

Biology

STANDARD



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Government of Kerala
Department of Education

State Council of Educational Research and Training
(SCERT), Kerala
2016

The National Anthem

Jana-gana-mana adhinayaka, jaya he
Bharatha-bhagya-vidhata.
Punjab-Sindh-Gujarat-Maratha
Dravida-Utkala-Banga
Vindhya-Himachala-Yamuna-Ganga
Uchchala-Jaladhi-taranga
Tava subha name jage,
Tava subha asisa mage,
Gahe tava jaya gatha.
Jana-gana-mangala-dayaka jaya he
Bharatha-bhagya-vidhata.
Jaya he, jaya he, jaya he,
Jaya jaya jaya, jaya he!

Pledge

India is my country. All Indians are my brothers and sisters.

I love my country, and I am proud of its rich and varied heritage. I shall always strive to be worthy of it.

I shall give respect to my parents, teachers and all elders and treat everyone with courtesy.

I pledge my devotion to my country and my people. In their well-being and prosperity alone lies my happiness.

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Dear students,

Hope you enjoyed the wonderful phenomena which occur in leaves of the green plants which provide food to the living world. You might have also learnt by now, about the various life activities inside the human body, various organ systems functioning in unison to perform these activities, the things to be cautious of in protecting these systems, the biology behind physical movements and maintaining a beautiful posture.

Here we provide you more information and opportunities to know the wonders of the living world. Aren't you eager to know how we sense and respond to our environment through the windows of knowledge? You shall definitely be surprised at the way in which the human brain, nerves and hormones unite in action to coordinate various physical activities. This textbook unravels genetic secrets, periodical growth of the biotechnological field which helps human life progress, the steps of evolution that is the process towards the entity called 'modern man'. This textbook also refers to ways in which diseases are resisted by the amazing machine, the human body and our duties and responsibilities to evade diseases.

The study of biology strides forward giving inspiration to observe and assess our environment and create innovations through enquiry. Suitable contexts are given for this purpose. This textbook will, undoubtedly help you to develop attitudes towards personal hygiene, social hygiene, preservation of biodiversity, waste disposal and thereby form desirable attitudes towards life and society, imbibing the values of equality and tolerance.

Wishing you all the very best !

Dr. P.A.Fathima

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**Certain icons are used in this
textbook for convenience**



For further reading
(Evaluation not required)



Significant learning outcomes



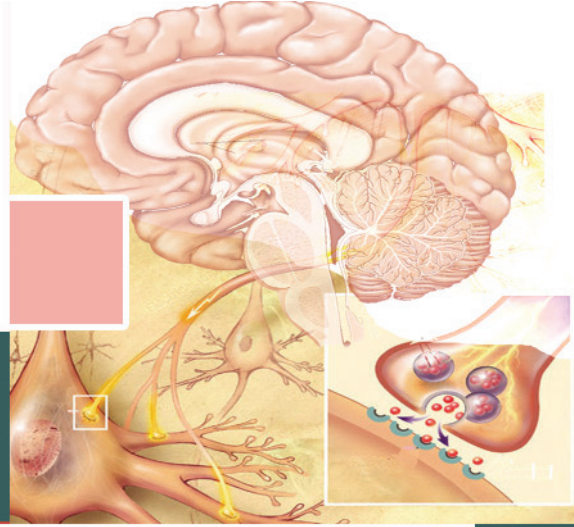
Let us assess



Extended activities

1

Sensations and Responses



Observe the picture. Don't children and other organisms have a variety of experiences? What are they?

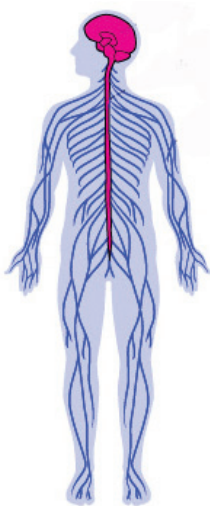
- a child tasting a mango.
- a snail withdrawing its body into the shell when it is touched.
-

What are the factors to which children and organisms respond here?

- touch
- sound
-
-
-

The senses that evoke responses in organisms are called stimuli. Do we recognise stimuli only from our immediate surroundings? Notice certain instances mentioned below.

- hunger
- thirst
-



Various stimuli are formed inside the body like this. There are many receptors in sense organs and other parts of the body to receive such external and internal stimuli. You have already studied that nervous tissues are tissues that help to respond to external and internal stimuli and coordinate life activities. The function of the nervous system is to generate and coordinate responses according to internal and external changes. The nervous system includes the brain, spinal cord, nerves and receptors.

Neuron

Neuron is the structural and functional unit of the nervous system. Like all other cells, the neuron also has a cell membrane, cytoplasm and nucleus. Observe Illustration 1.1. Analyse the main parts of a neuron and their functions on the basis of indicators and write them down in the science diary.

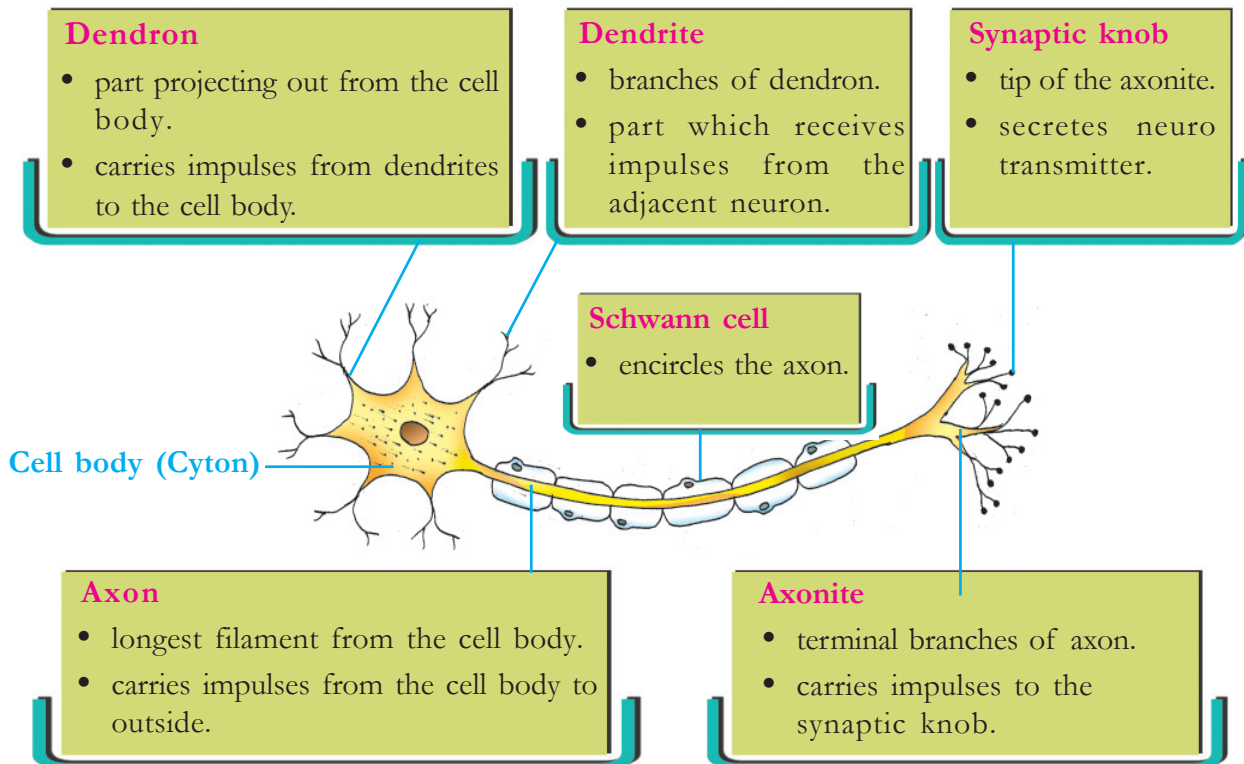


Illustration 1.1 Neuron-structure and function

Indicators

- main parts of a neuron.
- peculiarities of different parts of a neuron and their functions.

Axons of most of the neurons are covered by the myelin sheath, a membrane having a lipid called myelin. On the basis of the given indicators, analyse Figure 1.1 and the description and write your inferences on myelin sheath.

Schwann cells, a part of nervous tissues, repeatedly encircle the axons to form the myelin sheath. The myelin sheath has a shiny white colour.

The major functions of the myelin sheath are to provide nutrients and oxygen to the axon, accelerate impulses, act as an electric insulator and protect the axon from external shocks.

Indicators

- formation of myelin sheath.
- functions of myelin sheath.

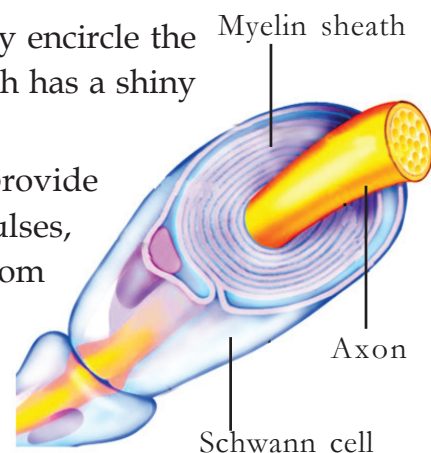


Figure 1.1 Myelin sheath

The part of the brain and the spinal cord, where myelinated neurons are present in abundance is called white matter and the part where the cell body and nonmyelinated neurons are present is called grey matter.

Generation of Impulses

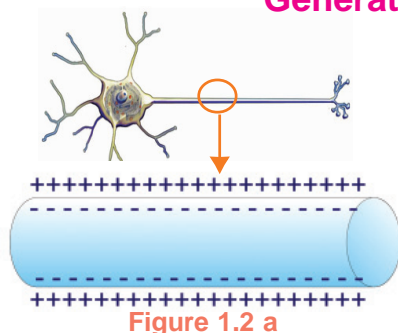


Figure 1.2 a

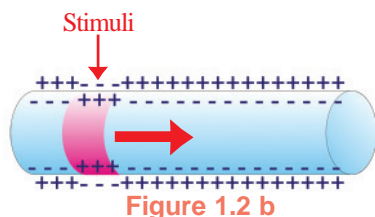


Figure 1.2 b

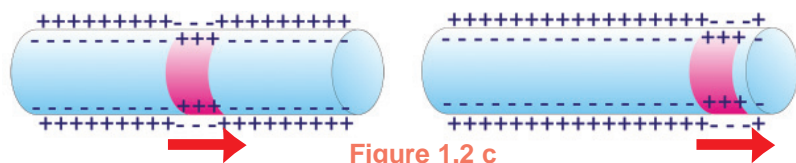


Figure 1.2 c

The nervous system manages control and coordination through nerve impulses. How are impulses transmitted through neurons?

Analyse the given Figures (1.2 a, b, c) on the basis of the description and indicators, and arrive at your own inferences.

Impulses are messages conducted through nerves. These impulses transmit in the form of electric charges. Impulses are generated when stimuli evoke changes in polarity in the plasma membrane of receptors, the modified neurons. The difference in the distribution of ions helps to maintain positive charge on the outer surface and negative charge inside the plasma membrane of the neuron (Figure 1.2 a).

When stimulated, the ionic equilibrium in the particular part changes. As a result polarity changes and the outer surface becomes negatively charged while the inner surface becomes positively charged (Figure 1.2 b). This change does not persist for long. It regains its original state. But the momentary charge difference in the axon membrane stimulates its adjacent parts and similar changes occur there too. As this process proceeds, impulses get transmitted through axon (Figure 1.2 c).

Indicators

- charge on either side of the plasma membrane in a resting state.
- change in the distribution of ions on both sides of the plasma membrane when it gets stimulated.

Impulses generated in the receptor cells reach the brain. The brain analyses it and gives direction for proper response. To make this possible, the impulses formed in a neuron are to be transmitted to other neurons and associated cells. How does it become possible? Analyse Illustration 1.2 and the description to understand how transmission of impulses takes place.

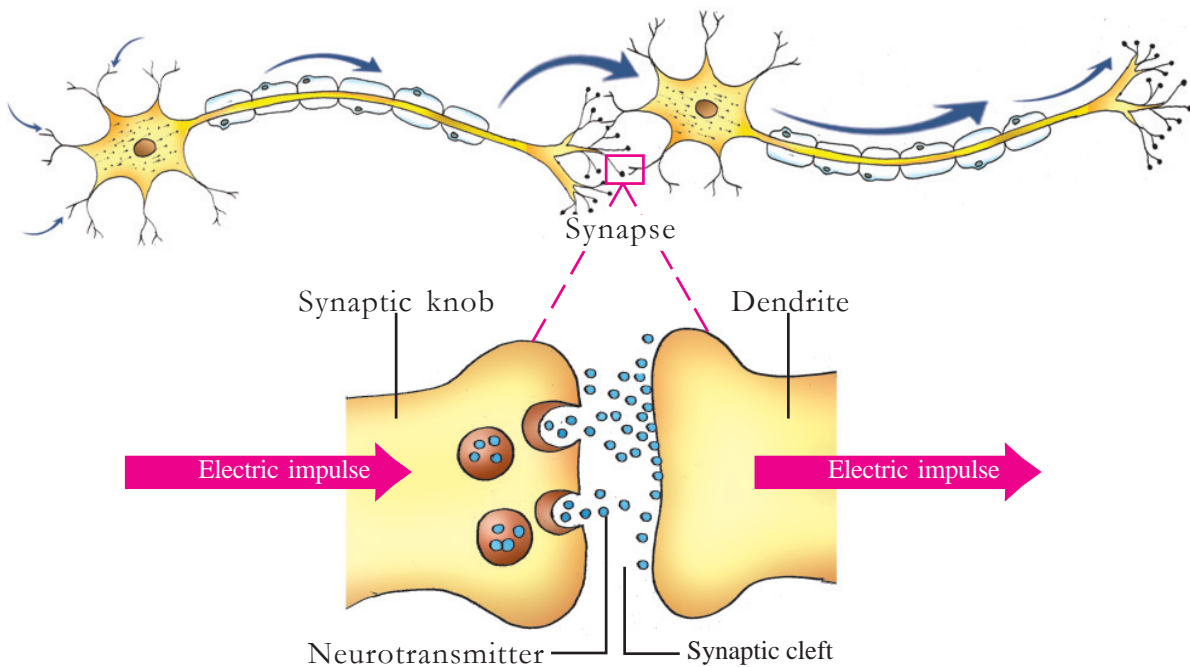


Illustration 1.2 Synapse

Synapse

Synapse is the junction between two neurons or a neuron and a muscle cell or a neuron and a glandular cell. Synapse helps to regulate the speed and direction of impulses.

The electric impulses generated by stimuli reach the synaptic knob where certain chemical substances are secreted. They are the neurotransmitters. The neurotransmitter which is released in the synaptic cleft stimulates the adjacent dendrite and new electric impulses are formed. Acetylcholine and dopamine are examples of neurotransmitters.

Indicators

- synapse
- significance of neurotransmitter.
- impulse transmission through synapse.

On the basis of the direction of impulses, neurons can be classified into sensory neurons and motor neurons. Sensory neurons carry impulses to the brain and spinal cord. Motor neurons carry impulses from the brain and spinal cord to various parts of the body.

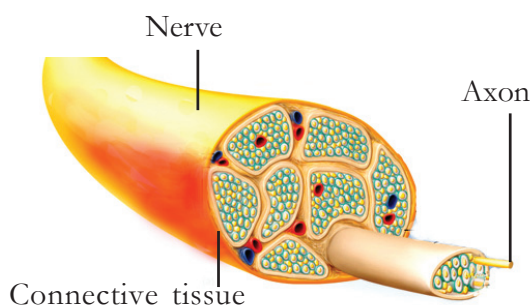


Figure 1.3
Cross section of a nerve

Nerves

Nerves are groups of axons or nerve fibres. They are covered by connective tissue (Figure 1.3).

On the basis of their functions, nerves are further classified. Analyse Table 1.1 and prepare notes in your science diary.

Nerves and their peculiarities	Functions
Sensory nerve (formed of sensory nerve fibres)	carries impulses from various parts of the body to the brain and the spinal cord.
Motor nerve (formed of motor nerve fibres)	carries impulses from brain and spinal cord to various parts of the body.
Mixed nerve (formed of sensory nerve fibres and motor nerve fibres)	carries impulses to and from the brain and spinal cord.

Table 1.1 Nerves and their functions

Nervous System

The nervous system consists of two parts, namely the central nervous system and the peripheral nervous system. Observe Figure 1.4. The central nervous system consists of brain and the spinal cord. The peripheral nervous system consists of 12 pairs of cranial nerves and 31 pairs of spinal nerves.

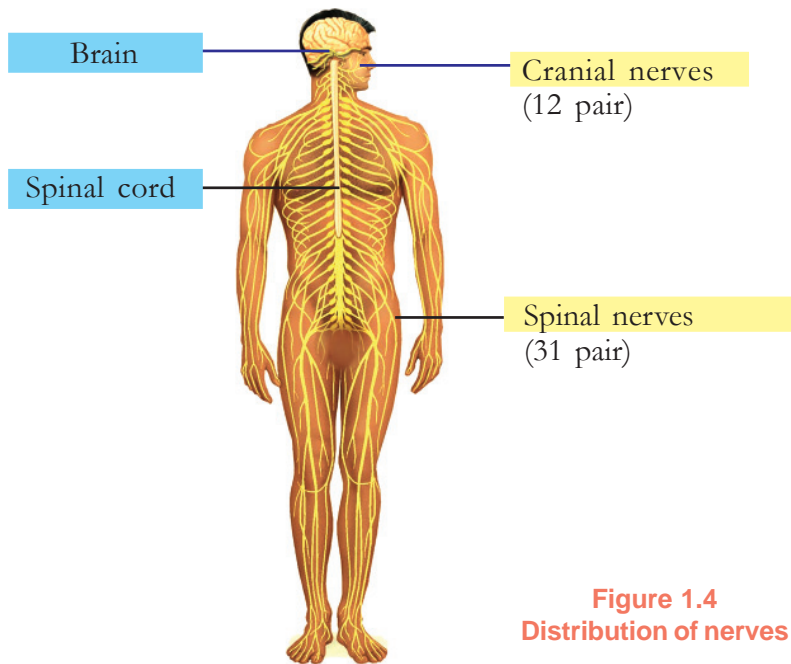


Figure 1.4
Distribution of nerves

Brain – Centre of the Nervous System

The brain contains the greatest number of neurons in the nervous system. Analyse Figure 1.5 and the description, based on the indicators, to understand the ways in which the brain is protected and write it in your science diary.

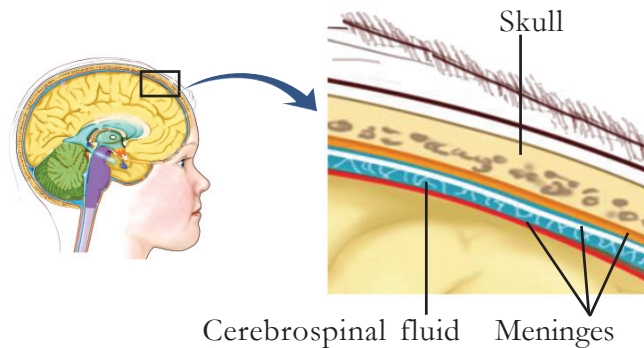


Figure 1.5

The brain is protected inside a hard skull. It is covered by the meninges, a three - layered membrane. The cerebrospinal fluid is filled within the inner membranes of meninges and the ventricles of the brain. The cerebrospinal fluid formed from blood is reabsorbed into the blood. The functions of the cerebrospinal fluid are to provide nutrients and oxygen to the tissues of the brain, regulate the pressure inside the brain and to protect the brain from injuries.

Indicators

- protection of the brain.
- nourishment of the brain.

The different parts of the brain control and coordinate various life activities. Analyse Illustration 1.3 showing the structure of the brain and list the characteristics and functions of each part.

Thalamus

- situated below the cerebrum.
- acts as relay station of impulses to and from the cerebrum.
- analyses impulses from various parts of the body and sends the important ones to the cerebrum.

Cerebrum

- the largest part of the brain.
- numerous fissures and folds are seen.
- grey matter is seen in the external cortex and white matter is seen in the internal medulla.
- centre of thought, intelligence, memory and imagination.

Hypothalamus

- situated just below the thalamus.
- plays a major role in the maintenance of homeostasis.

Medulla oblongata

- the rod shaped medulla oblongata is seen below the cerebrum, located near the cerebellum.
- controls involuntary actions like heart beat, breathing etc.

Cerebellum

- the second largest part of the brain.
- seen behind the cerebrum as two flaps.
- fissures and grooves are present.
- coordinates muscular activities and maintains equilibrium of the body.

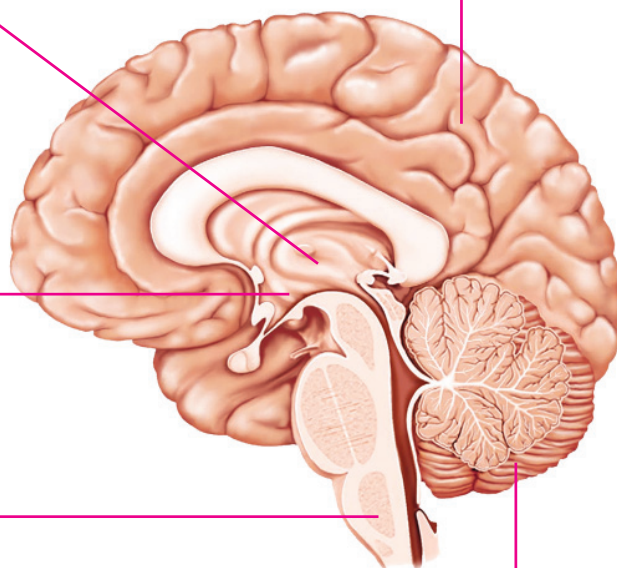


Illustration 1.3 Parts and functions of the brain

Spinal Cord

The spinal cord is the continuation of the medulla oblongata. On the basis of the indicators, analyse the description and Figure 1.6 and draw inferences on the spinal cord. Record them in your science diary.

The spinal cord is protected inside the vertebral column. Like the brain, the spinal cord is also covered by meninges. In the spinal cord, white matter is seen outside and grey matter is seen inside. The central canal seen in the centre of the spinal cord is also filled with cerebrospinal fluid.

The spinal cord is connected to different parts of the body through 31 pairs of spinal nerves. Each spinal nerve is connected to the spinal cord by a dorsal root and a ventral root.

Sensory impulses reach the spinal cord through the dorsal root. Motor impulses go out of the spinal cord through the ventral root. Impulses from different parts of the body are transmitted to the brain through the spinal cord. The spinal cord coordinates the rapid and repeated movements during walking, running etc.

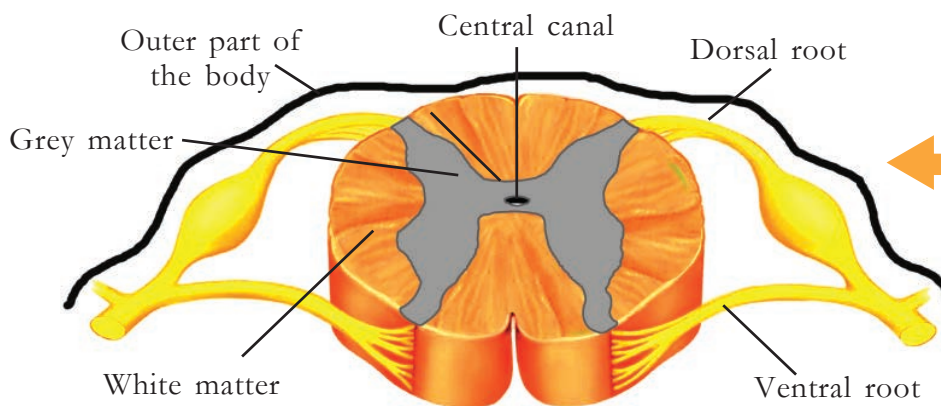


Figure 1.6 Cross section of the spinal cord

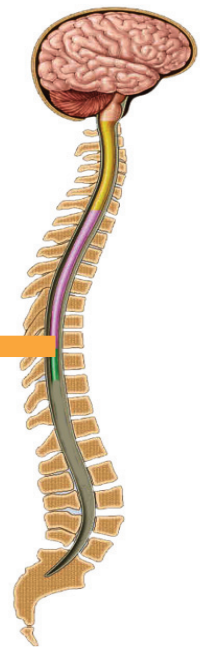
Indicators

- How is the spinal cord protected?
- How does the dorsal root differ from ventral root?
- The major functions of the spinal cord.

The Spinal Cord within the Vertebral Column



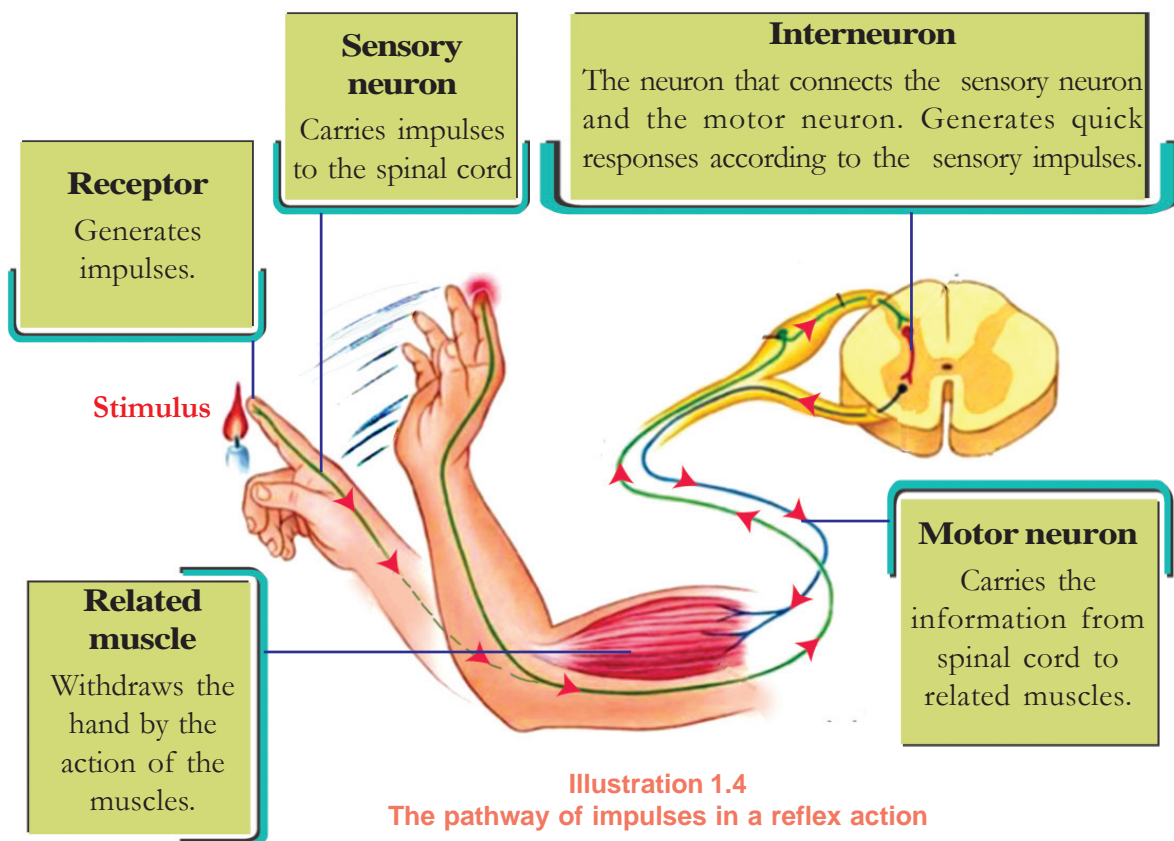
The spinal cord of a new born baby extends upto the tip of the vertebral column. But in adults, it is seen only upto the middle of the vertebral column. This is because the spinal cord does not grow in proportion to the growth of the vertebral column. The remaining portion of the spinal cord appears as a cluster of nerves.





Observe the pictures. Such responses are familiar to you too. They do not happen consciously. The accidental and involuntary responses towards stimuli are called reflex actions.

How does reflex action take place in our body? Analyse Illustration 1.4 and description and complete the flow chart.





Reflex arc is the pathway of impulses in the reflex action. Mainly spinal cord acts as the centre of reflex action.

But all reflexes are not under the control of the spinal cord. Don't we blink our eyes when light suddenly falls on our eye or when objects move towards them? This is also a reflex action. Such a reflex under the control of the cerebrum is called cerebral reflex.

There may be instances in your life when you felt sudden fear or sadness. Write down some of those experiences.

- seeing a snake suddenly while walking
-
-

What are the changes that take place in the body during such instances? Write them down in Table 1.2.

During an emergency situation	While in normal condition
Heart beat increases	
	Breathing rate decreases

Table 1.2

Activities that take place beyond the conscious level are controlled by the autonomous nervous system, a part of the peripheral nervous system. The endocrine system is also associated with the nervous system for performing this function. The autonomous nervous system contains the sympathetic system and the parasympathetic system.

Analyse Illustration 1.5 to understand the actions of sympathetic and parasympathetic systems during emergency situations and complete Table 1.3.

Sympathetic System

Parasympathetic System

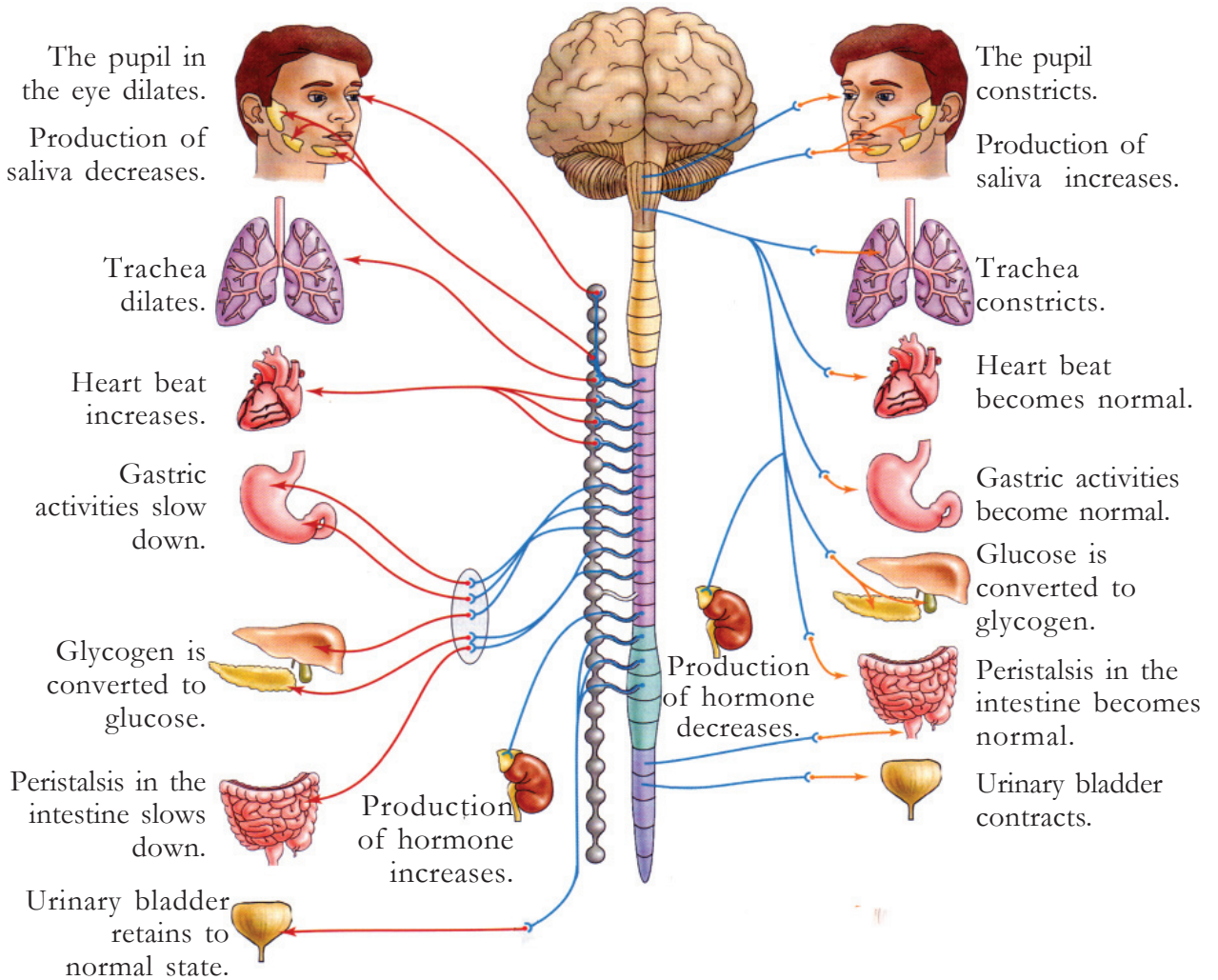


Illustration 1.5 Action of sympathetic and parasympathetic systems

Organ	Sympathetic System	Parasympathetic System
Eye		
Salivary gland		
Lung		
Heart		
Stomach		
Liver		
Intestine		
Urinary bladder		

Table 1.2
Physical changes during emergency situation

A healthy nervous system is the basis of rhythmic body activities. Even minor changes in the nervous system may affect physiological activities.

Conduct a seminar on 'The diseases affecting the nervous system' by analysing Table 1.4 and collecting more information on it. What should be your approach towards persons affected with such diseases? Discuss.

