# 28

# Control and Coordination

In the earlier lessons you have studied that the body of all living organisms is made up of cells. These cells aggregate and differentiate to form tissues and assembly of different tissues forms different organs. The various organs perform their functions at the right time so that they can work together efficiently. Therefore, some form of control is needed to coordinate their functions. For example, when we eat food, our eyes help in locating the food, our nose senses the food, our hand brings the food to our mouth and our jaw muscles help the teeth to chew the food. All these activities occur in a coordinated manner, and if any of these activities misses or does not occur in time then the body will not get nutrition.

In case of animals, including man, the chemicals produced by ductless (endocrine) glands also bring about coordination. This coordination by chemicals is brought about by the endocrine system. On the other hand the nervous system consists of a series of nerve cells throughout the body. Signals from one part of the body are transmitted to another part through these nerve cells.

You know that our sense organs are gateways for receiving information or stimuli from the environment and help in maintaining a state of stability between the internal conditions of an organism and its external environment. In this lesson we will learn about the nervous system, the endocrine system and sense organs of our body.

**OBJECTIVES**

After completing this lesson, you will be able to:

- relate nervous system and endocrine system with the function of control and coordination;
- recognise sense organs as gateways for receiving information from the environment;
- recall nerve cell as the basic structural and functional unit of nervous system and explain the terms synapse and nerve;
- define nerve impulse;
- identify the components of central nervous system and explain what is grey matter and white matter;
- describe the major regions of human brain and list their functions;

- describe the location and structure of spinal cord and recognise its function relating to reflex action;
- name the parts of the eye and explain vision in simple terms;
- explain accommodation of the eye and give reasons for short sightedness (myopia), long sightedness (hypermetropia) and their correction;
- explain the structure and working of the ear;
- describe various ways of taking care of sense organs;
- draw an outline diagram of human body and show the location of various endocrine glands;
- list the hormones secreted by pituitary, thyroid and pancreas;
- give a brief idea of feedback mechanism in hormonal activity;
- state the symptoms and cause of cretinism, goitre and diabetes mellitus.

## 28.1 NERVOUS SYSTEM

The organ system in an animal that serves to coordinate and control the functioning of all other organ systems in the body is known as nervous system.

Nervous system works with the endocrine system to communicate, integrate and coordinate the functions of various organs and systems in our body and helps the body to respond to the external stimuli. In humans, the nervous system has two main divisions:

- The central nervous system (CNS)
- The peripheral nervous system (PNS)

The **central nervous system** consists of brain and spinal cord. It is regarded as the 'thinker' or 'information processor' in the body.

The **peripheral nervous system** includes the sensory and motor nerves and connects the central nervous system with the sense organs, muscles and glands of the body. The peripheral nervous system is regarded as 'actor' or 'performer' in the body. The organisation of nervous system is given in Fig. 28.1.

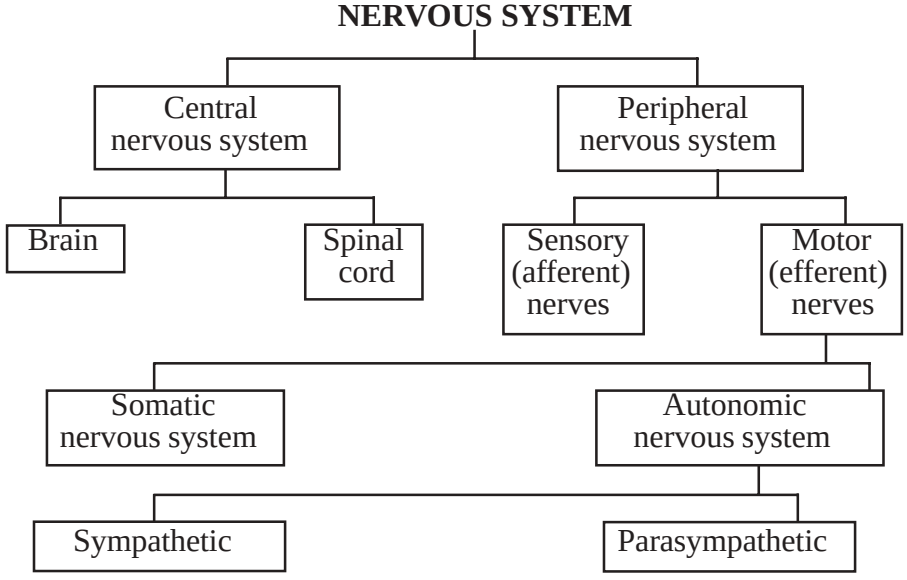



*Fig. 28.1 Organisation of nervous system in humans*

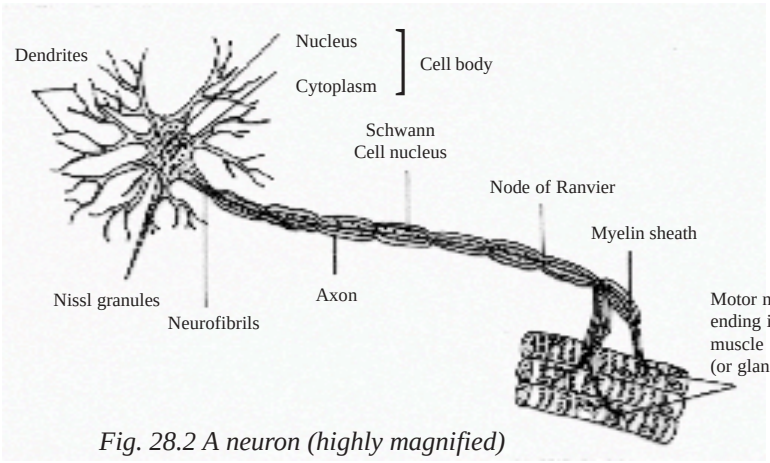



*Fig. 28.2 A neuron (highly magnified)*

### 28.1.1 Nerve cell or neuron

A neuron is the basic unit of nervous tissue. Our nervous system contains about 10 billion nerve cells, which communicate with each other in a specific manner.

### 28.1.1a Structure of the neuron

Each neuron has a central area called the cell body or cyton. The **cell body** has a large central nucleus and cytoplasm. Several short, thread like branches called **dendrites** arise from the cell body. One branch arising out of the cell body is very long in comparison to others. This branch is called **axon or nerve fibre**. Axon may or may not be covered by a fatty sheath called **myelin sheath.** This covering is missing at intervals. These gaps on the sheath are known as **nodes of Ranvier**.

### 28.1.1b Types of neurons

i. **Sensory neurons**, which transmit impulse from receptor (sense organ) to coordinator (brain or spinal cord).

ii. **Motor neurons**, which transmit impulse from modulator to effectors (muscle or glands).

iii. **Connecting neurons**, which connect sensory and motor neurons, found in the grey matter.

