Biology

Standard X

Part 2

Government of Kerala
Department of General Education

Prepared by

State Council of Educational Research and Training (SCERT) Kerala
2025

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 my parents, teachers and all elders, respect and treat everyone with courtesy.

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

State Council of Educational Research and Training (SCERT)
Poojappura, Thiruvananthapuram 695012, Kerala
Website : www.scert.kerala.gov.in
e-mail : scertkerala@gmail.com
Phone : 0471 - 2341883, Fax : 0471 - 2341869
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Dear friends,

Learning science will help one know about the world around us, also to indulge in the process of knowledge creation through self experiences. Scientific knowledge which is constantly updating, is the sum total of knowledge acquired till date. Science can also be termed as a specified method to know about one's surroundings and to make modifications inaccordance with one's favourable conditions.

The construction of scientific knowledge is done through various activities, and in this way the students get the opportunity to create knowledge through learning activities. The production and application of knowledge is also a social process. The learning experiences facilitated in this textbook is through considering all these things in the forefront.

This textbook provides sufficient information about the hormones that play a vital role in the coordination of body functions and in maintaining regulatory balance alongside the nervous system. In today's world, where health preservation is of utmost importance, this book clearly presents the need to improve quality of life through better health. It also helps cultivate the understanding that we must change our lifestyles and correct various unhealthy habits.

The areas influenced by biotechnology, revolutionary impacts it has made, and recent discoveries go beyond traditional knowledge and will help instill scientific awareness and a spirit of inquiry in children.

Let this knowledge help friends further update themselves and to leave their mark in new realms of knowledge acquisition.

Dr. Jayaprakash R.K.
Director
SCERT Kerala

TEXT BOOK DEVELOPMENT TEAM

Advisor

Dr Salahudeenkunju A.
Principal (Rtd.), University College, Thiruvananthapuram

Chairperson

Dr Sureshchandrakurup R.
Associate Prof. Department of Zoology, M.G. College, Thiruvananthapuram

Expert

Sri. Pratheep Kannamcode
HST (Rtd.), Edamon VHSS, Edamon

Members

Sri. Manesh P.
H.S.T., G.B.H.S.S., Manjeri, Malappuram

Sri. Satheesh R.
H.S.T., G.H.S., Pooyappally, Kollam

Sri. Ratheesh Kumar B.
H.S.T., G.H.S., Kalloor, Wayanad

Sri. Viswanandakumar T.K.
H.S.T., G.H.S.S., Pulamanthole, Malappuram

Sri. Venugopal B.
H.S.S.T., (Jr.) Zoology, G.H.S.S., Padiyoor, Kannur

Smt. Harija K.S.
H.S.T., Govt. V & H.S.S., Karakulam, Thiruvananthapuram

Dr Sreekala Devi R.
H.S.T., G.H.S.S., Vilavoorkal, Thiruvananthapuram

Dr Satheesh Chandran J.G
Lecturer, DIET, Attingal

Sri. Manual Jose
Headmaster, St.Sebastian's H S, Pallithode, Cherthala, Alappuzha

Dr. E.K. Simil Rahman (Artist)
H.S.T., K.M.H.S.S., Kuttoor North, Vengara, Malappuram

English Version

Sri. Viswanandakumar T.K.
H.S.T., G.H.S.S., Pulamanthole, Malappuram

Smt. Harija K.S.
H.S.T., Govt. V & H.S.S., Karakulam, Thiruvananthapuram

Dr Sreekala Devi R.
H.S.T., G.H.S.S., Vilavoorkal, Thiruvananthapuram

Shaji P.
H.S.T., G.H.S., Balaramapuram, Thiruvananthapuram

Experts

Sri. Bijesh V.Jose
Assistant Professor in English, Maharajas College, Ernakulam

Sri. James V. Das
Assistant Professor in English, KVSM Govt. College, Nedumangad, Tvpm

Academic Co-ordinator

Smt. Sujitha V.
Research Officer, SCERT

State Council of Educational Research and Training (SCERT), Kerala
Vidyabhavan, Poojappura, Thiruvananthapuram - 695 012

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Icons used in this textbook for convenience

Activities

Let's Assess

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Let's Find

Further reading

Evaluation not required

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a [1]**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the [2][unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

---

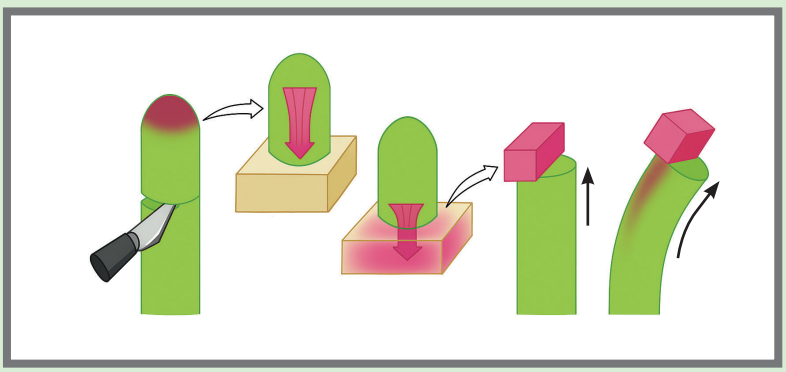
1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)

4

Chemoreception in Organisms

F. W. Went
(1903 -1990)

F W Went, a botanist from Holland cut the coleoptile of the oats plant while studying the growth of plants, and kept it in a jelly like substance called agar. After a few hours, he removed the coleoptile from agar and cut the agar into small pieces. When he kept the agar block on the cut end of coleoptile, he observed that the tip of the plant showed growth towards the upper



side. When it was placed on one side, the plant bent and grew towards the opposite side. It was later discovered that the chemical substance diffused into the agar from the coleoptile was responsible for the growth of the plant tip. It was later named auxin. Later , many such substances that influence the growth of plants were discovered by scientists. They are known as plant hormones.

You have understood how auxin, the plant hormone which influences the growth of the plants, was discovered. Are hormones present only in plants? What all things have you understood about hormones?

-
-
-

How do hormones control life processes? Analyse illustration 4.1 and the description based on the indicators, and form inferences.

Hormones and Life processes

Different types of hormones are present in plants and animals. All hormones do not function in all cells. A cell in which a hormone acts is called the target cell. The target cell of each hormone has receptors suitable for that hormone.

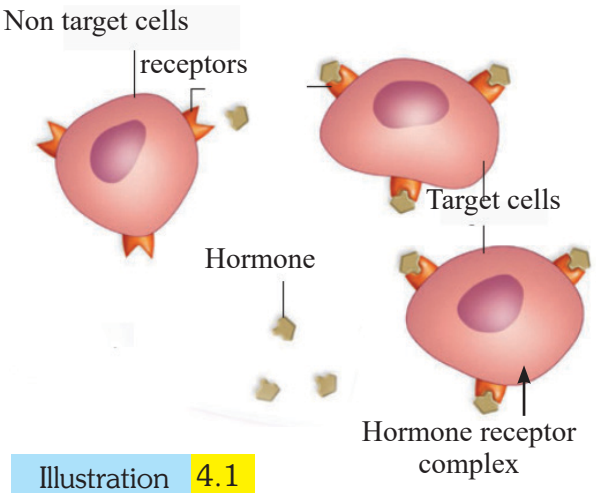


Illustration 4.1

Hormones to target cells

Receptors are seen in the cell membrane and within the cells. Hormones combine with their receptors to form a hormone- receptor complex. This complex controls activities inside the cell.

In animals, the hormones that are produced by endocrine glands reach the target cells through blood. Plant hormones are produced at the tip of the shoot or root, in seeds or in sprouting leaves. They reach the target cells via cell-to-cell transport or through xylem and phloem.

Indicators

- Target cells
- Relationship between hormones and target cells
- Transport of plant and animal hormones

You have read the experiment mentioned at the beginning of this chapter. How does auxin help in the bending and growth of the plant?

Auxins have a tendency to stay away from light. Let us understand how much this influences plant growth.

Analyse illustration 4.2 and the description given, and gain an understanding.

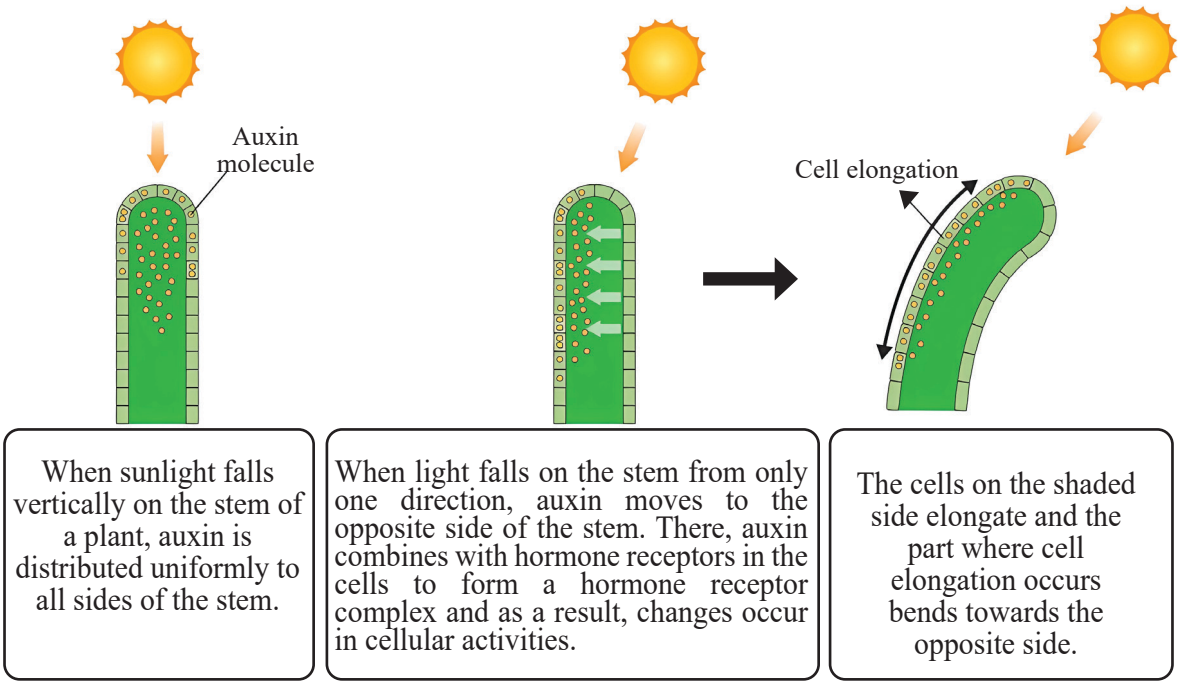
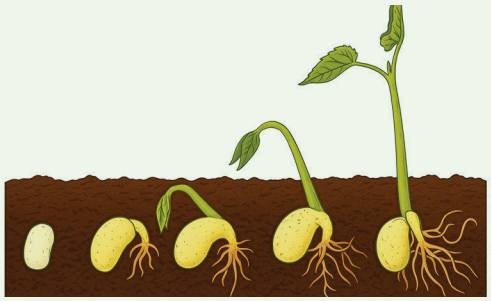


Illustration **4.2** Action of Auxin

Plant Hormones and their Functions

Analyse figure 4.3 and the description to understand how plant hormones influence plant growth and other activities, and complete worksheet 4.1.