Disease	Causes	Symptoms
Alzheimer's	Accumulation of an insoluble protein in the neural tissues of the brain. Neurons get destroyed.	Loss of memory, inability to recognize friends and relatives, inability to do routine works.
Parkinsons	Destruction of specialised ganglions in the brain. Production of dopamine, a neurotransmitter reduces.	Loss of body balance, irregular movement of muscles, shivering of the body, profuse salivation.
Epilepsy	Continuous and irregular flow of electric charges in the brain.	Epilepsy due to continuous muscular contraction, frothy discharge from the mouth, clenching of the teeth following which the patient falls unconscious.

Table 1.4 Certain diseases affecting the nervous system

The nervous system helps us to experience various stimuli as well as to respond towards them. We can detect the changes that take place in our external and internal environment and respond to it accordingly. The control and coordination of different organ systems in organisms is made possible by the combined actions of the nervous system and the endocrine system. Proper care should be taken to maintain the health of these organ systems.



Significant learning outcomes

The learner

- identifies and explains receptor, stimulus and response.
- recognizes that neurons are the fundamental unit of the nervous system and explains its structure and function.
- analyses the concept of synapse and the transmission of impulses through neurons and presents it.

- recognizes and explains the major parts and their functions of the central nervous system.
- illustrates reflex action by identifying the major components of a reflex action.
- identifies and explains the parts and functions of the peripheral nervous system.
- recognizes the actions of sympathetic and parasympathetic systems and explains their functions.
- explains different types of diseases affecting the nervous system.



Let us assess

1. The part of the brain which helps to maintain body balance.
 - a) Cerebrum
 - b) Cerebellum
 - c) Medulla oblongata
 - d) Thalamus
2. Identify the relation and fill in the blank.

Irregular flow of charge in the brain : Epilepsy

Decreased production of dopamine : -----
3. Analyse the following instances and answer the questions.
 - a thorn accidentally pierces the foot
 - the leg is withdrawn.
 - the thorn is taken out slowly.
 - a) Write the stimuli and responses.
 - b) Which is the conscious response?
 - c) Was the leg withdrawn after sensing the pain? Which action took place there? Prepare an illustration showing the parts through which the impulses transmitted.



Extended activities

- Prepare a model of the human brain using locally available materials and exhibit it in the class.
- Collect additional information on diseases affecting the nervous system and prepare a magazine.

2

Windows of Knowledge



So many are the wonders around us! What fabulous sights, varied sounds, different smells, drooling tastes! How many things to make us happy or irritable by their touch and pat! Sense organs are windows which lead sensations into our consciousness. It is necessary for all organisms to identify the changes taking place in the surroundings and respond accordingly.



Receptors help sense organs in receiving various stimuli from the surroundings. List various sense organs and the stimuli they receive.

- | | | |
|----------|----------------|-------|
| • Eye | Photoreceptors | Light |
| • Ear | ..... | ..... |
| • Tongue | ..... | ..... |
| • Nose | ..... | ..... |
| • Skin | ..... | ..... |

We experience different sensations like that of vision, hearing etc., when stimuli received by receptors reach the brain in the form of impulses.

Eye

About eighty percent of our sensations are provided by the eye. Let us observe how this organ is protected.

- Eye socket (orbit) : depressions in the skull
- External eye muscles : fixes the eye ball in the orbit
- Eyebrow :
- Eyelashes :
- Eyelids :
- Conjunctiva : secretes mucus which protects the anterior portion of the eye ball from being dry.
- Tears : clean and lubricate the anterior part of the eye ball. Lysozyme, the enzyme present in tears, destroys germs that enter the eyes.

Let us analyse how far the structure of an eye is adapted to perform its function. Observe Figure 2.1 and Illustration 2.1. On the basis of the indicators, write your inferences in the science diary.

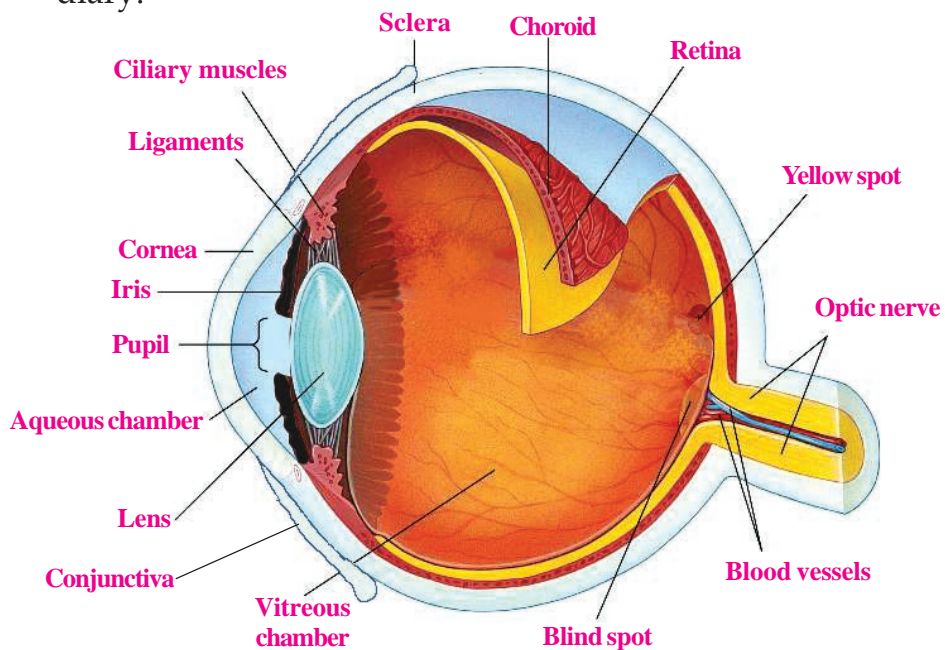


Figure 2.1 Structure of the eye

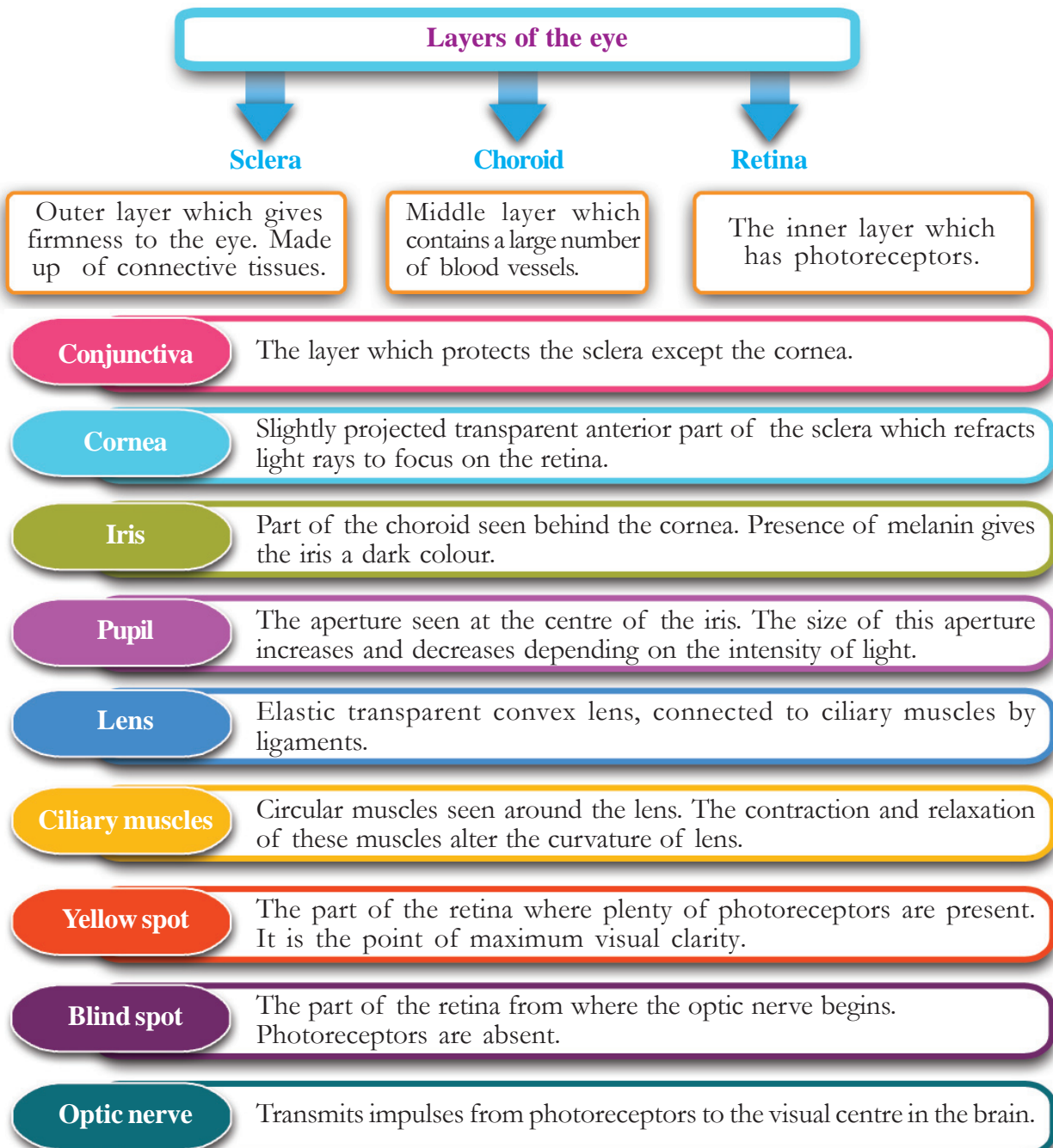


Illustration 2.1 The eye - parts and functions

The fluids in the eye	
Aqueous humor	Vitreous humor
<p>The fluid filled in the aqueous chamber between the lens and the cornea. It is formed from blood, and is reabsorbed by blood. Nourishes the tissues of the eye.</p>	<p>A jelly like substance seen in the vitreous chamber between the retina and the lens. Helps in maintaining the shape of the eye.</p>

Indicators

- layers of the eye.
- fluids present in the eye and their functions.
- the part where photoreceptors are present.
- the structure which carries impulses from the eye to the brain.
- nutrition of tissues in the eyes.

Regulation of Light in the Eye

Light which passes through the cornea reaches the lens through an aperture called the pupil. Do you know how bright light is prevented from entering the eye? The size of the pupil is regulated with the help of muscles in the iris. Thus the amount of light falling on the lens is regulated according to the intensity of light. Observe Figure 2.2.



Pupil dilates in dim light



Pupil constricts in bright light

Figure 2.2 Regulation of light in the eye



Radial Muscles (Pupillary dilator) and Circular muscles (Pupillary constrictor)

The size of the pupil is regulated by the antagonistic activity of the radial and circular muscles in the iris. When the circular muscles contract in intense light, the size of the pupil decreases. When the radial muscles contract in dim light, the size of the pupil increases. This also happens due to the functioning of the sympathetic nervous system. The regulation of the size of the pupil is a reflex action.

Light rays which reflect from an object is focussed on the retina with the help of curvature of the cornea and the lens.

Observe Figure 2.1.

We have a convex lens inside the eye. What are the peculiarities of image formed by this type of lens? List them.

-
-
-

We can see nearby and distant objects clearly. This is due to the property of the lens to adjust focal length according to the distance between the eye and the object. You are aware that in an artificial lens the focal length is constant. In order to get a clear image, we have to adjust the position of lens or screen. But it is the peculiarity of the eyes to adjust the focal length of the lens. Observe and analyse Table 2.1 and Figure 2.3 which explains this. Write your inferences in the science diary.

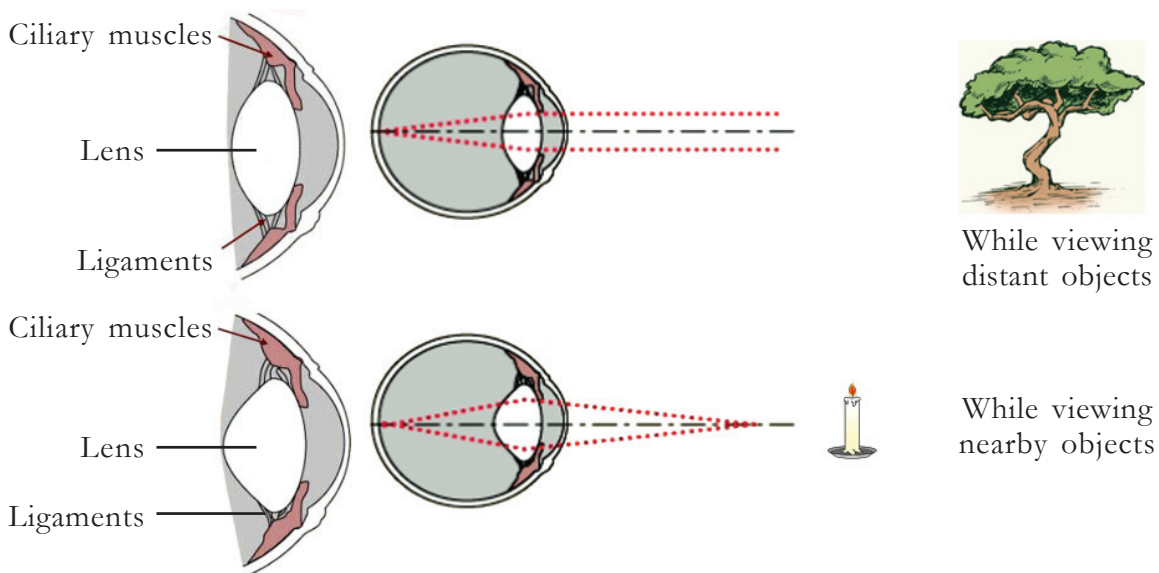


Figure 2.3 Power of accommodation of eye

While viewing near objects	While viewing distant objects
Ciliary muscles contract	Ciliary muscles relax
Ligaments relax	Ligaments stretch
Curvature of lens increases	Curvature of lens decreases
Focal length decreases	Focal length increases

Table 2.1

The capacity of the eye to change the curvature of lens depending on the distance between the eye and the object by adjusting the focal length is called the power of accommodation of the eye.

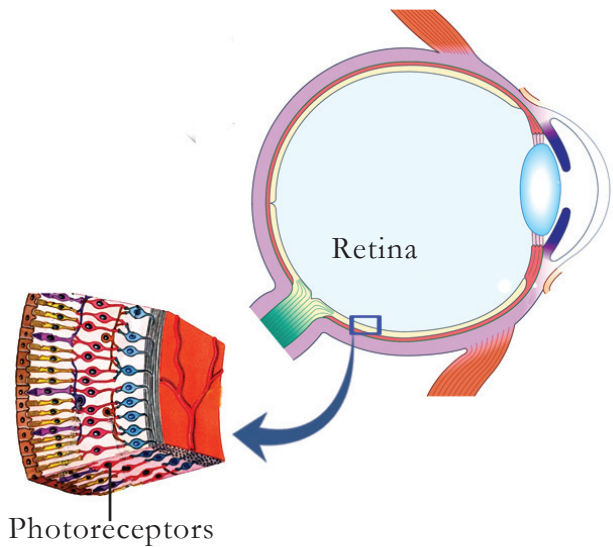


Figure 2.4
Photoreceptors

Photoreceptors in the Eye

Photoreceptors in the retina are stimulated by light which falls on it. As a result, impulses are formed in the eye. The two photoreceptors present in the retina of the eye are rod cells and cone cells. Rod cells are more in number than cone cells.



Rod cell

Cone cell

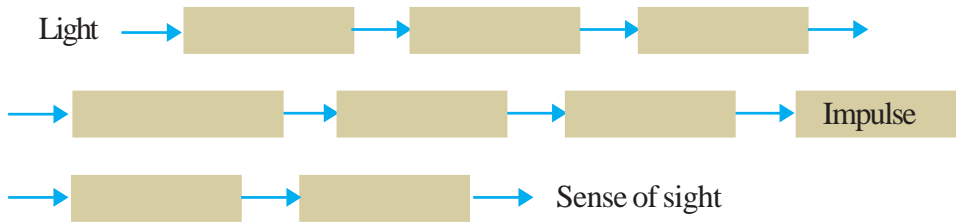
Figure 2.5
Rod cells and cone cells

Observe the structure of photoreceptors in Figure 2.5 and relate their shape with their names.

Rod cells contain visual pigment called rhodopsin. This pigment is formed from a protein named opsin and retinal which is a derivative of vitamin A. Rod cells are highly photosensitive and since they are activated even in very dim light, we are able to see objects in dim light. These cells cannot detect colour.

Cone cells contain a pigment called photopsin. This is also called iodopsin. This pigment is also composed of opsin and retinal. Three types of cone cells which help us to detect three primary colours of light – red, green and blue are present in our eyes. This is due to the change in amino acid in the opsin molecule. So, the cone cells provide us with colour vision.

Complete the flowchart showing the process of vision.



Chemistry of Vision

Do you know how impulses are formed in rod cells and cone cells when light falls on them? Observe the chemical reaction given below (Illustration 2.2). Discuss based on the indicators and write the inferences in your science diary.

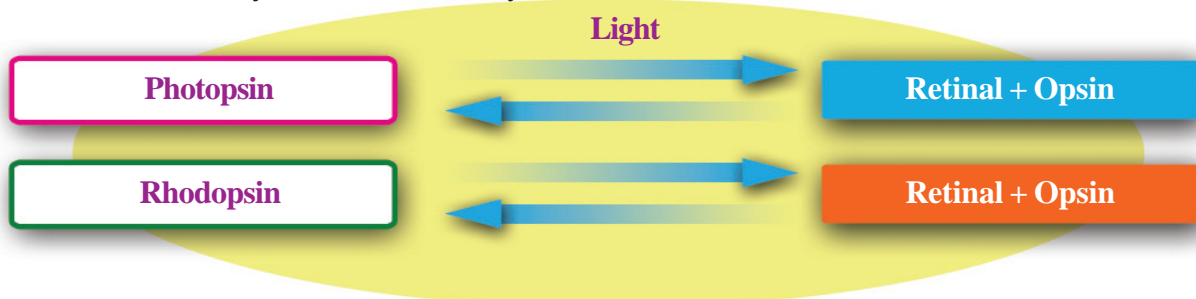


Illustration 2.2

When light rays fall on pigments present in photoreceptors, the pigments dissociate into retinal and opsin. This chemical change leads to the formation of impulses. These impulses are transmitted to cerebrum through the optic nerves and this enables vision.

Indicators

- photoreceptors and their pigments.
- function of cone cells.
- function of rod cells.
- the mechanism of vision.

Vision - From bright light to dim light



Pigments present in rod cells and cone cells show differences in their photoreceptivity. Rhodopsin dissociates in dim light but photopsin needs bright light. The resynthesis of rhodopsin which is completely broken down in bright light is a slow process than the resynthesis of photopsin. 90 percent of photopsin is resynthesized within one minute when it takes about five minutes to resynthesize 50 percent of rhodopsin. This delay in the resynthesis of rhodopsin, is the reason for the delayed vision as we enter a dimly lit room from bright light.

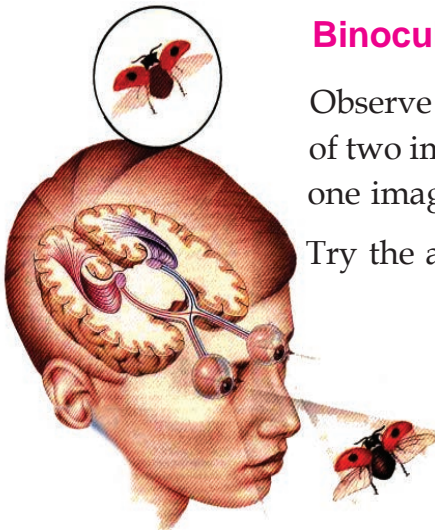


Figure 2.6
Binocular vision

Binocular vision

Observe Figure 2.6. Isn't there a possibility of the formation of two images of an object with our two eyes? But we see only one image of the object. Why does this happen?

Try the activity given below.

Stretch your left hand forward. Close your right eye and focus the forefinger of your left hand. Now close your left eye and without changing the direction of your head, focus on the same finger. Do you notice any change in the position of the finger?

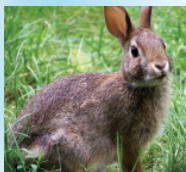
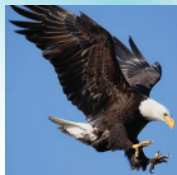
The images from two sides of the same object are formed in the left and right eye. These two images are combined together in the visual area of our brain to form a three dimensional image of the object. This is called binocular vision.

Food Habits and Health of the Eyes



Position of the Eye and Vision in Animals

The kite has a high power of vision. Its eyes are situated closer to each other and they possess large number of cone cells. This helps the bird to locate its prey from very high altitude. Have you noticed the position of eyes in rabbit? They are located on either side of the head. So they can see objects in front and to some extent the objects at the back through the sides. It is an adaptation to escape from predators. The position of the eyes in the prey and the predators are adaptations for their escape and hunt respectively.



You have studied that the retinal, which is a part of visual pigment seen in photoreceptors, is derived from vitamin A. The deficiency of vitamin A results in the low production of retinal. This in turn create the deficiency of rhodopsin in rod cells. The resynthesis of rhodopsin also gets blocked. This causes a

condition called night blindness. Persons with night blindness cannot see objects clearly in dim light. Due to the prolonged deficiency of vitamin A, the conjunctiva and cornea will become dry and opaque. This causes xerophthalmia and leads ultimately to blindness. Hence it is necessary to include food containing vitamin A in our diet.

Eye – Defects and Diseases

You are now aware of some of the eye defects. List them and their remedies.

- Myopia :
-
-

Let us familiarise ourselves with a few more eye defects and diseases.

Colour Blindness

Observe Figure 2.7. Can you read the number given in the figure clearly? You are aware that the retina contains cone cells which can detect red, green and blue colours. Colour blindness is caused due to the defect of cone cells which detect red and green colours. Persons with this defect cannot distinguish green and red colours. Can you guess why persons with colour blindness are not entrusted with jobs like that of a driver, pilot etc?

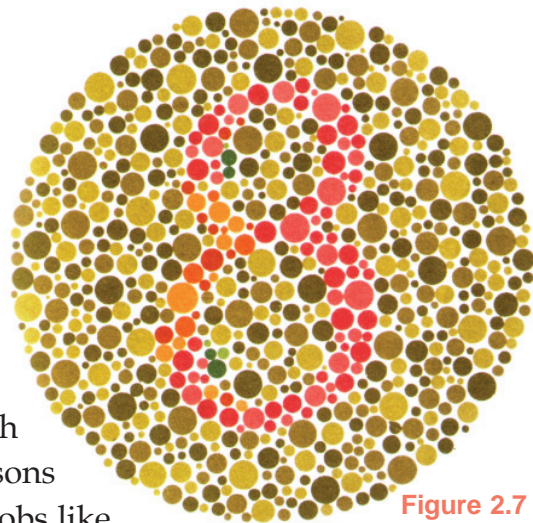


Figure 2.7

Glaucoma

Aqueous humor is a fluid which nourishes the tissues in the eyes. This is formed from blood and is reabsorbed into it. But at times, if the reabsorption does not occur, it causes an increase in the pressure inside the eyes which causes a defect called glaucoma. This causes damage to the retina and the photoreceptor cells and ultimately leads to blindness. This defect can be rectified by laser surgery.

Cataract

It is a condition in which the lens of the eyes become opaque resulting in blindness. This can be rectified by replacing the lens with an artificial one, through surgery.

Conjunctivitis

This is an infection of the conjunctiva. The causative organisms may be bacteria, virus etc. This disease is transmitted through contact and can be prevented by maintaining personal hygiene.



Observe the poster. Prepare posters for an awareness programme on the protection of eyes and donation of eyes.

Ear

The ear is the sense organ which transmits various sounds to our consciousness. How varied are the sounds around us! Like vision, hearing also makes us active. Not only does the ear help us in hearing, but it also helps in maintaining the balance of the body. Observe Figure 2.8.

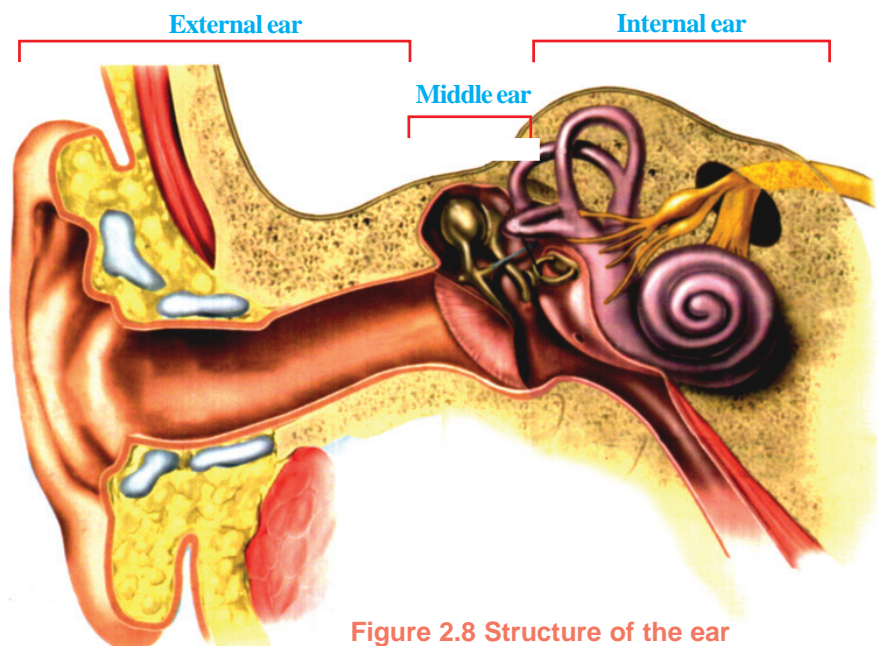


Figure 2.8 Structure of the ear

The ear consists of three parts - external ear, middle ear and internal ear. Let us examine their structure in detail.

External Ear

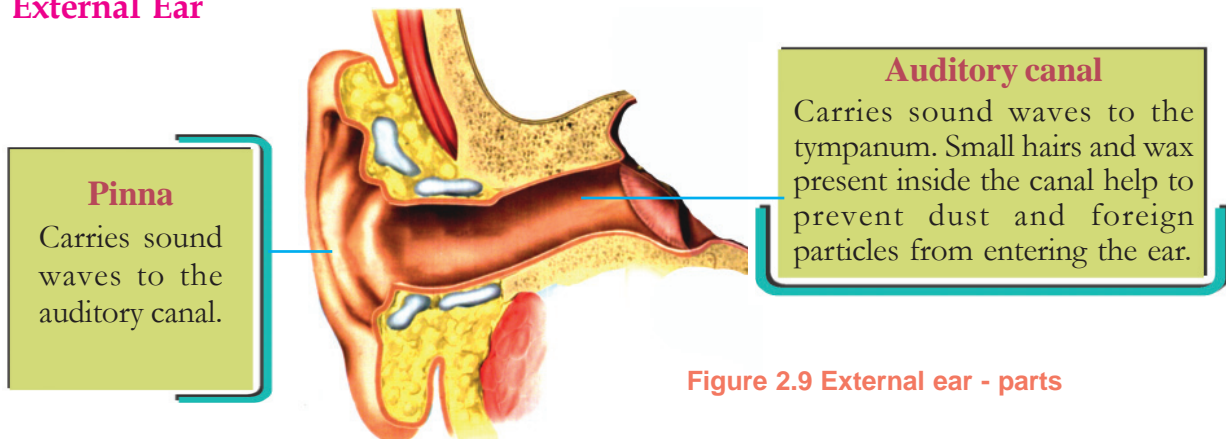


Figure 2.9 External ear - parts

Observe Figure 2.9 and prepare notes based on the indicators.

Indicators

- What are the parts of the external ear?
- How does the pinna help in hearing?
- What is the importance of ear wax ?

Middle Ear

Observe Figure 2.10 and understand the functions of various parts of the middle ear.

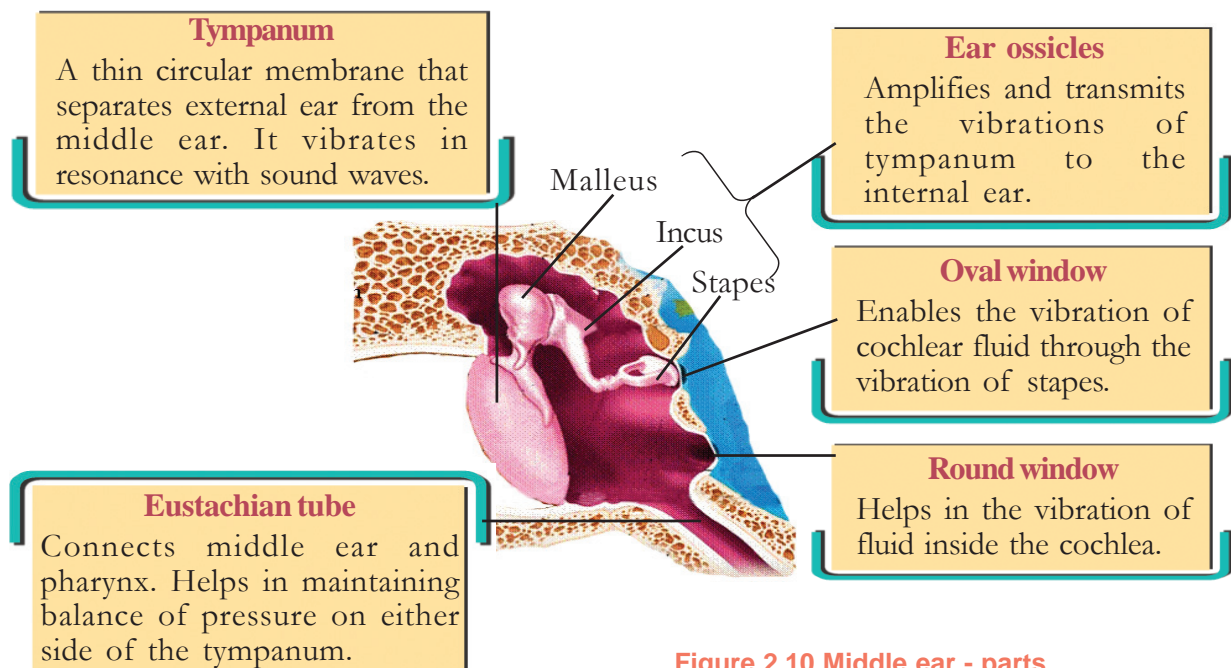


Figure 2.10 Middle ear - parts

Middle ear is a small chamber between the external ear and the internal ear. Tympanum, ear ossicles namely malleus, incus and stapes are the important parts seen inside the middle ear. Tympanum separates the middle ear from the external ear. A bony wall separates the middle ear from the internal ear. In this bony wall there are two openings which are covered by membranes. The upper opening is called oval window and the lower one is called round window. The ear ossicles connect the tympanum to the internal ear through the oval window.

Indicators

- functions of the ear ossicles.
- functions of eustachian tube.

Internal Ear

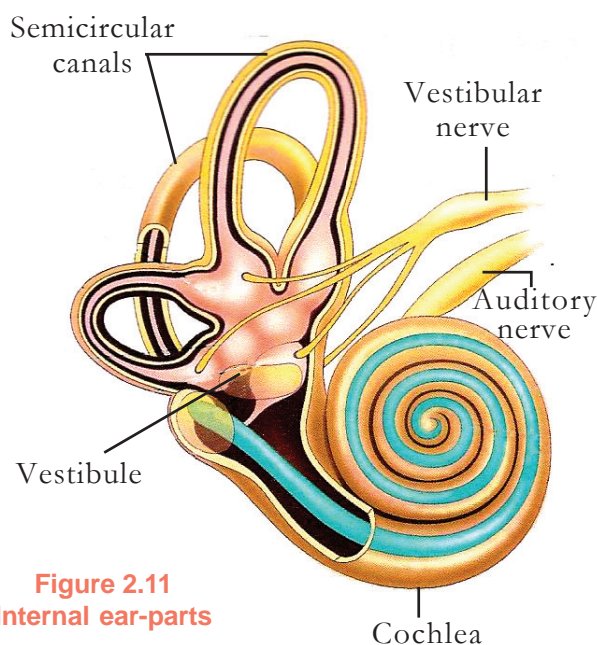


Figure 2.11
Internal ear-parts

The internal ear is situated inside a bony case in the skull called the bony labyrinth. In this bony case there are membranous labyrinths as well. The space inside the membranous labyrinth is filled with a fluid named endolymph. The space between the membranous and bony labyrinth is filled with a fluid called perilymph. Semicircular canals, vestibule and cochlea are the main parts of the internal ear. Semicircular canals and vestibule help in balancing the body where as cochlea helps in hearing.

Ear and Hearing

Cochlea is a coiled tube like a snail shell. It consists of three chambers. Specialized sensory hair cells which are present in basilar membrane that separates the middle and lower chambers, function as auditory receptors. The sound waves which passes through the external ear vibrates the tympanum. This vibration of the tympanum is transmitted to the ear ossicles which causes

the vibration of the membrane in the oval window. This vibration causes the movement of fluid inside the cochlea. As a result the sensory hair cells seen in the basilar membrane of the cochlea are stimulated and impulses are generated. These impulses reach the cerebrum through the auditory nerve and hearing is effected.