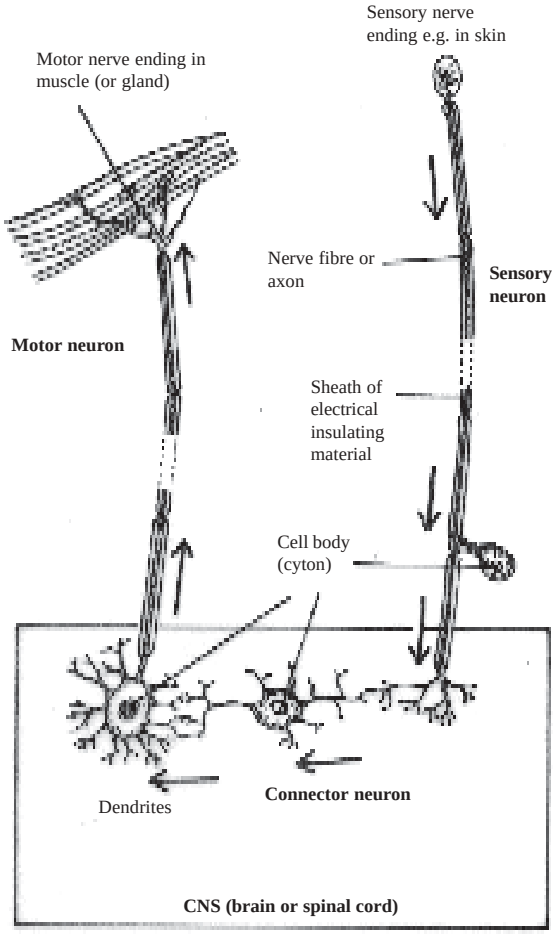



*Fig. 28.3 Types of neurons*

### 28.1.2 Nerves

Nerves are thread like structures, which emerge from brain and spinal cord and branch out to almost all parts of the body. The nerves are composed of axons or nerve fibres bundled together like the strands of an electric cable (Fig. 28.4).

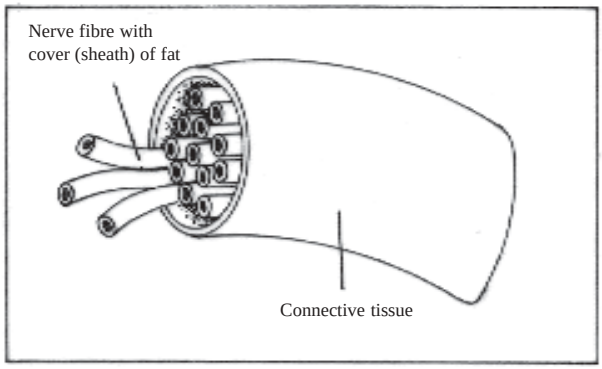



*Fig. 28.4 A nerve is a bundle of nerve fibres*

### 28.1.2a Kinds of nerves

There are three kinds of nerves. These are:

i. **Sensory nerves:** These nerves contain sensory fibres. Sensory nerves bring impulse from sense organs to the brain or the spinal cord.

ii. **Motor nerves:** These nerves contain motor fibres. Motor nerves carry impulse from brain or spinal cord to the effector organ like muscle or glands.

iii. **Mixed nerves:** These nerves contain both sensory and motor nerve fibres and perform a mixed function.

## 28.2 FUNCTIONING OF THE NERVOUS SYSTEM

The nervous system functions in a coordinated manner. It receives a stimulus through a receptor organ like eye, ear, tongue, etc. The stimulus through sensory nerves reaches the brain and spinal cord, which integrates it and give action. The motor nerves pass on the action to the required organ (muscle or gland) and this way a response is generated.

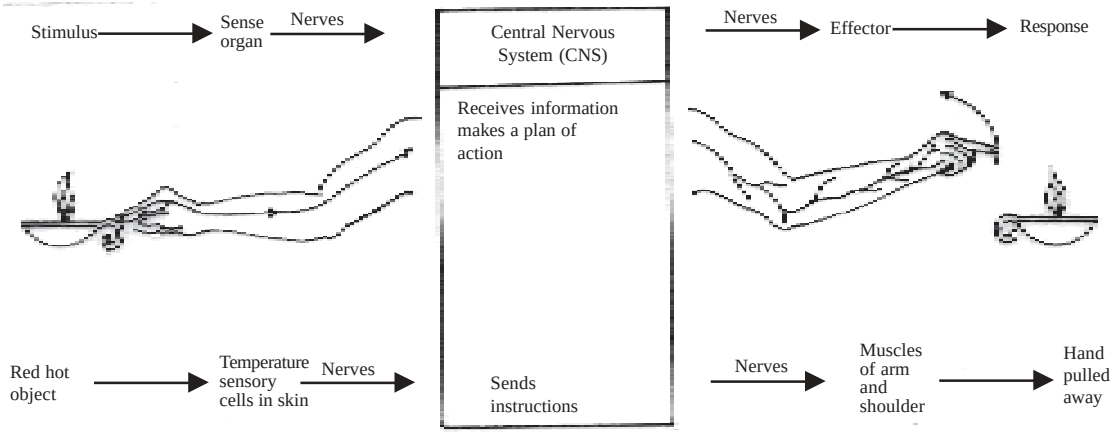



*Fig. 28.5 Nervous system works in a coordinated manner*

## 28.3 NERVE IMPULSE

### 28.3.1 What is an impulse?

Let us understand this by an example. Suppose your finger is pricked, you have felt the sensation. Then your brain senses the prick and generates a response and you withdraw your hand. This flow of message through the nerve is called impulse.

Nerve impulse upon generation passes along a neuron in only one direction. The neuron is connected to a sensory receptor that receives the message or stimulus and converts it into electrochemical waves. These electrochemical waves are carried by the neuron. The stimulus from the receptor organ is received by the dendrites, conducted to cell body (cyton) of the neuron and finally to the effector organ.

### 28.3.2 Synapse

The axon of one neuron is close to the dendrites of cell body of the next neuron. *This junction of two neurons is called synapse*. There is a space at the synapse between the end of axon of first neuron and cell body or dendrite of the next neuron. This is called **synaptic cleft.**

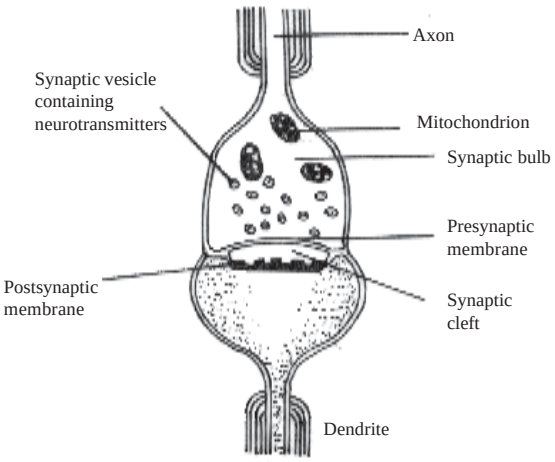



*Fig. 28.6 A synapse*

Through the synapse the impulse passes from one neuron to the next neuron. There are many synapses between the millions of nerve cells.

When the impulse reaches the end of axon of first neuron, a **neurotransmitter** (a chemical substance) is released in the synaptic cleft of the synapse, which helps in passage of nerve impulse from one neuron to the next neuron.

### 28.3.3 What does a synapse do?

- It allows the information to pass from one neuron to another.
- It ensures the passage of nerve impulse in one direction only.
- It helps in information processing by combining the effects of all impulses received.
- It filters out low-level stimuli.