- **Abscisic acid** maintains the dormancy of seeds until favourable conditions arise.
- **Gibberellins** break seed dormancy.
- **Cytokinins** stimulate cell division and cell differentiation in germinating seeds.

- **Auxins** increase the length of the stem, inhibit lateral bud growth, and regulate tropic movements.
- **Gibberellins and cytokinins** stimulate cell division in both stems and roots.
- **Cytokinins** stimulate the growth of lateral buds delay senescence and retains the green colour of leaves.

- **Auxins** stimulate the formation of flowers and fruits.
- **Gibberellins** influence the growth of fruits and seeds.
- **Cytokinins** promote the transport of nutrients to growing regions.

- **Ethylene** plays a role in the degradation of chlorophyll, proteins, and nucleic acids, leading to the ageing of leaves and flowers and ripening of fruits.
- **Abscisic acid** (ABA) inhibits the growth of plant parts and enables them to tide over unfavourable conditions. It also promotes abscission of mature leaves and fruits."

Illustration 4.3 Plant hormones and their functions.

Hormone	Function
Auxins	
Gibberillins	
Cytokinins	
Ethylene	
Abscisic Acid	

Worksheet 4.1 Plant hormones and Functions

Synthetic Plant Hormones and their Uses

You have now understood about natural plant hormones. Natural plant hormones are also artificially synthesized after a detailed study of their chemical struture and are being widely used in the field of agriculture.

Collect more information about synthetic plant hormones used in the agricultural sector and expand table 4.1.

Synthetic Plant hormone	Use
Synthetic auxins	Used to induce root formation in stem cuttings. Also used as a weedicide (2,4-D)
Synthetic gibberellins	To increase the size of fruits in grapevines and to promote stem elongation in sugarcane
Synthetic ethylene	In agricultural sector, ethylene is used to make fruits ripen uniformly for harvest at the same time. Ethylene is used to ripen bananas and tomatoes simultaneously.

Table 4.1 Synthetic plant hormones and uses

Find out the health issues and enviromental problems caused by synthetic plant hormones and organise a debate on this topic.

Behind Flowering

You have already understood the role of hormones in processes like flowering, fruit formation and seed dormancy. However, in addition to hormones, certain proteins and the duration of day and night also play a crucial role in these processes.

Analyse the given description based on the indicators and form inferences.

Reproduction plays a crucial role in the growth of plants just as in animals. It begins with flowering. Flowering is closely related to the length of day and night. This response of plants to the photoperiod is known as photoperiodism. Based on this, plants regulate flowering time, pollination, and seed formation. Phytochrome, a light-sensitive pigment, plays a major role in photoperiodism. Phytochrome is synthesized in the fully developed leaves at the shoot apex. These leaves, perceive the length of day and night through phytochrome and transmit a signal to the shoot apical meristem to induce flowering. As a result of this, genes that control flowering is stimulated.

Indicators

- Photoperiodism
- Phytochrome
- Flowering

You have understood the role of plant hormones in plant growth and other activities. Let us understand more about hormone action in human beings.

You have understood that the nervous system controls body functions very quickly. Along with nervous system, hormones also regulate and coordinate body functions. Let us understand them.

Control of Metabolism

Thyroid gland plays a crucial role in regulating metabolism, body growth and development. There are two types of cells in the thyroid gland: **Follicular cells and Parafollicular cells.** Follicular cells produce the hormone thyroxine, while parafollicular cells produce the hormone **calcitonin**.

Analyse the illustration 4.4 and table 4.2 based on the indicators and prepare a note on the functioning of the thyroid gland.

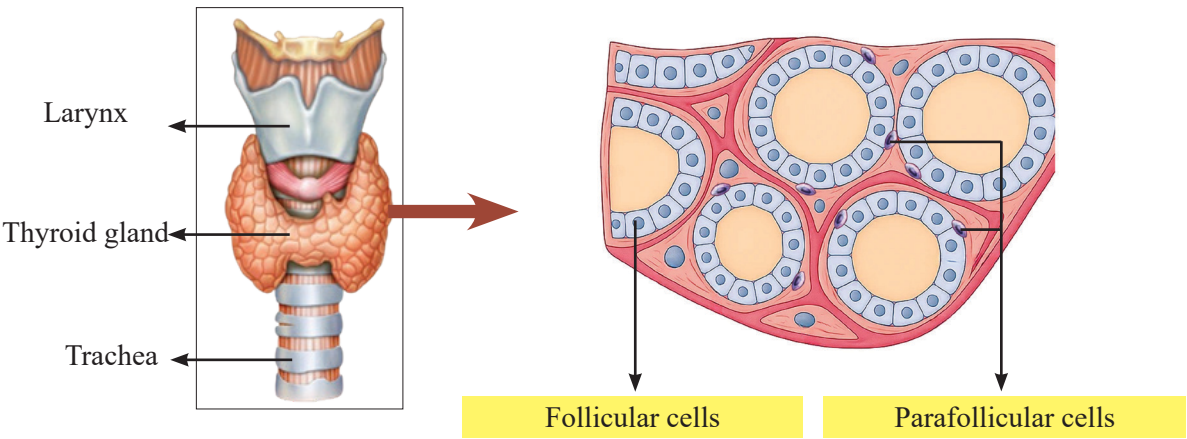


Illustration 4.4 Position and Structure of Thyroid gland

Hormone	Functions
Thyroxine	• Controls metabolism and body temperature • Development of brain in newborn babies and children • Helps to maintain the health of the heart, skin, reproductive system, etc.
Calcitonin	• Reduces the level of calcium in blood

Table 4.2 Thyroid hormones and their Function

Indicators

- Position of the gland
- Cells
- Hormone
- Function

Collect more information about the various forms of thyroxine, such as T3 and T4.

Fluctuation in the production of thyroxine and malfunctioning of the gland can lead to disease conditions. Analyse table 4.3 and gain understanding.

Condition	Causes	Symptoms
Hyperthyroidism	Excessive secretion of thyroxine	Increase in the rate of metabolism, weight loss, heart beat increases, excessive sweating, anxiety
Hypothyroidism	Reduced secretion of thyroxine	Metabolism decreases, body weight increases, heart rate slows down, fatigue, intolerance to cold
Goitre	Various disorders of thyroid gland, deficiency of iodine	Swelling in the neck region. difficulty in swallowing

Table 4.3 Defects related to thyroid gland

Regulation of calcium in blood

The normal level of calcium in blood is **9-11 mg/dL**. How is this level regulated? This is maintained at the proper level by the combined action of calcitonin produced by the thyroid gland and parathormone produced by the parathyroid gland located behind the thyroid gland.

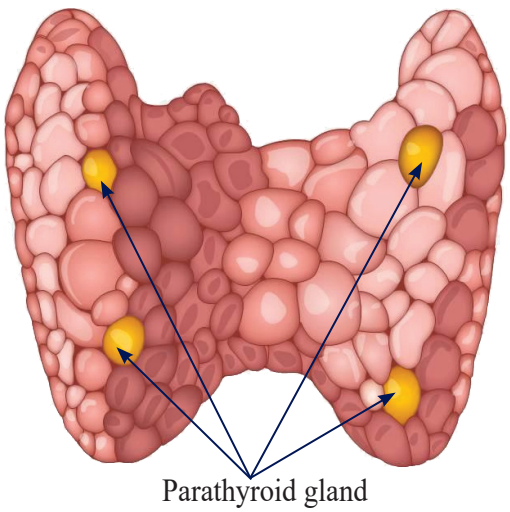


Figure 4.1 Parathyroid gland

Analyse illustration 4.5 using the indicators and prepare a note on how calcium level in the blood is maintained.