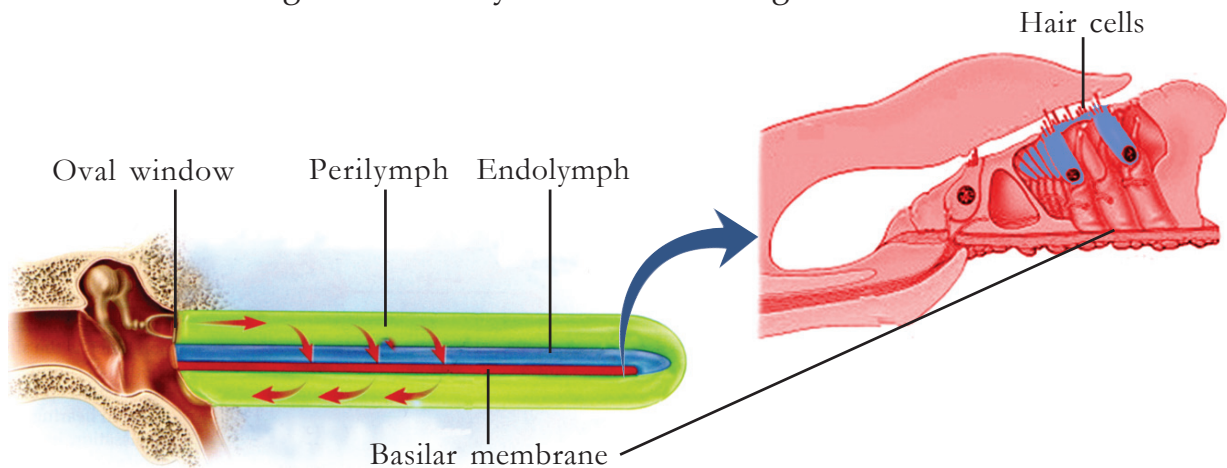
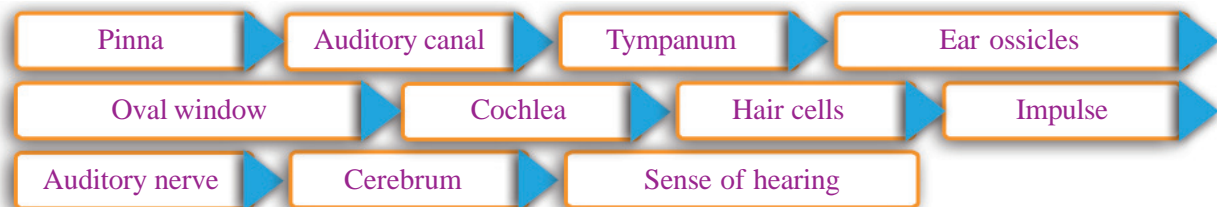


Figure 2.12 Structure of the cochlea (unfolded)

Observe Figure 2.12 and the flowchart given below. Prepare notes on process of hearing in the science diary.



Ear and Body Balancing

The parts seen inside the internal ear that help in balancing the body, are generally called vestibular apparatus. Observe Figure 2.13 and prepare notes on the arrangement of receptors in the vestibular apparatus in the science diary.

The vestibular apparatus is constituted of structures namely utricle, saccule and three semicircular canals. Cluster of receptors in the form of hair cells, seen inside the vestibule and semicircular canals help in balancing of the body. Body movements create movement of fluid inside the vestibule and semicircular canals. This creates movements of the sensory hair cells and generates

impulses . These impulses are transmitted by the vestibular nerves to the cerebellum. As a result, the cerebellum enables muscular movements that maintain the equilibrium of the body.

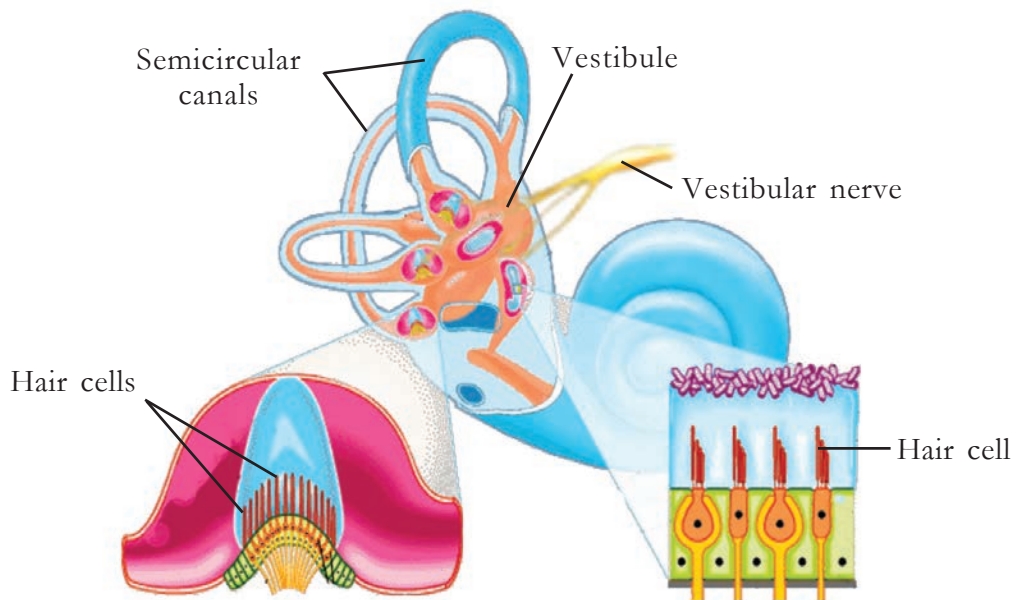


Figure 2.13 Ear - Vestibular apparatus

Indicators

- parts of the internal ear which help in body balance.
- peculiarities of receptors in the vestibule.
- How does the cerebellum act in accordance with the variation in the balance of the body?

To detect taste

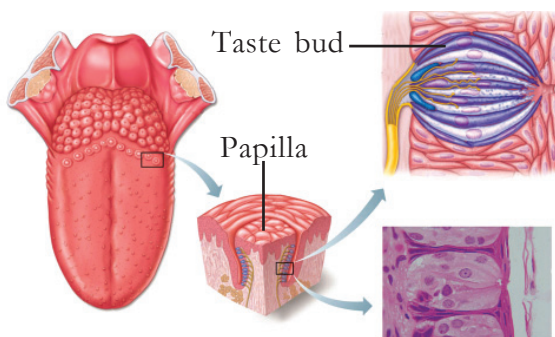


Figure 2.14
Receptors in the tongue

Isn't it because of its taste that we like food? Chemoreceptors seen inside the mouth and tongue help us to detect tastes. These are seen mainly on the surface of the tongue. The projected structures seen on the surface of the tongue are called papillae. Observe Figure 2.14.

Taste buds are chemoreceptors seen in the papillae. Taste buds are stimulated by four types of taste namely sweet, salt, sour and bitter. Substances which dissolve in

saliva, stimulate the taste buds and generate impulses. These impulses reach the brain and we experience taste.

Indicators

- arrangement of taste buds of the tongue.
- saliva and taste.
- experience of taste.

To detect Smell

How do we detect smell ?

Prepare notes based on the analysis of Figure 2.15 and the description given.

The smell of various substances diffuse in the air and enter the nostrils along with the inhaled air. These aromatic particles dissolve in the mucus inside the nostrils, stimulate olfactory receptors and generate impulses. These impulses from olfactory receptors reach the cerebrum and smell is detected.

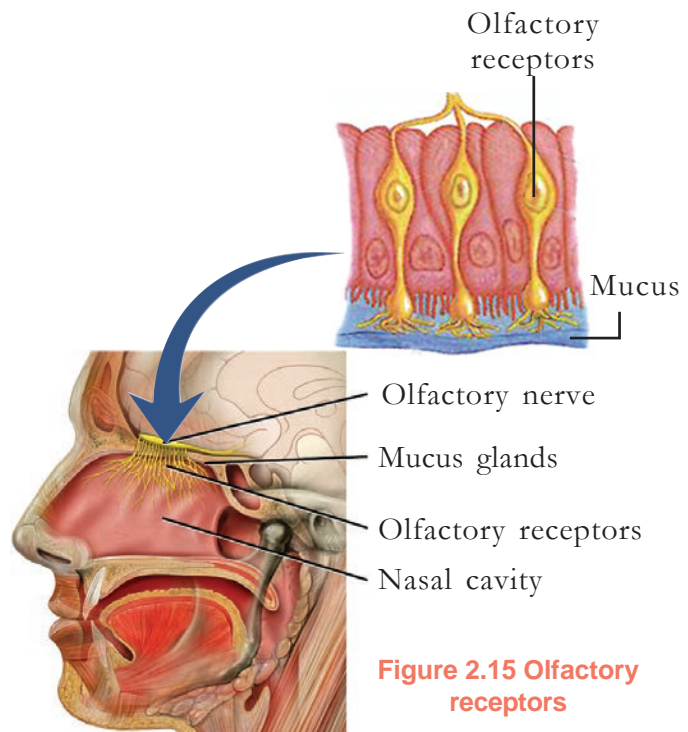


Figure 2.15 Olfactory receptors

Sense through Skin

What are the stimuli you sense through skin?

- heat
-
-

What all receptors are there in the skin to receive stimuli? Observe Figure 2.16 and write the inferences in your science diary.

Are these receptors uniformly distributed all over the skin? Let's perform this activity.

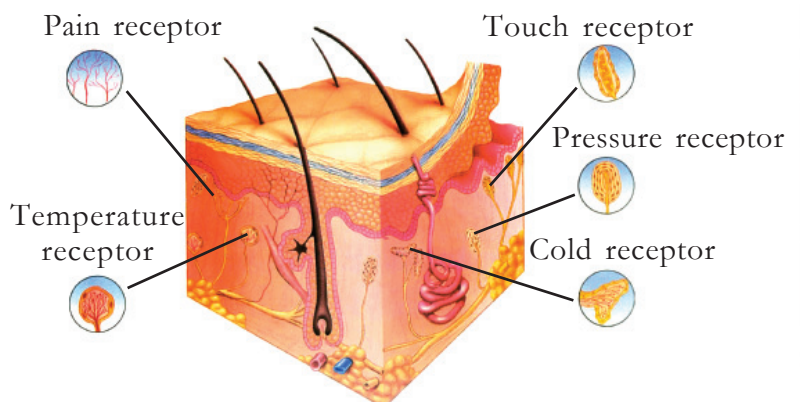


Figure 2.16 Skin

Take two refillers of any ball point pen. Ask your friend to close his/her eyes and stretch his/her hand. Place the two pointed tips of the refiller firstly at the finger tip and then at the wrist of your friend. Ask your friend about the experience he/she has felt. Is there any difference in the experiences? If so, what might be the reason? Can you now make out how blind people read braille script using their finger tips.



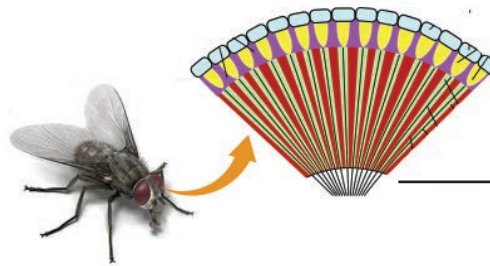
Observe Illustration 2.3 on the various receptors of certain organisms around us and their peculiarities. Write your inferences in the science diary.

Eye spot

to detect light.



Planaria



Ommatidia

The eyes of an insect consists of cluster of photoreceptors called ommatidia.

Housefly

Lateral line

There are receptors in the lateral line on either side of the body which helps to detect the change in the balance of body.



Shark

highly sensitive olfactory receptors.

Jacobson's organ

The aromatic particles that stick on the tongue of snake reach Jacobson's organ seen on the roof of the mouth cavity. The olfactory receptors seen there get stimulated then.



Snake

Illustration 2.3
Receptors in organisms

Now, you have understood that organisms detect their surroundings with the help of various sense organs and their receptors. This type of detection satisfies their needs and helps them in their survival on earth.



Significant learning outcomes

The learner

- explains the structure of sense organs in human beings.
- analyses and presents how the process of vision takes place.
- prepares notes and presents the various defects and diseases of the eye.
- explains the process of hearing.
- describes the role of ear in balancing the body.
- analyses and describes how taste is detected in the mouth.
- explains the process of smelling.
- describes various stimuli we feel through the skin.



Let us assess

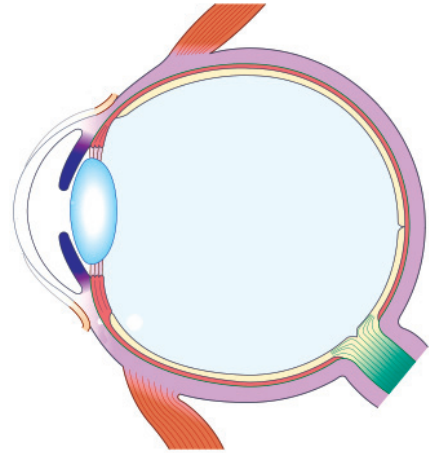
1. When we view nearby objects,
 - a. ciliary muscles relax
 - b. curvature of lens decreases
 - c. ciliary muscles contract
 - d. focal length increases
2. Identify the odd one and write down the common feature of others.

Malleus, Eustachian tube, Stapes, Incus

3. Copy the figure. Identify the parts according to the hints and label them.

Hints

- a. The part where the muscles that regulate the size of the pupil are seen.
- b. The chamber which is filled with vitreous humor.
- c. The layer of eye where photoreceptors are seen.

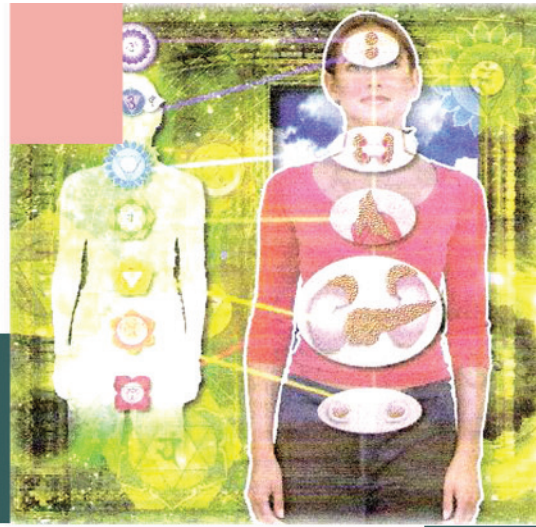


Extended activities

- Conduct a class seminar on the topic "Eye diseases and protection of the eye".
- Prepare notes on the peculiarities of sense organs of different organisms by collecting more information.

3

Chemical Messages for Homeostasis



How is it that there is so much difference in height between the two?



Did you notice the conversation between Neenu and Seena about the picture on the Science Club notice board?

Have you heard of hormones?

Which are the hormones you know? List them.

-
-
-

Do you want to know more about the hormones in our body? Read the following note and write down the inferences in the science diary.

You already know that the nervous system controls and coordinates all activities in the body. The endocrine system is an organ system that works along with the nervous system to perform these functions. Secretions of endocrine glands are called hormones.

These secretions are chemical substances that belong to different categories such as proteins, peptides, steroids, fatty acids etc. Endocrine glands do not have particular ducts to carry hormones to various tissues. Hence they are known as ductless glands. Hormones are transported through blood. As these substances regulate cellular activities, they can be called chemical messages to cells.

Observe the following Figure 3.1 showing the endocrine system of humans and complete Table 3.1.

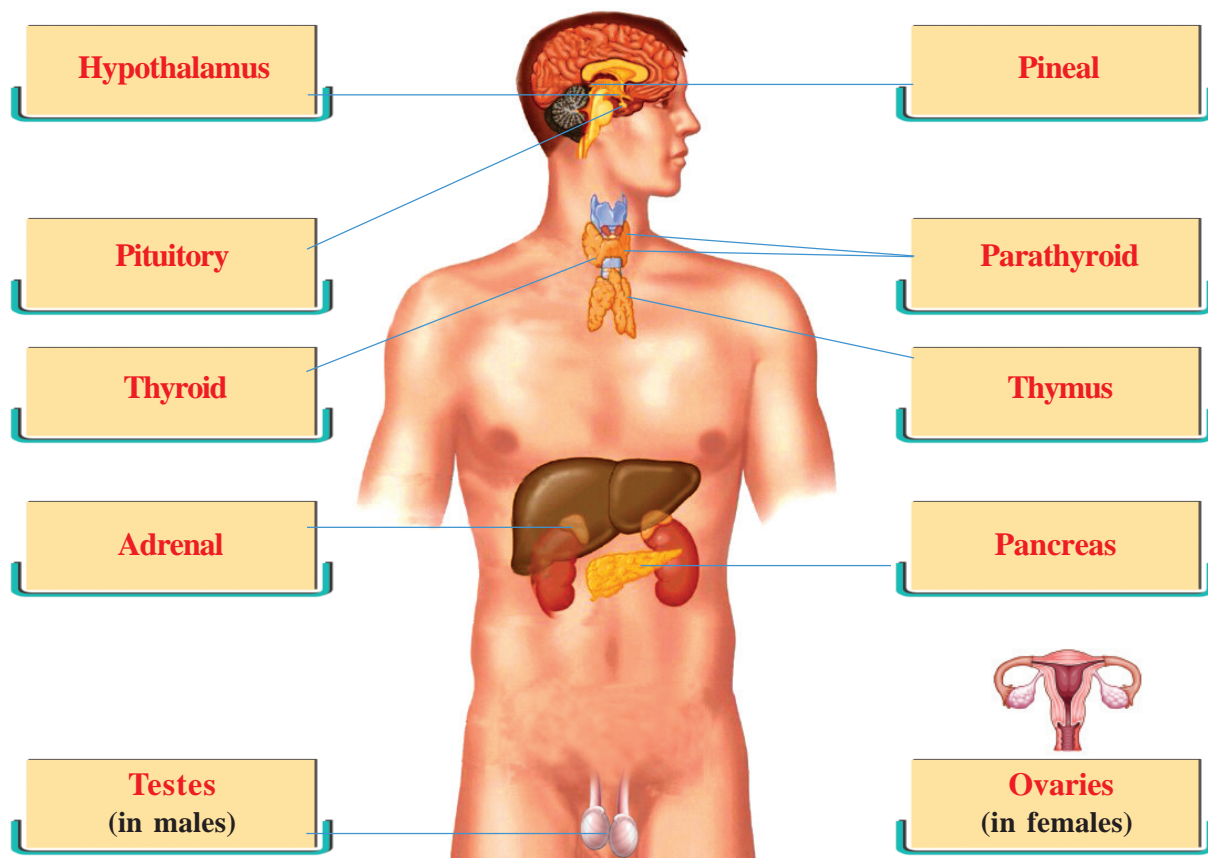


Figure 3.1

Endocrine gland	Location
Hypothalamus	
Pituitary	
	in the throat just below the larynx
Parathyroid	
Thymus	
Pancreas	
Ovary	
	in the scrotum, outside the abdominal cavity
	above the kidneys
Pineal	

Table 3.1

Hormones in Target Cells

Hormones reach every cell in the body as they are transported by blood. But all hormones do not act upon all cells. Each hormone acts upon only those cells which have specific receptors. The cells which are acted upon by hormones are called target cells. Only cells having specific receptors can receive a particular hormone. A hormone- receptor complex is formed by the combination of each hormone molecule and its receptor. Following this, enzymes are activated within the cell. As a result, certain changes occur in cellular activities.

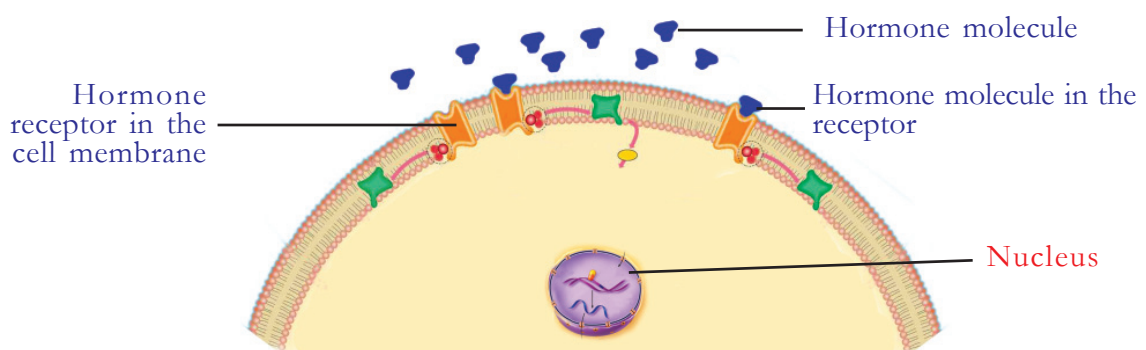


Illustration 3.1 Hormone in the target cell

Let's try to learn about the various endocrine glands in our body in detail.

Pancreas

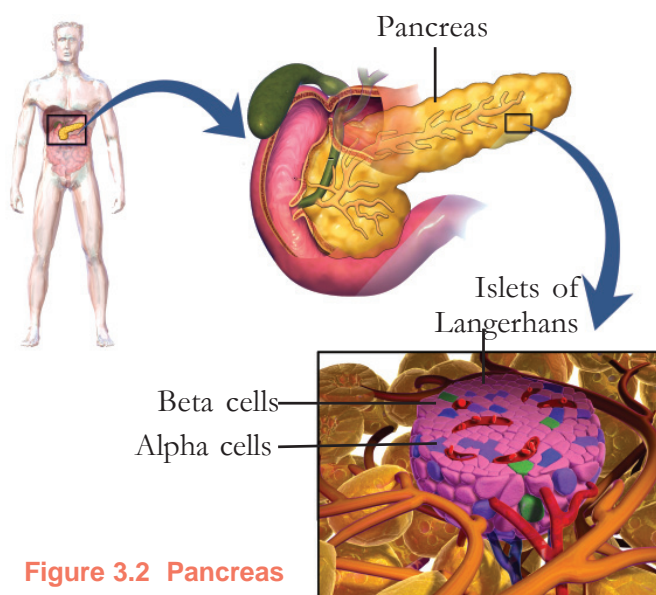


Figure 3.2 Pancreas

You have learnt how the pancreas helps in the digestive process. It functions as an endocrine gland too. The pancreas secretes two important hormones namely insulin and glucagon.

The beta cells in the Islets of Langerhans, a special group of cells in pancreas secrete insulin and the alpha cells secrete glucagon. Observe Figure 3.2.

The normal level of glucose in blood is 70-110mg/100ml. The rise or fall of this range will affect the homeostasis of the body. The level of glucose in blood is maintained by the hormones secreted by the pancreas. Observe Illustration 3.2.

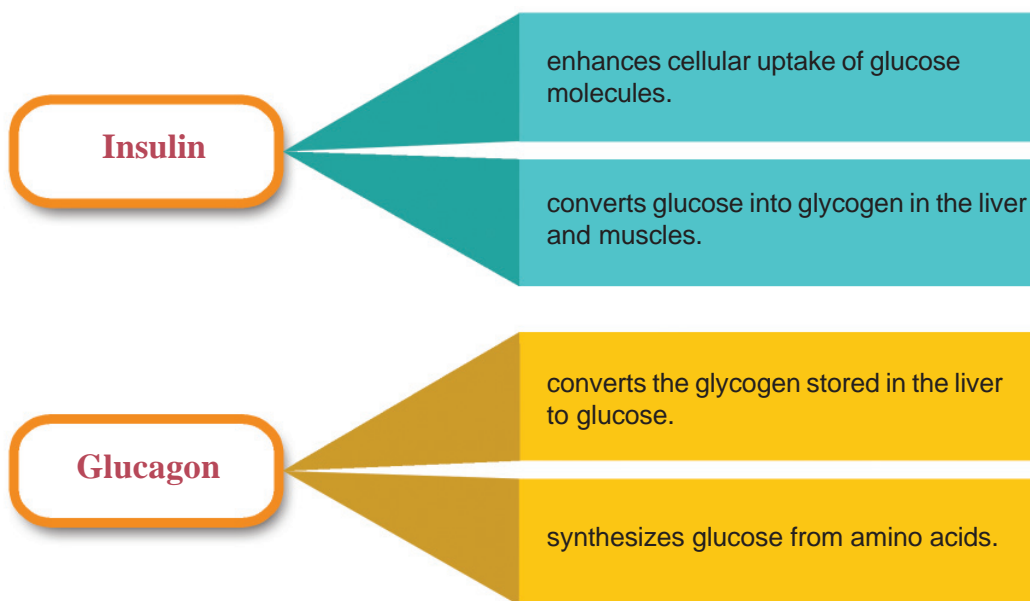


Illustration 3.2 Method of regulation of blood glucose level

The level of glucose in blood is maintained by the combined action of insulin and glucagon. It is carried out by regulating the production of both these hormones as the situation demands. Observe Illustration 3.3. Based on the indicators, discuss and write the inferences in your science diary.

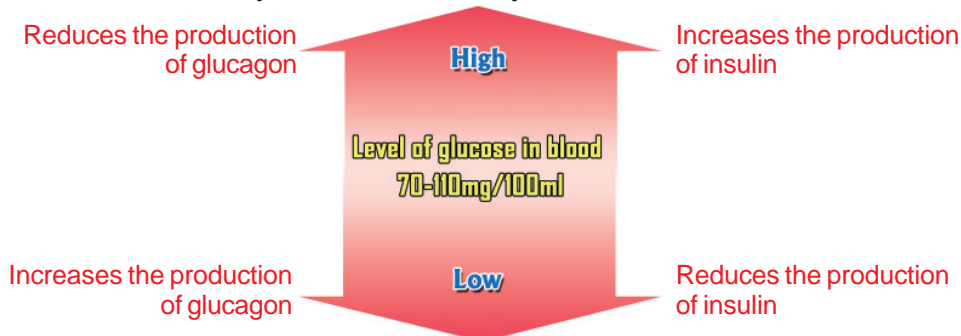


Illustration 3.3 Maintenance of glucose level-hormone action

Indicators

- action of insulin to prevent the rise in the level of glucose in blood.
- action of glucagon when the level of glucose in blood decreases.

How is the level of glucose in the blood maintained while fasting? Discuss.

Diabetes mellitus

Diabetes is clinically referred to as a condition when the level of glucose before breakfast is above 126mg/100ml of blood. It is caused either by the decreased production of insulin or its malfunctioning. Increased appetite and thirst and frequent urination are the major symptoms of diabetes. When the level of glucose in the blood increases, there will be traces of glucose in urine also.

Didn't you notice Deepu's doubt? What is your opinion? Write them down in your science diary.



The World Health Organisation and International Diabetic Federation jointly observes November 14 as World Diabetes Day every year. Its purpose is to create awareness against the increase in diabetes. Its logo is Blue Circle.



The increase of glucose in blood is said to be diabetes. Shouldn't one be more energetic if the glucose level in his/ her blood rises?

Thyroid Gland

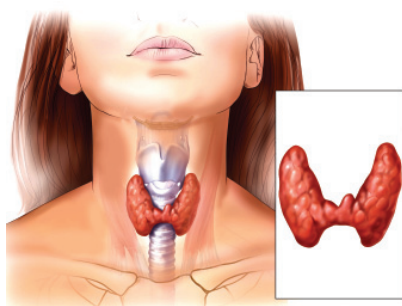


Figure 3.3 Thyroid gland

Observe Figure 3.3. Thyroid is a two-lobed gland situated on either side of the trachea, just below the larynx.

The thyroid gland secretes two hormones- thyroxine and calcitonin. Observe Illustration 3.4 on the functions of thyroxine. Write down your inferences in the science diary.



Illustration 3.4 Functions of thyroxine



Basal Metabolic Rate (BMR)

An organism needs a large amount of energy to carry out its life activities even while at rest. Basal Metabolic Rate is the minimum essential energy used for sustaining life. 60-75% of the energy produced in an organism is utilized for Basal Metabolic Rate. Maximum amount of energy in our body is produced in liver cells. Glucose and fat are mainly used for energy production. Thyroxine plays a major role in controlling BMR.

You are familiar with the functions of thyroxine. How would the body activities be affected if sufficient amount of thyroxine is not produced?

-
-
-
-

Under secretion of thyroxine - Hypothyroidism

The deficiency of thyroxine during the foetal stage or infancy leads to mental retardation and stunted growth. This condition is cretinism. Lack of thyroxine in adults leads to myxoedema. Low metabolic rate, sluggishness, sleeplessness, increase in body weight, hypertension, oedema etc., are the major symptoms.



Figure 3.4
Cretinism



Figure 3.5
Myxoedema

Over secretion of thyroxine - Hyperthyroidism

The condition in which all life activities controlled by thyroxine are accelerated due to the excessive production of thyroxine, is referred to as hyperthyroidism.

Have a look at its major symptoms:

- High metabolic rate
- Rise in body temperature
- Excessive sweating
- Increased heart beat
- Sleeplessness
- Weight loss
- Emotional imbalance

Persistent hyperthyroidism may lead to Graves disease, characterised by bulging of the eye balls.

Goitre

Iodine is essential for the production of thyroxine. The production of thyroxine is obstructed in the absence of iodine. In an attempt to produce more thyroxine, the thyroid gland enlarges. This condition is called goitre.

Indicators

- What is the importance of thyroxine in controlling life activities?
- What are the problems caused by excessive production of thyroxine?
- What are the problems due to thyroxine deficiency?
- How is iodine related to thyroid gland?



Figure 3.6
Symptom of
Graves disease



Figure 3.7
Goitre

Calcitonin

When the level of calcium in blood increases, thyroid gland secretes a hormone named calcitonin. It lowers the level of calcium in blood. This hormone helps in maintaining the level of calcium in blood by depositing excess calcium in bones and by preventing the mixing of calcium with blood from the bones.

Parathyroid gland

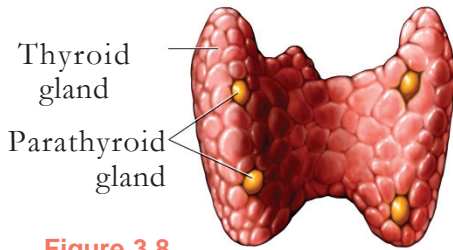


Figure 3.8
Parathyroid gland

The parathyroid gland is situated behind the thyroid gland. This gland secretes a hormone called parathormone. The function of this hormone is to raise the level of calcium in blood. This function is brought about in two ways. When the level of calcium in the blood decreases, it helps in the reabsorption of calcium to the blood from the kidneys and also prevents the deposition of calcium in bones. The function of parathormone and calcitonin is antagonistic.

Complete Illustration 3.5 showing the maintenance of the level of calcium in blood by the action of these hormones.

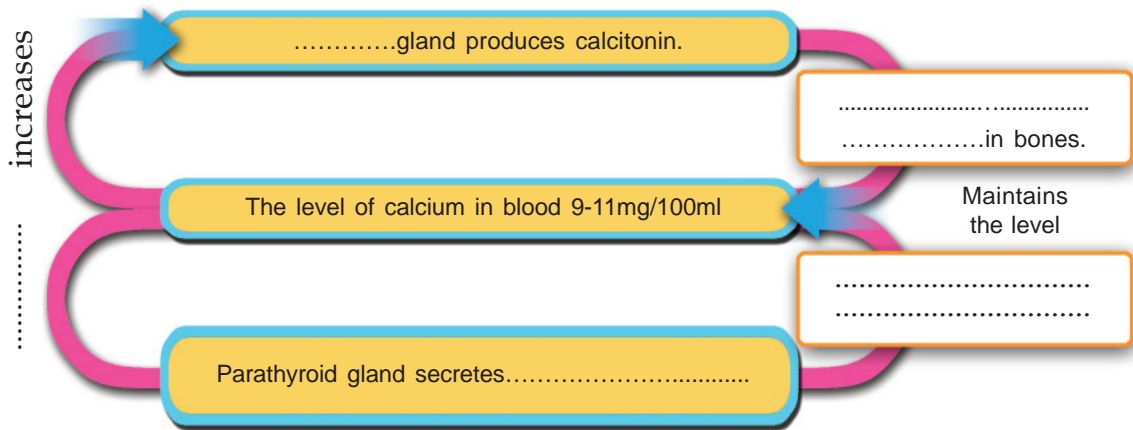


Illustration 3.5 Maintenance of the level of calcium in blood

The hormone only upto youth!



Figure 3.9 Thymus

The thymus gland is situated just below the sternum. This gland is very active during infancy but constricts as we reach puberty.

The major function of this gland is to control the activities and maturation of lymphocytes which help to impart immunity. This gland secretes a hormone called thymosin. It is also known as 'Youth hormone'.

Adrenal glands

These glands are situated above the kidneys. The outer part of the adrenal gland is known as the cortex and the inner part, medulla. The structure of the adrenal glands and the hormones produced by them are illustrated below (3.6). On the basis of the indicators given, discuss and write down the notes in the science diary.