## 28.4 CENTRAL NERVOUS SYSTEM- BRAIN AND SPINAL CORD

### 28.4.1 Brain

The human brain is a highly developed organ situated in the skull. It weighs about 1200-1400g in an adult. It has three main parts:

- Cerebrum
- Cerebellum
- Medulla oblongata

#### a) Cerebrum

The cerebrum is the largest and most prominent part of the brain. Among all vertebrates cerebrum of humans is most highly developed. It is divided into **left and right hemispheres** by a deep median longitudinal groove. Each hemisphere contains two regions - the outer region and the inner region. The outer region of cerebrum contains **grey matter**, which contains cell bodies of the neuron. The inner region of cerebrum contains **white matter**, which contains nerve fibres or axons of the neurons.

The cerebrum performs the following functions:

i. It governs our mental abilities like thinking, reasoning, learning, memorising and intelligence.
ii. It controls our will, emotions and speech.
iii. It controls feeling of love, admiration and hatred.
iv. It controls all involuntary functions.

#### b) Cerebellum

It is a small area of brain lying below the mid-brain which is under the large cerebrum. Like cerebrum, it also has grey matter in its outer region and white matter in the inner region.

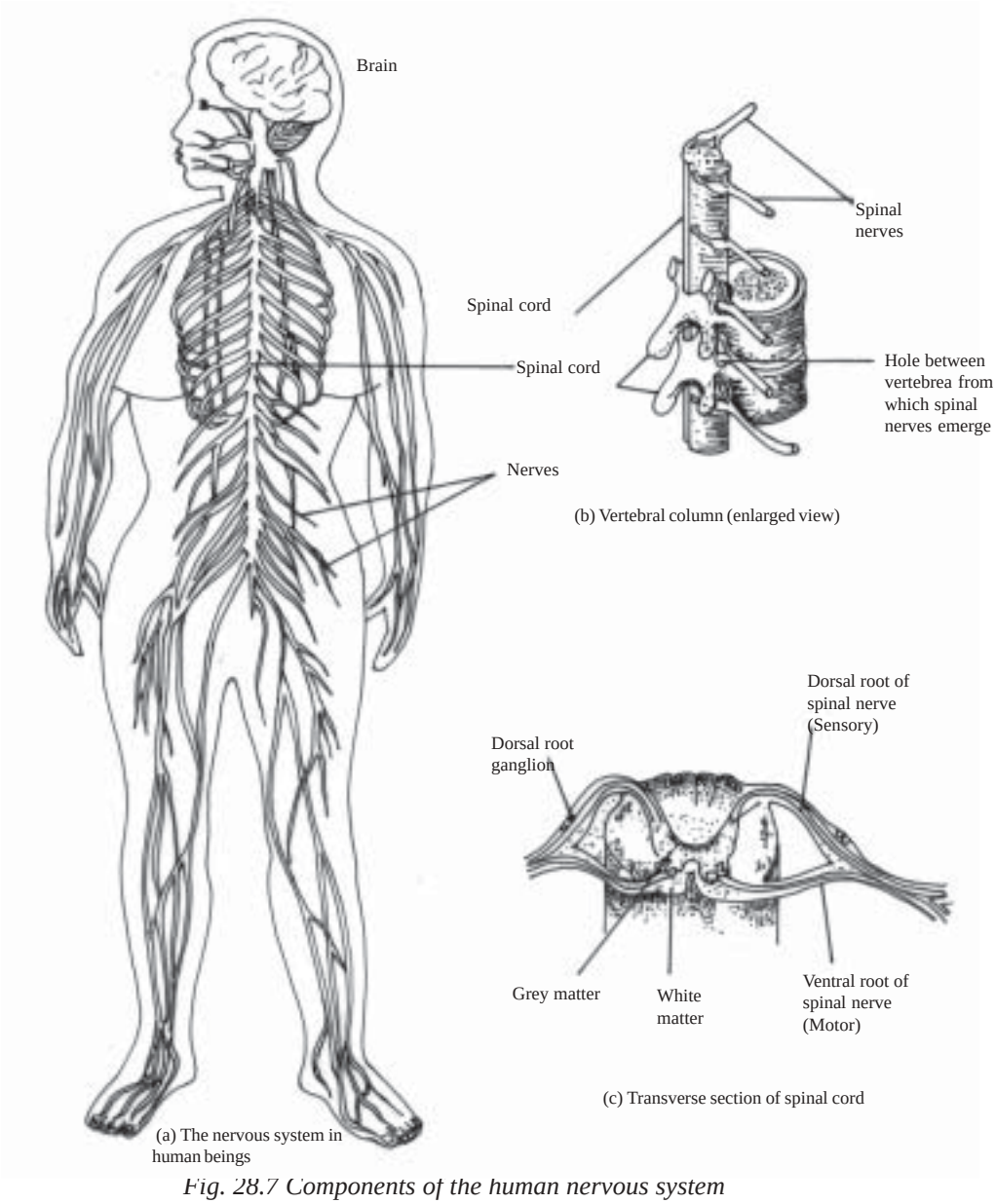



*Fig. 28.7 Components of the human nervous system*

The cerebellum performs the following functions:

i. It maintains equilibrium (balance) of the body.
ii. It controls posture of the body.
iii. It coordinates muscular movement.

### c) Medulla oblongata

It is the lowermost part of the brain located at the base of the skull.

The medulla oblongata performs the following functions:

i. It controls the internal organs like movement of lungs, heart etc., by regulating breathing and heart-beat.
ii. It controls vital reflex centres such as cardiac centre, respiratory centre and centres for swallowing, sneezing, coughing and vomiting (Fig. 28.8).

**Do you know?**

Our brain sends out certain waves, which are different in nature at different times depending on our body activity. An instrument called **electroencephalograph** can record this activity of our brain. For doing this, electrodes are taped on different parts of the scalp and the activity is recorded in the form of an **electrocephalogram** (EEG).

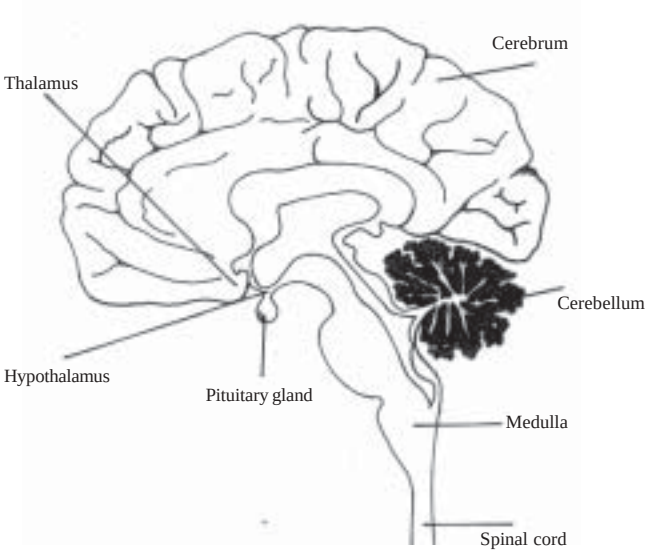



*Fig. 28.8 Different parts of the brain*

### 28.4.2 Spinal cord

The spinal cord is a long cord that extends from the medulla oblongata and continues downward inside the vertebral column.

