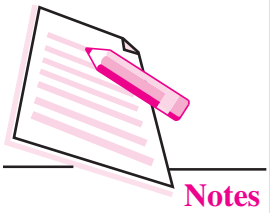


Notes

2. Name the following :

   (i) The part into which the sound waves are directed by the ear pinna.

   .....

   (ii) The kind of balance with which the semi-circular canals are concerned.

   .....

   (iii) Any two sensations felt through free nerve endings in the skin.

   .....

17.9 COORDINATION THROUGH HORMONES—THE ENDOCRINE SYSTEM

Hormones are secretions from specific cells or glands in the body called endoerine glands Harmones are carried by blood to target organs. Their effect is produced in one or more specific parts only. Most hormones are secreted by special glands called the endocrine glands. These are also called ductless glands because their secretions are poured directly into the blood and not through ducts. Certain hormones are produced by other glands or body parts also, for example, the stomach and the duodenum.

17.9.1 Nature and Function of Hormones

- Hormones are secreted from their source directly into the blood.
- Blood carries the hormone to the **target cells** which respond to it.
- Hormones **regulate** the physiological processes.
- They are produced in **very small quantities** and are **biologically very active**. For example, adrenaline is active even at a concentration of 1 in 300 million parts.
- Their **excess** and **deficiency**, both, cause serious disorders.
- Chemically, the hormones may be water-soluble **proteins (peptides), glycoproteins** and **amines** or lipid-soluble **steroids**.
- The extra hormones are not stored in the body and are excreted out.

17.9.2 Hormone Secretors — the Endocrine Glands

In humans there are more than a dozen tissues and organs that produce hormones. Most of these are shown in Fig. 17.8. These can be listed under two categories

(a) **Exclusively endocrine** : the **pituitary,** the **thyroid,** the **parathyroid, thymus** and the **adrenals.**

(b) **Partially endocrine** : The **pancreas, gastric and duodenal epithelium,** the **gonads** (testis in males and ovary in females) and **placenta** in females.

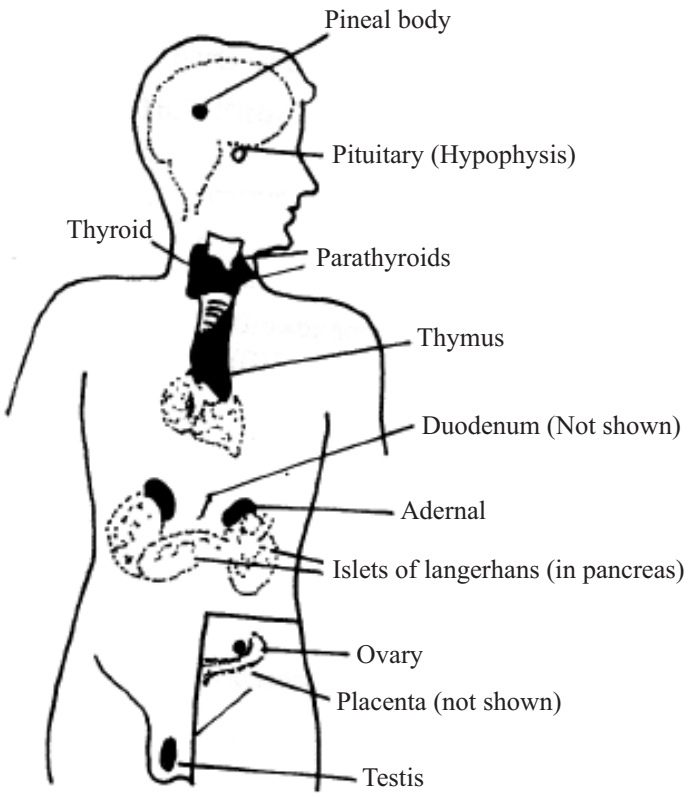


Fig. 17.8 Location of principal endocrine glands in the human body

1. Pituitary — the master gland

The pituitary gland (also called hypophysis) (Fig. 17.9) is a small projection (about the size of a pea) which hangs from the base of the mid-brain. It is connected to the hypothalamus of the brain by the pituitary stalk. The hypothalamus, although a part of the brain, also secretes some hormones.