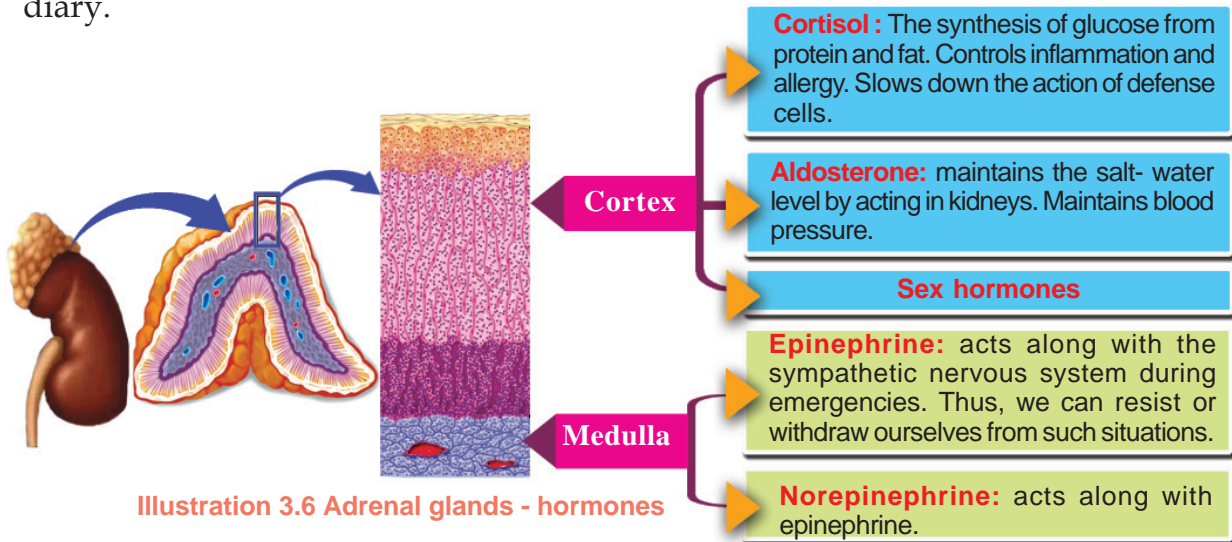


Illustration 3.6 Adrenal glands - hormones

Indicators

- hormones secreted by the adrenal cortex.
- the function of cortisol.
- maintenance of salt - water balance in the body.
- the functions of epinephrine and norepinephrine during emergencies.

The action of epinephrine and norepinephrine prolongs the body activities for more time, when the sympathetic system gets stimulated.

Hormones for Appetite and Digestion



Ghrelin is the hormone secreted when the stomach becomes empty. We feel hungry when this hormone acts upon hypothalamus. When food is taken, the stomach stops secreting ghrelin and the hypothalamus makes us feel no longer hungry. In addition to this, another hormone called gastrin controls the production of gastric juices. Secretin which is produced in the duodenum stimulates the activity of the pancreas and controls the production of gastric juice. Organs like heart and kidneys which are not considered as endocrine glands also produce certain hormones.

Pineal gland- a Biological Clock

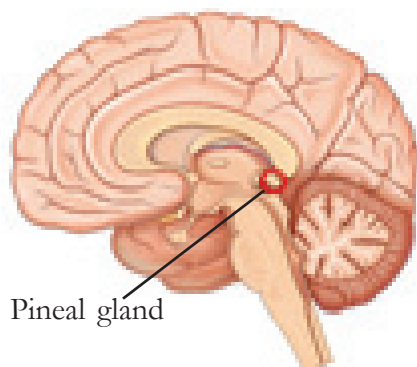


Figure 3.10 Pineal gland

Pineal gland is seen in centre of the brain. It secretes the hormone, melatonin which helps in maintaining the rhythm of our daily activities. The production of melatonin is high at night and low during the day. When the level of melatonin increases we feel sleepy and when it decreases we wake up. Thus, this hormone regulates the rhythm of life. This hormone also controls reproductive activities of organisms with definite reproductive periods.

Pituitary gland

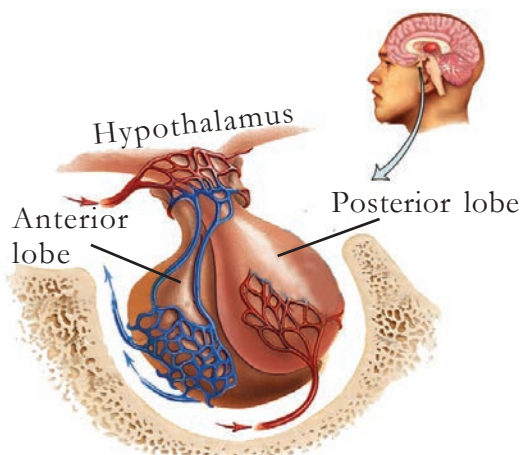


Figure 3.11 Pituitary gland

Pituitary gland is a bilobed gland situated just below the hypothalamus in the brain. Observe Figure 3.11. As the pituitary gland produces tropic hormones which regulate the functions of other glands, it has immense significance in the endocrine system. The hormones produced by the anterior lobe is listed in Table 3.2. Analyse it and write down your inferences in the science diary.

Hormones secreted by the anterior lobe of the pituitary gland	Function
Thyroid Stimulating Hormone (TSH)	stimulates the activity of the thyroid gland.
Adreno Cortico Tropic Hormone (ACTH)	stimulates the activity of adrenal cortex.
Gonado Tropic Hormone (GTH)	stimulates the activity of testes in males and ovary in females.
Growth Hormone (GH) Somato Tropic Hormone (STH)	promotes the growth of the body.
Prolactin	production of milk.

Table 3.2

Behind growth of the body



Figure 3.12 An acromegaly affected person

Somatotropin promotes growth of the body during its growth phase. It is secreted by the anterior lobe of the pituitary gland. If the production of this hormone increases during the growth phase, it leads to the excessive growth of the body. This condition is called gigantism. It causes another stage called dwarfism when its production decreases during the growth phase. Acromegaly is the condition caused by the excessive production of somatotropin after the growth phase. It is characterised by the growth of the bones on face, jaws and fingers.



Figure 3.13 Dwarfism and gigantism

The Posterior Lobe of Pituitary- a Storage Centre

Observe Figure 3.14.

The hormones oxytocin and vasopressin, which are secreted from the posterior lobe of the pituitary are actually produced in the neuro-secretory cells of the hypothalamus. The posterior lobe of the pituitary stores these two hormones and releases them into blood when required.

Observe Table 3.3. Write down your inferences in the science diary.

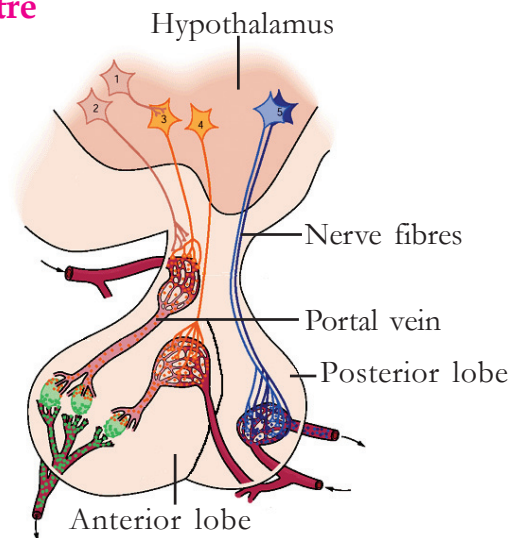


Figure 3.14 Pituitary gland and hypothalamus

Hormone	Function
Oxytocin	facilitates child birth by stimulating the contraction of smooth muscles in the uterine wall. facilitates lactation.
Vasopressin or Anti Diuretic Hormone (ADH)	helps in the reabsorption of water in the kidneys.

Table 3.3

Observe Illustration 3.7 which shows the action of vasopressin in kidneys. Based on the indicators given, discuss and write a note in the science diary.

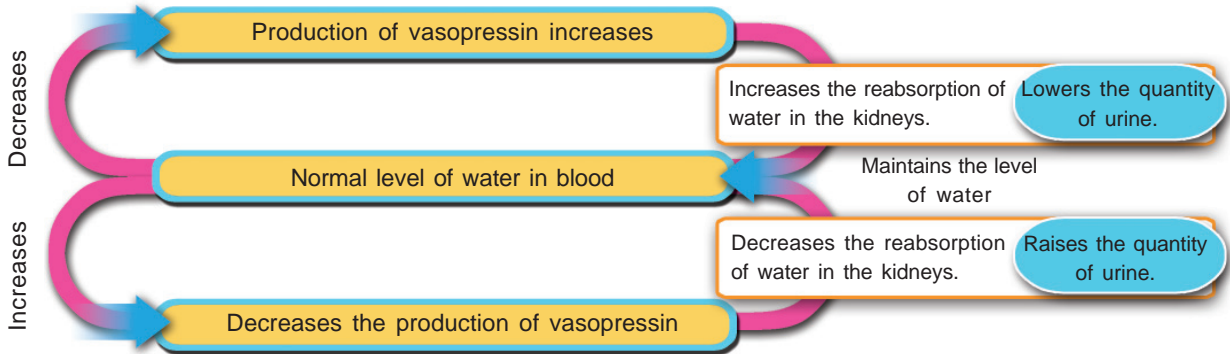


Illustration 3.7 Maintenance of the level of water in blood

The production of vasopressin and quantity of urine are related. The production of vasopressin is high during the summer season where water loss is excessive through sweat. Its production is less during winter and rainy seasons.

How does decrease in the secretion of vasopressin affect the body? The rate of reabsorption of water in the kidney is decreased when there is no sufficient amount of vasopressin. Hence excess amount of urine is excreted. This condition is known as diabetes insipidus. Frequent urination, increased thirst etc., are the symptoms.

Indicators

- the function of vasopressin in kidneys.
- the reason for excessive production of urine during the rainy season.
- the role of vasopressin in preventing loss of water from the body.
- Diabetes insipidus.

Gonads

Testes and ovary, the male and female sex organs respectively, secrete different types of hormones.

Gonadotropic hormones from the pituitary regulate the development and functions of the sex organs. Sex organs and their hormones are illustrated below (3.8). On the basis of the indicators, discuss and write your inferences in the science diary.

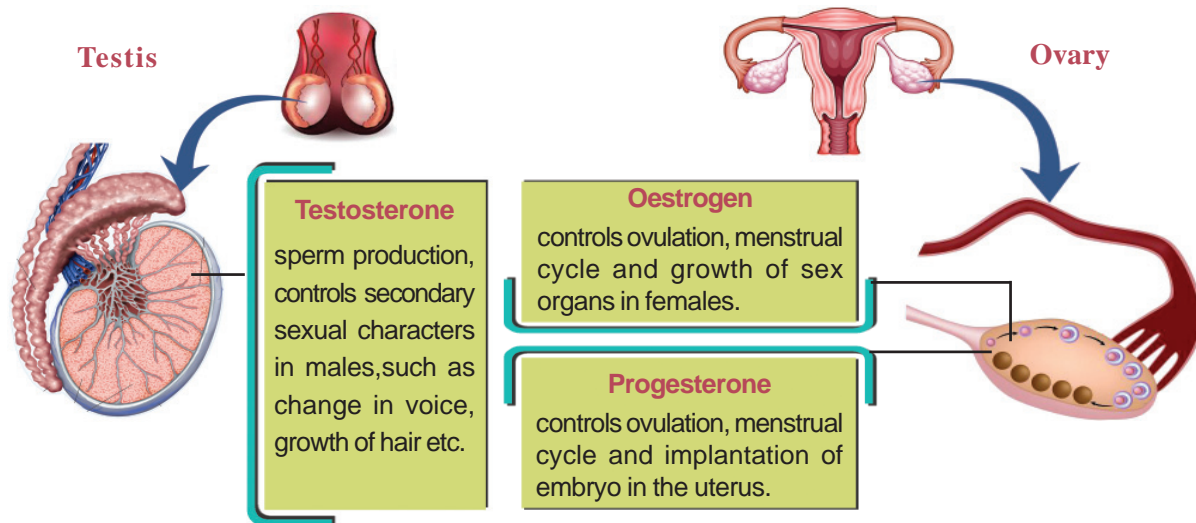


Illustration 3.6 Sex hormones

Indicators

- the action of male sex hormones.
- action of female sex hormones .
- the influence of gonado tropic hormones in sex organs.

Hypothalamus

Hypothalamus, a part of the brain has an endocrine function too. You have already learned that oxytocin and vasopressin are secreted by the hypothalamus. In addition to this, hypothalamus controls the pituitary gland by secreting a variety of releasing hormones and inhibitory hormones. Thus, it controls the entire endocrine system too.

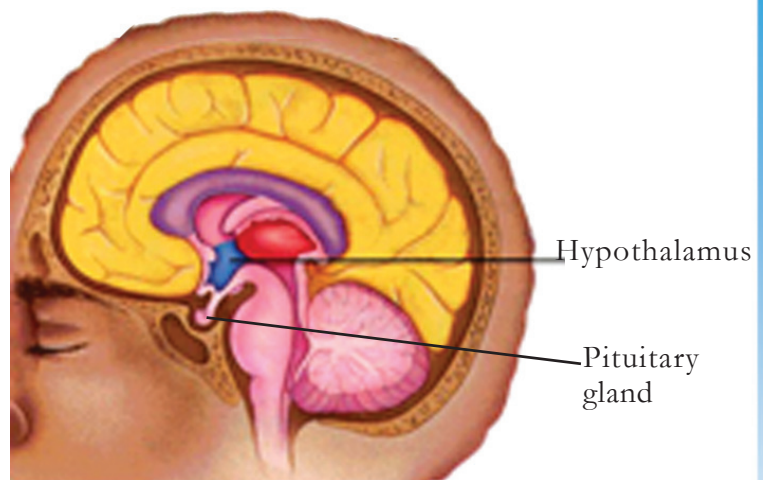


Figure 3.15 Hypothalamus

Observe Illustration 3.9 on the functions of releasing hormones and inhibitory hormones. On the basis of the indicators, discuss and write it down in the science diary.

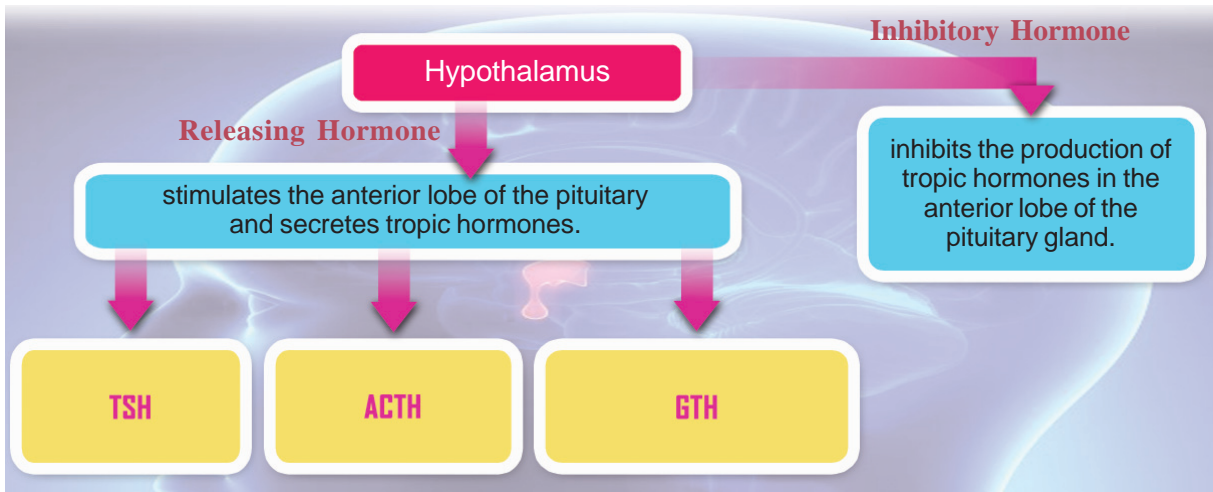


Illustration 3.9 The relation between hypothalamus and pituitary gland

Indicators

- action of releasing hormone.
- influence of tropic hormones in different glands.
- action of inhibitory hormones.

The endocrine system plays a crucial role in the control and co-ordination of various life activities in the body. This is carried out by the combined and sequential action of hormones secreted by the endocrine glands. The homeostasis of the body is maintained by the combined action of the nervous system and the endocrine system.



Exchange of Chemical Messages outside the Body



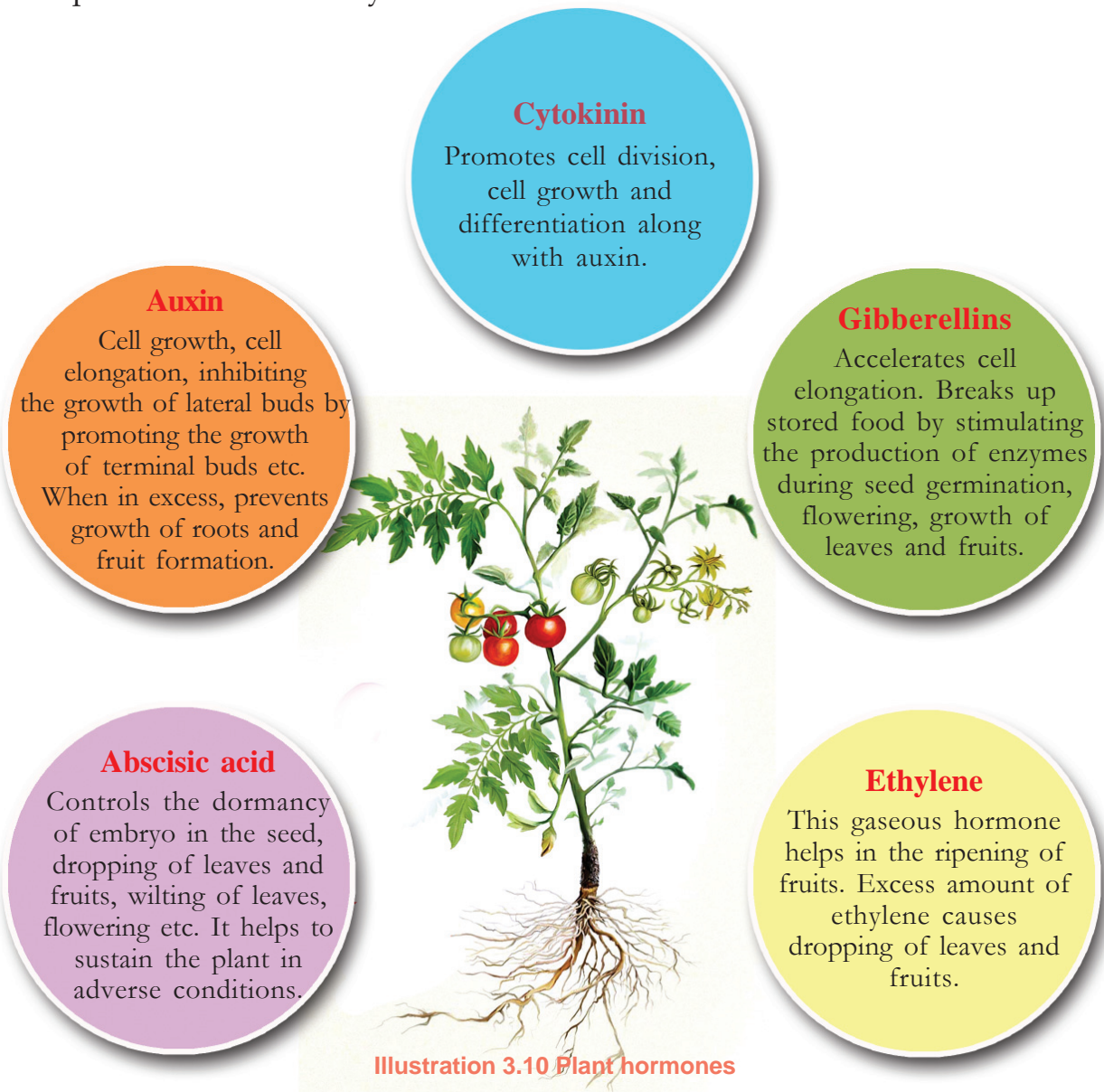
Pheromones are chemical substances that are secreted in trace amount to the surroundings, in order to facilitate communication among organisms. These chemicals cause certain responses in the life activities or behaviour of the organisms. Pheromones help in attracting mates, informing the availability of food, determining the path of travel, informing about dangers etc. Haven't you observed that ants get back to the trail even when some of them are removed? The chemical messages of pheromones also help



honey bees and termites to live in colonies. The musk in the musk deer, the civetone in the civet cat, bombycol in female silk worm etc., are examples for pheromones. Artificial pheromones are used for pest control in agricultural fields.

Plant Hormones

There are certain chemical substances in plant cells to control and coordinate life activities as in animals. These are the plant hormones. These are also called plant growth regulators. Observe Illustration 3.10 which show plant hormones and their functions. Complete Table 3.4 suitably.



Plant hormones	Function
Auxin	
Abscisic acid	
	break down of stored food in the seed
	helps in the ripening of fruits

Table 3.4

Artificial Plant Hormones

Plant hormones are synthesized artificially by identifying the chemical structure of the hormones. Use of such hormones has contributed a lot to the progress of the agricultural sector. Let us familiarise ourselves with some of such artificial plant hormones.



Seedless fruits by hormones

Seedless orange, grape and watermelon are produced by using artificial auxin. This process of formation of fruits from the ovary without fertilization is called parthenocarpy. Gibberellins also lead to parthenocarpy.

Auxins

Naphthelene Acetic Acid (NAA), Indol Butyric Acid (IBA) etc., are used for sprouting and the prevention of dropping of premature fruits. 2,4-D (2, 4-Dichloro phenoxy acetic acid) is used as a weedicide.

Gibberellins

It is used for increasing fruit size in grapes and apple and also for preventing ripening of fruits to assist in marketing.

Abscisic acid

As it accelerates the dropping of fruit, it is used for harvesting fruits at the same time.

Ethylene

Ethylene is used for the flowering of pineapple plants at a time and for the ripening of tomato, lemon, orange etc. Ethyphon, a chemical which is available in liquid form gets transformed into ethylene, when used in rubber trees, and it increases the production of latex.

By now, you are familiar with plant hormones too. The acceleration or retardation of plant growth, in accordance with the season, is controlled by the combined action of these plant hormones. Artificial hormones are used in agriculture by identifying these characteristics. It is a fact that the uncontrolled use of these chemicals causes many health and environmental issues.



Significant learning outcomes

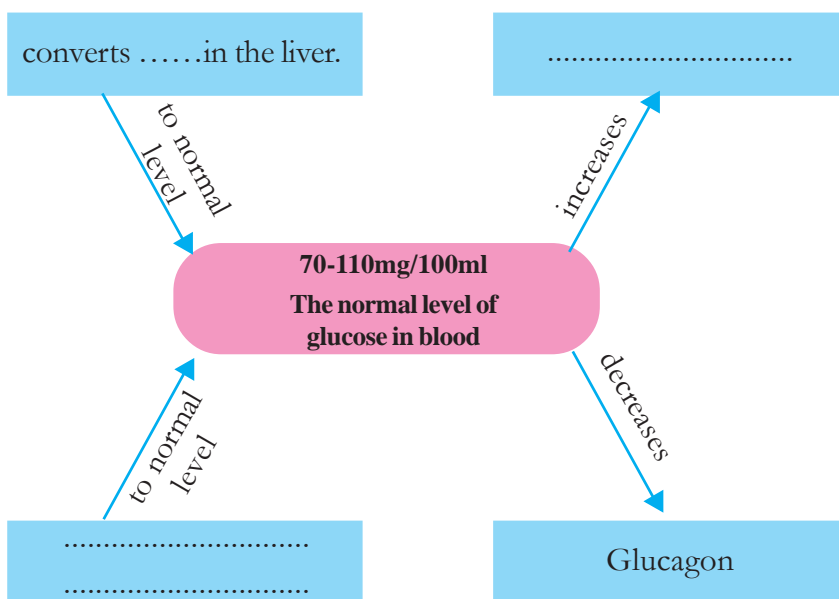
The learner

- analyses and presents the location of endocrine glands, hormones secreted by them and their functions.
- explains hormone action through suitable examples.
- explains the sex hormones in man and their functions.
- analyses and substantiates how hypothalamus controls and coordinates the endocrine glands.
- analyses and explains how hypothalamus plays a major role in maintaining homeostasis in humans.
- identifies and presents the plant growth regulators and their actions.
- analyses and explains how the use of artificial plant hormones helps in agricultural development.



Let us assess

1. The hormone that helps in the reabsorption of water in the kidneys.
 a. TSH b. ACTH c. ADH d. GTH
2. Identifying the word- pair relationship fill in the blank.
 Thyroxine : Thyroid gland
 Epinephrine :
3. Complete the illustration suitably .



Extended activities

- Conduct a seminar on the topic – The Role of the Endocrine System in maintaining homeostasis.
- Conduct a debate on 'Use of artificial plant hormones- problems and possibilities'.

4

Keeping Diseases Away



Is the increase in the number of hospitals a sign of health?

Hospitals increase in number when the number of patients increases, don't they?

What are the reasons for the proliferation of diseases? Discuss.

- lack of hygiene
-

What can we do to avoid such situations?

Discuss and list out practical suggestions.

Communicable diseases are caused by the invasion of pathogens into the body and are transmitted from one person to another.

Which are the common communicable diseases seen around us nowadays?

- Dengue fever
- Chikungunya

If we want to keep away diseases, we should know more about them. Don't you know that dengue fever is a communicable disease? Based on Illustration 4.1 and indicators, analyse the mode of infection of the dengue virus and prepare a note.

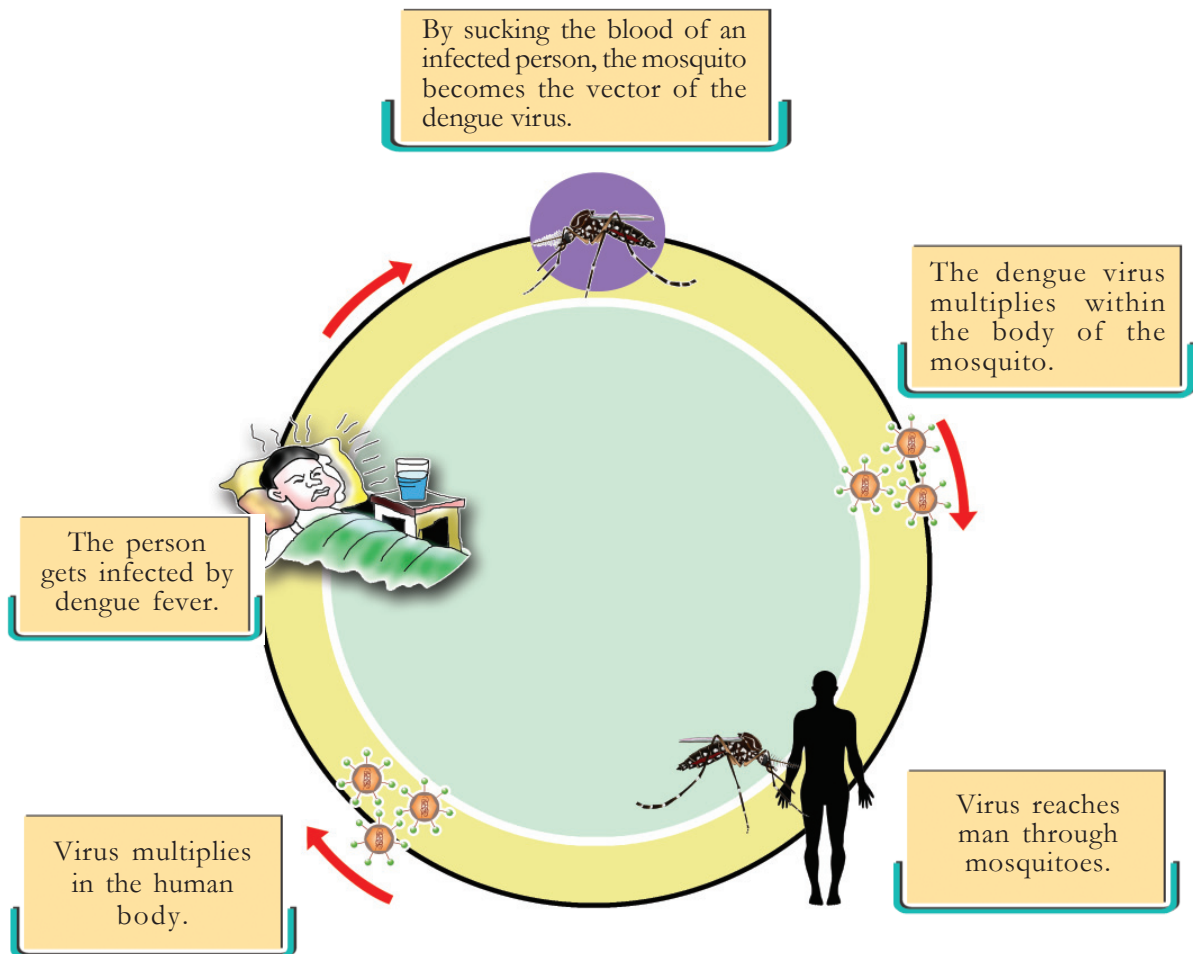


Illustration 4.1 Mode of infection of dengue fever

Indicators

- Which microorganism causes dengue fever?
- Which is the vector of the pathogen?
- Under which circumstances do the vectors multiply?
- Which is the host organism?

Some Viral Diseases

Virus has the simple structure with a DNA or RNA molecule within a protein coat. Virus has no cell organelles as seen in normal cells. Hence virus multiplies by taking control over the genetic mechanism of host cells. Viruses infect not only human beings but plants, other animals and even bacteria.

The modes of invasion of viruses into the human body and some diseases caused by them are given below.

- through body fluids- AIDS, Ebola
- through air- Chicken pox, SAARS
- through mosquitoes- Chikungunya, Dengue fever
- through animals- Rabies

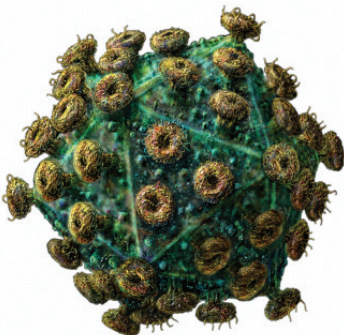


Figure 4.1 HIV

Haven't you heard of AIDS, the deadliest of the diseases in the 21st century? A note on this disease is given below. On the basis of the indicators, discuss the note and write your inferences in the science diary.

Dreadful Ebola



Ebola is a viral disease which spreads from wild animals to human beings in fearful proportions. It was first identified in central- Africa in March, 2014. It is transmitted through chimpanzee, gorilla and fruit eating bats. The disease can be spread through touch or by using materials used by the patients. The initial symptoms of the disease are severe fever and muscle pain. The other symptoms include vomiting, diarrhoea and internal and external bleeding. There is no effective treatment for this disease.



AIDS



AIDS (Acquired Immuno Deficiency Syndrome) is a dreadful disease that has gripped the world by fear. Lymphocytes play a major role in providing immunity to the body. HIV (Human Immuno deficiency Virus) enters the body and multiplies using the genetic mechanism of lymphocytes. Hence the number of lymphocytes decreases considerably and reduces the immunity of the body. Various other pathogens which enter the body in such a situation make the condition of AIDS even more fatal. Crores of people across the world are falling prey to AIDS.

Indicators

- How does HIV multiply in the human body?
- The number of lymphocytes and AIDS.
- Situation that makes AIDS fatal.

What are the ways by which HIV spreads?

Write your inferences in the science diary by analysing Illustration 4.2 given below.



The Red Ribbon is the international symbol for AIDS. This symbol is used across the world to show positive attitude towards AIDS patients. This ribbon is worn by people who deal with AIDS patients and those who are engaged in awareness campaigns against AIDS. Red Ribbon Clubs, under the leadership of State AIDS prevention and Control Society (SACS), are functioning in educational institutions in Kerala to participate in AIDS awareness programmes.

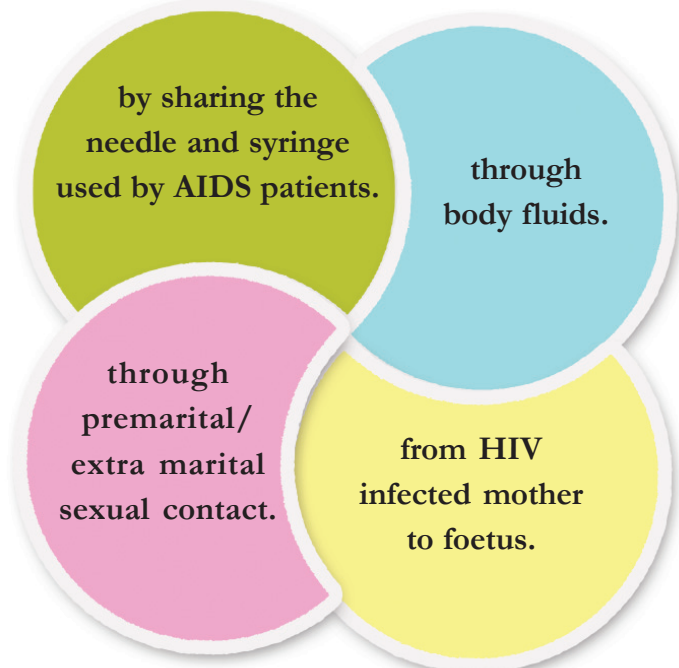


Illustration 4.2

How AIDS does not spread...

- by touch, shaking hands, coughing, sneezing etc.
- through insects like mosquitoes, house flies etc.
- by staying together and sharing food.
- by using same toilets.
- by taking bath in the same pond.

Do we need to fear AIDS patients?

What should be our attitude towards them? Discuss.

Certain Bacterial Diseases

Bacteria are unicellular organisms without a definite nucleus. Some bacteria, which are found in our intestine and skin are useful. But some bacteria are harmful to our body. Bacteria multiply through binary fission immediately after entering the body. The toxins produced by these bacteria damage living cells and thereby bring about diseases.

The modes of infection of pathogenic bacteria and certain diseases caused by them are given below:

- through contaminated water - Cholera, Typhoid
- through wounds - Tetanus
- through air - Tuberculosis
- through contact with animals - Anthrax
- through stale food - Botulism
- through sexual contact - Gonorrhoea, Syphilis

Tuberculosis is an air borne disease that affects the lungs. Based on the indicators, discuss the note given below and write your inferences about tuberculosis in the science diary.