Spinal cord has within it a narrow canal and this central canal of the spinal cord is filled with **cerebrospinal fluid**. The arrangement of the grey and white matter is just reversed in the spinal cord. *The grey matter lies on the inner side while the white matter on the outer side.*

The spinal cord performs the following functions:

i. It controls the reflexes below the neck region.
ii. It conducts sensory impulses from the skin and muscles to the brain.
iii. It conducts motor response from brain to the muscles of trunk and limbs.

### CHECK YOUR PROGRESS 28.1

1. Fill in the blanks.
   i) The central nervous system consists of _____ and _____
   ii) Pathway meant for transmission of the message from the receptors to modulators is called _____ pathway.
   iii) _____ nerves carry impulse from brain or spinal cord to the effectors.
   iv) The stimulus from the receptor organ is received by the _____, conducted to the cell body of neuron and finally to the _____ organ.
   v) A synapse is the point of contact between the terminal branches of the _____ of one neuron with the _____ of another neuron.
2. List any two functions of cerebellum.
3. Name the main organs of our body regulated by medulla oblongata.

## 28.5 PERIPHERAL NERVOUS SYSTEM

The peripheral nervous system includes nerves that carry impulse to and from the central nervous system. These nerves are of two types:

- **Afferent or sensory nerves**, which carry information from sensory receptors into central nervous system, and
- **Efferent or motor nerves** which carry information from the central nervous system to the effector organ.

The peripheral nervous system is further subdivided into two systems:

### a) Somatic nervous system

It receives and processes information from receptors in the skin, voluntary muscles, tendons, joints, eyes, tongue, nose and ears and thus gives an organism the sensation of touch, pain, heat, cold, balance, sight, taste, smell and sound. It also controls voluntary actions like movement of arms and legs.

### b) Autonomic nervous system or visceral nervous system

It consists of a pair of chains of ganglion (a ganglion is a group of cell bodies of neurons) and nerves found on either side of the backbone. It is subdivided into **sympathetic** and **parasympathetic nervous systems**. It controls the involuntary actions of the internal organs of the body like heart etc. You will learn more about autonomic nervous system in higher classes.

## 28.6 REFLEX ACTION AND REFLEX ARC

There are many actions in our body which are spontaneous and do not require any processing by brain. These responses are called reflex actions. Reflex actions are controlled by spinal cord. For example, we blink our eyes in response to high beam of light that falls on our eyes. Similarly we withdraw our hand immediately if we prick our finger or touch a hot object.

A reflex action may be defined as a spontaneous, autonomic and mechanical response to a stimulus controlled by the spinal cord without the involvement of brain.

### 28.6.1 Components of a reflex arc

A reflex arc has the following components:

i. a receptor or sensory neuron which perceives the stimulus,
ii. a sensory nerve which carries the message from sensory neuron to spinal cord,
iii. a relay or intermediate neuron of spinal cord which transmits the impulse from sensory to motor neuron, and
iv. motor nerve which carries the message from spinal cord to effector organ-muscle or gland.

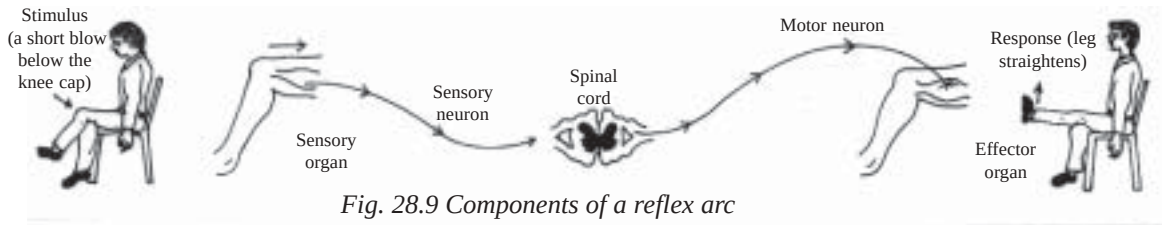



*Fig. 28.9 Components of a reflex arc*

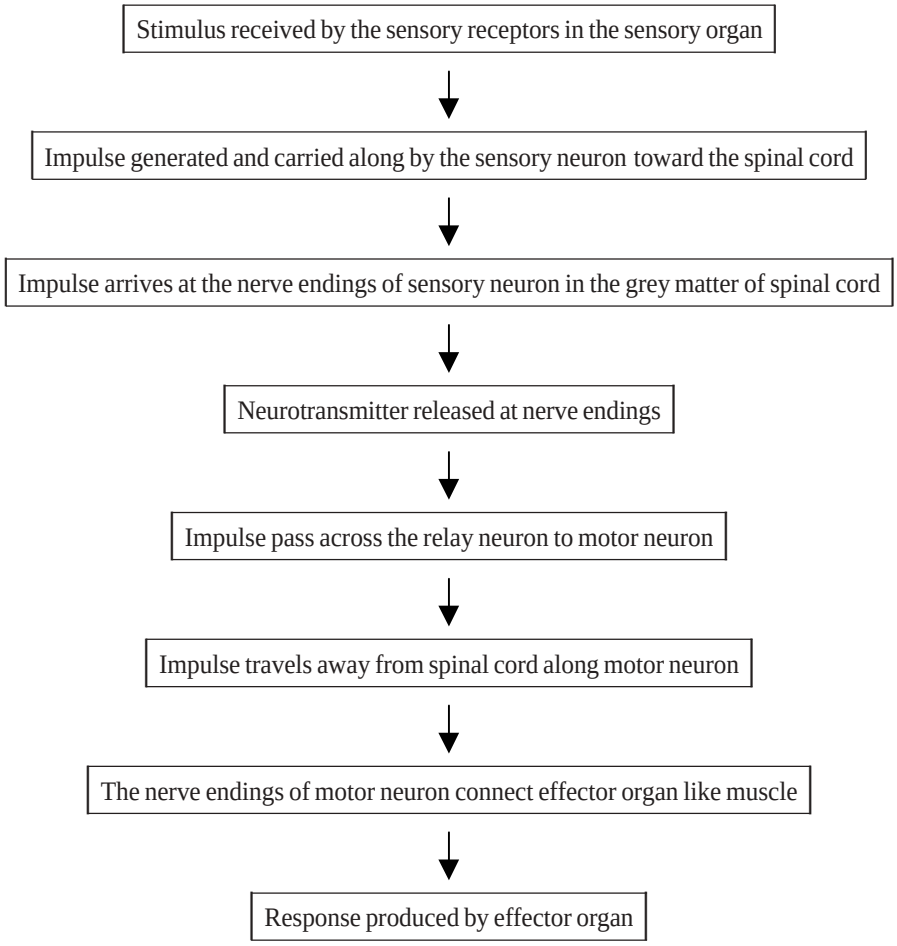



*Fig. 28.10 Sequence of events in a reflex arc*

## CHECK YOUR PROGRESS 28.2

1. Fill in the blanks.
   ii. _____ carry information from sensory receptors to central nervous system.
   iii. _____ system receives and processes information from receptors in the skin, voluntary muscles and eyes.
   iiii. The pathway followed by sensory or motor nerves in a reflex action is called _____
2. Define reflex action.
3. What are the various components of a reflex arc?

## 28.7 OUR SENSE ORGANS

**What are sense organs?**

Sense organs are the organs through which we sense or feel change in the external environment.