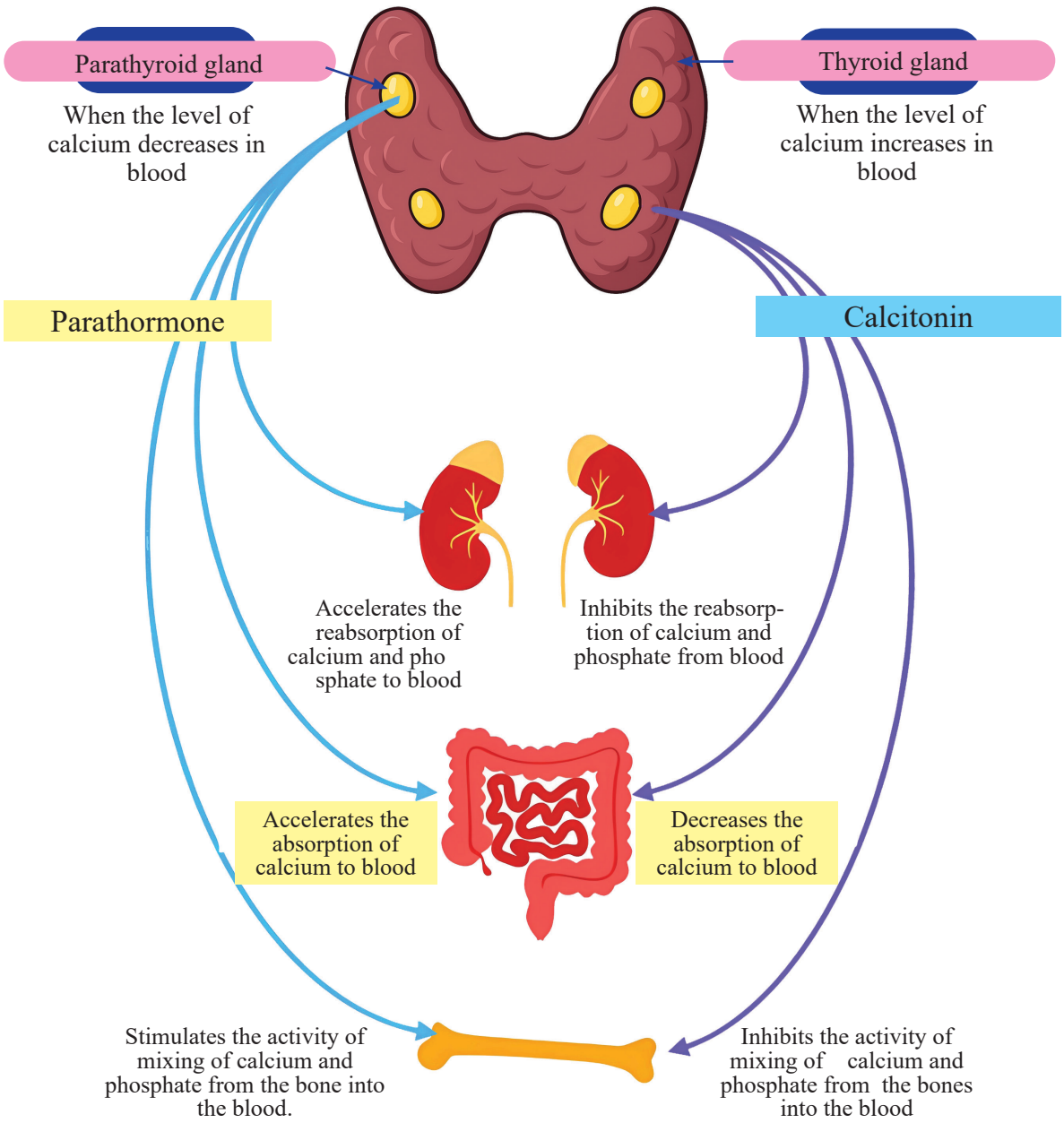


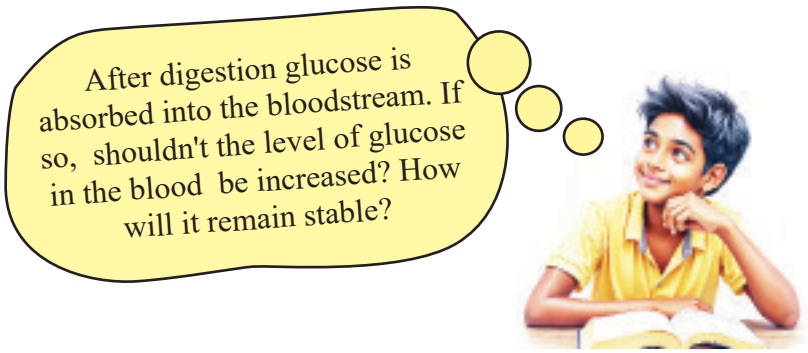
Illustration 4.5 Regulation of calcium in blood

Indicators

- Normal level of calcium
- Action of Calcitonin
- Action of Parathormone

Regulation of glucose in blood

The fasting blood glucose (FBS) level in healthy individuals typically ranges from **70 to 100 mg/ dL**. The glucose level should be below **140 mg/ dL**, two hours after having food(PPBS). If the average blood glucose level of three months measured using HbA1c test is below 5.7 %, it can be considered a normal glucose level .



Didn't you notice the child's doubt? Analyse the description and illustration 4.6 and understand how the level of glucose in blood is regulated.

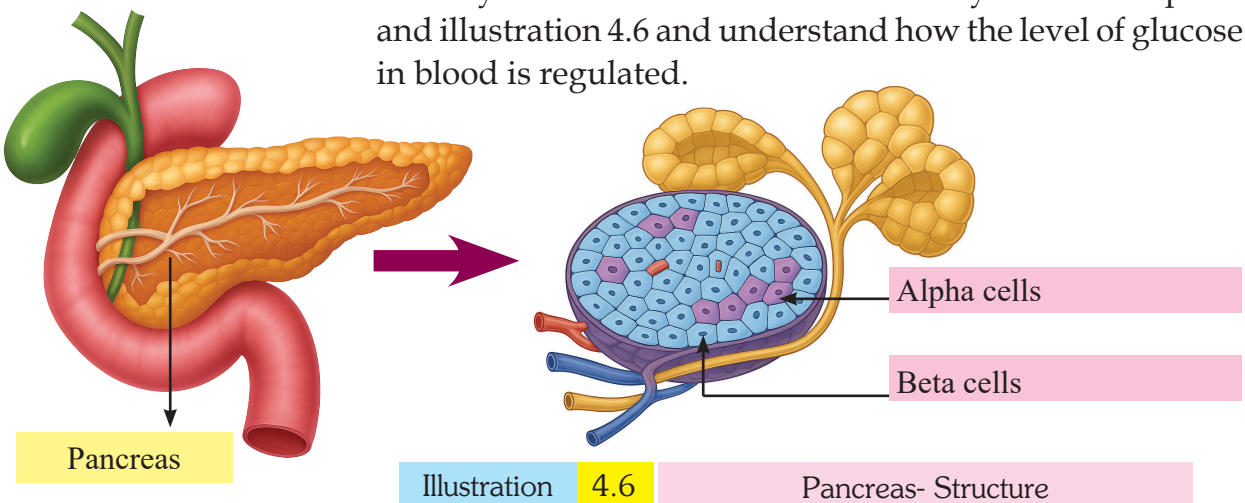


Illustration 4.6 Pancreas- Structure

The pancreas is the gland that plays a key role in regulating the glucose level in the blood. You have already learned the location of the pancreas and its role in the digestive process. A group of cells in the pancreas that functions in relation to hormone production is called the **Islets of Langerhans**. There are two types of cells in it: **Alpha cells** and **Beta cells**. Alpha cells produce the hormone **glucagon** and beta cells produce the hormone **insulin**. How do these hormones regulate the level of glucose in blood? Analyse the illustration 4.7 based on the indicators and prepare notes.