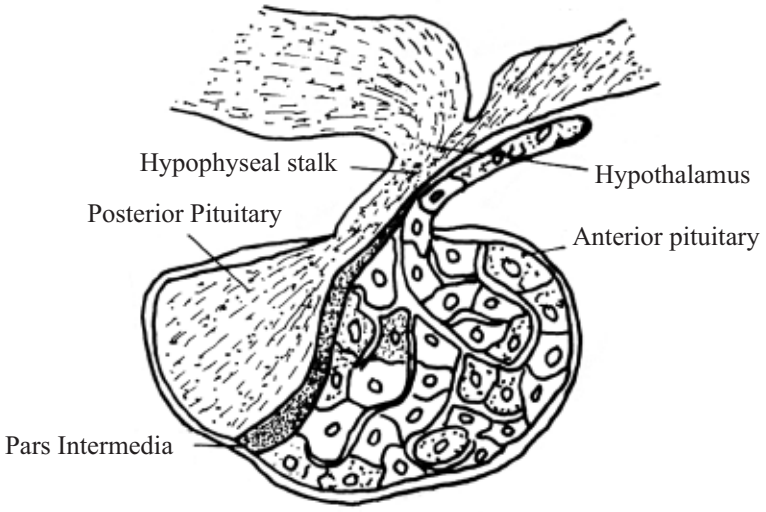


Fig. 17.9 Pitutary gland

The pituitary controls most other endocrine glands. It has two distinct parts: the **anterior pituitary** and the **posterior pituitary**. Various hormones produced from these two parts and their actions are listed below in Table 17.2.

Table 17.2 Pituitary hormones, their action and abnormalities due to its oversecretion or undersecretion

Source	Hormones	Action and abnormalities produced
Anterior lobe of pituitary	Growth hormone (GH), also known as somatotropic hormone (STH)	Promotes growth of whole body, particularly of the skeleton. Undersecretion in childhood lead to Dwarfism; oversecretion in childhood causes gigantism and in adult, acromegaly.
	Tropic hormones (stimulate other endocrine glands)	1. Thyroid stimulating hormone (TSH) stimulates thyroid. 2. Adrenocorticotropic hormone (ACTH) stimulates adrenal cortex.
	Gonadotropic hormones	3. Follicle stimulating hormone (FSH) stimulates egg formation in females and sperm formation in males. 4. Luteinizing hormone (LH) stimulates ovulation and the formation of corpus luteum which produces the female hormone progesterone and LH stimulates testis to produce the male hormone testosterone. 5. Prolactin stimulates milk production.
Posterior lobe of pituitary	Antidiuretic hormone (ADH) or vasopressin	Increases absorption of water from the kidney tubules (osmoregulation). Its deficiency causes **diabetes insipidus**.
	Oxytocin	Stimulates contractions of the uterus during childbirth.

2. Thyroid

Thyroid is a bilobed structure situated in the front region of the neck (Fig. 17.10). It secretes two hormones—**thyroxine** and **calcitonin.**

Thyroxine regulates basal metabolism i.e. the rate of cellular oxidation resulting in heat production. Controls growth and development, ossification of the bones, body temperature, mental development, etc.

Undersecretion of thyroxine (hypothyroidism) produces three conditions

- Simple **goitre.** Enlargement of thyroid visible as a swelling in the neck. It is caused due to iodine deficiency in food as iodine is needed for production of thyroid hormones.
- **Cretinism.** Poor body growth (dwarfism) and mental retardation
- **Myxoedema.** Swelling of the face and hands. General sluggishness.

Oversecretion of thyroxine (hyperthyroidism) produces exophthalmic goitre. This condition causes marked increase in the metabolic rate, rapid heart beat, shortness of breath and the eyes protrude out together with goitre in the neck.