We all touch, taste, smell, hear and see because of our sense organs. When a sense organ detects a stimulus it sends messages along the nerves to brain. The brain gives us feelings or sensations. Our sense organs and their functions are given in Table 28.1.

**Table 28.1: Different sense organs in our body**

| Sense organ | Sensitive to stimuli | Senses |
|---|---|---|
| Skin | Pressure, heat and cold, pain | Touch |
| Tongue | Chemicals in food and drink | Taste |
| Nose | Chemicals in air | Smell |
| Ears | Sound and movement | Hearing and balance |
| Eyes | Light | Sight |

### 28.7.1 Skin

The sense of touch is produced by the ends of nerve cells called nerve endings or receptors because they receive stimulation from the outside world. These nerve endings are of different types for different stimulations.

- **Touch and pressure:** These receptors are concentrated on fingertips. They detect the texture of objects, whether they are rough, smooth, hard or soft. Touch receptors are attached to hair.
- **Pain:** Pain receptors are evenly distributed over the skin.
- **Temperature:** There are separate cold and heat receptors. These detect changes in temperature. The fingertips can detect temperature differences as small as 0.5 $^{o}$C.

In a human adult the surface area of the skin is 1.5 to 1.7 sq. meters. The thickness of the skin varies from about 0.5 to 3 mm. The skin is composed of two distinct layers:

i) **epidermis**, which contains hair, nails, sweat glands, etc.

ii) **dermis**, which is made up of connective tissue mixed with blood vessels and nerves.

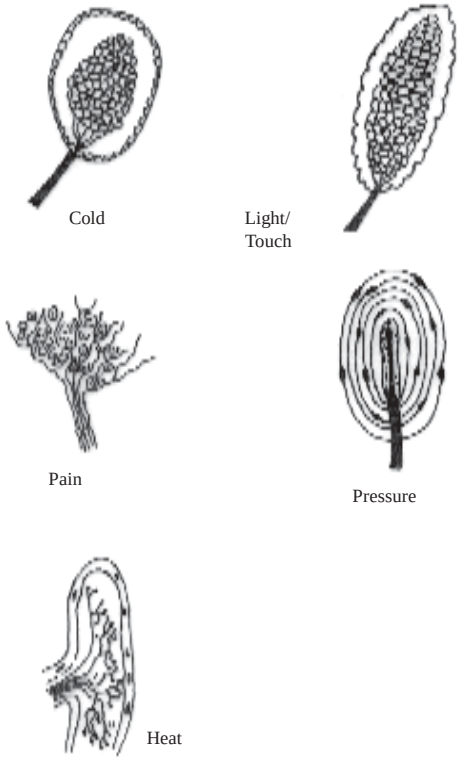



*Fig. 28.11 Different types of sensory cells of skin*

### 28.7.1.a Functions of skin

- Skin protects the body from mechanical injuries, bacterial infections, heat and cold.
- Skin is sensory to touch, pain and temperature.
- Skin regulates our body temperature. Excessive heat is lost through evaporation of sweat otherwise it is conserved by fat and hair in the skin.

- Oily substances are freely absorbed by skin.
- The excess of water, salts and waste products are excreted through the sweat.
- Vitamin D is synthesized in the skin.

**Table 28.3: Common skin diseases**

| Nature | Disease | Symptoms | Prevention |
|---|---|---|---|
| Fungal | Ring worm | Itching/rashes/burning sensation | Personal hygiene |
| Allergic | Eczema, dermatitis | Itching, scaly skin | Most of the allergy can be prevented by avoiding offending substances |
| Parasitic | Scabies | Itching | Personal hygiene and domestic hygiene |

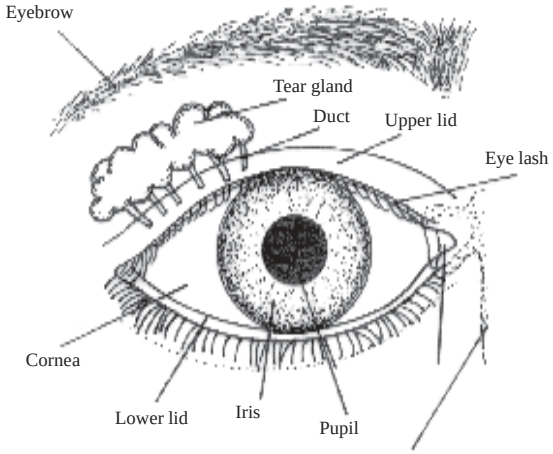



*Fig. 28.12 The human eye*

**We should take care of our skin!**

- The skin must be washed daily because it gets dirty by dust and sweat.
- It should be protected from injury.
- It should be protected from sun rays and fire.

### 28.7.2 Eyes

Eyes are well-protected organs of our body through which we see. The eyes are lodged within the skull. When we close our eyes a layer of skin with hair (eye lashes) in its margin covers each eye. It is an eyelid. This eyelid protects our eye from an external discomfort. Different parts of the eye are cornea, iris, pupil, retina etc. as shown in fig. 28.12.

**How do we see?**

The light rays enter our eyes through transparent structures (conjunctiva, cornea, aqueous humour, lens and vitreous humour). The curvature of cornea and lens bend the light rays to form an image on the retina. The image formed on retina is inverted and real. The nerve impulses are produced in retina, which are transmitted to the brain (visual area of cerebrum). The brain interprets the image and the image that was formed inverted on the retina is viewed or perceived here correct and upright.

### 28.7.2a Focusing and accommodation

**(i) Eye focused on a distant object**

Lens is less convex (somewhat flattened) due to being stretched by suspensory ligament, the ciliary (circular) muscles along the suspensory ligament are relaxed.

(Fig. 28.13a).

(ii) **Eye focused on a near object**

Ciliary (circular) muscles contract. This reduces tension of the suspensory ligament and the lens turns thicker and more convex (Fig. 28.13b).

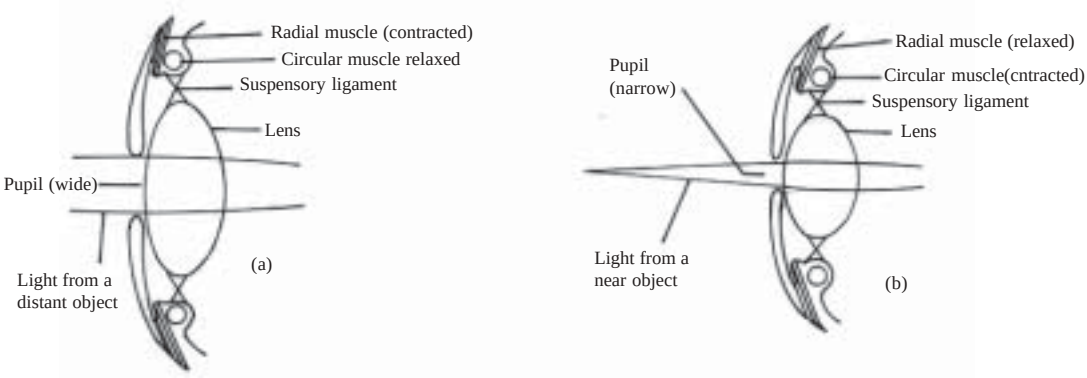



*Fig. 28.13 Focussing and accomodation of the eye*
*a) Distant object b) Near object*

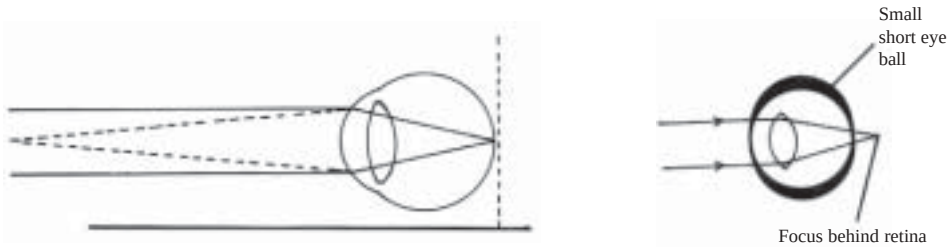
### 28.7.2b Defects of the eye

i) **First, understand the normal sight**

Both distant and near objects can be focused on the retina (Fig 28.14a).