Figure 4.2
The cholera causing bacterium



Directly Observed Treatment Short course (DOTS) is the treatment system recommended for tuberculosis by World Health Organisation. This treatment is approved for treating tuberculosis across the world. The treatment is carried out under the direct observation of doctors or health workers. This method of treatment completely cures the disease by regular use of antibiotics.

Tuberculosis

Tuberculosis is caused by the bacterium *Mycobacterium tuberculosis*. This disease can affect us at any age. Loss of body weight, fatigue, persistent cough are the major symptoms. When the patient speaks, coughs or sneezes, the pathogens spread to air providing a chance to reach other people. Tuberculosis mainly affects the lungs. Kidneys, bones, joints, brain etc., are also affected by this disease.

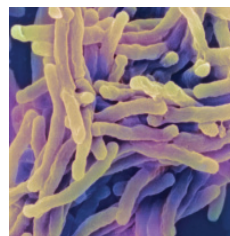


Figure 4.3

The treatment is done mainly by administering antibiotics. BCG is the vaccine used against tuberculosis across the world.

Indicators

- Which is the causative agent of tuberculosis?
- Which parts of the body can be affected by tuberculosis?
- How does tuberculosis spread?

Prepare a chart by collecting information related to National Tuberculosis Prevention Programme and exhibit it in the class.

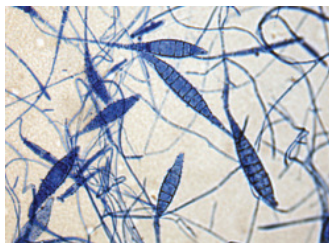


Figure 4.4
Fungus which causes ringworm

Fungal Diseases

Fungi are of various types. Some fungi are pathogenic. The toxins produced by the fungi cause diseases. Complete Table 4.1 on some fungal diseases that affect human beings by analyzing the given note and Figure 4.4 and 4.5.

Ringworm is a skin disease caused by certain types of fungi. The disease manifests as round, red blisters on the skin. This disease spreads through contact. Athletes' foot is a fungal infection which manifests on the sole of the foot and between the toes. Appearance of reddish scaly rashes that cause itching is the major symptom.

Pathogens enter through the toes when they come in contact with contaminated water and soil.



Ringworm



Athletes' foot

fig 4.5

Disease	Symptom	Mode of infection

Table 4.1

Diseases Caused by Protozoa

Protozoans are unicellular eukaryotes. Malaria is an example for a disease caused by protozoa. Prepare a note by analyzing Illustration 4.3 and information on malaria.

Malaria is caused by the protozoan, plasmodium. High fever with shivering and profuse sweating are the major symptoms of malaria. Other symptoms include headache, vomiting, diarrhoea, anaemia etc.

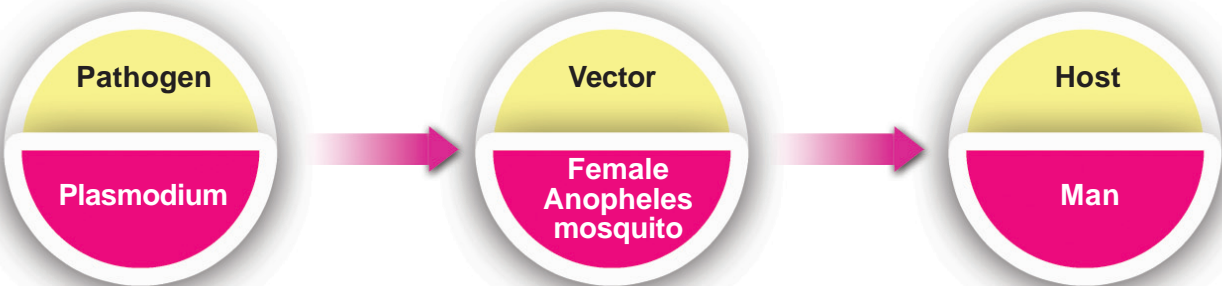


Illustration 4.3

Worms - the pathogens

Filariasis is caused by filarial worms that are spread by culex mosquitoes. The worms stay in the lymph ducts and obstruct the flow of lymph by blocking the ducts. This causes swelling in the lymph ducts in the legs.



What are the preventive measures to be taken against communicable diseases?

What is the significance of observing “Dry Day” in schools and at home? Discuss.

Contaminated surroundings promote the multiplication of pathogens. The increase in the number of vectors like mosquitoes leads to the spread of communicable diseases much beyond control. In order to control the spread of communicable diseases, it is necessary to avoid situations that lead to the multiplication of pathogens and vectors. It is our duty to keep our surroundings clean.

Nonpathogenic Diseases

Are diseases caused only by pathogens?

Are they caused by other factors too?

Observe the following illustration.

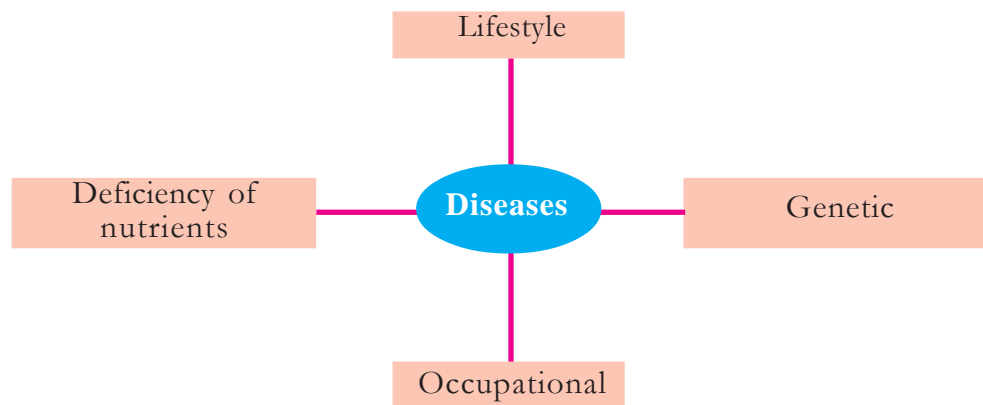


Illustration 4.4

Have you learnt about diseases caused by the deficiency of nutrients? Let's examine some other reasons and situations that cause diseases.

Genetic Diseases

Genes regulate cellular activities. The defects in genes also bring about diseases. Such diseases are called genetic diseases. Haemophilia, sickle cell anaemia etc., are examples of genetic diseases.

Haemophilia

You may know that clotting of blood in wounds prevents excessive loss of blood. Blood clots with the help of some proteins present in blood plasma. The synthesis of proteins fails when the genes that control protein synthesis become defective. Hence excess blood is lost even through minor wounds. This condition is haemophilia.



As haemophilia is a genetic disease, a complete cure is not possible at present. Temporary relief is brought in by injecting the deficient protein identified through clinical diagnosis.

Some social organisations are working for haemophilia patients who need special care and attention. These organisations volunteer to provide adequate care to haemophilia patients and make their relatives and the public aware of it.

Sickle Cell Anaemia

The defects of genes may also cause deformities in the sequencing of amino acids which are the building blocks of haemoglobin. As a result of this, the structure of haemoglobin changes and this in turn decreases its oxygen carrying capacity.

Observe the changes that occur in the red blood cells of sickle cell anaemia patients given in Illustration 4.5.

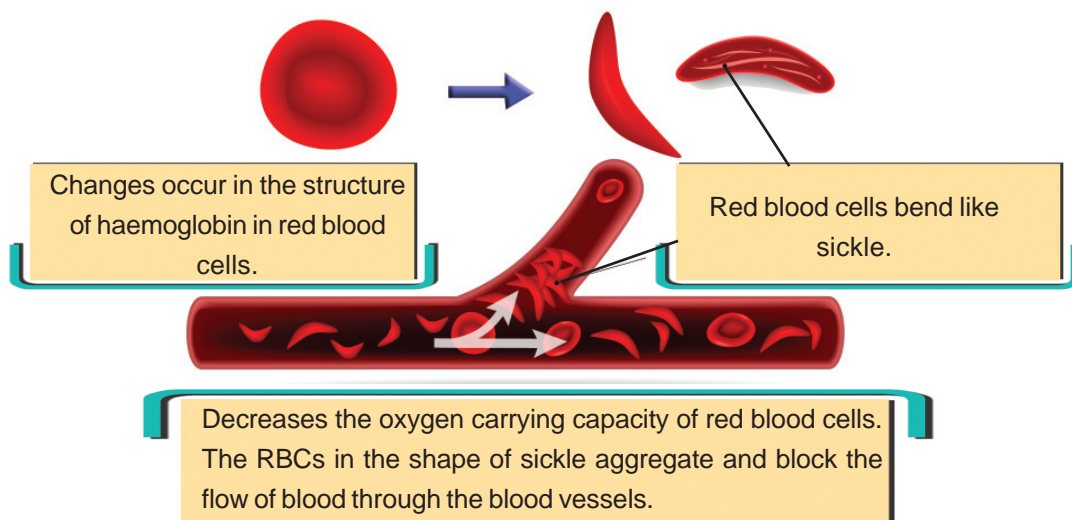


Illustration 4.5 Change in the shape of red blood cells

Write your inferences in the science diary based on the indicators given.

Indicators

- Why do haemophilia patients loose blood excessively, even through minor wounds?
- How does the deformity of red blood cells in sickle cell anaemia patients affect their body?

Cancer

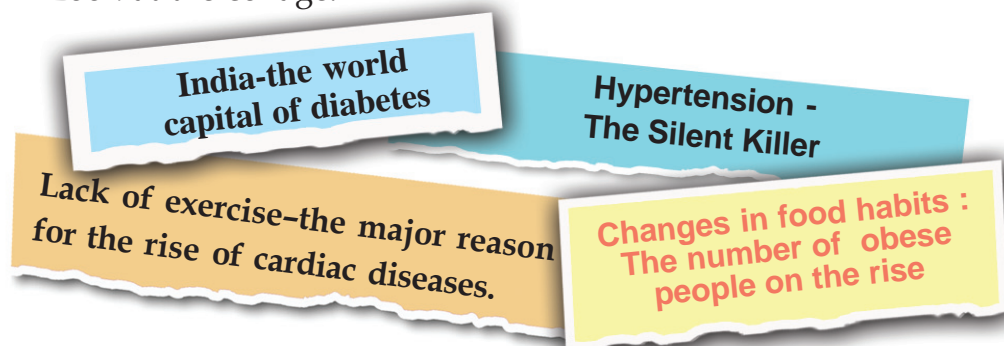
Cancer is caused by the uncontrolled division of cells and their spread to other tissues. The normal cells get transformed into cancerous cells when the control system of cell division fails. Various reasons such as environmental factors, smoking, radiations, virus, hereditary factors and alterations in genetic material lead to the transformation of normal cells into cancer cells. The disease may become complicated with the spread of cancer cells to other parts of the body through blood and lymph.

Currently surgery, chemotherapy, radiation therapy etc., are used in the treatment of cancer. It is difficult for the patients to recover if the disease becomes severe. Hence, early diagnosis of the disease is crucial in the treatment of cancer.

Many voluntary organisations are involved in our society to offer better care to cancer patients. What are the importance of such activities? Love and care are as important as food and medicine. Discuss.

Lifestyle Diseases

Look at the collage.



The newspaper reports point to the ill effects of unhealthy life style?

Read the following description about lifestyle diseases.

Lifestyle diseases are caused by unhealthy living style. The changes in food habits, lack of physical exercise, stress, bad habits like consumption of alcohol, drug abuse, smoking etc., lead to various lifestyle diseases.

Observe the following table (4.2) about some lifestyle diseases.

Disease	Cause
Diabetes	deficiency of insulin or its malfunctioning
Fatty Liver	deposition of excess fat in the liver
Stroke	rupture of blood vessels in brain, block of blood flow.
Hypertension	decrease in the diameter of arteries due to deposition of fat.
Heart attack	block of blood flow due to deposition of fat in coronary arteries, which carry blood to heart.

Table 4.2

Observe Illustration 4.6 on some of the health problems associated with smoking.

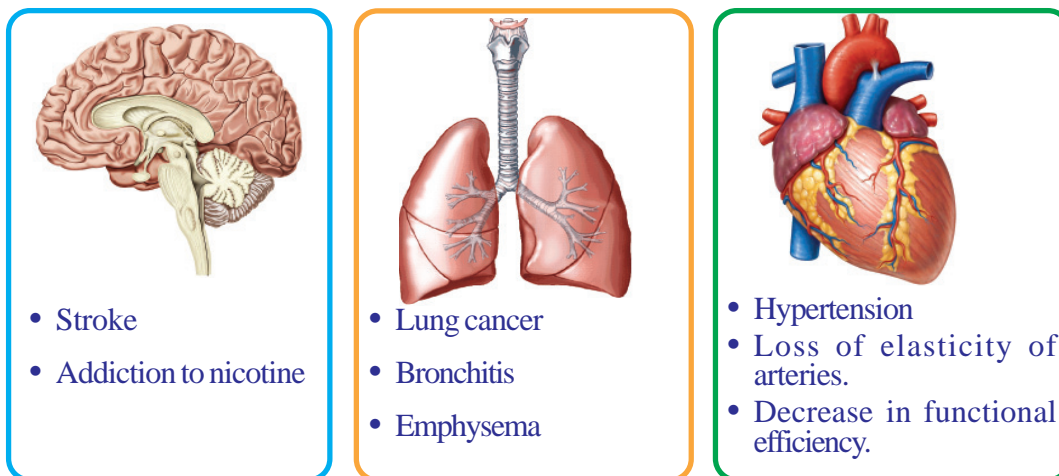


Illustration 4.6 Smoking and health hazards

Collect more information on the bad effects of smoking and write it in your science diary.

Conduct a poster exhibition to make people aware of drug abuse.

Animal Diseases

Not only human beings, animals are also affected by diseases.

Observe the following table about some animal diseases.

Disease	Pathogen
Anthrax, Inflammation of udder	Bacteria
Foot and mouth disease	Virus

Table 4.3 Some animal diseases

Elaborate the table including details of other animal diseases.

Plant Diseases

Plants are also affected by various diseases. Examine Table 4.4 to identify some of the plant diseases caused by microorganisms like bacteria, virus and fungi.

Pathogen	Disease
Bacteria	Blight disease of paddy, Wilt disease of brinjal
Virus	Mosaic disease in peas and tapioca, Bunchy top of banana
Fungus	Quickwilt in pepper, Bud rot of coconut.

Table 4.4 Some plant diseases

Collect more information on plant diseases that adversely affect food production and write it in your science diary.



Occupational Diseases

Occupational diseases are caused by the situations in work sites. Some examples for occupational diseases are given below. Pneumoconiosis affecting the labourers engaged in coal mining. Silicosis affecting mining workers related to gold, tin, mica and labourers in quarry, pottery and ceramics. Asbestosis affecting workers in asbestos factories.

You may also make use of agricultural publications for collecting additional information.

Try to understand the problems faced by farmers in your locality and participate in preventive activities against plant diseases.

The complete physical, mental and social well-being of a person is called health. Healthy people are the real wealth of a society. The attitude towards patients is as important as keeping away diseases by practising healthy habits. It is our duty to console those who are affected by noncurable and fatal diseases.



Significant learning outcomes

The learner

- explains about different pathogens by classifying them.
- lists the cause and preventive measures for dengue fever.
- collects and presents information relating to situations that lead to various kinds of diseases.
- explains the different diseases caused by bacteria.
- collects information on different kinds of viral diseases and takes part in awareness programmes against them.
- explains genetic diseases through examples.
- adopts a lifestyle that prevents lifestyle diseases.
- lists the collected information on different types of animal and plant diseases.
- empathises with patients and engages in activities to provide comfort and care for them.



Let us assess

1. Which among the following is not a bacterial disease?
 - a. Tuberculosis
 - b. Tetanus
 - c. Chicken pox
 - d. Anthrax
2. "Food safety will be adversely affected with the spread of plant diseases."
 - a. Do you agree with this statement? Why?
 - b. Give two examples of plant diseases.
3. How do other pathogens make the condition of AIDS fatal?



Extended activities

- Prepare a check list and collect information on various lifestyle diseases. Find out the lifestyle diseases that are seen commonly.
- Prepare and exhibit posters highlighting the fact that social hygiene is as important as personal hygiene.

5

Soldiers of Defense



Observe the illustration.

Our surroundings are full of microorganisms. Most of them are pathogens too. Though we live in the midst of germs are we susceptible to diseases? What may be the reason? Discuss.

-

What are the mechanisms in the body which prevent pathogens from entering it?

List them.

-

Immunity is the natural ability of our body to prevent germs from

entering the body and also to destroy those that have entered it. Our body is well equipped with a variety of defense mechanisms. This is why we are not affected by diseases even though we are in constant contact with germs.

Defense Mechanisms

The defense mechanism in our body can be classified into two, namely nonspecific defense mechanism and specific defense mechanism. The nonspecific defense mechanism is a mechanism that protects us from all pathogens and their toxins without considering their variety or characteristic features. Specific defense mechanism is a defense process by which lymphocytes, a type of white blood cells, identify pathogens and prevent them from causing diseases.



Bacteria too for resistance

Human body is a natural habitat for many kinds of bacteria. Bacteria live in the skin, trachea, alimentary canal, urethra etc. Though some bacteria causes pimples and bad odour in sweat, most of them help in life activities and immunity. Bacteria seen in the alimentary canal are the primary source of vitamin K and biotin.

Antibiotics, change in food habits, damages of tissues etc., will affect the existence of these useful bacteria.

Nonspecific Defense

First level defense is the mechanism that prevents germs from entering the body. Second level defense is the mechanism that destroys the germs that have entered the body.

First Level Defense

First level defense is enabled by certain peculiar features of the body. A note regarding such features is given below. Analyse it based on the indicators given and write your inferences in the science diary.

Keratin layer

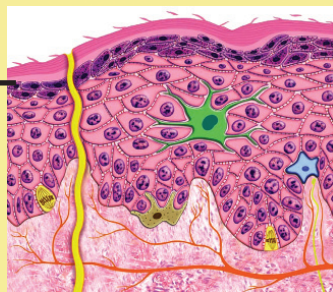


Figure 5.1

A protein called keratin makes the skin a thick fort which prevents germs from entering it. Sebum produced by sebaceous glands and some acids in the skin are also disinfectants.

Mucus in the trachea prevents the entry of germs into the lungs. The cilia in the bronchus wipe out dust that enters it. Cough, sneezing etc., are methods to expel foreign bodies from the respiratory tract.

The wax in the ear prevents pathogens. The enzyme lysozyme present in tears and saliva and hydrochloric acid in the stomach also fight against germs.

Indicators

- Skin is referred to as 'a fort of resistance'. Why?
- What is the function of cilia and mucus in the respiratory tract?
- What are the methods in ears, eyes and saliva to prevent germs?
- What is the role of hydrochloric acid in the stomach to prevent germs that enter the body through food?

Second Level Defense

The body has a system to destroy germs when they enter it by overcoming the immune system. The wounds and cuts in the skin may cause infection. Second level defense are activities to destroy the germs in such situations. Based on the indicators, analyse the following note and Illustration 5.1. Write your inferences in the science diary.

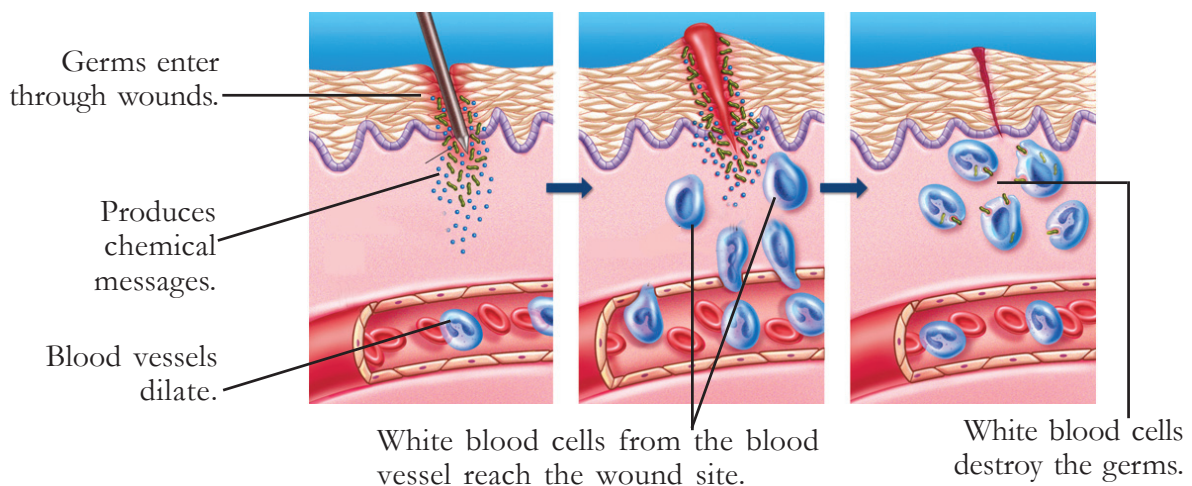


Illustration 5.1

The cells that get damaged by a wound or an infection produce certain chemical substances. These substances dilate the blood vessels thereby increasing the blood flow. Blood plasma and white blood cells reach the wound site. This is the reason for the swelling of the wound site. This defense mechanism is known as inflammatory response.

Indicators

- What is the advantage of the dilation of blood vessels at the wound site?
- Is inflammatory response a defense activity? Why?

Warriors

White blood cells are soldiers of defense for the body. There are five types of white blood cells. Among these, neutrophil, basophil, eosinophil and monocyte act as part of nonspecific defense. They respond to pathogens in different ways. Examine Illustration 5.2 which shows the defense activities of white blood cells.


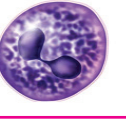


White blood cells		Defense activity
	Neutrophil	engulfs and destroys the bacteria. produces chemicals that can destroy bacteria.
	Basophil	stimulates other white blood cells. dilates the blood vessels.
	Eosinophil	produces chemical substances that destroy foreign bodies. produces chemical substances needed for inflammatory response.
	Monocyte	engulfs and destroys germs.

Illustration 5.2

Phagocytosis

Phagocytosis is the process of engulfing and destroying germs. The cells engaged in this process are called phagocytes (phago- to engulf, cyte-cell). Monocytes and neutrophils are phagocytes.

Complete the flowchart by analysing Illustration 5.3 showing the stages of phagocytosis.

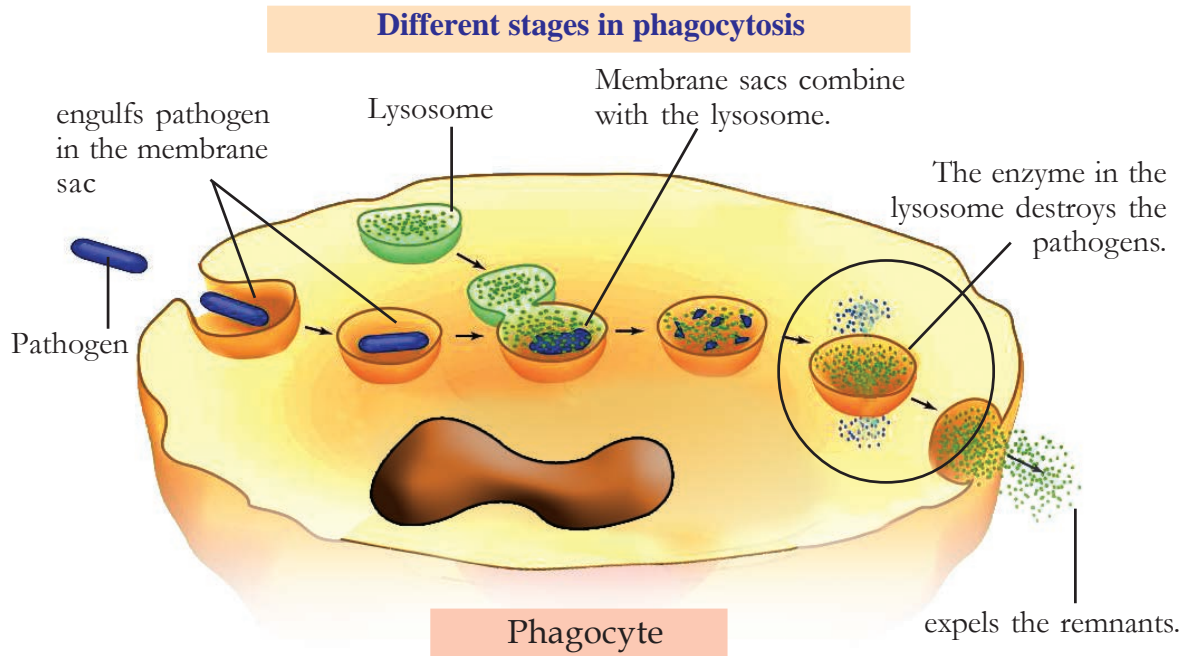
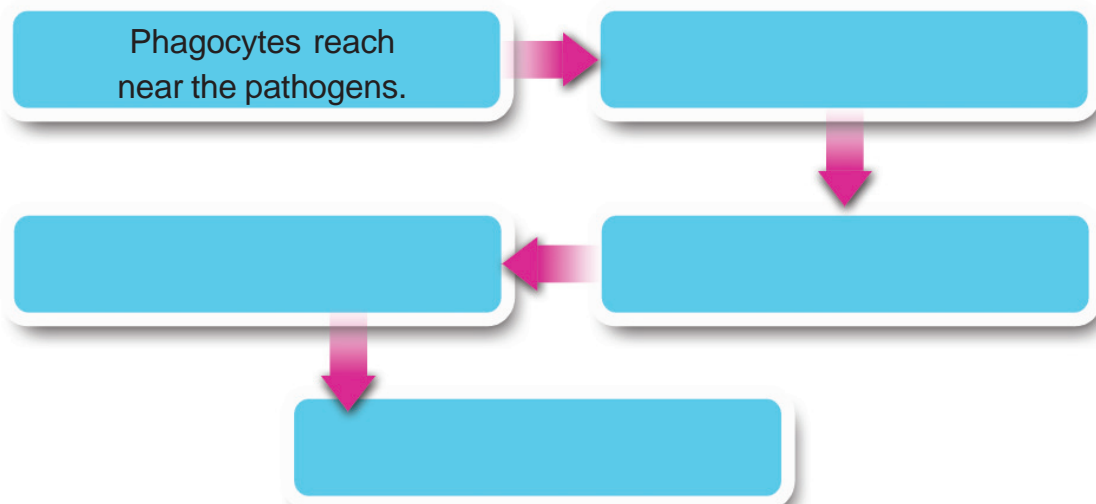


Illustration 5.3 Phagocytosis



Blood Clotting

Blood clotting is a defense mechanism to prevent the loss of blood through wounds. In this process, fibrin, the plasma protein, forms a fibrous network. Blood cells get entangled in this network to form a blood clot.

Analyse the following Illustration 5.4 that details the stages of blood clotting.

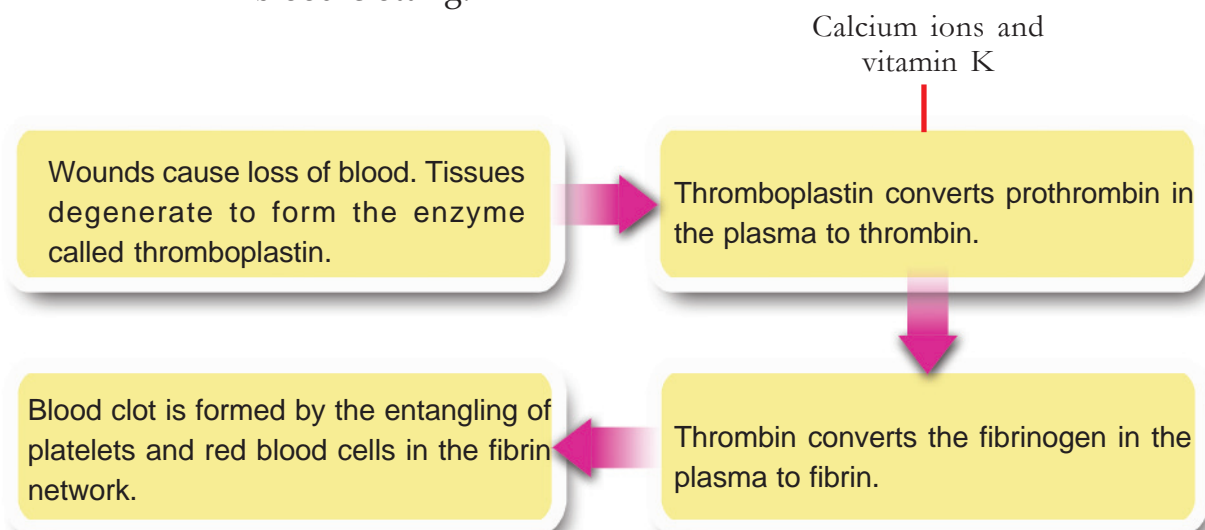


Illustration 5.4 Blood clotting

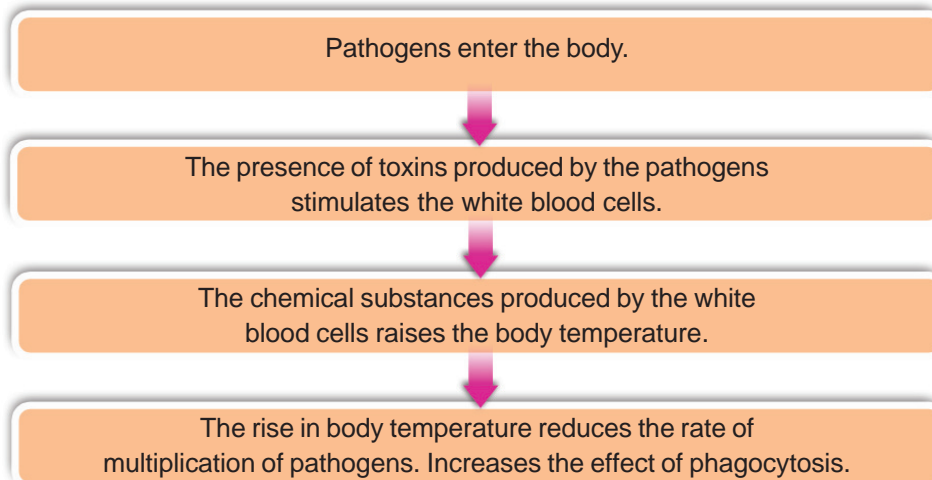
Healing of Wounds

Healing of the wound is a stage after inflammatory response and blood clotting. When wound occurs new tissues are formed in place of the tissues damaged by the wound. In such situations the wound scar does not remain. In cases when new tissues cannot be formed, the connective tissue heals the wound. In such situations, the wound scar remains.

When there is a wound, doesn't the body temperature change? Fever is the rise in body temperature. Is it beneficial to the body?

Fever, a Defense Mechanism

The normal body temperature is 37°C (98.6°F). Body temperature rises during fever. Is it a disease or a symptom? Analyse the flow chart given and write your inferences in the science diary.



You must have understood that fever is a defense mechanism of the body.

When infection becomes uncontrollable, the body temperature may rise very high. We take medicines to reduce the body temperature. But it is advisable to treat after diagnosing the exact reason. If the rise in body temperature persists for a long time, it may badly affect the internal organs including the brain. Hence it is necessary to seek medical assistance immediately.

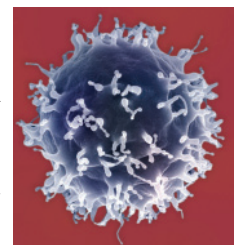
Specific Defense

In certain situations, pathogens enter the body and multiply by overcoming the immune system. Specific defense is the system which identifies and destroys such pathogens.

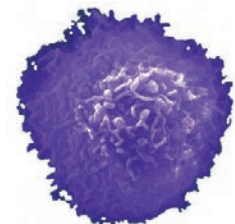
White blood cells known as lymphocytes are capable of destroying the pathogens in this way. Lymphocytes are of two types, namely B lymphocytes and T lymphocytes. B lymphocytes mature in the bone marrow. T lymphocytes mature in the thymus gland. Lymphocytes are capable of identifying harmful and harmless substances.

B Lymphocytes

Any foreign body that stimulates the defense mechanism can be called antigens. B lymphocytes produce certain chemical substances to act against them. The chemical substances which act against antigens are called antibodies.



B lymphocyte



T lymphocyte

Antibodies destroy the pathogens in three different ways.

1. Destroy the bacteria by disintegrating their cell membrane.
2. Neutralise the toxin of the antigens.
3. Destroy the pathogens by stimulating other white blood cells.

T Lymphocytes

T lymphocytes stimulate other defense cells of the body. Moreover these cells are capable of destroying cancer cells and cells affected by virus.

Lymphocytes become activated in the presence of certain particular types of antigens. Lymphocytes can defend only such antigens. Hence, this defense mechanism is known as specific defense mechanism.

Complete the following Illustration 5.5 suitably.