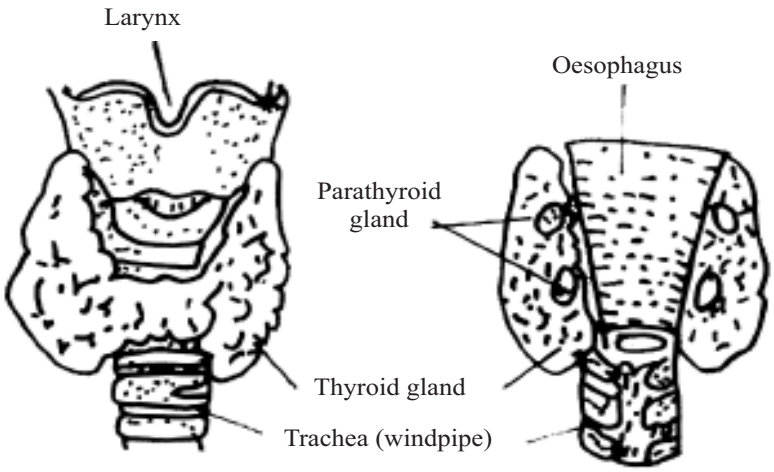


Fig. 17.10 The thyroid gland

Calcitonin. It regulates the calcium and phosphate levels in the blood. If the calcium level in blood is high more calcitonin is secreted and the calcium ions are moved from the blood to the bones making them harder. The reverse happens when the calcium level in the blood is low making the bones soft.

3. Parathyroids

These are two small pairs of glands wholly or partially embedded in the thyroid gland. Their secretion **parathormone** raises blood calcium level by stimulating release of calcium from bones.

4. Thymus

It is located at the base of neck. It produces some hormones involved in maturation of T lymphocytes. It begins to atrophy after puberty.

5. Adrenals

The adrenals (ad: adjacent, renal; kidney) are a pair of glands situated like caps one above each kidney. Each adrenal consists of two parts: a central **medulla** and a peripheral **cortex**.

The **adrenal medulla** secretes adrenaline which,

- increases heart beat accompanied by an increase in the blood pressure.
- increases blood supply to the muscles while decreasing blood supply to the visceral organs.
- releases more glucose into the blood from the liver.

The **adrenal cortex** secretes two categories of hormones: **glucocorticoids** and **mineralocorticoids**.

(a) **Glucocorticoids** e.g. **cortisone**

- In response to stress it raises blood glucose through action of the liver including deamination of amino acids. During starvation and prolonged fasting the required glucose is partly provided through this hormone.
- It adapts the body to stresses such as extreme heat or cold, burns, infections, etc.
- Some of the cortical hormones behave like sex hormones.
  - **Overgrowth of adrenal cortex in young children** causes premature sexual maturity.
  - **Overgrowth of adrenal cortex in mature females** results in the development of male characters such as beard and deep voice.
  - **Overgrowth of adrenal cortex in mature males** results in the development of some feminine characters such as enlargement of breasts.

(b) **Mineralocorticoids** e.g. **aldosterone**

This hormone is concerned with water retention. It increases reabsorption of sodium and chloride ions in kidneys. Read the role of aldosteronl in increasing blood volume and blood pressure in increasing blood volume and blood pressure in lesson 14 (14.3.6)

6. Pancreas

Pancreas is an endocrine as well as an exocrine gland. It has special groups of cells called **Islets of Langerhans**, which consists of three kinds of cells – *alpha cells* producing the harmone glucagon, *beta cells* producing harmone *insulin* and *gamma* cells producing harmone **somatostatin**.

(i) **Glucagon.** It stimulates breakdown of glycogen to glucose in the liver, leading to rise in the blood sugar level.

(ii) **Insulin**. It performs two principal tasks;

- Promotes glucose utilization by the body cells.
- Stimulates deposition of extra glucose in the blood as glycogen in the liver.

Gluccagon and insulin have oppsite functions.

Non-secretion or under secretion of insulin causes **diabetes mellitus** (***hyperglycemia***, meaning 'more than normal sugar in blood'.