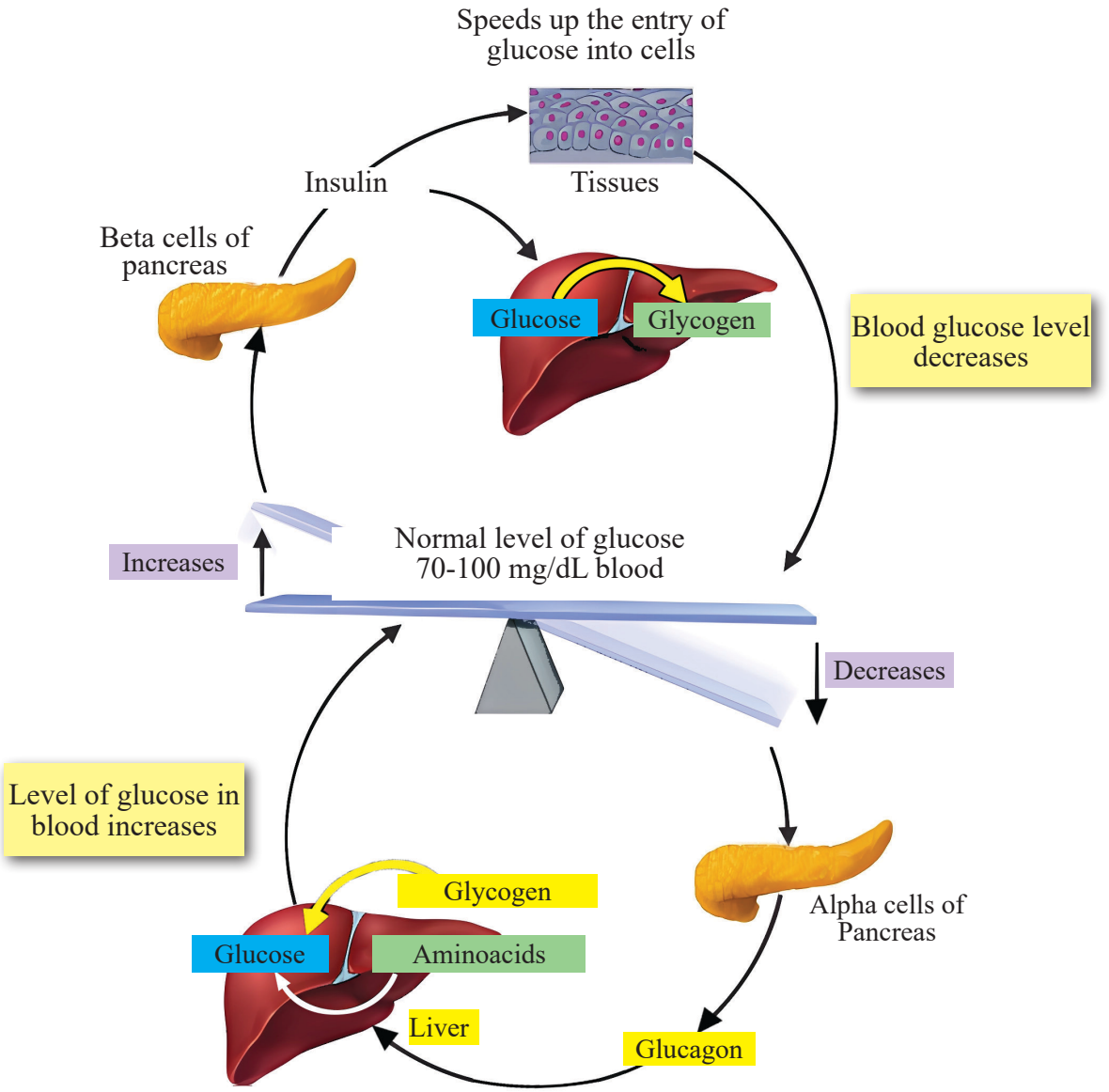


Illustration 4.7 Regulation of glucose in blood

Indicators

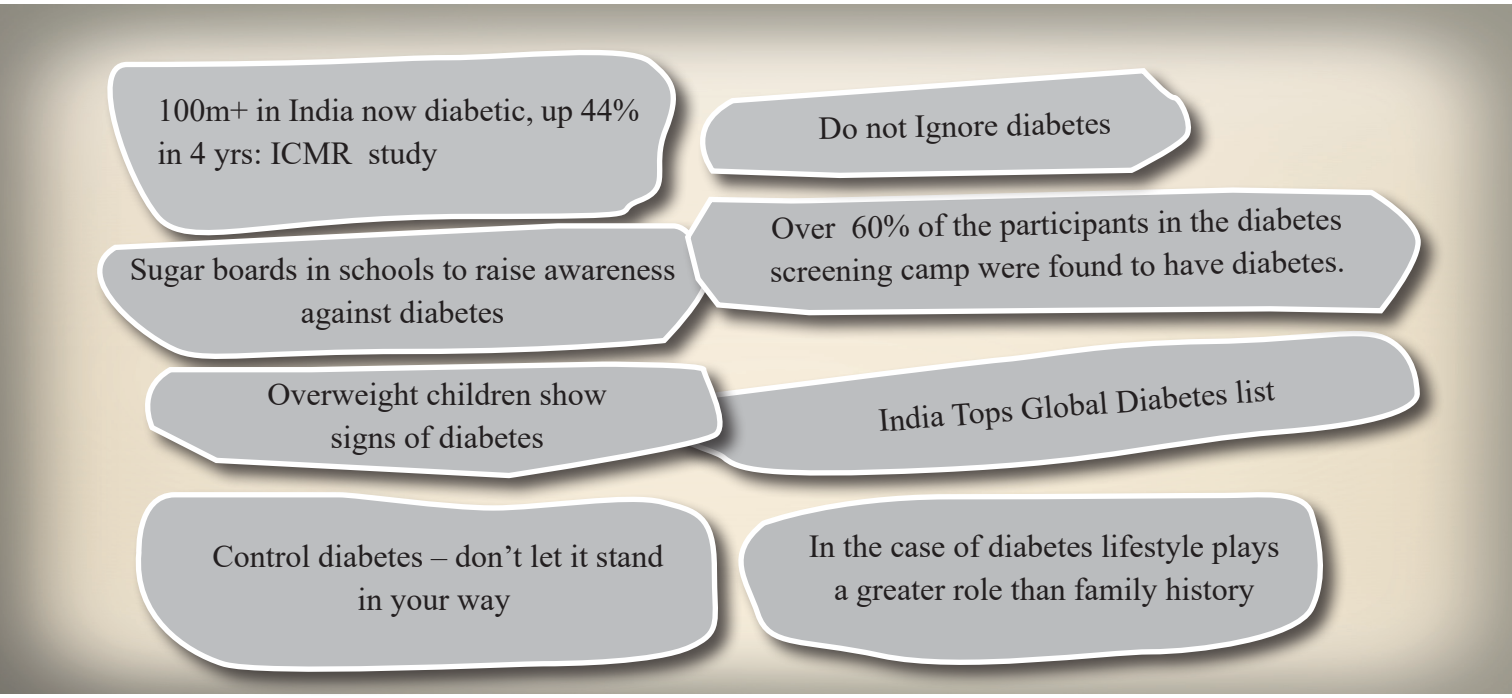
- Action of insulin
- Action of glucagon

You have understood that the level of glucose in blood is regulated as a result of the action of insulin and glucagon. Based on the understanding gained, complete table 4.4.

	Regulation of glucose	
	Level increases	Level decreases
Hormone produced		
Producing cell		
Process taking place		

Table 4.4 Regulation of Glucose

Diabetes mellitus is a condition in which the level of glucose in blood rises above normal (FBS above 126mg/dL). Excessive thirst, hunger, frequent urination, weight loss and fatigue are its symptoms. Read the news headlines and the article related to diabetes. Prepare a note based on the given indicators.



The number of diabetes patients is increasing globally. If ignored, it can lead to heart disease, stroke, renal diseases, and vision problems. There are two types of diabetes. Type II diabetes is a condition caused by factors such as variation in insulin production, lack of dietary control, and decreased effectiveness of insulin. Type -1 diabetes is the condition in which insulin production capacity is lost due to the destruction of beta cells.

Early identification of diabetes and preventive measures to avoid the disease, as well as making lifestyle changes is crucial in healthcare.

Indicators

- Different type of diabetes
- Causes
- Symptoms

Unhealthy dietary habits and lack of exercise are the causes of an elevated level of type 2 diabetes among children. What will be the consequences if diabetes is not controlled?

Prepare a questionnaire based on the hints given below, conduct an interview with a doctor and prepare a report.

- Retinopathy
- Neuropathy
- Nephropathy
- Resistance to insulin
- Preventive treatment for diabetes

Overcoming emergency situations

Haven't you understood the activity of sympathetic system during emergency situations? List out the physical changes that occur during that time.

- Heartbeat increases
-
-
-

Why are hormones needed when the sympathetic system is able to control physical changes during emergencies? Find out.

Some hormones produced by the adrenal gland which is part of the endocrine system also functions along with the sympathetic system. After analysing the illustration 4.8 and the description based on the indicators, prepare a note.

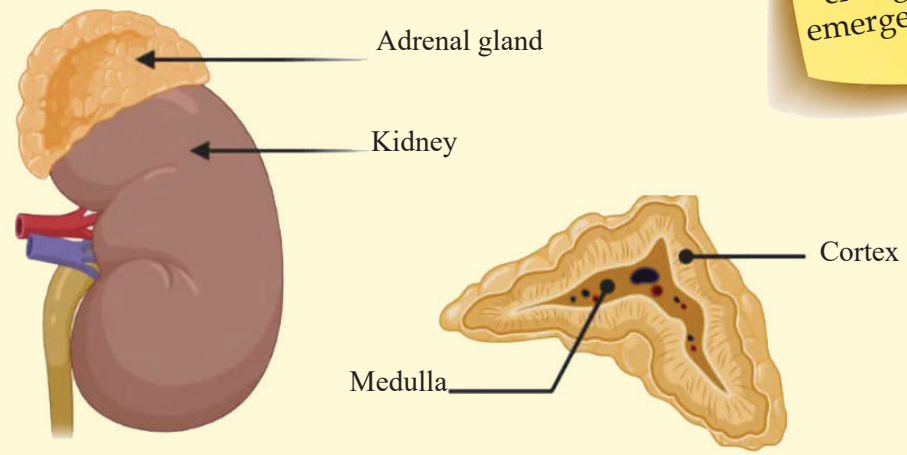


Illustration 4.8 Adrenal gland - Structure

The inner part of the adrenal gland called **medulla** secretes two hormones namely **epinephrine** and **norepinephrine**.

These hormones prepare the body to deal with an emergency situation through a number of physiological changes such as an increased heart rate and blood pressure, increased blood glucose levels, increased blood flow to the heart and muscles, decreased blood flow to the skin and digestive organs, etc.

Indicators

- Position of the adrenal gland
- Parts
- Hormones secreted by the medulla
- The way to overcome an emergency

The **cortex** of the adrenal gland produces various hormones that belong to the class of glucocorticoids, mineralocorticoids, and gonadocorticoids. They are generally known as **corticosteroids.**

Analyse the illustration 4.9 and record the hormones secreted by the cortex and their functions in table 4.5.

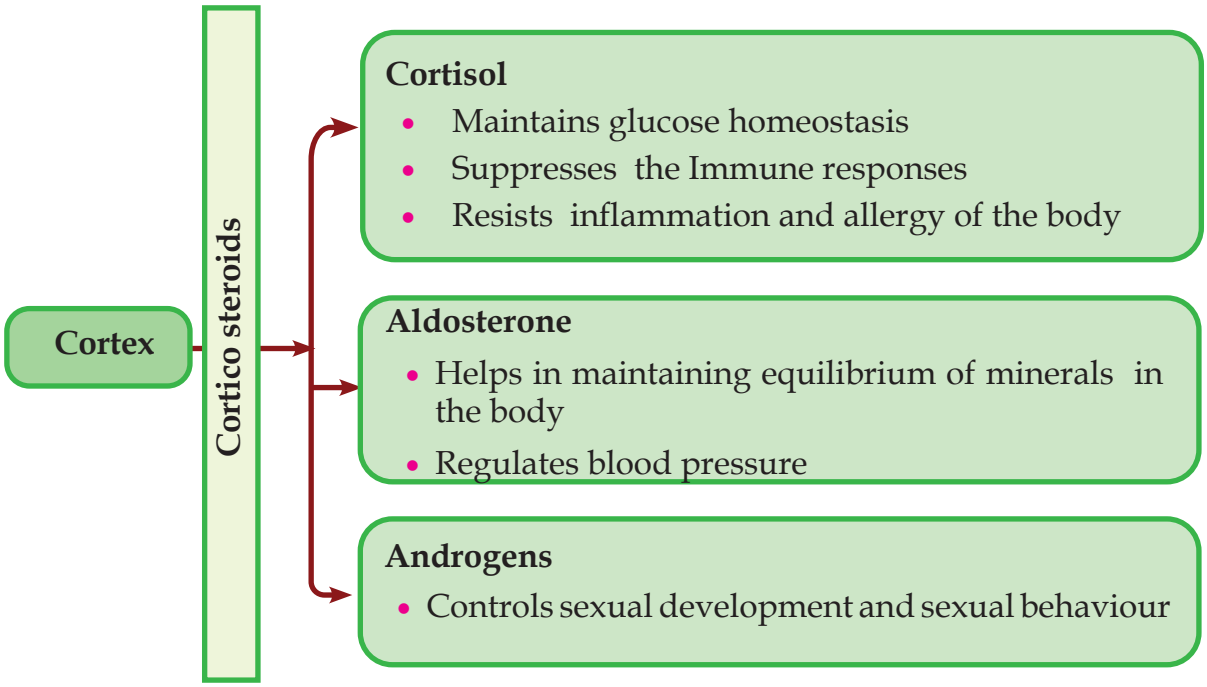


Illustration 4.9 The hormones produced by cortex and their functions

Hormone	Function

Table 4.5 Hormones and Functions

Sleep and Awakening

The **pineal gland**, located near the thalamus in the human brain, produces a hormone called **melatonin**. The variations in the secretion of this hormone influences sleep and wakefulness.