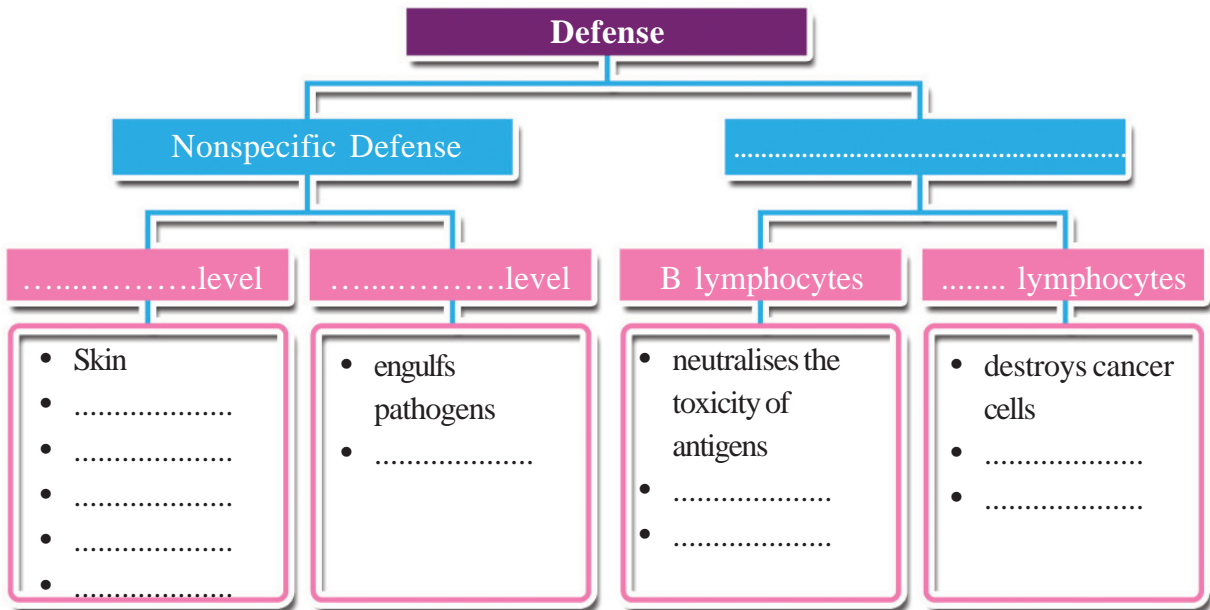


Illustration 5.5

Diseases...inspite of all these!

Our body has many defense mechanisms. Why do we still get affected by diseases? Lifestyle, unhealthy food habits, lack of hygiene, abundance of germs etc., lead to the damage of our defense system.

Medical treatment becomes necessary when we are affected by diseases, crossing all obstacles of our immune system. Elaborate the following list of the various systems of medicine that we depend on to recover from diseases.

- Allopathy
- Ayurveda
- Homeopathy
- Unani
-

Traditional Methods of Treatment

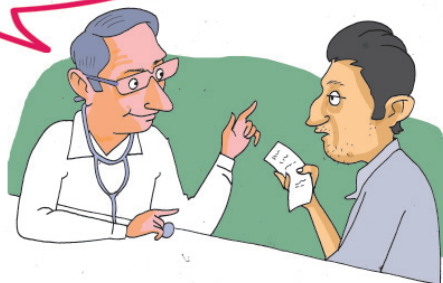
In various parts of the world, methods of treatment have evolved in accordance with the lifestyle of the people, their culture and available natural resources. These methods are the result of long periods of experience and observation. Some of these methods have become widely known. Ayurveda is one such world famous system of medicine which has its origin in India. Ayurveda is more of a lifestyle in tune with nature rather than a method of treatment. The speciality of Ayurveda is the medicine, taken from nature.

Prepare a journal by collecting more information related to various systems of medicine.

Diagnosis is the first stage of treatment in any system of medicine. It is done by examining the physical condition of the patient and the disease symptoms.

Modern laboratory tests and equipment are used for diagnosis today.

As the fever is persisting,
we have to test the count of
platelets.



Why could it be that the doctor suggested a test of platelet count? The dengue virus prevent the formation of platelets from the bone marrow. In such situations there is considerable decrease in the number of platelets. Hence, by testing platelet count, the presence of dengue virus, can be confirmed. Don't doctors suggest many such tests?

Collect more information on various tests and note it down in your science diary.

Collect sample lab reports from a nearby Primary Health Centre. Analyse the information and prepare a note on it.

The equipment for diagnosis are as important as these laboratory tests.

Write the name and use of the equipment you are familiar with, from those given below (Figure 5.2).

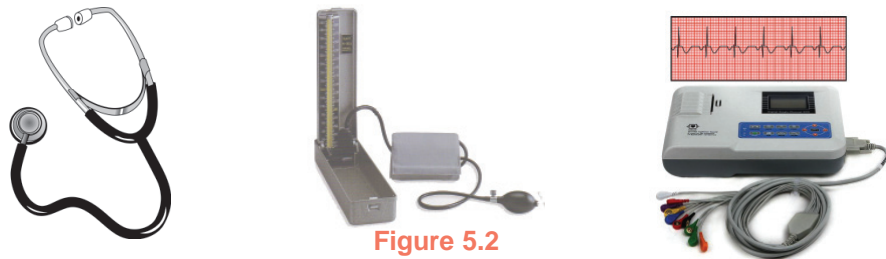


Figure 5.2

Given below is Table 5.1, including a few other modern equipment. Conduct an exhibition on such equipment, including their pictures and details of their uses.

Equipment	Use
Electroencephalogram (EEG)	to record electric waves in the brain.
Electrocardiogram (ECG)	to record electric waves in the heart muscle.
Ultra Sound Scanner	to understand the structure of internal organs using ultrasonic sound waves.
C.T. Scanner (Computed Tomography Scanner)	to get three-dimensional visuals of internal organs with the help of computer, using X-rays.
MRI Scanner (Magnetic Resonance Imaging Scanner)	to get three-dimensional visuals of internal organs.

Table 5.1

Such kinds of tests make diagnosis more precise.

Therapy

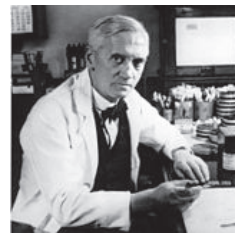
Modern medical science proposes treatment using medicines. Medicines are substances either extracted from plants, animals or microorganisms or chemical substances synthesized in laboratories.

Antibiotics

It was the scientist, Alexander Fleming, who first synthesized antibiotics in 1928. Antibiotics are used to resist bacterial diseases.

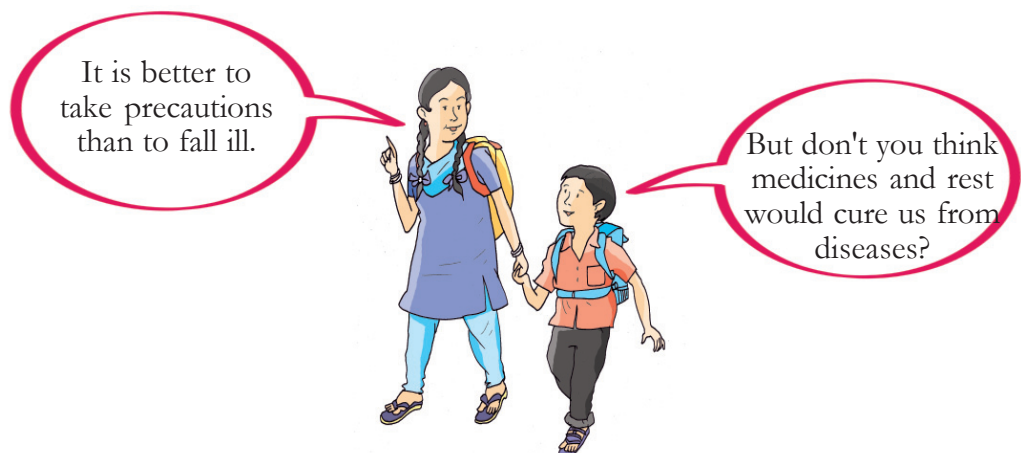
Though antibiotics are effective medicines, their regular use brings many side effects. Some important side effects are listed below:

- regular use develops immunity in pathogens against antibiotics.
- destroys useful bacteria in the body.
- reduces the quantity of some vitamins, in the body.



Alexander Fleming

Is it proper to use antibiotics without recommendation by a doctor? Why? Discuss. Write your inferences in the science diary.



Did you observe the discussion in the cartoon? What is your opinion?

Which is better, treating diseases or preventing them? Discuss.

Read the article from a science excerpt .

It is a false notion that we can build up a healthy society with hospitals, doctors and medicines. In fact, a healthy society can be formed by taking nutritious food, maintaining hygiene and a proper lifestyle. You may seek for treatment using medicines only in inevitable situations.

Our traditional knowledge can play an important role in defending and controlling diseases. What can we do to conserve our vanishing folk knowledge in this regard? Discuss.

All traditional treatments are based on the bio-resources of a region. It is necessary to conserve the biodiversity in order to preserve folk knowledge. Collect more information regarding this topic.

Medicines are not the only method of treatment. You might have heard of radiation therapy in the treatment of cancer and eye diseases. Surgery and transplantation of organs are also being done for curing ailments. In some cases, blood transfusion may also be needed.

**Wanted urgently AB^{-ve} blood for
a four year old child.**

Did you notice the message?

What are the instances in which blood becomes necessary?

- when blood is lost excessively in accidents.
- when affected with diseases like blood cancer.
-

Blood Transfusion

Can a patient receive blood from any person? Have you heard about different types of blood groups?

Observe table 5.2 and identify the various types of blood group, antigens and antibodies present in them.

Blood group	Antigens	Antibodies
A	A	b
B	B	a
AB	A and B	Nil
O	Nil	a and b

Table 5.2 Different types of blood group

Read the following description.

The basis of blood grouping is the presence of antigen A and antigen B in red blood cells. The blood group of a person is named according to the antigen present in that person's blood. In blood transfusion, antibodies present in the blood plasma are of special importance. In blood group A, antibody **b** and in group B, antibody **a** are present. In addition to antigens A and B, another antigen called D or Rh factor is present in the cell membrane of red blood cells of certain persons. The blood groups in which Rh factor is present are known as positive blood groups and those without Rh factor are called negative blood groups.

When a foreign antigen reaches one's blood, it stimulates defense activity. As a result, the antigen present in the received blood and antibody in the recipient's blood will react each other and form a blood clot. Hence, everyone cannot receive blood from all blood groups.

Prepare posters on the greatness of donating blood and exhibit them in your classroom.

Induced Immunity

Many incurable diseases can be prevented by acquiring induced immunity.

In induced immunity, antibodies, which can act against pathogens or toxins produced by them, are synthesised in the body itself. Dead germs, or their toxins or neutralized pathogens are used for this purpose. The body prepares antibodies to act against these



India - a Polio free Nation

The Government of India started the Total Polio Eradication Programme in 1995 as part of the Polio eradication programme of WHO. As part of this, a comprehensive plan for giving Oral Polio Vaccine (OPV) for all children below the age of five years was implemented. The government declared national polio eradication days and made arrangements to distribute vaccines on those days across the country. As a result of these initiatives, the number of polio affected cases decreased significantly. No cases of polio were reported in our country after 2011. WHO declared India a Polio Free Nation on 27 March 2014.

foreign bodies. Such substances used for synthesizing antibodies are called vaccines.

Vaccination

The first vaccine developed was against smallpox. The scientist Edward Jenner discovered the first vaccine. The observation that small pox did not become fatal in people who were affected by cowpox, helped him in this discovery. Today effective vaccines have been made with the help of genetic engineering.



Edward Jenner

Collect the schedule of preventive vaccines to be taken at different stages of childhood from birth from nearby Primary Health Centre.

Examine Table 5.3. Understand the different types of vaccines and their peculiarities and the diseases against which they are used. Discuss on the basis of indicators given and write the inferences in the science diary.

Major components in the vaccine	Diseases
Killed germs	Cholera, Rabies
Alive, but neutralized germs	Typhoid, Measles
Neutralized toxins	Tetanus, Diphtheria
Cellular parts of pathogens	Hepatitis B

Table 5.3

Indicators

- What are vaccines?
- Which components of vaccines act as antigens?
- How do vaccines induce immunity?

Defense Mechanisms in Plants

Defense mechanisms function in plants too. The defense mechanism in plants is entirely different from those in animals. The characteristics in their body structure and the specific molecules produced by plant tissues protect the plants from diseases. The bark of plants acts as a strong coat against pathogens. In trees, the thick bark formed of dead cells protects inner cells from the germs.

The cuticle, the external layer of the epidermis of leaves defends the attack of microorganisms. Cell wall is a well equipped resistant coat. Chemical substances such as lignin, cutin, suberin etc., provide rigidity to the cell wall. A polysaccharide called callose prevents the entry of germs which have crossed the cell wall, through the cell membrane. Complete the following Illustration 5.6.

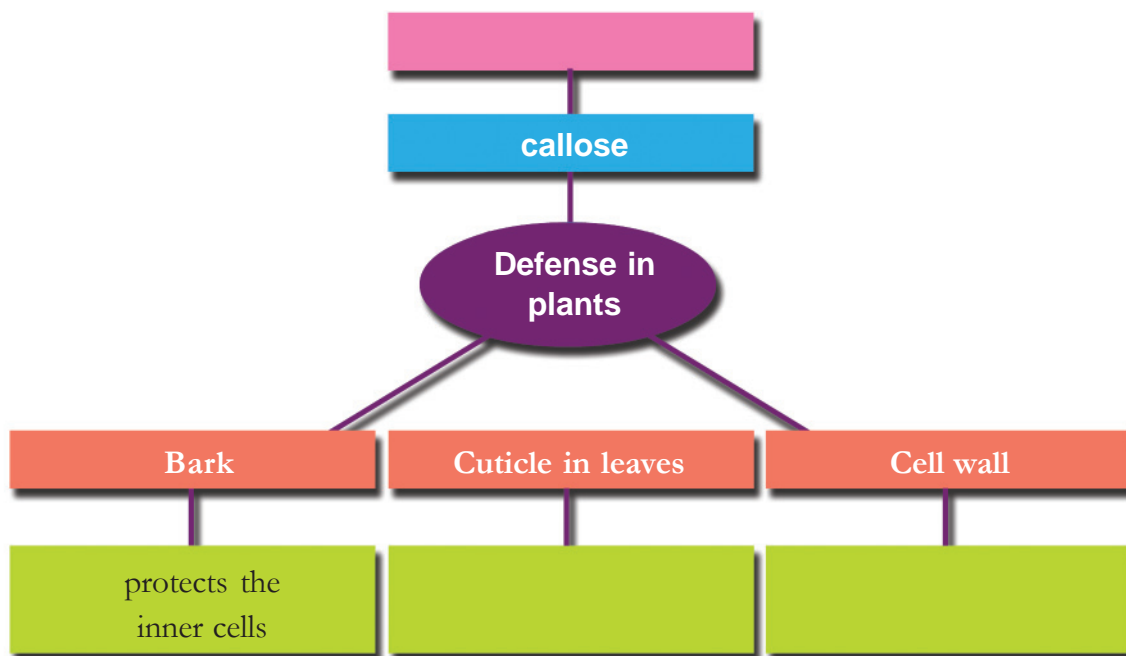


Illustration 5.6

The well equipped defense mechanism of the body protects us from diseases. Our lifestyle should aim at strengthening the soldiers of defense from skin to white blood cells.



Significant learning outcomes

The learner

- classifies and presents different defense mechanisms in the body.
- explains how white blood cells act against pathogens.
- recognises and explains that fever is a defense mechanism.
- prepares and presents notes by collecting information on the significance of traditional methods of treatment.
- collects and presents information on different equipment for diagnosis.
- uses antibiotics judiciously by assessing their merits and demerits.
- engages in awareness programmes by internalising the importance of blood donation.
- participates in awareness programmes by understanding the importance of vaccination.
- prepares illustration of defense mechanism in plants.
- avoids habits that reduce immunity.



Let us assess

1. Which among the following is not included in first level defense?
 - a. production of sebum
 - b. action of hydrochloric acid in the stomach.
 - c. action of B lymphocytes.
 - d. action of lysozyme in saliva.
2. Write the functions of the two types of lymphocytes in the defense mechanism of the body.
3. What is the basis of grouping blood into different types? Everybody cannot receive blood of all blood groups. Why?

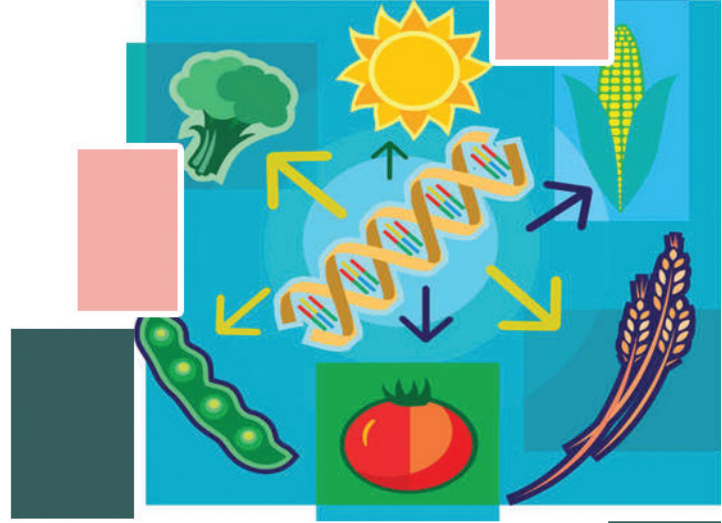


Extended activities

- Plan and implement activities to destroy mosquitoes at home and in the school premises.
- Conduct a debate in class on the topic - 'Are antibiotics useful or harmful'?

6

Unravelling Genetic Mysteries



Observe the picture.

What differences do you notice between the two children?

Complete Table 6.1 given below.

Body part	Features	
	Daughter	Son
Hair	curly	.....
Forehead	.....	V shaped
Ear	lobed	.....

Table 6.1

Are there such features among us too?

What are the features that make us different from others?

Write them down.

- height
- colour of the skin
-

Certain features among these may be inherited either from father or mother. Features that are not seen in parents may also be found in children. Combination of all these features constitute the personality of an individual.

The transmission of features of parents to offsprings is termed heredity. The features seen in offsprings that are different from their parents are called variations. The branch of science that deals with heredity and variations is called genetics.

Emergence of Genetics

This branch of science emerged at the beginning of the 20th century. Now, genetics influences almost all areas of life like diagnosis, therapeutics, food production etc.

Certain laws of inheritance, formulated by Gregor Johann Mendel, on the basis of hybridization experiments in pea plants, have led to the foundation of genetics. Mendel is considered the Father of Genetics.



Gregor Johann Mendel

1822
Birth

1854
Started hybridization experiments.

1856-1863
Grew about 29000 pea plants for experiments.

1856-1863
Formulated well known laws of inheritance.

1866
Published his findings.

1884
Death



Illustration 6.1

Experiments of Mendel

Observe the illustration of the hybridization experiment carried out by Mendel on garden pea based on the trait, height.

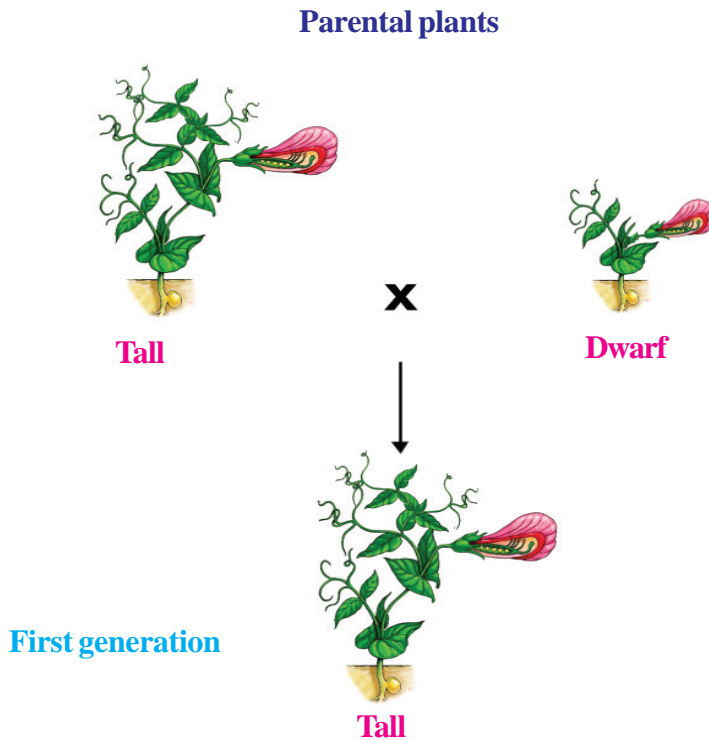


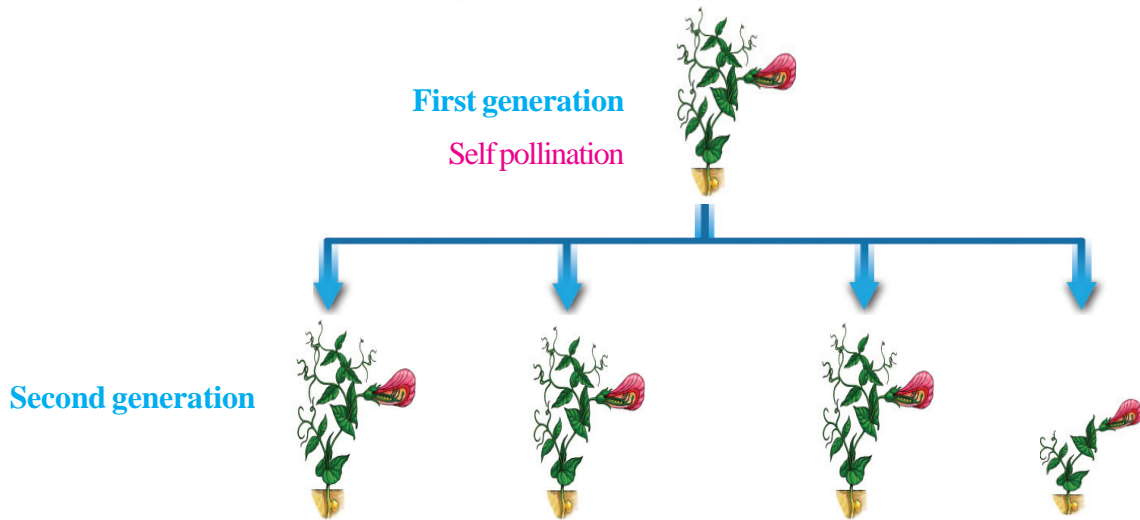
Illustration 6.2

Indicators

- Which trait of the pea plant was considered in this experiment?
- What variant forms of the trait are considered here?
- Which form of the trait was expressed in the first generation?

When he germinated the seeds collected from hybridised plants, no plant was seen to be dwarf. He assumed that there may be some factors in the seed that control various traits. What has happened to the factor that controls the character dwarfness?

To find out the answer, he self pollinated the plants obtained in the first generation and produced the second generation.



Among the 1064 plants obtained in the second generation, 787 plants were tall and 277 plants were dwarf.

He continued his experiments with six other contrasting characters of the pea plants. The ratio of the result obtained is about 3:1 like the result of the first experiment. Observe the list showing the traits that were experimented by Mendel.

<p>1. Height</p> <p>Tall dwarf</p>	<p>4. Colour of the seed</p> <p>Green Yellow</p>
<p>2. Position of the flower</p> <p>Terminal Axial</p>	<p>5. Colour of the flower</p> <p>Purple White</p>
<p>3. Shape of the seed</p> <p>Round Wrinkled</p>	<p>6. Shape of the pod</p> <p>Inflated Constricted</p>
	<p>7. Colour of the fruit</p> <p>Yellow Green</p>

Illustration 6.4

Inferences of Mendel

The inferences formulated by Mendel from such experiments paved the way for genetics. The main inferences were as follows.

- A trait is controlled by the combination of two factors.
- One character is expressed (dominant character) and the other character remains hidden (recessive character) in the offsprings of the first generation.
- The character which remains hidden in the first generation appears in the second generation.
- The ratio of the dominant character and recessive character in the second generation is 3:1.

Observe the illustration of hybridization experiment in pea plants using symbols for the factors that control traits.

Based on the indicators, analyse Illustration 6.5 and the description given. Write down the inferences in the science diary.

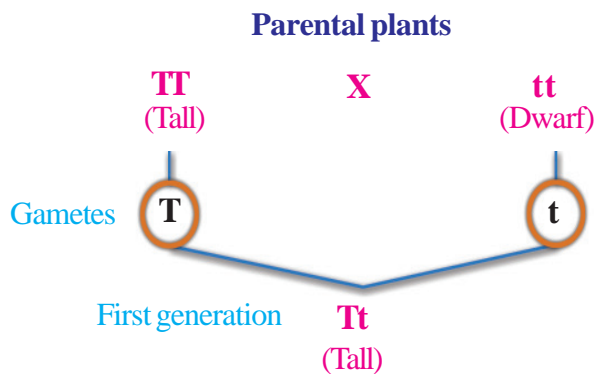


Illustration 6.5

Gene-Allele

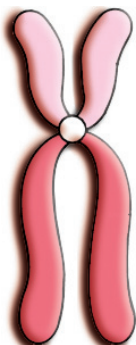
The fact that the gene present in the chromosome of the nucleus determines the character was discovered after Mendel's period. A gene that controls a trait has different forms. The different forms of a gene are called alleles. Generally a gene has two alleles. The different alleles of the gene that controls the trait, height in the illustration of hybridization, given above are **T** and **t**. The allele **T** determines the trait tallness and the allele **t** determines the trait dwarfness. When we illustrate hybridization experiment, the allele that controls the dominant character that is expressed in the first generation is generally indicated by a capital letter and the allele that controls recessive character is indicated by a small letter.

Indicators

- Which are the alleles of a tall plant?
- Which are the alleles of the dwarf plant?
- How do the allele combination of the first generation differ from parental plants?

You know gametes are seen in chromosomes. Genes are the specific part of DNA in the chromosome. Read the description given below and prepare a note based on the indicators.

Chromosomes in humans



Specific number of chromosomes are found in each species. 46 chromosomes are seen in humans. Among these, 44 chromosomes are autosomes (somatic chromosomes) and two chromosomes are sex chromosomes. An autosomal pair constitutes two identical chromosomes. Hence 22 pairs of autosomes are found in humans.

Sex chromosomes are of two types. They are called X chromosome and Y chromosome. Two X chromosomes are seen in female but an X chromosome and a Y chromosome are seen in male. That is, the genetic constitution of female is 44 + XX and that of male is 44 + XY.

Indicators

- chromosome number
- autosomes
- sex chromosomes

You know gametes are formed through meiosis. Observe Illustration 6.6 showing how alleles from the chromosomes of gametes segregate into offsprings. Write your inferences in the science diary.

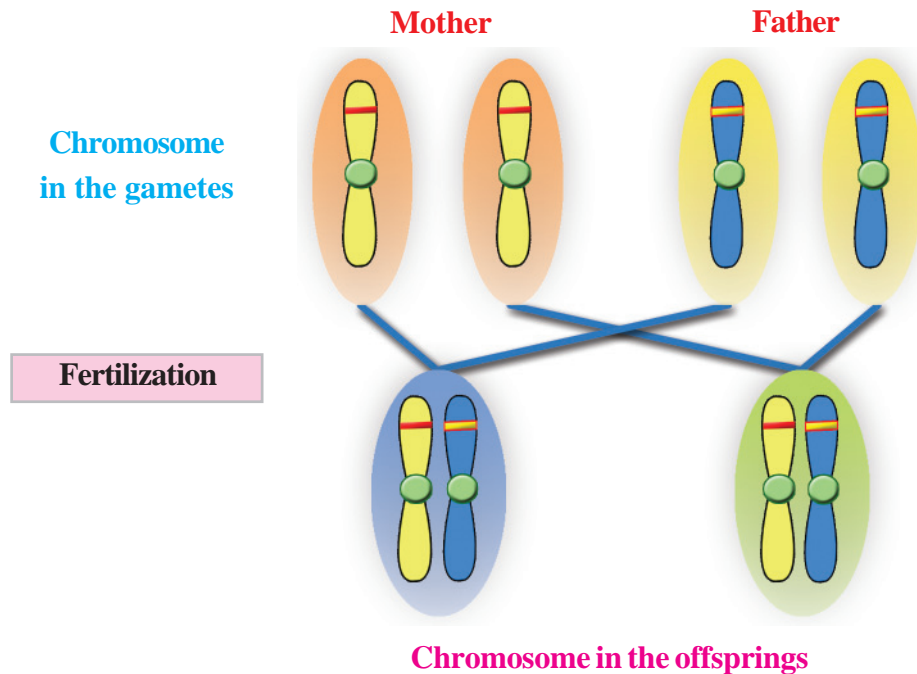


Illustration 6.6

Indicators

- Which chromosomes are combined in fertilization?
- What change has occurred in the allele combination due to fertilization?

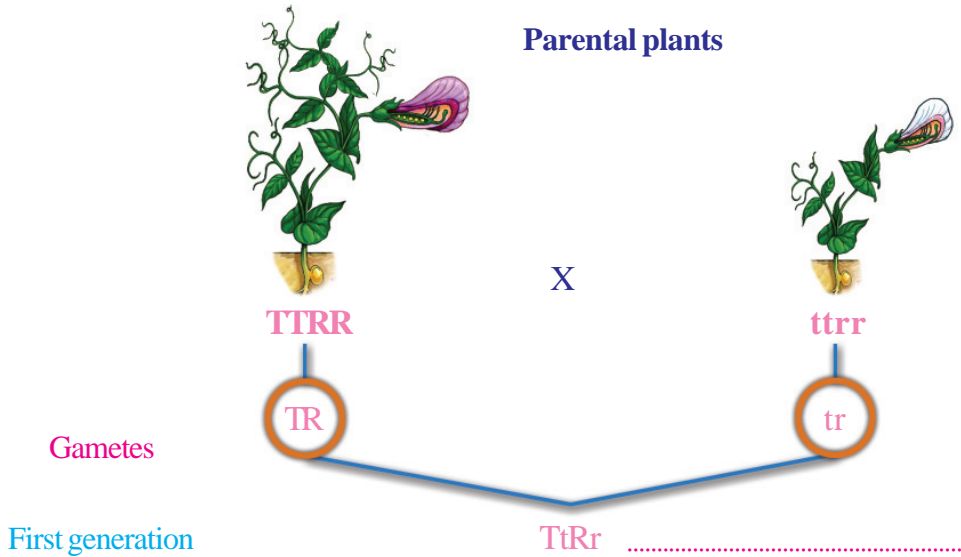
Genetics of Variation

You have understood that fertilization causes change in the allele combination. This change causes variations in the offsprings. Combination of paternal and maternal chromosomes determines the genetic constitution of the offspring.

Mendel observed the inheritance of a single trait namely, height in his first experiment. He observed the segregation of two different traits of the same plant in the next stage. Observe the illustration showing the hybridization experiment conducted by Mendel on two traits namely height and colour of flowers.

Complete the illustration and table suitably.

Based on the indicators, analyse Illustration 6.7 and write down the inferences in the science diary.



Self pollination in first generation - TtRr X TtRr

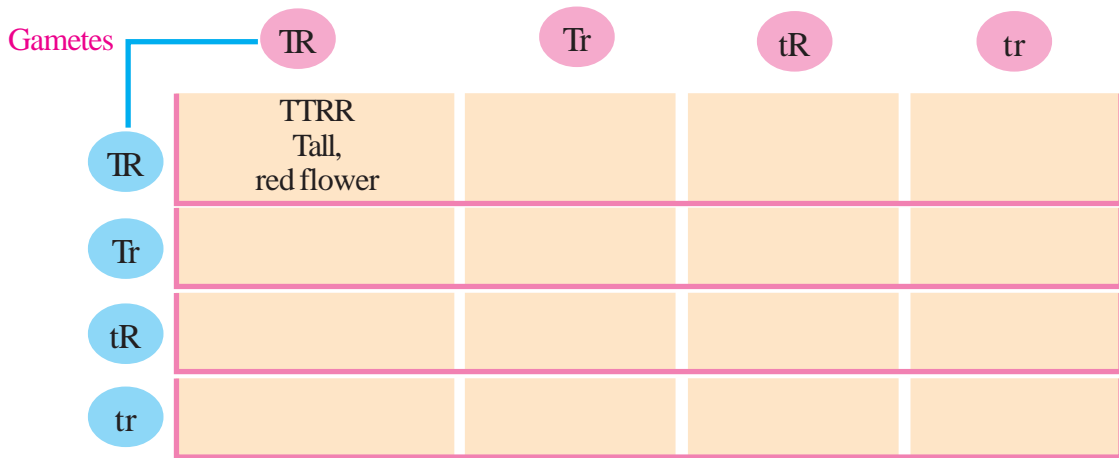


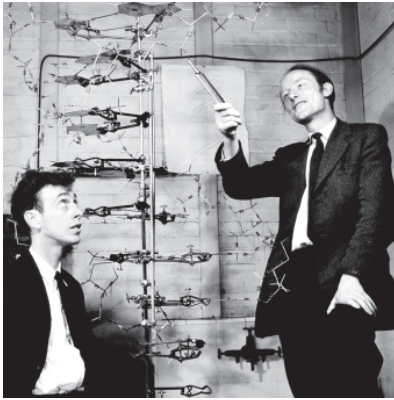
Illustration 6.7

Indicators

- What are the characters expressed in the offsprings of the first generation? Which are the recessive ones?
- Are there new combination of characters different from parents appeared in the second generation? Which are they?

Mendel explained that the appearance of new combination of characters in offsprings, is due to the independent assortment of each character. This question regarding the carriers of heredity remained as a mystery in the scientific world for many years. It was later found that the carriers of heredity, which Mendel described as factors, were the genes seen in the DNA (Deoxyribonucleic Acid). In order to know more about the gene and its action, we must learn the structure of DNA.