A diabetic person,

- has higher glucose in blood;
- excretes a great deal of urine loaded with sugar;
- feels thirsty because of loss of water through too much urination;
- loses weight and becomes weak. In some cases, the patient even loses the eyesight.

Oversecretion of insulin causes **hypoglycemia** or low blood sugar. The brain may enter a state of coma if the level of sugar in blood becomes too low.

(iii) **Somatostatin** also called Growth Hormone-Inhibiting Hormone (GHIH) inhibits secretion of insulin as well as glucagon.

7. Gonads (testis and ovary)

Testes in males possess two kinds of cells : the sperm-producing germinal cells and the hormone-producing interstitial cells. The hormones produced are called androgens and the commonest one among them is **testosterone**.

The **testosterone** stimulates the development of the male characters during which the body at **puberty** starts developing facial hair**,** and their voice cracks and deepens.

Ovaries in females produce two kinds of hormones—**estrogen** and **progesterone**. **Estrogen** is secreted from the follicles of the ovary and stimulates the development of breasts and fat deposition on the hip in a mature woman. Estrogen prepares the wall of the uterus for receiving the fertilized egg.

Progesterone is secreted by the corpus luteum (follicle left after the release of ovum). It brings about the final changes in the uterus for the retention and growth of the foetus during pregnancy.

8. Placenta

Placenta of a pregnant woman produces certain hormones. One such hormone is **human chorionic gonadotropin** (HCG), which maintains the activity of corpus luteum in secreting progesterone continuously, when a women becomes pregnant.

9. Hormones from stomach and intestine

(i) **Gastrin** is the hormone secreted by the mucus membrane of the pyloric end of the stomach. It stimulates the gastric glands to secrete gastric juice.

(ii) **Secretin** is the hormone secreted by the inner lining of the duodenum. It stimulates the production of pancreatic juice while the hormone **cholecystokinin** stimulates release of bile from gall bladder.

17.10 THE FEEDBACK MECHANISM (CONTROL OF HORMONAL SECRETION)

The amount of hormone released by an endocrine gland is determined by the body's need for the particular hormone at any given time. The product of the target tissue exerts an effect on the respective endocrine gland. This effect may be positive ('*secrete more*') or negative ('*secrete no more*' or '*slow down*'). This can be explained by taking the example of thyroid gland.

Feed back mechanism of thyroid activity (Fig. 17.11). Hypothalamus releases a hormone TSH-RH (TSH- Releasing Hormone) which instructs the anterior pituitary to release TSH (thyroid stimulating hormone). The TSH stimulates thyroid to release thyroxine. If the level of thyroxine in blood increases, the pituitary stops the release of TSH. When the level of thyroxine falls in the blood, the thyroid gets stimulated

to secrete more of it. In feedback mechanism the starting point of an activity receives back the information whether to continue or increase, or to slow down or even stop.

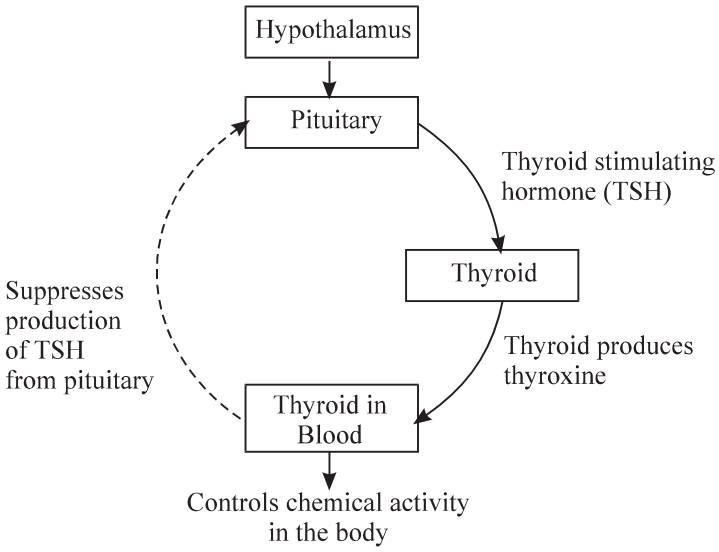


Fig. 17.11 Feed back mechanism in hormone action
(solid line = stimulation; broken line = suppression/inhibition)

17.11 COMPARISON OF HORMONAL AND NERVOUS COORDINATION

The table 17.2 below lists a few major differences between these two different kinds of control and regulating mechanisms.