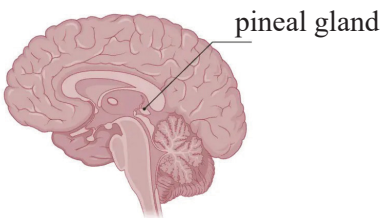
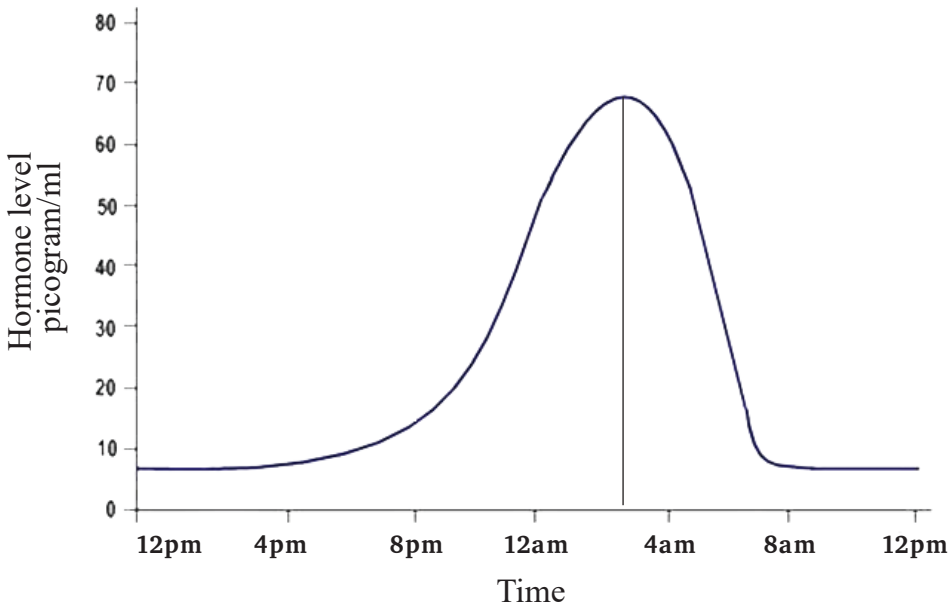


Figure 4.2 Pineal gland

Analyse the graph and draw inference regarding the relation between the variations in melatonin production and sleep.



Melatonin plays a major role in controlling the activities that occur at regular intervals throughout the day. Therefore, pineal gland is known as the **biological clock.**

Is darkness necessary for sleeping? Why? Find out.

Using a computer or mobile phone for a long time at night can lead to difficulty falling asleep, disrupt sleep and feeling sleepy during the day. The use of such devices should be completely avoided before sleeping. Melatonin is produced in the required quantity for the brain only under such conditions, thereby promoting quality sleep.

Collect information and prepare a Wall poster on the theme **Good Sleep, Good Health.**

Figure 4.3 Thymus gland

Behind immunity

The **thymus gland**, located behind the sternum, plays a major role in the body's immune system. The hormone thymosin produced by thymus gland helps in the maturation of **T lymphocytes.**

Hypothalamus and Pituitary : Master Control System

The functions of most endocrine glands are controlled by the hypothalamus. You have understood the role of the hypothalamus in homeostasis. The **pituitary gland** is seen below the **hypothalamus**. The hypothalamus controls the functioning of other endocrine glands by regulating the production of tropic hormones secreted by the anterior lobe of the pituitary gland. Therefore, we can say that the hypothalamus can be considered as the master controller of the hormone production process.

Observe the illustration 4.10 and discuss based on the indicators, and prepare a note on how hypothalamus is related to the pituitary gland.

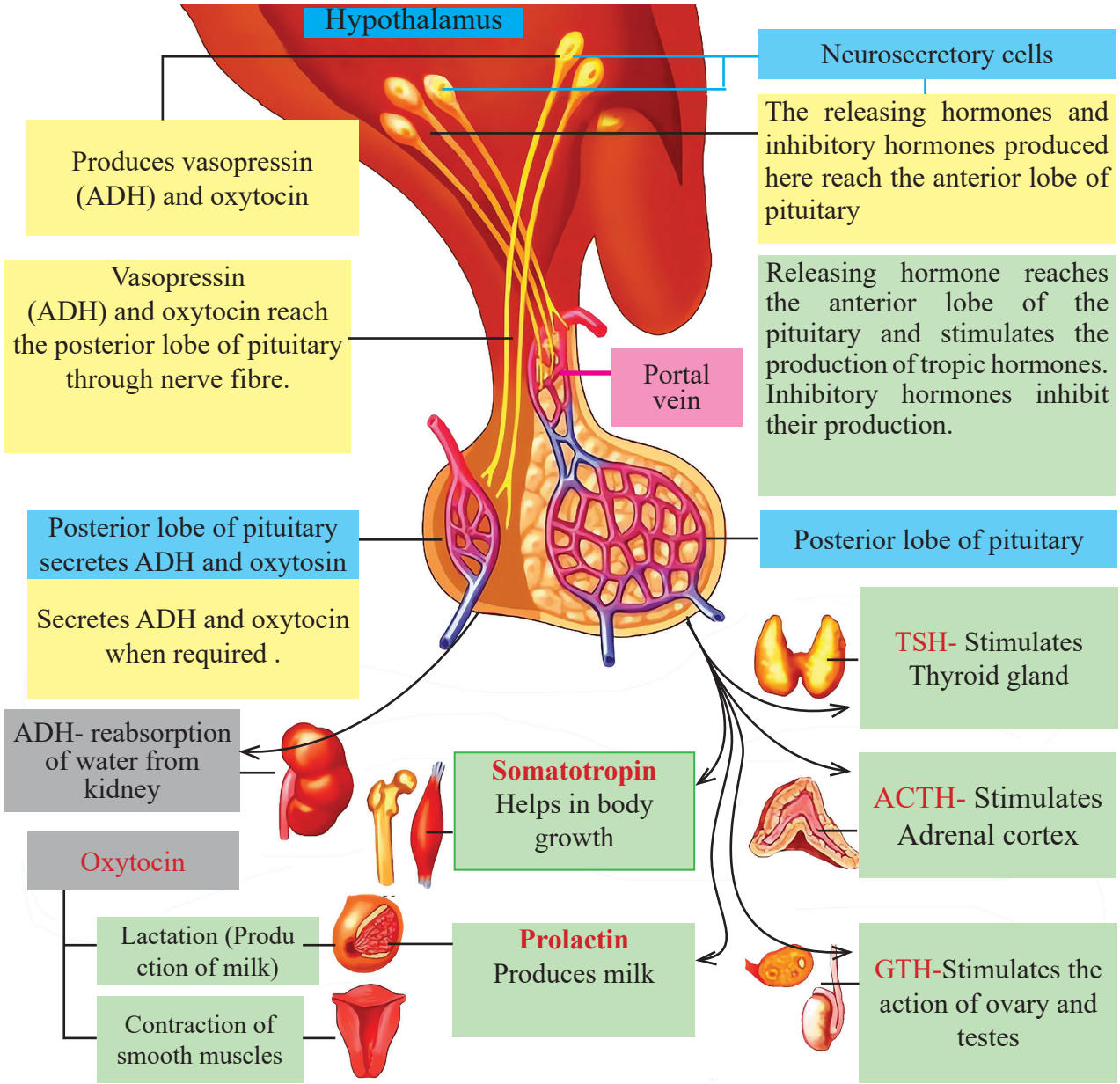


Illustration 4.10 Hypothalamus, Pituitary - Hormones and function

Indicators

- Parts of the pituitary gland
- The lobes of the pituitary gland and their relationship with hypothalamus
- The hormones that reach the anterior lobe and their functions
- The hormones that reach the posterior lobe and their functions
- Pituitary hormones and their functions

Behind growth

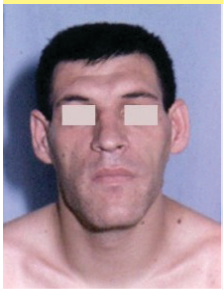
Growth hormone (somatotropin, GH) is a growth regulating hormone produced by the anterior lobe of the pituitary gland. This is a hormone that accelerates the process of cell division known as mitosis and increases cell size, leading to body growth. The variations in its production cause growth disorders.

Analyse table 4.6 indicating the disorders, causes and symptoms due to the variation in the production of somatotropin and gain an understanding.

Figures 4.4 (a) Gigantism

Dwarfism

Acromegaly



Figures 4.4 (b) Dwarfism , Acromegaaly

Disorder	Cause	Symptoms
Dwarfism	The production of somatotropin decreases during the growth phase	Stunted growth
Gigantism	The production of somatotropin increases during the growth phase	Excessive body growth
Acromegaly	The production of somaotropin increases after growth phase	Excessive growth of body parts such as palms, foot and jaws

Table 4.6 Important growth disorders

Water balance

Water balance is maintained by the action of a hormone called **vasopressin or antidiuretic hormone** (ADH), which is stored in the posterior lobe of the pituitary gland. Analyse the given description of its action and complete illustration 4.11 using the given hints.