(ii) **Long sightedness** or **hypermetropia**

It occurs when the eyeball is shorter than normal. In this defect distant objects can be focused properly, but the point of focus for an object close to the eye is behind the retina (Figs. 28.14 b,c).




*(a) Normal sight* *(b)Long sightedness or hypermetropia*

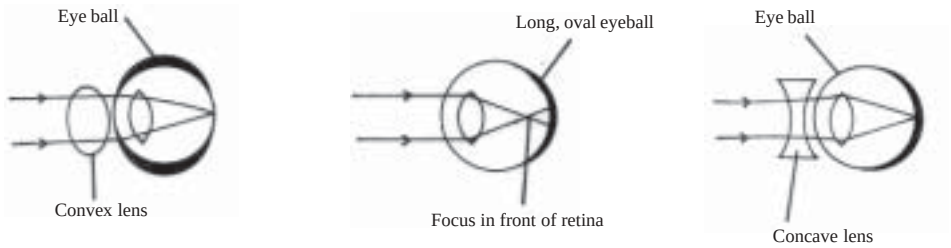



*Fig. 28.14 The normal sight and the defects of vision*

*(c) Correcting hypermetropia using convex lens* *(d) Short sightedness or myopia,* *(e) Correcting myopia using concave lens*

**(iii) Short sightedness or myopia**

It occurs when the eye-ball is longer than normal. In this defect objects close to the eye can be focussed properly, but the point of focus for distant objects is in front of the retina (Fig. 28.14 d,e).

**We should take care of our eyes!**

- Do not read in the dark or when the light is too bright. You must keep your book at a proper distance from your eyes. While reading, maintain correct posture.
- Do not rub your eyes with unclean hands because germs can enter into your eyes.
- When dust, insects or other object goes into your eyes, do not rub them. Rinse the objects away with plenty of clean water.
- Wash eyes daily carefully. Eyes should be protected from direct sunlight sparkling and injuries.
- In case of an injury consult the doctor immediately.

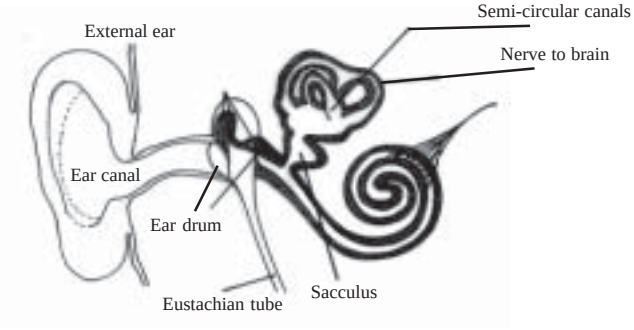



*Fig. 28.15 Structure of the ear*

### 28.7.3 Ears

Ears help us in hearing different sounds and balancing our body. The air around us is full of vibrations called **sound waves.** We have one ear on each side of the head. Ears change vibrations in the air into nerve impulses, which travel to brain where they are interpreted as sound.

#### 28.7.3a Functions of ears

The part, which we call our ear, is a flap of skin in the shape of a funnel. This is the **external ear.** This leads to a tunnel – the **ear canal**, at the end of which is a thin sheet of skin called the **eardrum**. Sound waves are collected by the outer ear and directed inside the ear canal, where they set the eardrum vibrating.

The eardrum is connected to the inner ear by three small bones or semicircular canals called **ear ossicles**. These are hammer **(malleus)**, **anvil (incus)** and **stirrup (stapes)**. These bones transmit and amplify the vibrations increasing their force by about 20 times.

The ossicles are connected to an oval window. Due to vibrations, oval window moves in and out causing vibrations through the **cochlea**.

The cochlea contains a carpet of tiny hair like structures, which are connected to nerves. They are actually sensory cells which help us to hear the sound.

**Our ears helps us to balance**

Our ears tell us if we are standing upright or not. The semicircular canals of our inner ear tell us to keep balance or to move. The semicircular canals are three tubes full of liquid. When we move the liquid moves. Sensitive hair cells inside the tubes detect this movement and send impulses along nerves to the brain. Our brain detects loss of our balance and sends impulses to muscles to keep us upright.

### 28.7.3b Deafness—disorder of the ears

The vibrations of the eardrum cause disturbance within the middle ear. This space is linked with the back of a canal – the **Eustachian tube**. We know that when the air pressure changes, we feel a strong sensation in our ears until we open our mouth, and the air in the mouth and the pressure is equalized. Unfortunately, the Eustachian tube may become a channel for infection. This may happen for a brief period during a cold and if neglected the infection may spread to the middle ear and cause inflammation. The eardrum may become thickened and the little bones may have their articulations affected. This may cause deafness. Deafness may also be due to the injury to the ear nerve.

**We must take care of our ears!**

- We should clean our ears with towel after bath every day.
- Never use a pin or stick to remove wax from the ear.
- We should protect our ear from injury, cold and dirt.

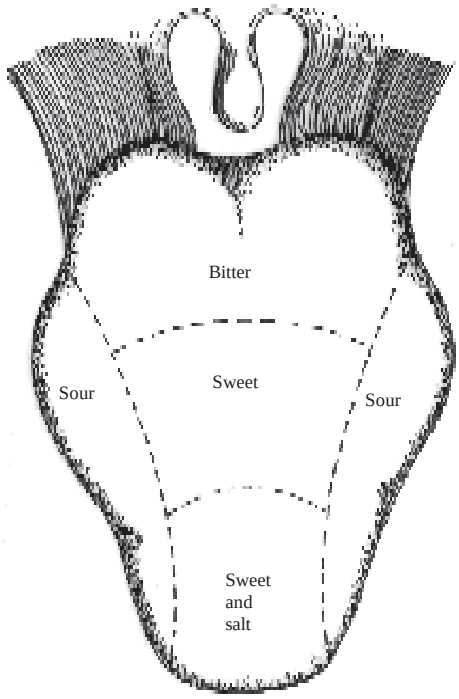



*Fig. 28.16 Our tongue*

### 28.7.4 Tongue

You know that your tongue helps you to talk and helps in moving food inside the mouth and swallowing the food. Tongue is a sense organ, which distinguishes different tastes. Our tongue contains **taste buds**. Taste buds are groups of sensory cells. These are sensitive to chemicals, which must dissolve in saliva, before we can taste them. Taste buds send messages to brain by taste nerves for analysis, resulting in the sensations. This is why dry food has no taste until we chew it with saliva.