Table 17.2 difference between hormonal and nervous control

Property	Hormonal control	Nervous control
1. Nature of signal	All hormones are chemical signal	Nerve impulses are electrical signals. Chemical signalling takes place at synapses
2. Speed of signal	Slow	Rapid. Between 0.7 metres per second and 120 metres per second
3. Effect in the body	General effect. The hormones can influence cells in many different parts of the body.	Localized effect – affects only the particular muscle or the gland

4. Effect on growth	Can affect growth	Cannot affect growth
5. Capacity for modification	Cannot be modified by learning from previous experience	Can be modified by learning from previous experiences
6. Duration of effect	Short term or long lasting.	Short – lived

17.12 PHEROMONES—THE CHEMICAL MESSENGERS AT SOCIAL LEVEL

Pheromones are the secretions given out by **an individual** into the environment, which bring about a specific response **in other members of the same species**. Some of the examples of the pheromones are as follows:

- **Common ants march on the floor or walls in a trail** on an invisible path laid down by a secretion from their bodies. It helps them to reach the destination one after another, as well as to return correctly to their own nest.
- **When disturbed honey bees give out an alarm pheromone** from their sting at the back and mandibles in the mouth. This alerts the inmates of the hive to face the attack.
- Females of a particular moth gives out a scent which can attract a male from as much distance as 3-4 kilometers.
- Introduction of a male mouse into a group of female mice shortens oestrus cycle (cycle of development of eggs in the ovary and ovulation).
- Introduction of a **strange male mouse** of a different strain disturbs to the extent that the **newly pregnant females abort their foetuses**. The source of pheromone of the strange male mouse is in its urine.

INTEXT QUESTIONS 17.6

1. Name the following

   (i) The organ in the neck on the trachea close to which thyroid is located

   .....

   (ii) The condition caused due to oversecretion of thyroxin

   .....

   (iii) The hormone concerned with facing dangers

   .....

Notes

(iv) The condition of passing much glucose in the urine

.....

(v) The source gland of ADH

.....

2. What are pheromones?

.....

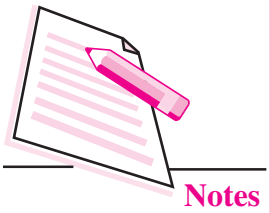
WHAT YOU HAVE LEARNT

- The coordination of body activities inside the body of an organism is brought about by two systems- the nervous and the endocrine systems.
- The nervous system is composed of the central nervous system (brain and spinal cord) and the peripheral nervous system (cranial and spinal nerves and the autonomic nervous system).
- The autonomic nervous system consists of a pair of chain of ganglia by the side of spinal cord. It is largely concerned with the normal functioning of the visceral organs.
- The nervous system of cockroach is made of brain or cerepral gangha, suboeso phaegeal ganglion, thoracic ganglia gangha and six abdominal ganglia from which nerves come out.
- Cerebrum is the largest part of the brain and is the seat of intelligence.
- Cerebellum is the centre of balance.
- Medulla oblongata controls breathing and heart beat.
- Spinal cord is the centre for simple reflexes.
- The sensitive layer of the eye is the retina which is composed of rods (sensitive to dim light) and cones (sensitive to bright light and for colour vision).
- The internal ear performs two tasks perception of sound by the cochlea and that of disturbance in body balance by the semicircular canals, utriculus and sacculus.
- The nose perceives chemical stimuli by the chemicals carried by the air and the tongue by direct contact with them.
- Skin possesses receptors for touch, pain, heat cold etc.
- Chemical coordination is brought about by hormones produced by the ductless glands, that are carried by the blood and which act on the target cells or organs away from their source.
- There is a close link between the nervous and the endocrine systems, shown by the way in which the pituitary gland interacts with the hypothalamus of the brain.