The structure of DNA



Scientists had been laying efforts to find out the structure of DNA molecules since 1868. Two scientists, James Watson and Francis Crick presented the double helical model of DNA in 1953. This model got

wide acceptance in the scientific world, for which they were awarded the Nobel Prize in 1962. As per the double helical model, DNA contains two strands. A model of two long strands with sugar and phosphate and steps with nitrogen bases, was suggested.

Based on the indicators, analyse Figure 6.1 and the description given below. Prepare a note on the structure of DNA.

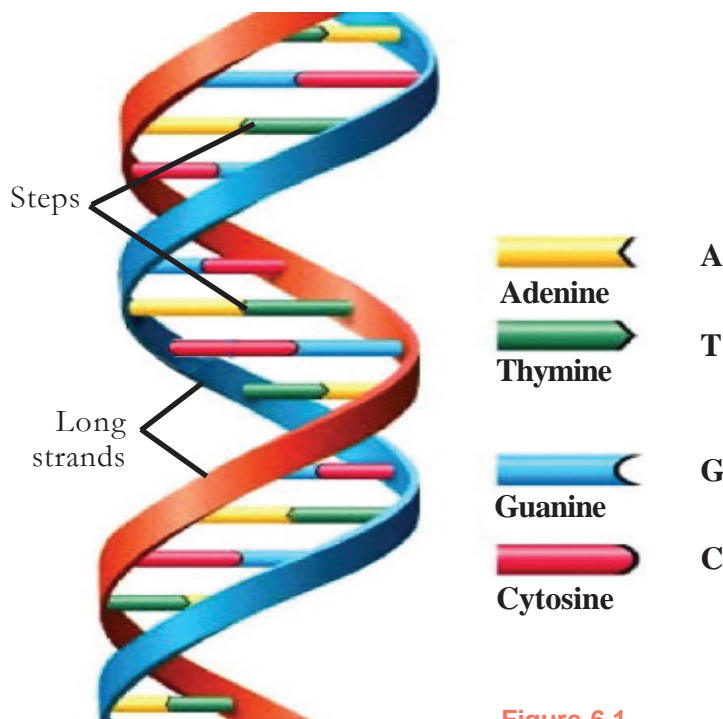
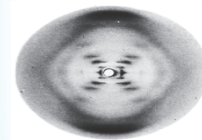


Figure 6.1



Humble attempt, great achievement

Watson and Crick presented the double helical model of DNA when they were research scholars of Cambridge University and gained worldwide appreciation. Watson and Crick got the idea of the double helical model from a beautiful X-ray diffraction picture of chromosome captured by Rosalind Franklin, a researcher who was conducting research in the same field. X-ray



diffraction pictures are pictures captured using the X-ray. Based on this picture Watson and Crick produced the model using many things in their hostel room and ensured its possibility.



Rosalind Franklin

Nitrogen bases and Nucleotides

DNA contains four kinds of nitrogen bases. They are adenine, thymine, guanine and cytosine. Nitrogen bases are molecules that contain nitrogen and are alkaline in nature. Nitrogen bases which are the basic units of DNA are molecules with special features. In DNA, the base adenine pairs with thymine and guanine pairs with cytosine. DNA molecule is the repetitive unit of a deoxyribose sugar molecule, a phosphate molecule and a nitrogen base. This unit is called nucleotide. Since DNA has four kinds of nitrogen bases, DNA has four kinds of nucleotides too.

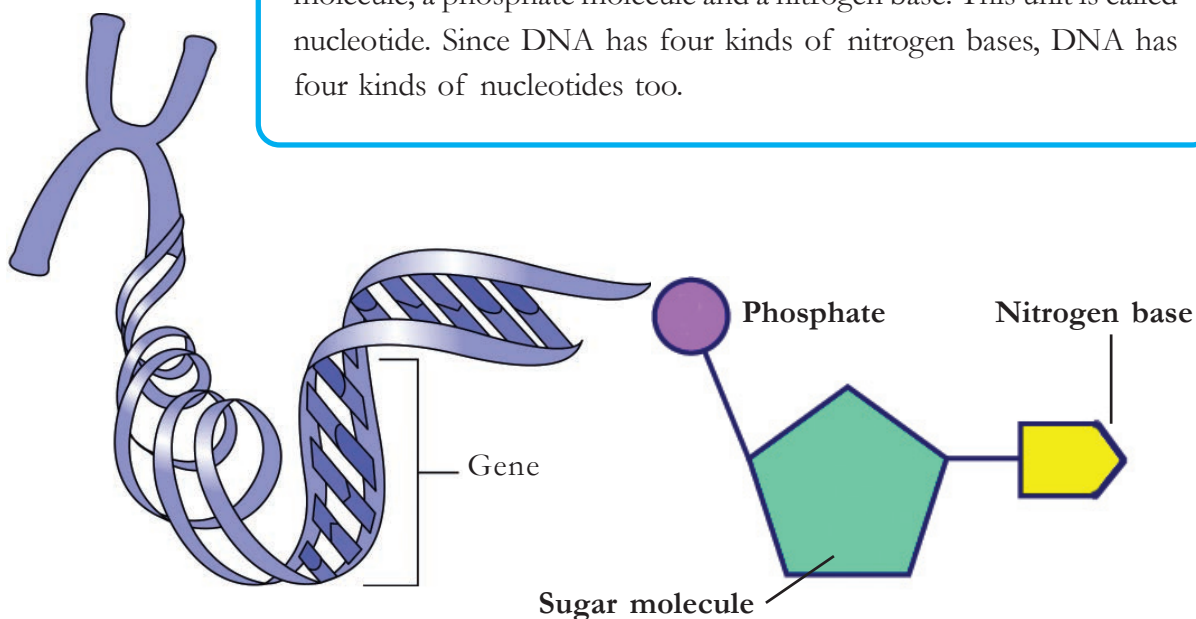


Illustration 6.8

Indicators

- What are nitrogen bases? Which are the nitrogen bases seen in DNA?
- What is the speciality seen in the pairing of nitrogen bases?
- What are the components of nucleotides?

Did you observe the illustration of nucleotides? Can you complete its second strand, based on the information given above.

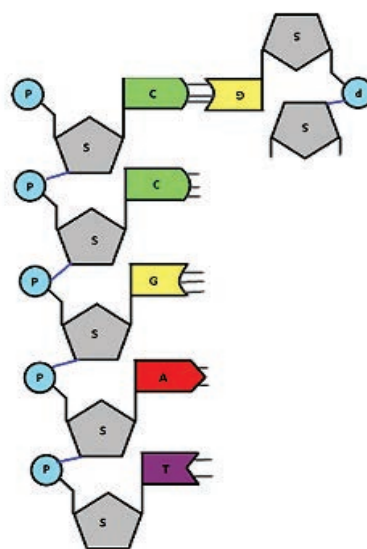


Figure 6.2
Strands of nucleotides

How do genes act?

Have you understood that genes which are the specific units of DNA control metabolic activities and they are responsible for specific characters? How do genes act?

Observe Illustration 6.9. Discuss on the basis of indicators and write down the inferences in the science diary.

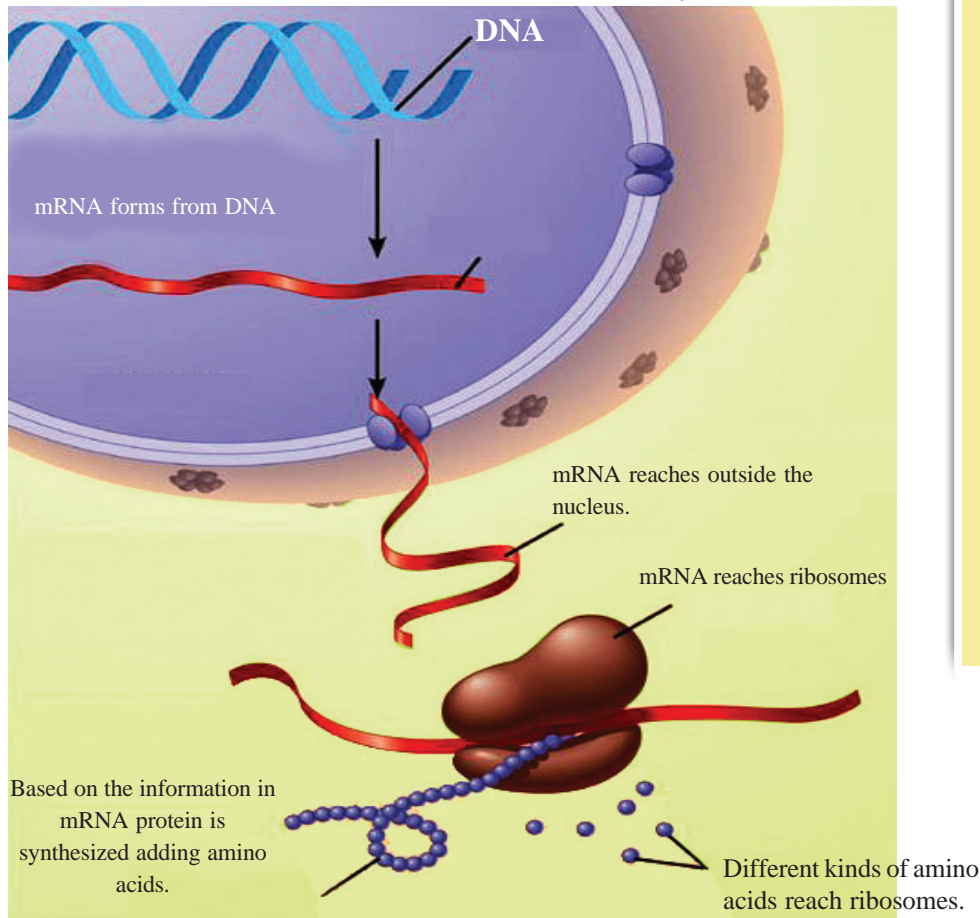


Illustration 6.9 Gene action

Indicators

- Where does mRNA get messages for protein synthesis from?
- What is the role of mRNA in protein synthesis?
- Where does protein synthesis occur?
- What are the building blocks of protein?

Besides mRNA, different kinds of RNA are present in the cells. There are tRNA (Transfer RNA) that carry amino acids to the ribosome and rRNA (Ribosomal RNA) that are seen associated with ribosomes. Protein molecule is synthesized by adding amino acids as a result of all these activities.

Messenger

DNA does not participate directly in protein synthesis. RNA (Ribo Nucleic Acid) is the molecule that carries information from DNA to ribosomes and controls protein synthesis. Since this RNA is the messenger of DNA, it is called messenger RNA or mRNA.

Like DNA, RNA is also made of nucleotides. But only one strand is seen in majority of RNA. Besides this, instead of thymine the nitrogen base uracil is seen in RNA. The sugar seen in RNA is ribose type. Complete Table 6.2 given below suitably.

	Number of strands	Type of sugar	Nitrogen bases
DNA			
RNA			

Table 6.2

Crossing over in chromosomes - a source of variation

During the initial phase of meiosis, chromosomes pair and exchange their parts. This process is called crossing over of chromosomes. As a result of this, part of a DNA crosses over to become the part of another DNA. This causes a difference in the distribution of genes. When these chromosomes are transferred to the next generation, it causes the expression of new characters in offsprings.

Based on the indicators, analyse Figure 6.3 given below and write down the inferences in the science diary.

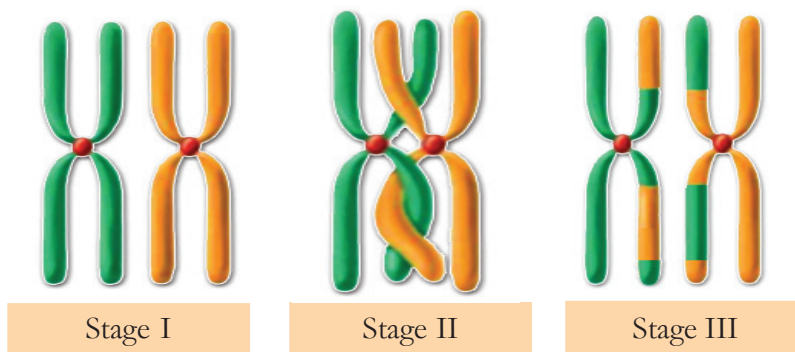


Figure 6.3

Indicators

- What is crossing over of chromosomes?
- How does crossing over cause variation?

Mutation and Variation

A sudden heritable change in the genetic constitution of an organism is called mutation. This may occur due to the defects in the duplication of DNA, certain chemicals, radiations etc.

Certain mutations are harmful and some are helpful for survival. Mutations lead to variations in characters. The effects of certain mutations are visible immediately while some are expressed after many generations. Mutation has great relevance in evolution.

Child - male or female?

What is the genetic mechanism that determines whether a child is male or female?

Observe Illustration 6.10. Discuss with the help of the indicators and write down the inferences in the science diary.

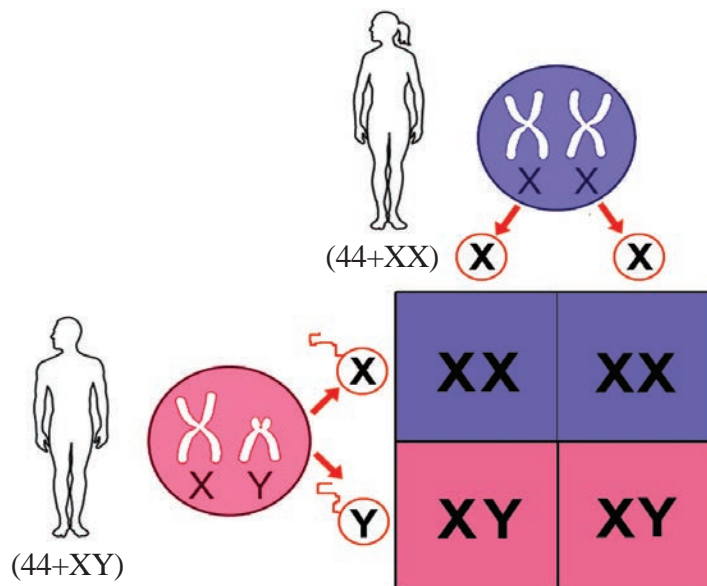


Illustration 6.10

Indicators

- Is there any difference in the number of chromosomes in male and female?
- Which chromosome is different in male and female?

What is the possibility for the birth of a male or a female child?
Discuss.

The XY chromosomes of the father determines whether the child is male or female. Child with XX sex chromosomes is female and one with XY sex chromosomes is male.

Is it fair to criticize mothers who deliver only female children?
Substantiate your opinion scientifically.

Difference in colour



What may be the reason for the difference in the colour of skin in people living in various parts of the world?

Melanin, a pigment protein imparts colour to the skin. It can be assumed that the difference in gene function is the reason for the colour difference of skin.

It is not the racial difference which makes the skin colour dark or light. This is simply an adaptation to live under sun. Races among mankind are only cultural. Scientifically, all men are of the same race. Only when one attains an awareness to consider all men equal, without racial difference, then only genetic study becomes meaningful.



Significant learning outcomes

The learner

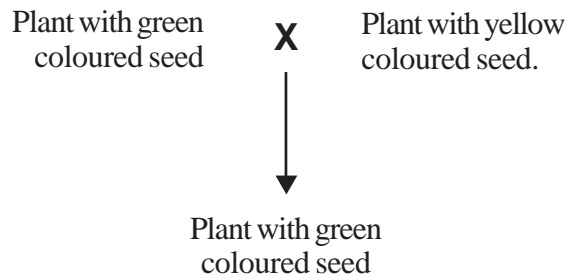
- gives examples for the fact that peculiarities of the body of an individual are due to heredity and variation.
- defines what genetics is.
- explains the contribution of Gregor Mendel in laying foundation to genetics.
- utilizes hybridization experiments to explain the inheritance of hereditary characters.
- differentiates and explains gene and allele.
- explains the structure of DNA.
- compares DNA and RNA and lists similarities and differences.
- identifies and explains the reasons for variations in organisms.
- illustrates what determines sex in humans.
- identifies that the difference in humans is only cultural and genetically all humans belong to one race.



Let us assess

1. The nitrogen base absent in RNA
 - a. Adenine
 - b. Thymine
 - c. Uracil
 - d. Cytosine
2. Arrange the stages of protein synthesis in the form of a flow chart.
 - combines amino acids.
 - mRNA reaches ribosomes.
 - mRNA is formed.
 - amino acids are carried to the ribosomes.

3. Observe the hybridization experiment given below.



- a. Prepare an illustration of this hybridization experiment using symbols.
- b. Prepare an illustration for the second generation.

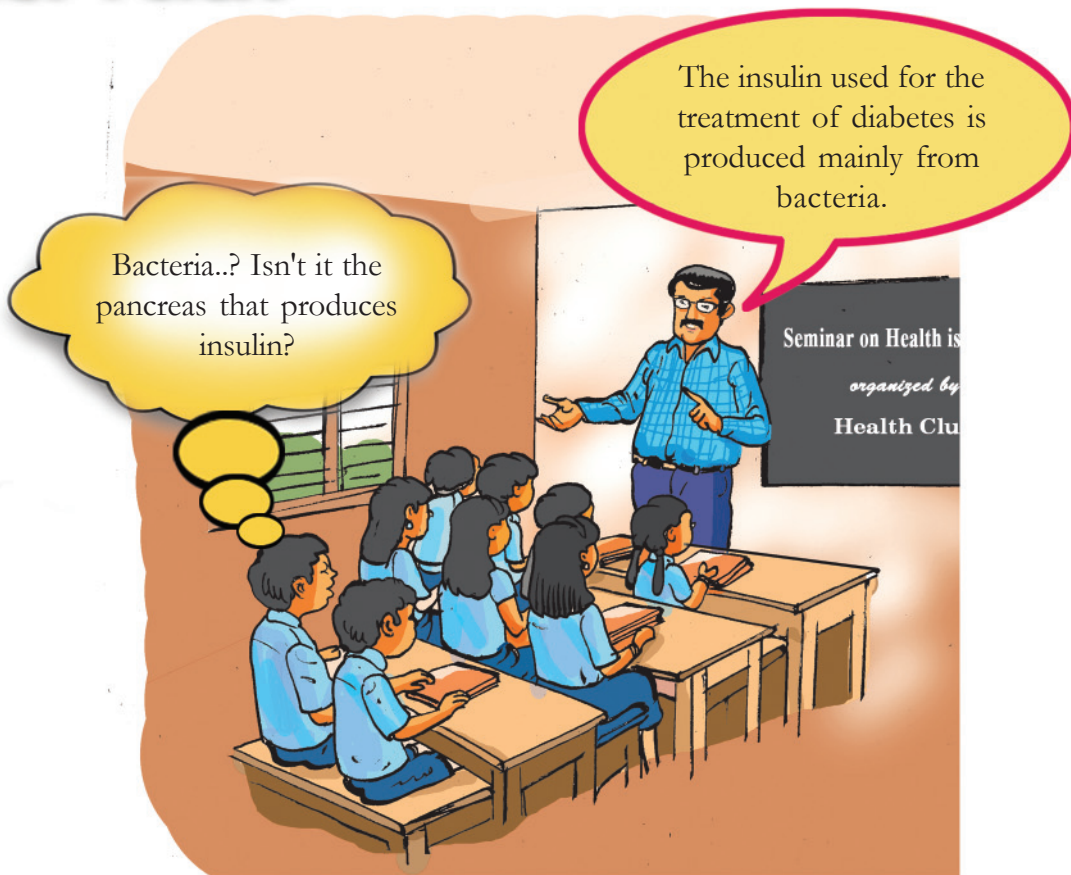


Extended activities

- Prepare an excerpt including information on scientists who made contributions in the progress of genetics.
- Prepare models of DNA and RNA using locally available materials and present them in a science exhibition.

7

Genetics for the Future



Did you notice Saju's doubt on hearing the doctor's talk in the seminar conducted by the Health Club?

Isn't it possible if we can separate the gene responsible for the production of insulin and insert it in bacteria?

Science is so developed today that we can manipulate genes as we wish.

Read the description given below.

Progress of genetics



Human beings utilised microorganisms for various purposes centuries ago. In BC 4000, yeast, a kind of fungus, was used to prepare food items like bread. We too utilize the ability of bacteria and fungi to convert sugar to alcohol to make cake and *appam*. Farmers traditionally adopted the method of selection and rearing of cattle and crops of superior hybrid variety. These methods can be considered as traditional biotechnology. But modern biotechnology

includes the production of organisms with desired qualities by changing their genetic material.

Analyse Table 7.1 based on the indicators and write down the inferences in the science diary.

Crop	Productivity	Disease resistance	Life span
A	less	more	less
B	more	less	more

Table 7.1

- What are the desirable qualities of crop A ?
- What are the desirable qualities of crop B ?
- What qualities can be seen in the new plant produced by incorporating the gene responsible for disease resistance from plant A to plant B ?
-

The technology that controls traits of organisms by bringing about desirable changes in their genetic constitution is genetic engineering.

Observe Illustration 7.1 on the stages in the production of bacteria that are capable of producing insulin through genetic engineering. Analyse it based on the indicators and write down the inferences in the science diary.

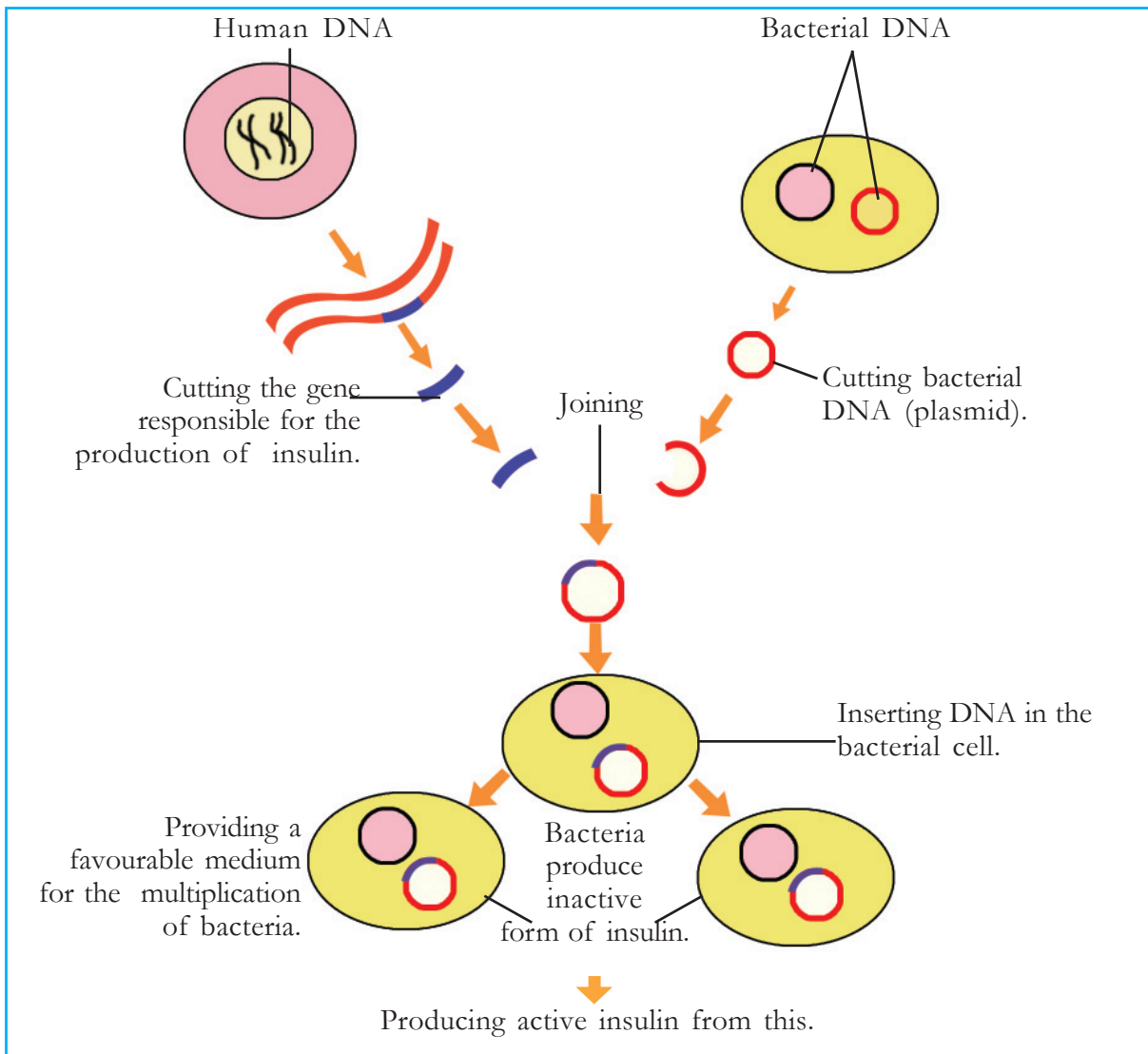


Illustration 7.1

Indicators

- How insulin producing bacteria are created?
- What is the change that occurred in the genetic constitution of the bacteria that can produce insulin?
- Will the future generation of this bacteria have the ability to produce insulin? Why?

To cut and ligate

The basis of genetic engineering is the discovery of the fact that genes can be cut and joined. Enzymes are used for this. The enzyme Restriction endonuclease is used for this purpose. This enzyme is known as 'genetic scissors'. The enzyme ligase is used for joining, this enzyme is called 'genetic glue'.

Suitable vectors are used to transfer genes from one cell to another. Bacterial DNA is generally used as vectors. DNA with ligated genes enter the target cell. Thus new genes become a part of the genetic constitution of target cells.

Progress of this technology influences various fields of life.



Scope of Biotechnology

Biotechnology is advancing rapidly. Genetic engineering is the technology behind this. It became possible to modify



organisms and create new varieties through manipulation of genes. Organisms that can withstand adverse conditions, beautiful flowers, amazing animals, effective vaccines etc., can be developed through biotechnology.



**Lost child found after years :
Identified through DNA testing**

Did you notice the headline of the newspaper report?

How are persons identified through DNA testing?

Read the description given below. Discuss it on the basis of the indicators given and formulate inferences. Write them down in the science diary.

The arrangement of nucleotides in the DNA of each person differs. This finding led to the DNA testing. The technology of testing the arrangement of nucleotides is DNA profiling. Like the difference in the fingerprint of each person, the arrangement of nucleotides in each person also differs. Hence this technology is also called DNA finger printing.

DNA Finger printing

The arrangement of nucleotides among close relatives have many similarities. So DNA finger printing is helpful to find out hereditary characteristics, to identify real parents in cases of parental dispute and to identify persons found after long periods of missing due to natural calamities or wars.

Certain experiments conducted by the scientist Alec Jeffrey in 1984 paved the way for DNA testing. DNA of the skin, hair, nail, blood and other body fluids obtained from the place of murder, robbery etc., is compared with the DNA of suspected persons. Thus, the real culprit can be identified from among the suspected persons through this method.



Alec Jeffrey

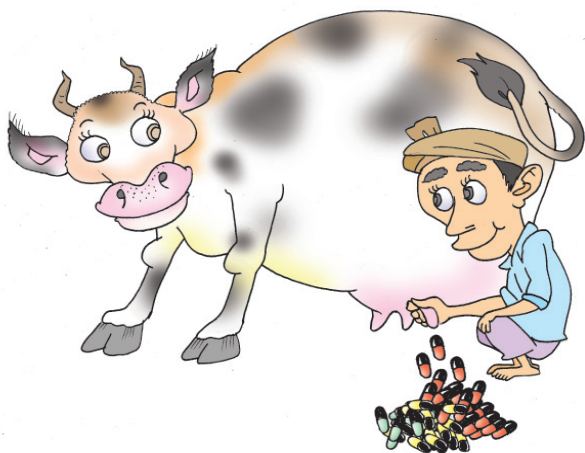
Indicators

- What is the basis of DNA testing?
- How are relations identified through DNA testing?
- What is the scope of DNA testing?

Medicine from Animals

One of the future promises of genetic engineering is pharm animals.

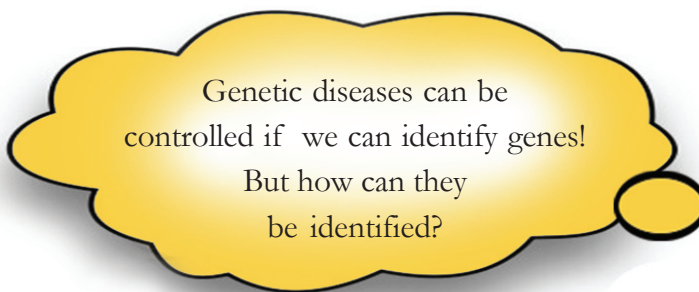
This is a result of the extension of researches on the production of medicines from within the four walls of the laboratory to the vast arena of the living world.



Genes responsible for the production of human insulin and growth hormones etc., are identified and inserted in animals like cow, pig etc., transforming them into pharm animals.

Bacteria were used for such experiments in the beginning. However, the culturing of bacteria is not so easy. They should be cultured with utmost care in the laboratory. It is easy to rear animals. Medicines can be extracted from their blood or milk.

Collect more information on the great leap in genetic engineering in areas like therapeutics, treatment and diagnosis and prepare a science excerpt.



What is your response to Thara's doubt?

Based on the indicators, analyse the description given below and write down your inferences.

In search of the mysteries of genome

The sum of genetic material present in an organism is called its genome. The human genome includes about thirty thousand genes present in 46 chromosomes.

Majority of these genes are nonfunctional. They are known as junk genes. Even though science has progressed a lot, we couldn't control genetic diseases. The reason for this is that we could not identify the exact gene and its location which is responsible for each trait. In 1990, the Human Genome Project was started as an attempt to solve the issue. As a result of experiments conducted in various laboratories of the world until 2003, the secrets of human genome were revealed. The technology known as gene mapping helped to identify the location of a gene in the DNA responsible for a particular trait.



Figure 7.1
The logo of Human Genome Project

If it were possible to remove genes responsible for diseases and disabilities and insert functional genes? You have learnt that this is possible through genetic engineering. We can cure genetic diseases by removing disease causing genes from the genome and inserting normal functional genes. This method of treatment is called gene therapy.

Indicators

- What is the significance of the human genome project?
- What is the benefit of gene mapping?
- Why is gene therapy essential?

Observe Illustration 7.2 and prepare a note on the scope of genetic engineering. Elaborate the illustration including more information.

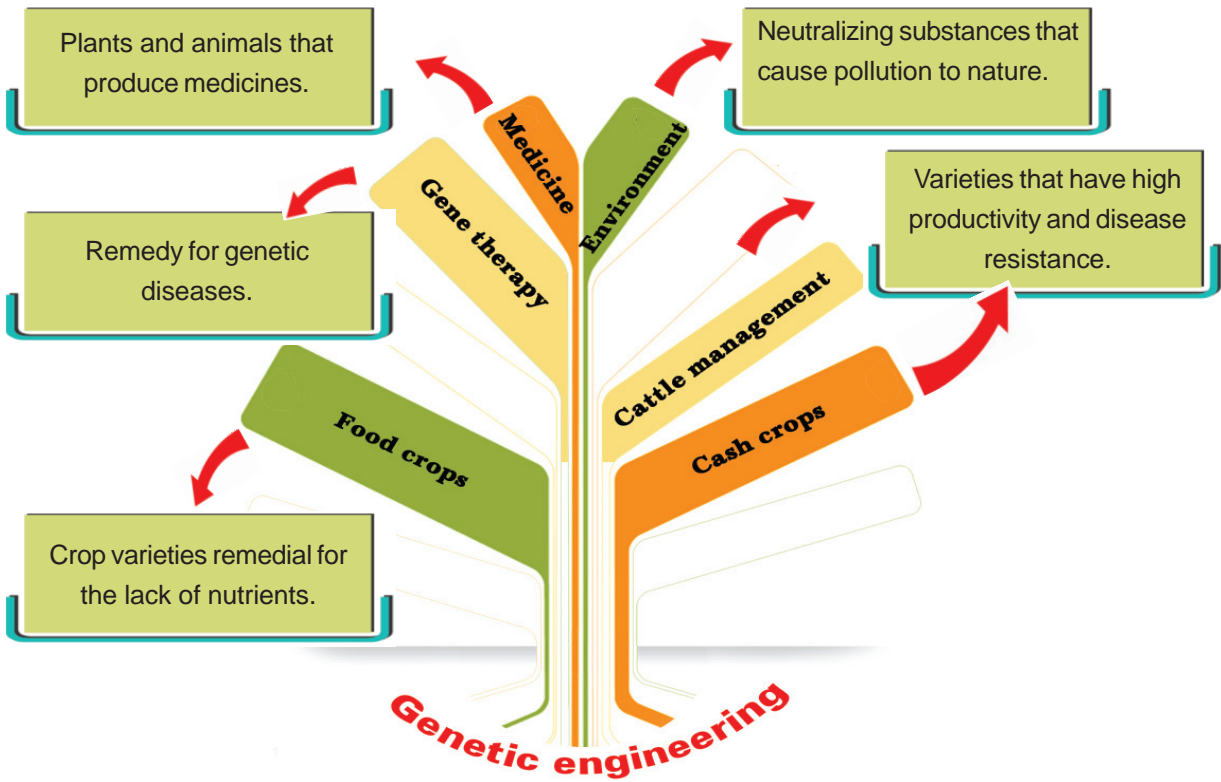


Illustration 7.2

We have familiarized ourselves with certain never ending scope of genetic engineering. This branch of research has become one of the most lively branches of learning and it has been advancing day by day through new discoveries. But, like any other technology, genetic engineering is also misused. Observe the collage given below.

Threat to indigenous varieties

It is criticized that genetically modified varieties cause harm to indigenous varieties and may cause health issues to humans.