**We must take care of our tongue!**

- It should be cleaned daily by tongue cleaner.
- If there are any rashes or cut on the tongue it should be treated as per doctor's advice.

### 28.7.5 Nose

We can detect about 3000 different kinds of smells. Smell helps animals to hunt food and find their way. Smell can also warn if there is certain danger.

Our nose is sensitive to smell. Smell is basically detecting chemicals in the air. The chemicals dissolve in moisture on lining of our nose. The stimulation of nerve endings in our nose send message to the brain which produces the sensation of smell. Smell receptors are called **olfactory receptors**.

### CHECK YOUR PROGRESS 28.3

1. Name the five sense organs in our body.
2. Fill in the blanks.
   i) Skin is made up of _____ and _____
   ii) Oily substances are freely absorbed by _____

*3. Match the items in column A with those in column B:*

| A | B |
|---|---|
| i) Eustachian tube | a) Eye |
| ii) Cornea | b) Nose |
| iii) Nerve ending | c) Ear |
| iv) Olfactory organ | d) Skin |

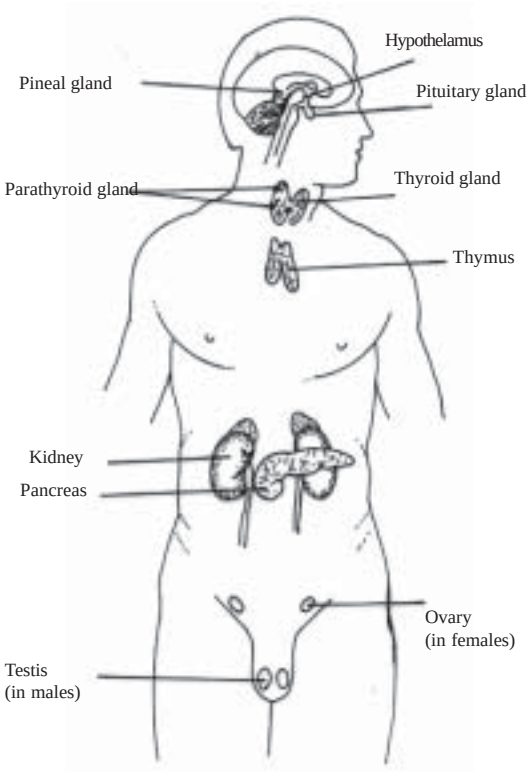



*Fig. 28.17 Location of various endocrine glands in the human body*

## 28.8 ENDOCRINE SYSTEM

Our body has a number of organs called endocrine glands. Their main function is to produce chemical secretions and these secretions are known as **hormones**. The term hormone has been derived from the Greek word **hormaein** meaning to set in motion or to spur on. Hormones play an important role in control, coordination and regulation of the functioning of tissues and organs in the body. For the smooth and normal functioning of the body, different hormones are required in different quantities.

Hormones are secreted by **ductless glands** or **endocrine glands** (Greek: *endo* means within, *krinein* means to separate). The endocrine system is responsible for chemical coordination in the animals including man.

**What are hormones?**

A hormone is a chemical secreted by an endocrine gland and carried by blood or lymph to a target organ elsewhere in the body to stimulate a specific activity.

There are different endocrine glands for secretion of different hormones (Fig. 28.17).

Table 28.2 lists some important hormones, glands secreting them and their effects on the functioning of our body.

**Did you know?**

Hyperactivity (overactivity) or hypoactivity (underactivity) of endocrine glands cause disease.

### 28.8.1 Pituitary gland

- Hyperactivity of cells of pituitary gland cause Cushing's disease. In this disease excessive growth of hair occurs in males. In some cases this disease may even cause atrophy of testes leading to impotency. In females, this disease causes sterility, musculisation, growth of beard, moustaches, etc.
- Deficiency (hypoactivity) of growth hormone (GH) or somatotrophic hormone (STH) secreted by pituitary gland causes **dwarfism** (retarded growth of the long bones) while its excessive secretion or hyperactivity causes **gigantism** (excessive growth of long bones) making a person very tall.

### 28.8.2 Thyroid gland

- Hypoactivity of thyroid gland causes **hypothyroidism** causing **cretinism** in young children. In this disease the child has stunted growth, short club like fingers, deformed bones and teeth. The skin becomes rough, dry and wrinkled with scanty hair growth. The abdomen gets pot-bellied and the child is mentally retarded.
- Hypoactivity of thyroid gland also causes abnormal swelling of thyroid called **goitre**.

### 28.8.3 Pancreas

- Hyposecretion of insulin secreted from pancreas, causes **diabetes mellitus**, in which glucose present in excess in the blood sometimes appears in urine.

**Table 28.2: Major hormones secreted in the human body, their sources and effects**

| Endocrine glands and their location | Hormone secreted | Effects |
|---|---|---|
| **Pituitary gland**<br>(It is attached to the lower surface of the brain. It has three lobes-anterior lobe, middle lobe and posterior lobe) | Growth hormone (GH) or Somatotrophic hormone (STH) | Controls the overall growth of the body, muscles and bones. |
| | Adenocorticotropic hormone (ACTH) | Controls the growth and functioning of adrenal cortex. Stimulates adrenal cortex to produce steroid hormones called glucocorticoids. |

| | | |
|---|---|---|
| | Thyroid stimulating hormone (TSH) | Controls the growth and functioning of thyroid gland. Stimulates thyroid gland to produce thyroxin. |
| | Follicle stimulating hormone (FSH) | Stimulates the maturation of ovarian follicle and secretion of estrogen by ovary in females; and in males stimulates the process of spermatogenesis. |
| | Luteinizing hormone (LH) | In females stimulates the ovulation and secretion of progesterone and hence helps in preparation and maintenance of pregnancy. In males it stimulates the secretion of testosterone. |
| | Prolactin (PRL) | Enhances development of mammary glands and milk production in females. |
| | Melanocyte stimulating hormone (MSH) | Controls the production of melanin pigment in skin. |
| | Oxytocin | Controls the uterine muscle contraction at the time of child birth (parturition). |
| | Antidiuretic hormone (ADH) | Controls reabsorption of water in kidney tubules. |
| **Thyroid gland** (It is situated in the neck region on the ventral side of the body. It has two lateral lobes,one on either side of the trachea). | Thyroxin | Stimulates the cellular metabolism and oxidation. In general it controls the growth and metabolism of the body. |
| **Pancreas** (Situated in the abdominal region. Its endocrine cells - **Islets of Langerhans** secrete hormones. | Insulin | Regulates the conversion of glucose to glycogen. |
| | Glucagon | Regulates the conversion of glycogen and some non-carbohydrates back to glucose. |

## CHECK YOUR PROGRESS 28.4

1. Fill in the blanks.
   i) A hormone is carried by _____ or _____ to the target organ.
   ii) Thyroid stimulating hormone is secreted by _____
   iii) _____ hormone regulates the conversion of glucose to glycogen.
   iv) _____ hormone controls the reabsorption of water in kidney tubules.
   v) Hypoactivity of thyroid gland leads to_____

## LET US REVISE

- Nervous system works with the endocrine system to communicate, integrate and coordinate the functions of various organs and systems in our body and responds to the external stimuli.