Vasopressin helps to maintain water balance in the body. Excessive heat and sweating during summer can lead to dehydration, which increases the production of vasopressin. It speeds up water reabsorption in the kidney. As a result, the production of urine decreases, and dehydration is prevented. During winter, since dehydration through sweating is reduced, the reabsorption of water from the kidneys also decreases.

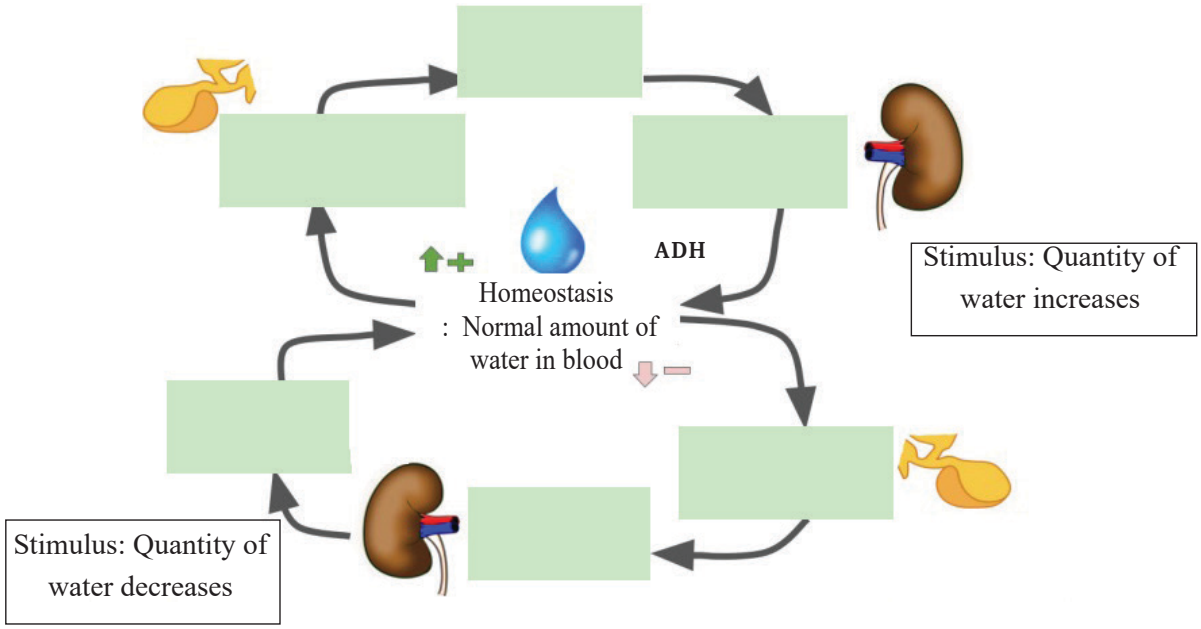


Illustration 4.11 Water balance

Hints

- Production of ADH increases
- Production of ADH decreases
- Kidneys increase the reabsorption of water
- Kidneys decrease the reabsorption of water
- Production of urine increases
- Production of urine decreases

Reproduction, birth

List some hormones related to reproduction that you are familiar with.

Analyse table 4.7, make necessary additions and gain an understanding about the hormones associated with the processes of reproduction and birth.

Hormone	Gland	Function
Testosterone	Testes	• The activity of male sex organs • Sperm production • Controls secondary sexual characteristics
Estrogen	Ovary	• The activity of female sex organs • Production of ovum • Menstrual cycle • Control of secondary sexual characteristics
Progesterone	Ovary	• Maintaining the foetus in the uterus • Menstrual cycle
Prolactin		
Oxytocin		

Table 4.7 Reproductive hormones and their functions

To feel hungry and to reduce hunger

There are some tissues that are not part of the normal endocrine system, but act like endocrine glands by producing hormones. Examples are the stomach lining and adipose tissue.

Ghrelin produced by certain cells in the upper part of the stomach , is known as **the hunger hormone. Leptin**, produced by adipose tissue, is known as the **satiety hormone**. Leptin reduces appetite by signalling the hypothalamus that the body has enough energy stored, which reduces food intake and promotes energy expenditure.

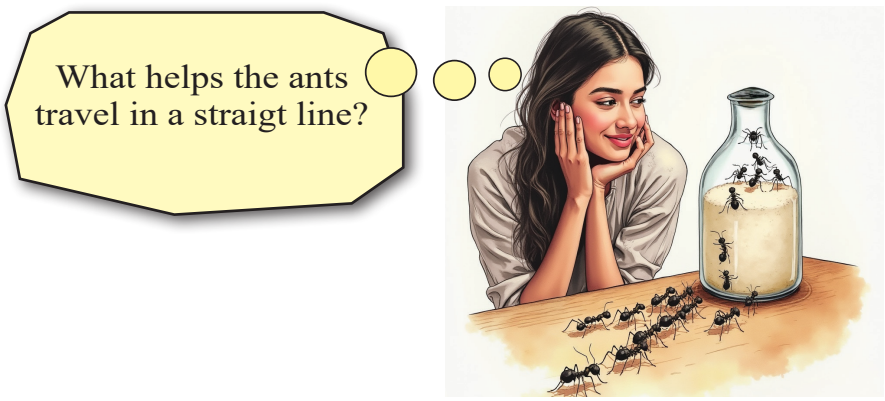
Ghrelin acts on the hypothalamus to stimulate appetite, which increases food intake and promotes fat storage.

Mental health

Mental health is as important as physical health. You have understood the chemical messengers in the nervous system, known as neurotransmitters. Neurotransmitters such as dopamine, serotonin and endorphins also function as hormones.

These chemical components are directly related to mental health. Collect more information about these, prepare a presentation and present it in the class.

Communication can also be like this



Didn't you notice the child's doubt?

Analyse the given description, table 4.8 and find the answer to the child's doubt.

Pheromones are chemical substances that are secreted by organisms to their immediate surroundings to facilitate communication with the same species. These volatile substances perform various functions.

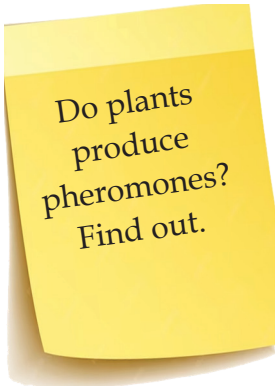
Different type of pheromones	Function
Territorial pheromone	To determine the territory
Aggregation pheromone	To ensure the availability of food
Alarm pheromone	Signalling dangers
Trail pheromone	For trail marking
Sex pheromone	To attract mates

Table 4.8 Different types of Pheromones and their Functions

You have also understood the technique of using 'pheromone traps' for pest control in agricultural fields

Some pheromone curiosities

The pheromones produced by ants are used to signal danger and to indicate food availability. The queen bee secretes pheromone primarily to prevent the emergence of new queens and for the worker bees to care for the queen. Haven't you noticed dogs and cats and other mammals that do urination in their surroundings.? They make their presence known within the habitat boundaries and determine the territory through this behaviour. Rabbits and insects produce pheromones that attract mates and trigger mating responses. **Mammary pheromones** in rabbits and the **Apasins** in dogs are examples of pheromones.



For any living organism to sustain life, the internal environment must also be conducive. The metabolic processes necessary for this occur in every cell. Metabolic processes require precise control and coordination to function smoothly. In higher organisms, the nervous system and the endocrine system play a major role in this matter.

Let's assess

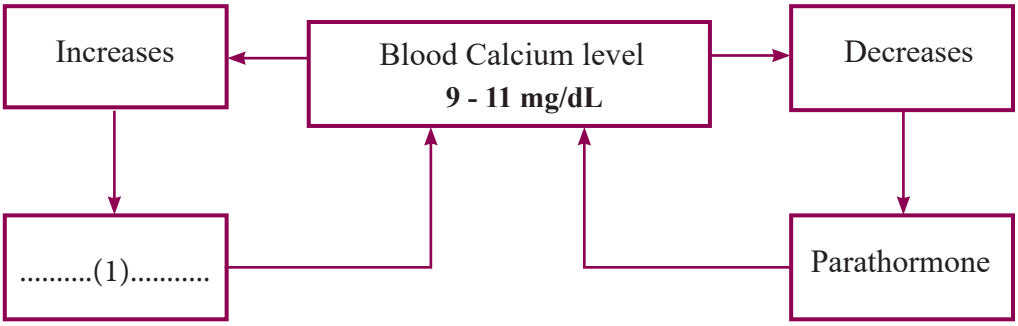
1. The illustration related to the transmission of hormones to their target cells is given below. Analyse it and answer the questions.

   i. Write the function of A with respect to the formation of C.

   ii. If A is the releasing hormone, where can B be found?

   iii. How does the secretion and transmission of A differ in plants and animals?

2. The illustration given below is related to the regulation of calcium level in blood. Analyse it and answer the questions.



(a) Which hormone is indicated as 1?

(b) Redraw the illustration showing glucose instead of calcium.

3. The amount of thyroxine in the blood decreases. Through various stages, the amount of thyroxine is brought back to an adequate level. List the actions that take place for this in order and the hormones responsible for it.

4. Is it possible to sleep during the day just as one can sleep at night? Justify your opinion by relating it to the functions of the pineal gland.

5. The hypothalamus functions as part of the nervous system and the endocrine system. Evaluate the statement.

6. 'A person runs very fast and escapes from a ferocious dog'. This incident involves the functions listed below. Write them in the correct sequence.
   - Action of adrenal gland
   - Action of the sympathetic nervous system
   - Action of parasympathetic nervous system

7. Information about a chemical substance is provided in the box. Analyse it and answer the questions.

- Organisms belonging to the same species secrete it into the surroundings for communication.
- It is used to mark a path and to attract mates.

i) Which chemical substance is mentioned in the box?

ii) Write any two other properties of this chemical substance.

iii) How do farmers make use of this chemical substance?