Bioweapons - A new challenge

Application of genetically modified pathogens and pathogens multiplied through biotechnology upon enemies is called biowar. This becomes a threat to the existence of human beings.

Genetic modification - violation of rights

Certain organizations argue that genetic modification is an intrusion upon the freedom of living beings and it is a violation of rights.

Is it right to misuse technologies that are used for human progress?

As such possibilities prevail, can we promote genetic engineering?



Organize a debate in the class on this topic.

Science and technology are the products of human thought. We can justify this only if they are utilized for human benefit.

We must use science and technology as a means to

overcome the challenges faced by human beings.



Significant learning outcomes

The learner

- presents with evidences that organisms with desirable qualities can be produced through genetic engineering.
- analyses and presents how genetic engineering influences diverse areas of life.
- gives examples for DNA finger printing and its uses.
- explains with examples the scope of genetic engineering in the production of pharm animals.
- defines genome.
- explains how human genome project and gene mapping becomes beneficial for the sustenance of human beings.
- explains gene therapy and its scope.
- develops an attitude against the misuse of genetic engineering and engages in awareness programmes.



Let us assess

1. Which of the following is not a part of modern genetic engineering?
 - a) DNA profiling
 - b) Gene mapping
 - c) DNA finger printing
 - d) X-ray diffraction
2. Gene therapy is an example of the benefits of science for human existence.
 - a) What is gene therapy?
 - b) What was the discovery that led to gene therapy?
 - c) How does gene therapy become useful to human beings?
3. 'Since genetic engineering has many harmful effects, it can't be promoted'. Do you agree to this statement? Why?



Extended activities

- Prepare a slide presentation including the stages of production of insulin through genetic engineering.
- Prepare a science excerpt collecting pictures and news related to genetic engineering.

8

The Paths Traversed by life



How did life originate on earth? This is a question that has fascinated human beings always. Though many arguments originated in course of time, most of them were discarded for want of evidences. Scientific enquiries are going on even today to collect more evidences and to make explanations more logical.

The Panspermia Theory and the Theory of Chemical Evolution are theories related to the origin of life on earth and are discussed even today.



A.I Oparin



J.B.S Haldane

The panspermia theory argues that life has originated in some other planet in the universe and accidentally reached the earth. The theory of chemical evolution puts forward the argument that life originated as a result of the changes that occurred in the chemical substances in water, under specific conditions of the primitive earth. Though the organic substances identified in meteors that fell on earth supports the panspermia theory, it is the theory of chemical evolution that is generally accepted owing to experimental evidences.

The Russian scientist A.I Oparin (1924) and the British scientist J.B.S Haldane (1929) are the proponents of the theory of chemical evolution.

Analyse Illustration 8.1 that lists the main concepts of the theory of chemical evolution and prepare a note on it in your science diary.

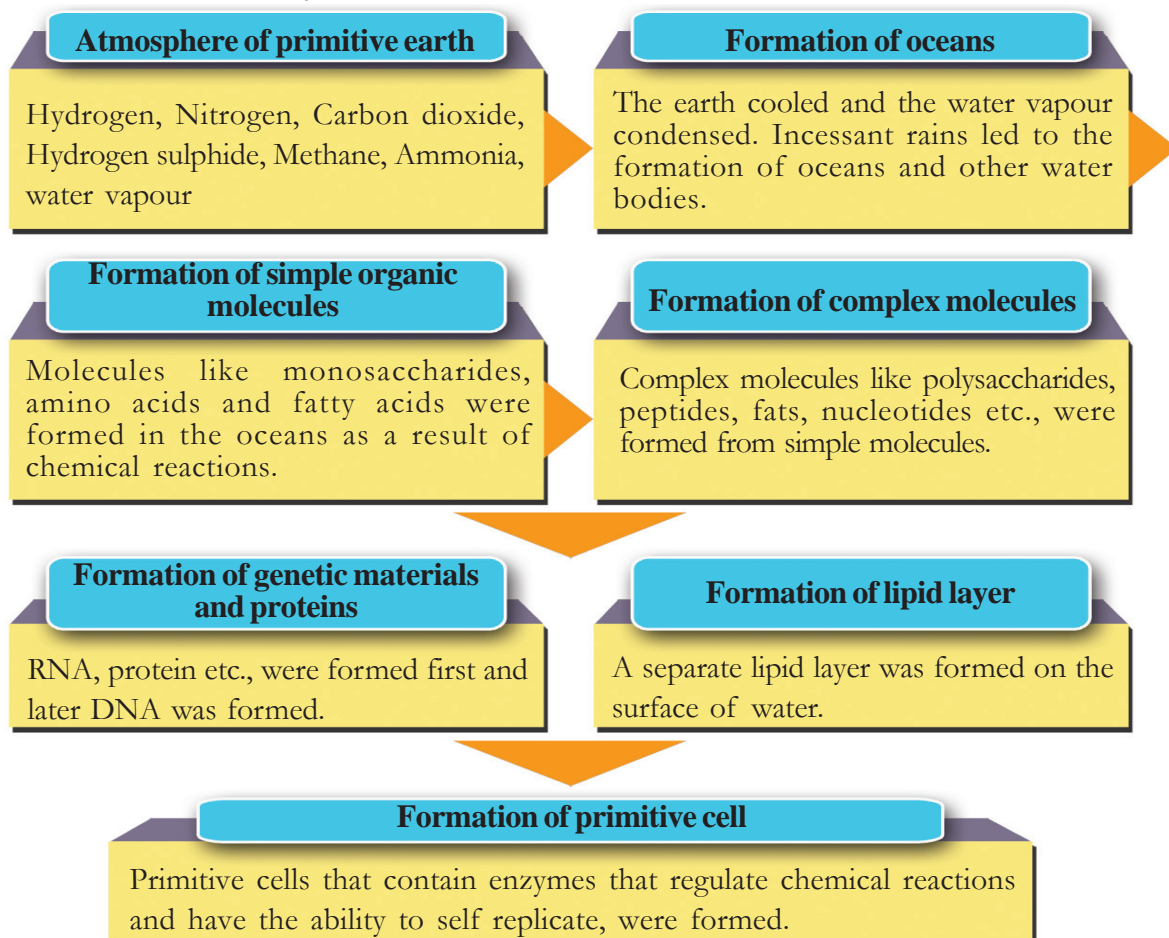


Illustration 8.1 Chemical evolution

The scientific basis of this hypothesis regarding the origin of life was later proved through a set of experiments.

Urey – Miller Experiment

Urey and Miller artificially recreated the atmosphere of primitive earth that contained methane, ammonia, hydrogen and water vapour for their experimental set up.

Analyse Illustration 8.2 and the description on the basis of the indicators given and prepare a note in your science diary.

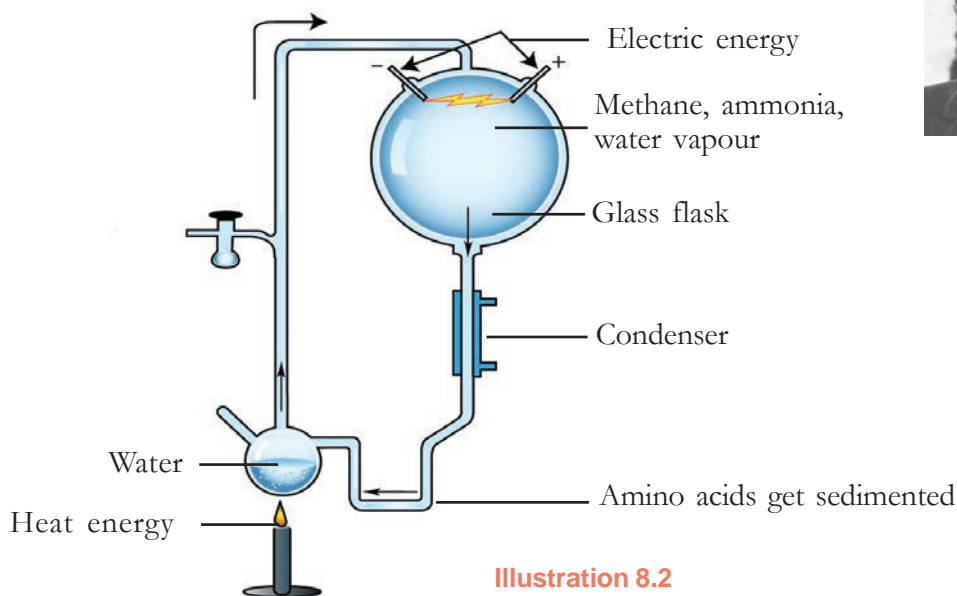
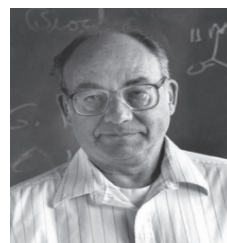


Illustration 8.2

In the place of energy sources like thunder and lightning in the atmosphere of primitive earth, high voltage electricity was passed through the gaseous mixture in the glass flask. Then, this gaseous mixture was cooled with the help of a condenser. The sedimented substances were separated and when observed, organic molecules such as amino acids, were found. Later many scientists designed similar experiments and more organic compounds were synthesized. This finally gave more acceptance to the Oparin – Haldane Hypothesis.

Indicators

- Which are the chemical components in the glass flask shown in the illustration?
- Which organic molecules were formed after the chemical reaction?
- What inference was arrived at from this experiment?



Stanley Miller



Harold Urey

Did you understand the environment of primitive earth recreated by Urey and Miller? In the oceans of primitive earth, organic compounds were formed due to chemical evolution that continued for millions of years. Later, the primitive prokaryotic cells that are similar to the present day bacteria originated. Prokaryotic cells have no definite nucleus. The origin of eukaryotic cells having membrane bound cell organelles from prokaryotic cells is a milestone in the history of evolution. Gradually colonies of eukaryotic cells were formed. This led to the emergence of multicellular organisms.

On the basis of indicators given, analyse Illustration 8.3 related to the major eras of the origin of life on earth and prepare a note in your science diary.

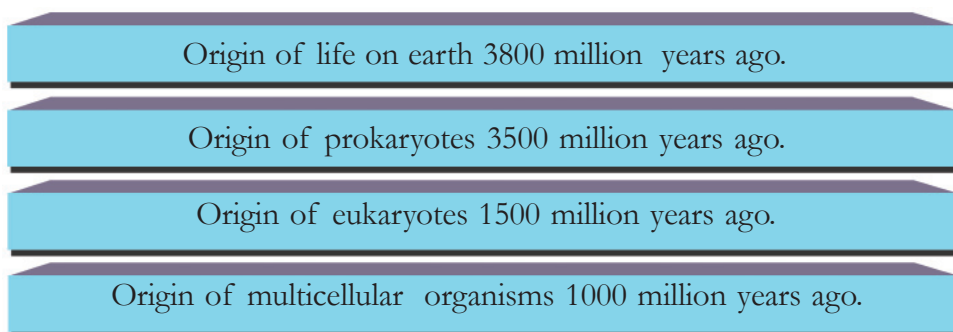


Illustration 8.3 Geological Time Scale

Indicators

- origin of eukaryotes
- origin of multicellular organisms

Researches are still going on all over the world to unravel the mysteries related to the origin of life on earth.

Origin of Biodiversity

Many scientists have attempted to explain the history of evolution from primitive cells to the biodiversity that exists today. The first attempt to analyse the existing postulates based on evidences and to present them in the form of scientific theory was started with Jean Baptist Lamarck, a French biologist.

In the beginning, giraffes had short necks. As they faced food scarcity, they stretched their necks to reach out to tall trees. Thus their necks get elongated. The characters thus developed during the life time of organisms are called acquired characters.

Lamarck explained that the accumulation of acquired characters led to the formation of new species. But this argument was not accepted by the scientific world as these acquired characters were not inheritable.

Darwinism

A logical scientific theory on evolution was put forward by Charles Robert Darwin, an English naturalist. Darwin adopted a scientific method which incorporated inferences arrived at through observation and data collection. These eventually paved way for larger acceptance of Darwin's theory of evolution.

Darwin's Voyage

Charles Darwin formulated his theory of evolution on the basis of the studies conducted on organisms in Galapagos Islands. Darwin's voyage to the island in the ship HMS Beagle was a turning point both in his life and in the history of evolution. Darwin was only 22 years old when he joined a group appointed by the British government to construct maps of coastal areas.

By the time he returned to Britain after 7 years, he had collected necessary evidences for his theory of evolution. After further follow up enquiries, observations and studies, he presented his theory on the *Origin of species by means of natural selection* when he was 50 years old. Not only did the theory get acceptance in the scientific world, but also broke off many existing beliefs and arouse valuable discussions and criticisms on the topic.



Charles Darwin

Finches were one among the organisms observed and closely studied by Darwin in the Galapagos island. Though the finches look similar to one another, the differences in their beaks attracted Darwin.

On the basis of indicators, analyse Illustration 8.4 and the description given. Write down your inferences in the science diary.

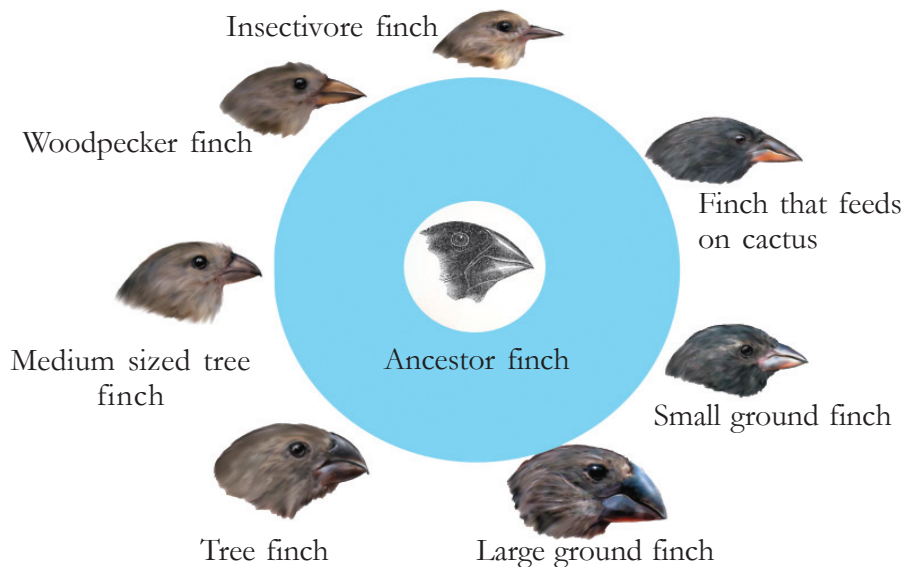


Illustration 8.4

Insectivore finches have small beaks and those that feed on cactus plants have long and sharp beaks. There were also woodpecker finches that feed on worms from the holes in tree trunks using small twigs taken with its sharp beak. The ground finches that feed on seeds with large beaks were also present.

Indicators

- Which peculiarity of the finches attracted Darwin?
- How do these peculiarities help finches in their survival?

It is clear that the finches Darwin observed had beaks adapted to their feeding habits. Another idea that influenced Darwin's thought about the diversity of the beaks of finches was that of Thomas Robert Malthus, an economist.



Robert Malthus

Rate of food production is not proportionate to the growth of human population. Thomas Robert Malthus pointed out that scarcity of food led to diseases, starvation and struggle for existence.

Analyse the description and flowchart given below and identify the main concepts of the 'Theory of Natural Selection' put forward by Darwin including Malthusian ideas. Prepare a note including these concepts in your science diary.

The Theory of Natural Selection

Every species produce more number of offsprings than that can survive on earth. They compete among one another for food, space and mates. The competition becomes hard when the number of organisms is greater and the availability of resources is less.

Many variations are visible in organisms. You are also aware of how these variations occur. These variations may be favourable or unfavourable. Those with favourable variations survive in the struggle for existence. Others are eliminated. Variations that are inherited through generations and repeated differently help to form species different from their ancestors. This type of selection, done by nature, leads to the diversity of species that we see around us. This is the explanation of Darwin's theory which is known as the theory of natural selection.

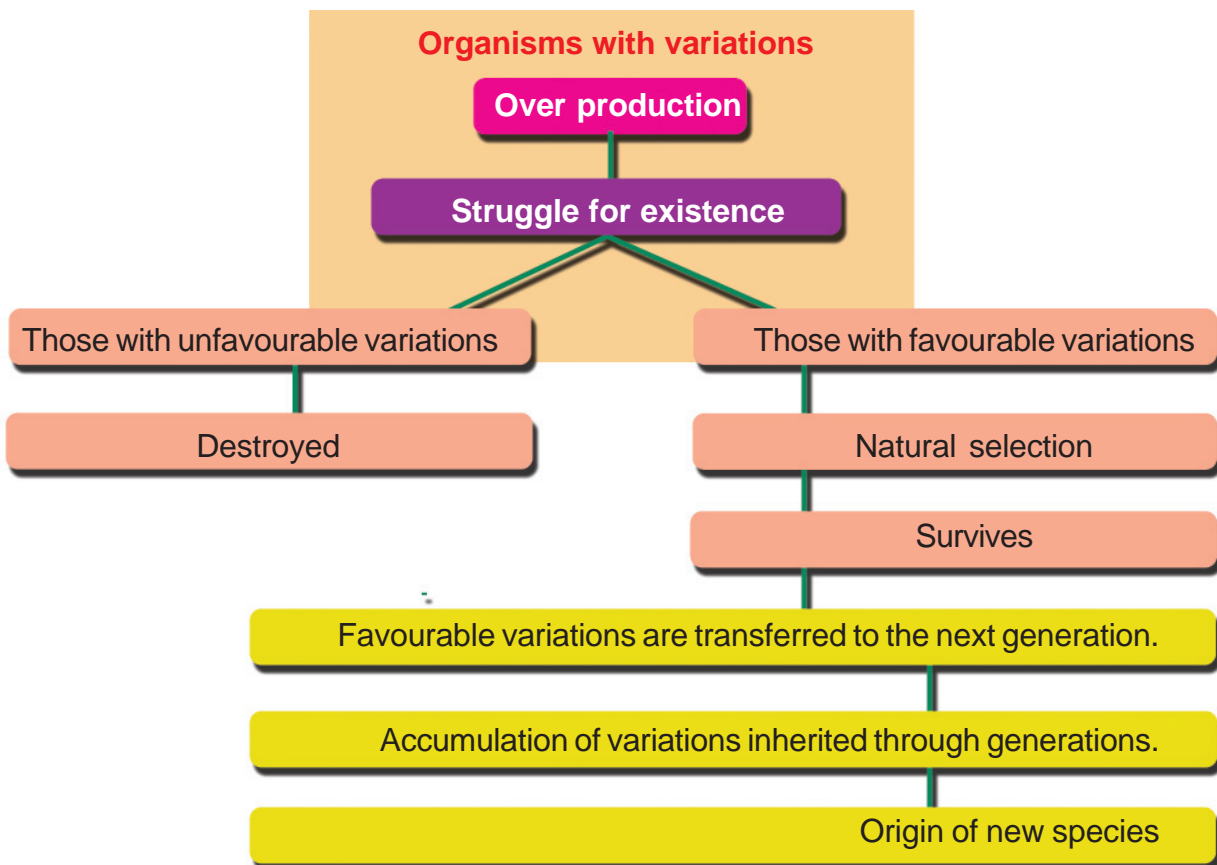


Illustration 8.5

Neo Darwinism

Though Darwin identified that continuous variations occurred in organisms, he could not explain the reasons for these variations. During his period there was no idea regarding genes, chromosomes etc. Later it was explained that mutations that caused variations led to the evolution of organisms.

Darwinism was revised in the light of new information from the branches of genetics, cytology, geology and paleontology. This modified version of Darwinism is known as Neo Darwinism.



Hugo deVries

Mutation Theory

You know that changes in genes is one of the reasons for variations in organisms. Sudden changes that occur in genes are called mutations. Mutation theory explains that new species are formed by the inheritance of such changes. This theory was formulated by a Dutch scientist, Hugo deVries.

Evidences of Evolution

There are many evidences to support the evolution of new species. Paleontology, comparative morphology, physiology and modern molecular biology provide evidences to validate evolution.

Fossils – Evidence of evolution

Fossils are the remnants of primitive organisms. They are evidences that explain the history of life on earth.

Fossils may either be the body its parts or imprints of organisms. The age of fossils can be calculated scientifically. They are categorised on the basis of geological time scale and their peculiarities are studied. What are the inferences you can arrive at from such studies?

Analyse Illustration 8.6 and prepare notes.

Primitive fossils have simple structure.

Recently formed fossils have complex structure.

Certain fossils are connecting links between different species.

Illustration 8.6

Comparative Morphological Studies

Observe Figure 8.7 and compare the structure of the forelimbs in lizard, bat, sea cow etc.



Illustration 8.7

The forelimbs of these organisms differ in their external appearance. Are they different in their anatomy too?

These forelimbs are made up of blood vessels, nerves, muscles and bones. Differences in their external appearances are their adaptations to live in their own habitats. Organs that are similar in structure and perform different functions are called homologous organs.

Do such anatomical resemblances justify the inferences that all organisms evolved from a common ancestor?

Discuss and write down your inferences in the science diary.

Biochemistry and Physiology

How different are microbes, plants and animals in their appearance! But there are close resemblances in their cell structure and physiology.

Observe Illustration 8.8.

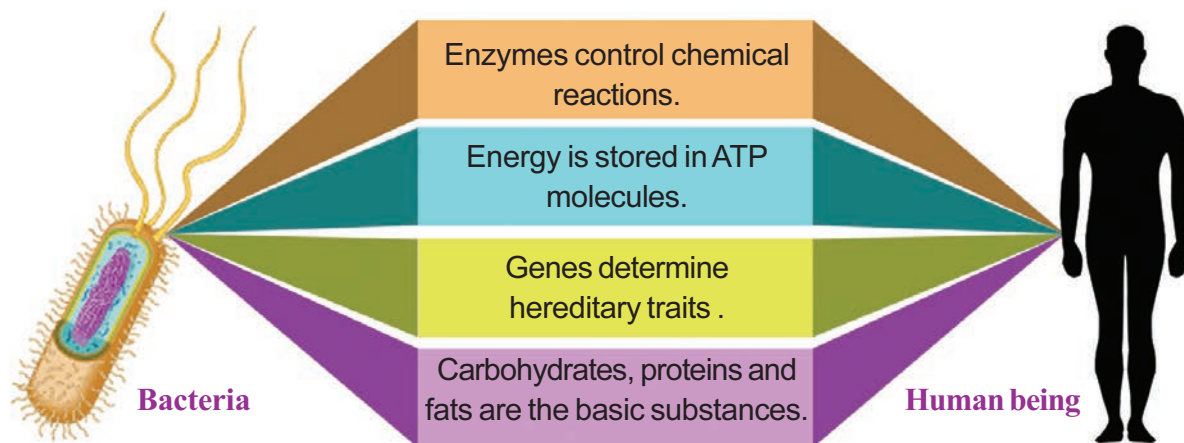


Illustration 8.8

What idea of evolution do you get from these facts?

Isn't it clear from these facts that different species that exist today have a common ancestor? Discuss.

Molecular Biology

Through a comparative study of protein molecules in different species, the evolutionary relationship among organisms can be identified. This is an effective method to draw the evolution showing the branching of organisms from a common ancestor. Mutations may occur in the genes that determine amino acid sequence in protein molecules. This causes changes in amino acids. Haemoglobin, the respiratory pigment in man, chimpanzee, gorilla and rat contains two α chains and two β chains of amino acids. The amino acids in the β chain of haemoglobin in man has been compared to the amino acids in the β chain of other organisms. Available data are listed below. Based on the indicators, analyse Table 8.1 and write your inferences in the science diary.

Organism	Difference from the amino acids in the β chain of haemoglobin in man
Chimpanzee	no change
Gorilla	difference of one amino acid
Rat	difference of 31 amino acids.

Table 8.1

Indicators

- How many amino acids differ in the β chain of haemoglobin in man and chimpanzee?
- What is the difference in the number of amino acids in the β chain of haemoglobin in man and gorilla?
- Which organism is close to man from the evolutionary point of view? What is the reason for this?

These kinds of molecular studies help to find out the evolutionary relationship of different species of organisms.

Evolution of Human beings

An evolutionary tree relating to certain organisms including humans is given below. Organisms which have evolved from a common ancestor show many resemblances. Analyse Illustrations 8.9, 8.10 and description on the main branches in the history of human evolution. Prepare a note in your science diary.

Humans, chimpanzee, gorilla, orangutan, gibbon and monkeys are included in anthropoidea. This is further classified into cercopithecoidea and hominoidea.

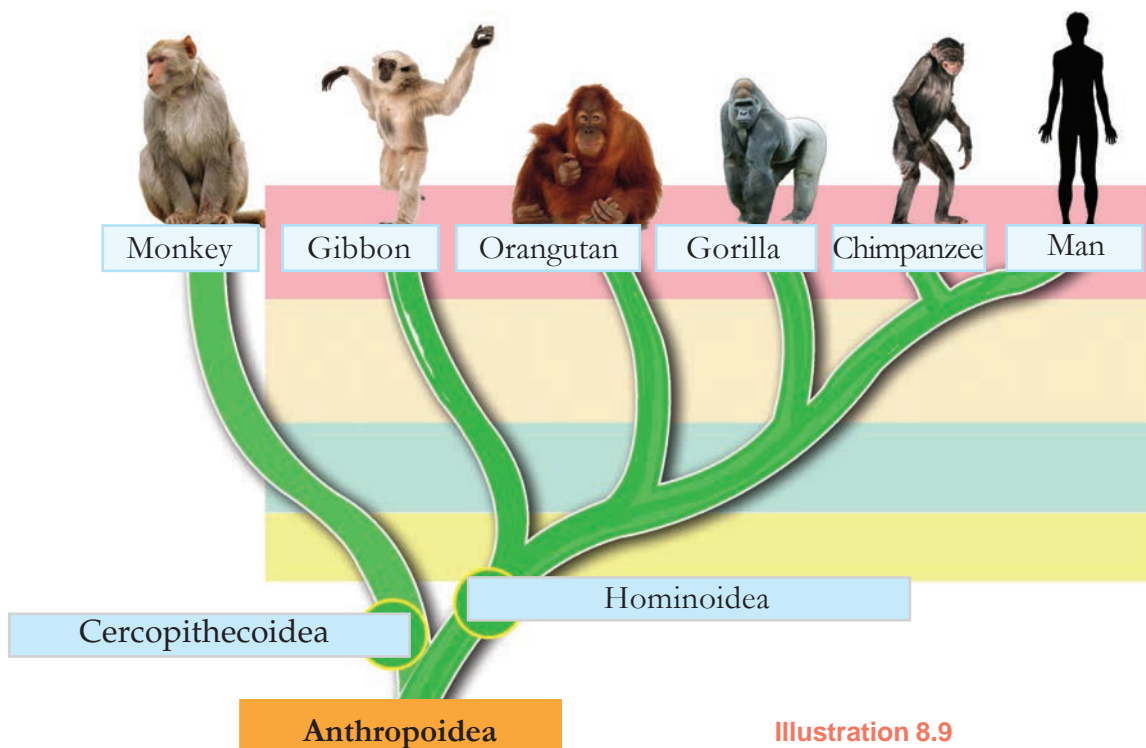


Illustration 8.9

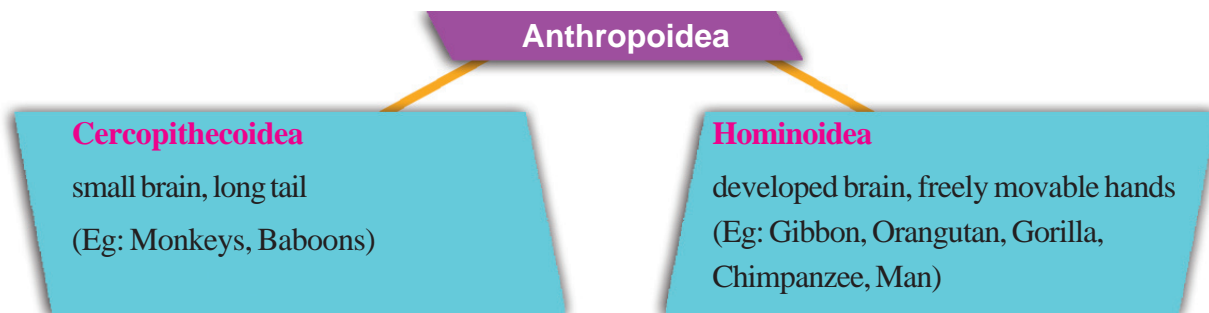
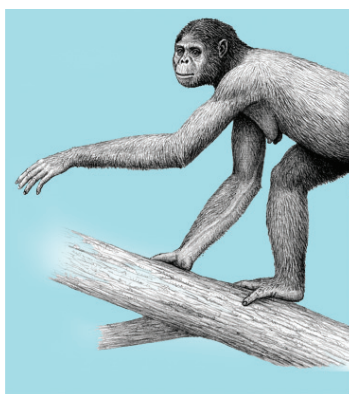


Illustration 8.10

Indicators

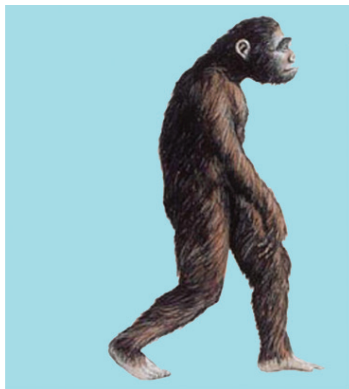
- Which organism is the closest to humans in specific characters?
- Has a species directly evolved from another species? Why?
- What are the characteristics of the organisms which belong to the group hominoidea?
- “Man evolved from monkeys”. How would you respond to this statement?

There are many other organisms that are included in the evolutionary history of modern man. Analyse the descriptions and Illustration 8.11 given on the basis of the indicators and record your inferences in the science diary.



Ardipithecus ramidus

- Most primitive member of the human race.
- Fossils were discovered from Africa.
- Cranial capacity is 325 cm³



Australopithecus afarensis

- Slender body.
- Fossils were discovered from Africa.
- Cranial capacity is 460 cm³



Homo habilis

- Made weapons from stones and bone pieces.
- Fossils were discovered from Africa.
- Cranial capacity is 610 cm³.



Homo erectus

- Thick chin and large teeth.
- Fossils were discovered from Africa and Asia.
- Cranial capacity 1000 cm³.
- Have the ability to stand erect.



Homo neanderthalensis

- Contemporary to modern man.
- Fossils were discovered from Europe and Asia
- Cranial capacity is 1430 cm³.



Homo sapiens

- Modern man.
- First fossils were discovered from France.
- Cranial capacity is 1700 cm³.

Illustration 8.11

Indicators

- places from where fossils were discovered.
- differences in cranial capacity.

What are the features of man that differentiate him from other animals included in human evolutionary history?

•

Does the interference of human beings have a negative impact on the existence of organisms and nature itself?

Read the following passage.



Mass Extinction

History records that the biodiversity on earth has passed through various rates of growth. After the initial years of rapid growth, the growth rate was on a steady track for over 200 million years. History not only has stories of growth to tell; it also has tales of mass extinction. Of these tales, the most extensive of extinctions took place about 225 million years ago. 96 percent of the species became extinct from the earth. The most studied mass extinction took place 63 million years ago. It was during this period that organisms including dinosaurs disappeared from the earth.

It is recorded in evolutionary history that there occurred five mass extinctions till now and that biodiversity got reestablished rapidly afterwards. Biodiversity at global level has increased much recently than ever before. But this biodiversity is on a dangerous decline due to the interference of human beings. Statistics indicate that if these conditions persist $\frac{1}{4}$ th species of organisms will vanish from the earth within the next 50 years. If it happens, it will be the largest and the sixth mass extinction of species on earth.

Modern man is considered to be the last visitors on the earth, which was formed as a result of long process of evolution that lasted for millions of years. Will the unwise interference of intelligent human beings destroy the continuity of life on earth? Discuss.

Today we are aware of the challenges raised by climatic changes brought in by human interventions and the extinction of organisms. Individuals and organizations are actively participating in programmes for the conservation of nature. This solidifies the reality that human life is possible on earth only with the existence of many other diverse ecosystems. Human beings are capable of foreseeing far-reaching consequences and taking necessary precautions in this regard. This leaves us with hopes of a future life on earth.



Significant learning outcomes

The learner

- illustrates and explains the origin of the first life form on earth.
- logically explains the evolution of eukaryotes from primitive cells and the evolution of multicellular organisms from eukaryotes.
- analyses major theories of evolution and explains their merits and demerits.
- accepts and evaluates the contributions and efforts of scientists who have formulated various theories of evolution.
- gives examples of evidences for theories of evolution from day to day situations.
- analyses and explains how fossil studies provide evidence to evolution.
- analyses and explains how modern technologies have become helpful for studies of evolution.

- illustrates the evolutionary tree.
- illustrates and explains the major stages of human evolution.
- engages in further enquires related to the origin and evolution of life on earth.



Let us assess

1. Which concept is put forward by the theory of natural selection?
 - a. Origin of life
 - b. Origin of species
 - c. Origin of eukaryotes
 - d. Chemical evolution of life
2. List the main concepts that indicate how the biodiversity seen today has been developed from prokaryotes.
3. How does the interference of human beings in nature influence the process of evolution? How do these affect the existence of other organisms?



Extended activities

- Prepare and exhibit a model of the experimental set up constructed by Urey - Miller to scientifically prove the theory of chemical evolution.
- Prepare a chart illustrating the evolutionary tree of man.