- In humans the nervous system has two divisions, the central nervous system and the peripheral nervous system.
- The central nervous system comprises of brain and the spinal cord, while the peripheral nervous system includes the nerves, which connect the central nervous system with sense organs, muscles and the glands in the body.
- Nerves are thread like structures that emerge from brain and spinal cord and branch out to almost all parts of the body.
- A neuron is the basic unit of nervous system. There are three types of neurons - sensory neurons, motor neurons and connecting relay or intermediate neurons.
- A synapse is the junction of the terminal branches of the axon of one neuron with the dendrites or cell body of another neuron. It is the site of transfer of nerve impulse from one neuron to another.
- The brain has three parts - cerebrum, cerebellum and medulla oblongata.
- A reflex action is a spontaneous, autonomic and mechanical response to a stimulus controlled by the spinal cord without the involvement of the brain.
- The pathway followed by sensory or motor nerves in a reflex action is called reflex arc.
- Sense organs are the organs by which you detect changes in the external environment.
- The five sense organs are eyes, ears, skin, tongue and nose.
- Messages from the sense organs are carried to the brain by nerves. Brain analyses these messages and as a result the sensations are produced.
- Without our sense organs we would know nothing about our environment. Therefore we should take care of them and protect them from injury and disease.

## TERMINAL EXERCISES

**A. Multiple choice type questions.**

**Tick the most appropriate answer of the following.**

1. Which of the following carry impulse from brain to effector?
   a) Sensory neuron b) Motor neuron
   c) Connecting neuron d) Mixed nerve

2. Short thread like branches of nerve cell are called
   a) dendrites b) synapse
   c) nodes of Ranvier d) neuron

3. A chemical known as neurotransmitter is released from the ends of
   a) axon b) synapse
   c) nodes of Ranvier d) neuron

4. The pituitary gland is found
   a) in the neck
   b) at the base of the brain
   c) beneath the stomach
   d) near the kidneys

5. The transparent window at the front of the eyeball is called
   a) cornea
   b) iris
   c) cone
   d) retina

6. Hormones are carried around in the body by
   a) blood
   b) nerves
   c) lymph
   d) both blood and lymph

7. Which of the following glands secretes the hormone thyroxin?
   a) Pituitary gland
   b) Thyroid gland
   c) Brain
   d) Pancreas

8. Which of the following hormones is secreted by the pancreas?
   a) Growth hormone
   b) Thyroxin
   c) Insulin
   d) Prolactin

9. The disease cretinism is caused due to
   a) hypoactivity of pituitary gland
   b) hyperactivity of pituitary gland
   c) hypoactivity of thyroid gland
   d) hyperactivity of thyroid gland

10. Hyposecretion of insulin causes
   a) Goitre
   b) Cretinism
   c) Diabetes insipidus
   d) Diabetes mellitus

**B. Descriptive type questions.**

1. Define the following:
   (i) central nervous system,
   (ii) hormone,
   (iii) receptor
   (iv) neuron,
   (v) nodes of Ranvier,
   (vi) impulse,
   (vii) synapse,
   (viii) reflex action,
   (ix) reflex arc, and
   (x) power of accommodation

2. Differentiate between the following:
   i) Sensory nerve and motor nerve
   ii) Cerebrum and cerebellum
   iii) Somatic nervous system and autonomic nervous system
   iv) Grey matter and white matter
   v) Hypermetropia and myopia
   vi) Insulin and glucagon

3. What are nerves? Classify nerves into different types stating their functions.

4. What are sensory neurons? How do they help in transmission of nerve impulse in our body?

5. What is a synapse? What is the main function of a synapse?

6. State the main functions of cerebrum and medulla oblongata.

7. Mention one function of each of the five sense organs of our body.
8. Draw a labelled diagram of the human eye.
9. What is the function of sweat glands?
10. What are endocrine glands? How do their secretions reach various parts of our body?
11. Name various hormones secreted by pituitary gland stating functions of each one of them.
12. Endocrine glands are ductless glands, then how do their secretions reach the target site?
13. Name the hormone secreted by thyroid gland and state its main functions.
14. What is Cushing's disease? Name the endocrine gland responsible for this disease.

## ANSWERS TO CHECK YOUR PROGRESS

**28.1**

1. i) brain and spinal cord
   ii) sensory pathway
   iii) motor
   iv) dendrites, effector
   v) axon, dendrites
2. Any two functions of cerebellum like, maintenance of equilibrium of the body, controlling the posture of the body, coordinating muscular movement, etc.
3. Internal organs of the body like lungs, heart, etc.

**28.2**

1. i) Afferent nerves
   ii) Somatic nervous system
   iii) Reflex arc
2. A spontaneous, autonomic and mechanical response to a stimulus controlled by the spinal cord without the involvement of brain is called reflex action.
3. Components of a reflex arc
   i) A receptor or sensory organ which perceives the stimulus,
   ii) A sensory nerve which carries message from receptor to spinal cord,
   iii) A relay neuron of spinal cord which transmits the impulse from sensory to motor neuron, and
   iv) Motor nerve which carries the message from spinal cord to effector organ - muscle or gland.

**28.3**

1. Eyes, Nose, Ear, Skin and Tongue
2. (i) Dermis, epidermis
   (ii) Skin
3. (i) (c)
   (ii) (a)
   (iii) (d)
   (iv) (b)

**28.4**

1. i) Blood, lymph
   ii) Pituitary gland
   iii) Insulin
   iv) Antidiuretic hormone
   v) Goitre

## GLOSSARY

**Nervous system :** The organ system in an animal that serves to coordinate and control all the physiological systems in its body.

**Neurons :** The nerve cells that transmit messages throughout the body.

**Nerves :** Thread like structures that emerge from brain and spinal cord and branch out to almost all parts of the body. They are bundles of axons or nerve fibres enclosed in a sheath.

**Synapse :** The junction between the terminal branches of the axon of one neuron with the dendrites or cell body of another neuron.

**Nodes of Ranvier :** Regular gaps on the medullary sheath covering the axon.

**Neurotransmitter :** A chemical released at the synapse which helps in the transmission of nerve impulse from one neuron to another.

**Cerebrum :** The largest and most prominent part of the brain. It controls intelligence activities, motor activities, etc.

**Cerebellum :** The region of the brain under the large cerebrum which controls balance of the body.

**Medulla oblongata :** The lowermost part of the brain located at the base of the skull. It controls cardiac and respiratory activities.

**Spinal cord :** A long cord that extends from the medulla oblongata and runs inside the vertebral column.

**Reflex action :** The action in our body which are spontaneous and do not require any processing by brain.

**Sense organs :** The organs through which we sense or feel change in the external environment.

**Hypermetropia :** The defect of the eye in which the eye can focus the distant objects clearly but the point of focus for an object close to the eye is behind the retina.

**Myopia :** The defect of the eye in which the eye ball is longer than normal. In this defect objects close to the eye can be focused properly but the point of focus for distant objects is in front of the retina.

**Hormone :** A chemical secreted by an endocrine gland and carried by blood or lymph to a target organ elsewhere in the body to stimulate a specific activity.