8. X, Y, and Z are the functions of different plant hormones. Analyse them and choose the correct option.

Helps to tide over unfavourable situtation	Delays senescence of leaves and retains the greenness in that	Prevents the growth of the lateral bud
X	**Y**	**Z**

	X	Y	Z
i)	Gibberellin	Ethylene	Abscisic acid
ii)	Auxin	Abscisic acid	Gibberellin
iii)	Abscisic acid	Cytokinin	Auxin
iv)	Cytokinin	Gibberellin	Ethylene

9. Explain how the pancreas regulates the amount of glucose in the blood in the following situations.
   - A person eats carbohydrate-rich food.
   - A person fasts for 12 hours.
   - A person has type-1 diabetes and takes insulin regularly.

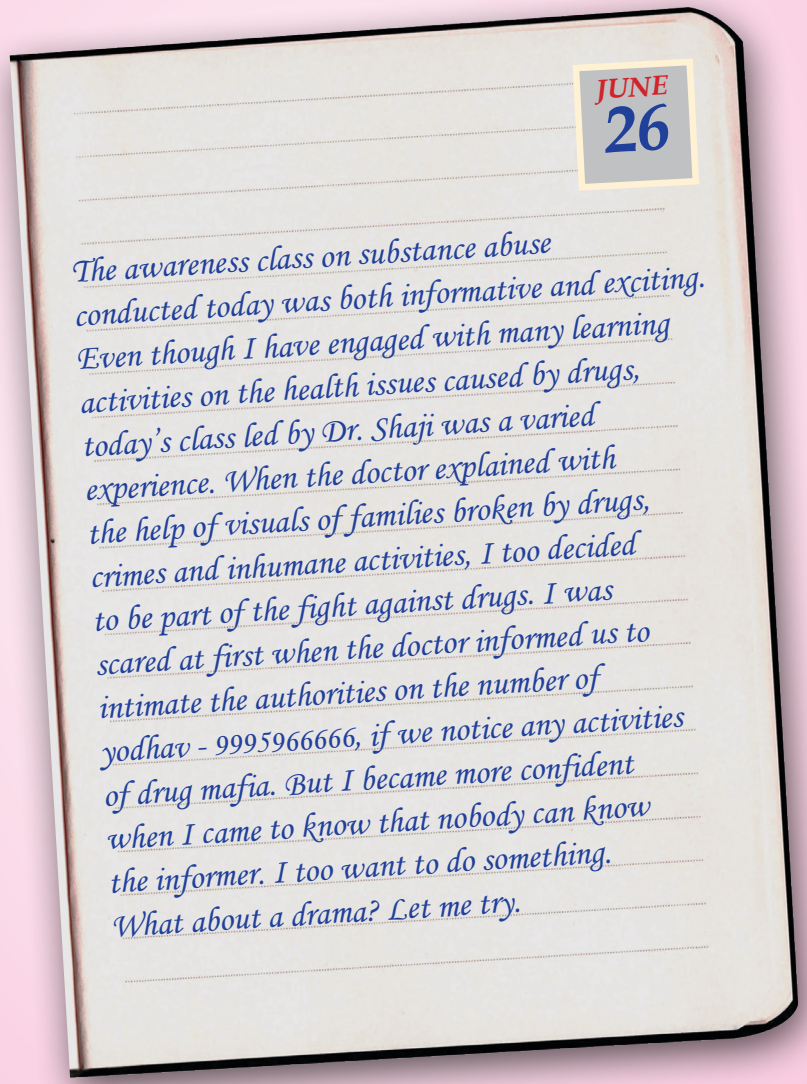
10. Explain how hormones influence plant growth in the following situations?
    - A seedling grows in complete darkness.
    - A farmer sprays gibberellins on a crop.

Extended activities

1. Create an awareness poster, video, etc. on the prevention of diabetes through lifestyle changes.
2. Apply plant parts containing natural auxins on plants and observe their growth pattern. Conduct an experiment by cutting the tip of a plant and observing the effects on its growth.
3. Research and present the life stories of famous people who experienced growth-related disorders.
4. Maintain a one-month **diet journal** focusing on foods rich in calcium and their impact on bone health.
5. Research on how plant hormones are used in fruit ripening and present your findings as a report.

5

Immunity and Healthcare



Didn't you notice the diary ? What are the things that you understood from it?

You have realised that substance abuse is one of the biggest dangers which adversely affects our health.

What is meant by health?

Look at the definition of health by the World Health Organisation.

Health

Health is a complete state of physical, mental and social well being. It means not merely the absence of disease or infirmity.

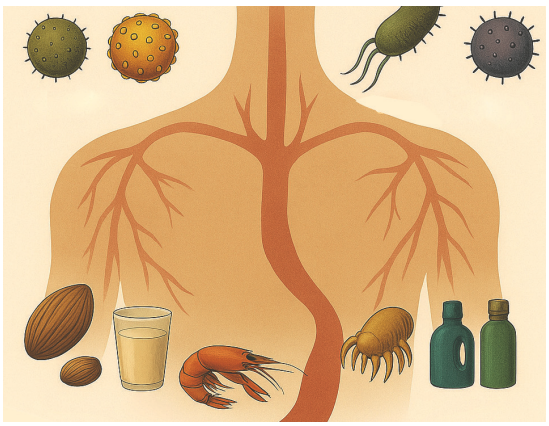
Apart from drugs, list the other factors that adversely affect health.

- Pathogen
- Malnutrition
-
-

Any change in the homeostasis of the body due to these factors is called disease.

Pathogens around us cause different types of diseases. They enter our body in many ways. In what all ways do they enter our body?

-
-
-



Anything, including pathogens which enter the body in this way and cause diseases are called antigens.

Pathogens, pollen grains, dust, certain food items, chemicals etc. are examples of antigens.

Even though we live in the midst of pathogens, most of the time we don't suffer from diseases? What would be the reason?

Didn't you notice the doubt that the child has? What is your response to the doubt? Write it down.

Immunity is the ability of the body to prevent the entry of pathogens and to destroy those that have already entered. Some of them are innate and some others are acquired.

Analyse illustration 5.1 and gain more understanding.

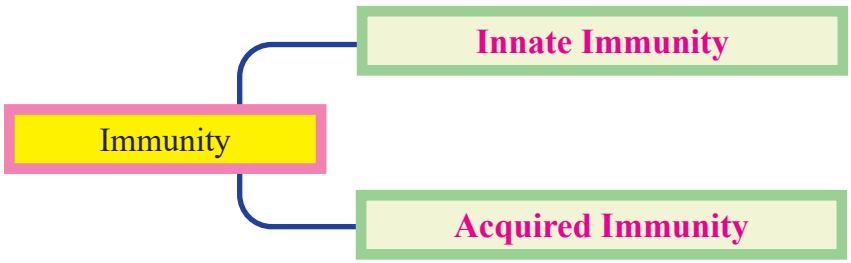


Illustration 5.1 Immune Mechanisms

We shall learn more about these functions in our body.

Innate Immunity

The natural immune mechanism that exists in the body by birth is called innate immunity. Innate immunity includes various mechanisms to prevent antigens from entering the body. These are generally called **primary level immunity**.

Analyse illustration 5.2 and complete the table 5.1.

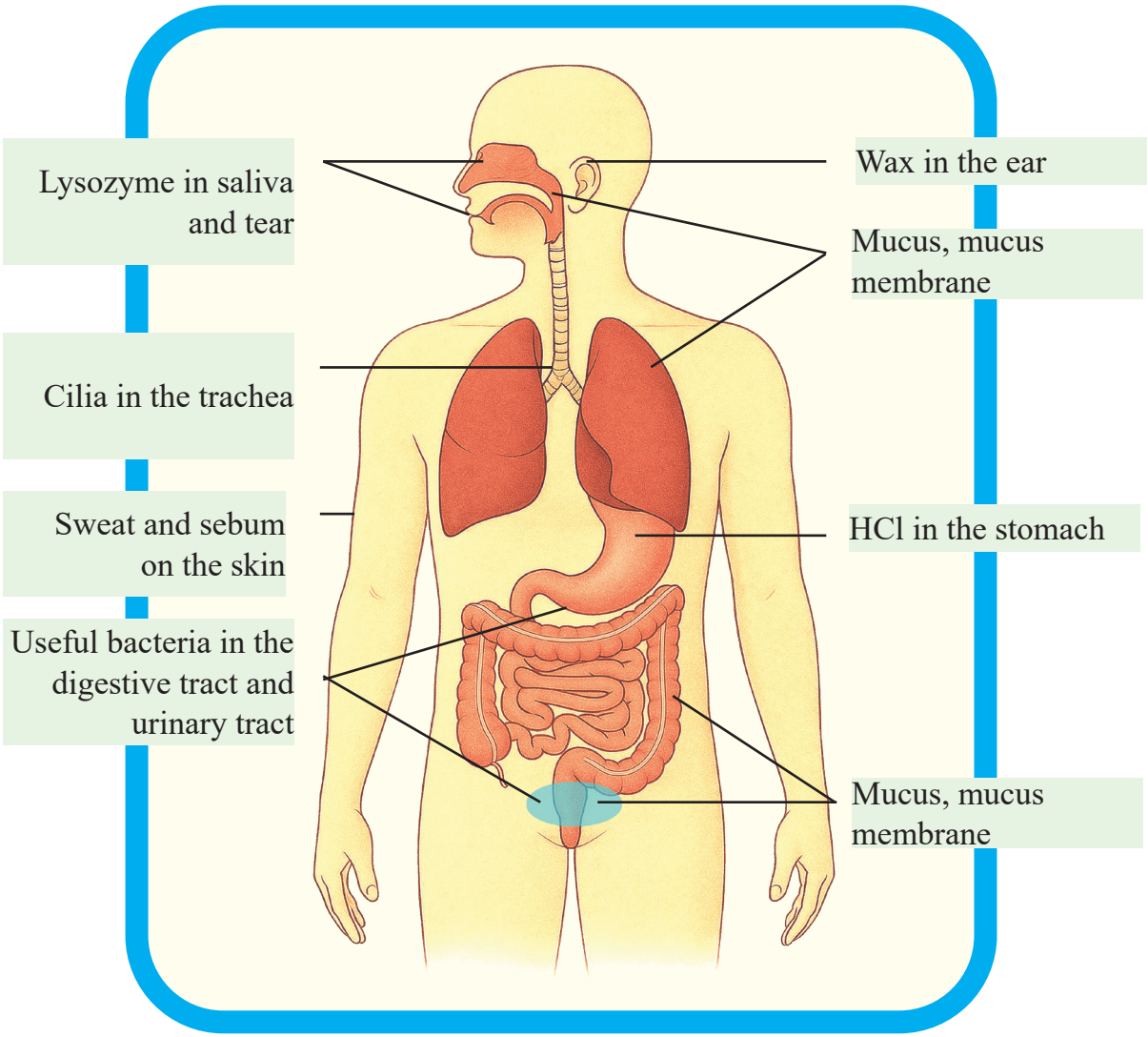


Illustration **5.2** Primary level immune mechanisms

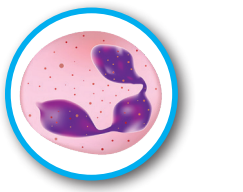
Part of the body	Immune mechanism

Table **5.1** Primary level immune mechanisms

If the pathogens bypass the primary level immunity and enter the body, the innate immune system that defends against them is called the secondary level immunity .