- Our endocrine glands include the pituitary, thyroid, parathyroid, thymus adrenals, pancreas, gonads and placenta.
- The pituitary controls and regulates the activities of almost all other endocrine glands.
- The undersecretion as well as the oversecretion of the hormones, both produce ill effects.
- Hormone levels are generally controlled by feed back mechanism.
- Pheromones are secretions released outside in the enviroment, which produce response in other individuals of the same species.

TERMINAL QUESTIONS

1. Name the two divisions of the nervous system?
2. What is gray matter?
3. Name the chemical involved in the transmission of nerve impulse across a synapse.
4. Give two examples of sensory nerves.
5. Name the respective areas of the retina concerned with best vision and no vision.
6. What is the role of the eustachian tube in the ear?
7. Name the hormone and its source glands, whose deficiency leads to diabetes insipidus.
8. What are pheromones?
9. Name and explain the event that happens immediately when a nerve fibre gets stimulated?
10. Are the endocrine glands and the ductless glands one and the same thing? Give one example.
11. Describe any one example of condition reflex in the humans.
12. List the functions of medulla oblongata.
13. Differentiate between sympathetic and parasympathetic nervous systems.
14. What are the two principal tasks of insulin?
15. Explain the following terms: (i) synapse (ii) stimulus and (iii) impulse
16. Draw a diagram to show the arrangement of the bones inside the middle ear.
17. Write short notes on the following :
    (i) myopia
    (ii) taste buds
    (iii) accommodation of the eye



Notes

18. How do sympathetic and parasympathetic nervous systems act differently on (i) pupil of the eye, and (ii) urinary bladder?

19. Draw a labelled diagram of the cross section of the spinal cord and the nervous pathway of a simple reflex concerned with it.

20. Explain the role of ciliary muscles in our eyes

21. Taking the example of thyroxine secretion, explain what is meant by feedback mechanism?

ANSWERS TO INTEXT QUESTIONS

17.1

1. FIg. 16.1, page 337
2. (a) supraoesophageal ganglion (b) sub oesophageal ganglion
3. Ventral nerve cord
4. Cerebrum, cerebellum, medulla oblongata, thalamus and hypothalamus
5. (i) Cerebrum–intelligence/thinking/reasoning/memory;
   (ii) Cerebellum– balance/muscular coordination
   (iii) Medulla oblongata–involuntary actions
   (iv) Hypothalamus–homeostasis
6. Gray matter–composed of neuron cell bodies
   White matter–composed of axon fibres
7. Cerebrospinal fluid

17.2

1. Sympathetic nervous system and parasympathetic nervous system
2. (i) parasympathetic nervous system
   (ii) parasympathetic nervous system
   (iii) sympathetic nervous system
   (iv) parasympathetic nervous system
   (v) parasympathetic nervous system
3. because it connects the periphery (surface) of the body
4. sensory = afferent, motor = efferent

17.3 1. (i) simple (ii) conditioned (iii) conditioned

(iv) simple (v) conditioned

17.4 1. (i) contracts and dilates pupil

(ii) helps in near vision/contracts to make lens thicker

(iii) controls amount of light entering the eye

(iv) maintains shape of the eye ball and protects retina

(v) produces nerve impulses into the optic nerve

2. (i) yellow spot (ii) concave lens

(iii) cataract (iv) accommodation

17.5 1. (i) vestibule (ii) cochlea

2. (i) auditory meateus

(ii) static balance

(iii) touch/pressure/warmth/cold/ ….

17.6 1. (i) larynx, (ii) cretinism, (iii) adrenaline (iv) diabetes mellitus,

(v) posterior pituitary

2. Pheromone is a secretion from one individual that is given out into the environment and which elicits a response in other members of the same species.