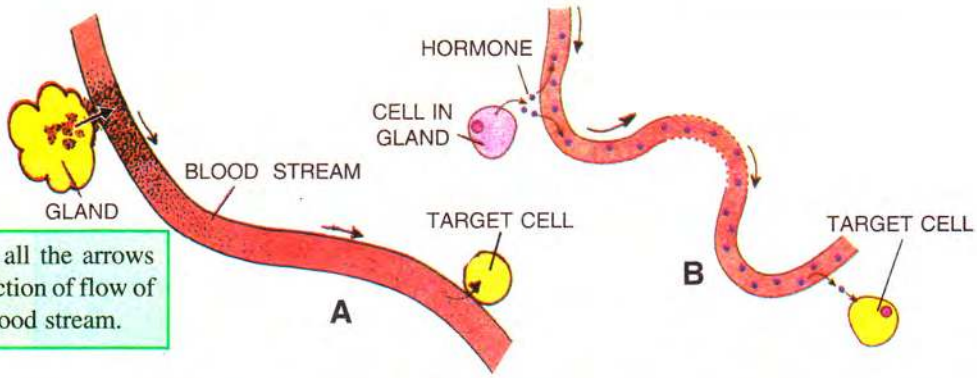
3. Given alongside is an outline diagram of human body showing position of certain organs.



(a) **Name** the parts numbered 1 to 4.
(b) **What** is common to all these parts in regard to the nature of their functions ?
(c) **Name** the nutrient element which is essential for the normal working of part 2.

4. Given below are two diagrams (one is correct, the other is somewhat incorrect) showing the transport of a hormone from its source gland/cell to the target organ/cell.

(a) **Which** one has the error — A or B? ..... (b) **What** is the error? .....



HINT : Look at all the arrows indicating the direction of flow of hormone inside blood stream.

JUST FOR CURIOSITY!

(But not in syllabus)

HE or SHE?

Given alongside is the picture of a **woman** with otherwise feminine characteristics. Hormonal disturbance has led to the growth of moustaches, beard and even hair on chest.

Which hormone you think is involved in this abnormality? .....

(Clue : Read the matter on page 137)

THE SHORTEST AND THE TALLEST

The short and long : He Pingping (2 feet 5 inches) of China and Sultan Kosen (8 feet 1 inch) of Turkey, in Istanbul. (Times of India, Jan. 15, 2010).

Such abnormalities are usually the result of respective undersecretion and oversecretion of growth hormone

THE "MAGIC" OF THE FEMALE SEX HORMONE!

The **normal male cock was injected with the female hormone oestrogen**. In due course of time, the changes in the appearance (right one) markedly reduced its maleness and brought in femaleness.

A CASE OF ACROMEGALY (7 FEET 3 INCHES TALL)

This could be due to a tumour in pituitary, causing excessive secretion of growth hormone.