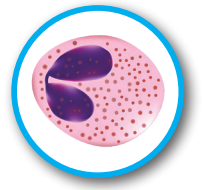
It includes the coordinated action of defence mechanisms that destroy the pathogens that have entered the body.

Analyse illustration 5.3 and prepare a table of the white blood cells that are involved in secondary level immunity and their functions.



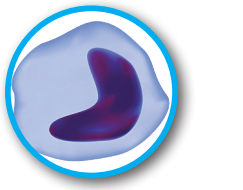
Neutrophil

It engulfs and destroys bacteria , produces chemicals against pathogens



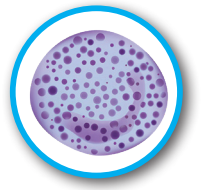
Eosinophil

Neutralizes chemicals releases when there is an allergy, destroys parasites



Monocyte

It engulfs and destroys foreign substances, bacteria, and dead cells; stimulates other immune cells.



Basophil

It produces heparin, which prevents blood clotting, and histamine, which causes inflammation in cases of allergy.

Illustration **5.3** White blood cells and their functions

Analyse illustration 5.4 (a, b, c) and description based on the indicators and prepare notes on the main activities included in the secondary level immunity.

Phagocytosis

Phagocytosis is the process by which white blood cells engulf and destroy pathogens. The blood cells that take part in phagocytosis are called phagocytes. White blood cells such as neutrophils and monocytes are phagocytes.

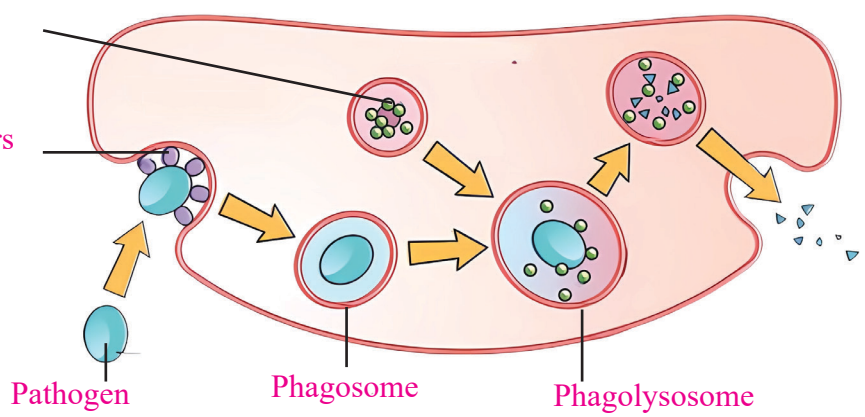


Illustration 5.4(a) Phagocytosis

Are neutrophils and monocytes the only types of phagocytes? Find out.

Indicators

- Phagosome
- Importance of the formation of phagolysosome
- Phagocytosis – stages

Inflammatory response

It is the process by which blood flow increases to the injured or bruised area to bring white blood cells to fight an infection.

The cells at the injured part releases histamine and other chemical substances. This dilates the blood vessels. As blood flow increases, blood cells such as monocytes and neutrophils reach the injured area. They engulf and destroy the pathogens.

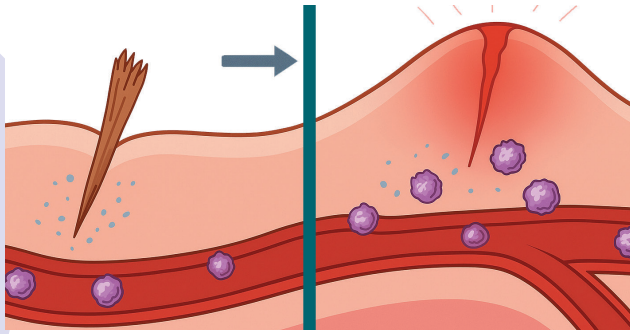


Illustration 5.4(b) Inflammatory Response

Indicators

- Histamine – Function
- The advantage of the dilation of capillary wall
- Inflammatory response – an immune activity

Fever

Fever is the condition that occurs when the body temperature rises above the normal range (98.6^0 F or 37^o C). When infection or inflammation occurs, white blood cells release chemical substances called pyrogens. These trigger the brain to raise the body temperature.

Fever is a kind of immune mechanism. High temperature helps phagocytes to destroy pathogens more quickly by engulfing them, inhibit the growth of pathogens, and enhance immunity. This is a sign that the body is fighting against the disease. Once the infection is gone, the body temperature returns to the normal level.

Why does the inflamed area become red and warm? Find out.

Indicators

- Pyrogens- importance
- The advantage of the rise in body temperature

Clotting of blood

It is a mechanism to prevent the flow of blood as well as to block the entry of pathogens into the body when a wound forms on the skin.

When an injury occurs, the platelets and damaged tissues at the site produce an enzyme called **thromboplastin.** This converts a protein in the blood plasma called **prothrombin** into thrombin. **Thrombin** then converts an inactive protein called **fibrinogen** into fibrin. The fibrin forms a network of fibers that traps red blood cells, forming a blood clot. This clot prevents further blood loss until the wound is healed.

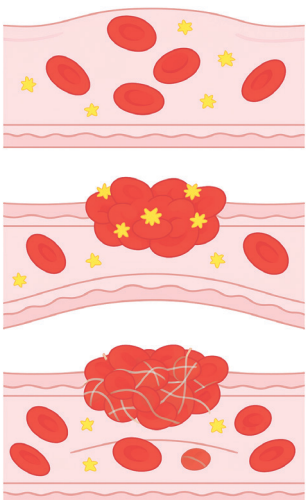


Illustration 5.4(c) Clotting of blood

Indicators

- Factors that help in the clotting of blood
- Processes involved in the clotting of blood
- Clotting of blood – an immune activity

Wound healing

As blood clots and inflammation occur at the wound , new tissues are formed leading to wound healing. If the wound is healed with connective tissue replacing the lost tissues, a scar will remain.

You have seen that all innate immune responses are irrespective of the type of pathogen or their actions. Hence, this type of immunity is called **non-specific Immunity.**

Didn't you understand innate immune responses ?

Let's look at **acquired immunity,** which develops after the birth of an individual.

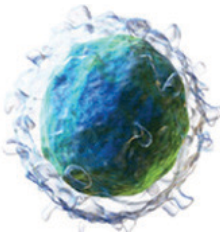
To which category does the immunity received through antibodies from breast milk belongs? Find out.

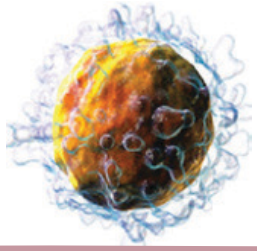
Acquired Immunity

This is the immunity that develops after birth. This immune mechanism specifically recognises and defends antigens (like the pathogens) that enter the body. Hence, this is also called as **specific immunity.**

This immune defence is primarily carried out by lymphocytes.. There are two types of lymphocytes - **T lymphocytes and B lymphocytes.**

Analyse illustration 5.5 and appropriately complete table 5.2 containing information about lymphocytes.





B Lymphocytes

Form and mature in bone marrow. Produce proteins called antibodies which act against antigens.

T Lymphocytes

Form in bone marrow and mature in thymus gland. Identify and destroy the infected cells and cancer cells

Illustration 5.5 Lymphocytes

Cells in specific immunity	T lymphocytes	B lymphocytes
Formation		
Maturation		
Function		

Table 5.2 Lymphocytes

You have understood the natural immune mechanisms of the body. Is it always possible to resist pathogens using only these mechanisms? Given below is a poster displayed at the primary health centre. Analyse it.

Edward Jenner (1749-1823)

Edward Jenner, an English doctor in the 18th century, realised that people who had contracted cowpox would not get smallpox. He successfully tested this theory by inoculating a child with secretions containing cowpox pathogens. The name 'vaccine' comes from the Latin word 'Vacca,' which means cow. Jenner is also known as the father of vaccination.

In deadly diseases like Diphtheria and Tetanus , by the time natural immunity develops and becomes effective, the pathogens will have multiplied and the chances of death are high. In such situations, we have to rely on artificial immune mechanisms. **Vaccines** are the substances used for this.

Immunisation is an artificial method of preparing the immune cells in advance, expecting the attack of pathogens. The immunity acquired in this way is called **artificial immunity.**

What vaccines do you know about?

Analyse table 5.3 related to vaccines and gain understanding. Find out how vaccines are classified based on their components.

Vaccine	Components of vaccine	Preventable diseases
MMR	Contains neutralised pathogens	Measles, Mumps, Rubella (German measles)
OPV	Contains dead pathogens	.....
HPV vaccine	Contains parts of pathogens	Cervical cancer
COVID- 19 vaccine	Contains parts of the genetic material of the pathogen	.....

Table 5.3 Vaccines and Diseases

Indicators

- Vaccination
- Vaccines components
- Types of vaccines

The components of vaccines are pathogens or their parts. How do they impart immunity?

Didn't you notice the child's doubt?

Note your opinion.

.....

Analyse the description and prepare a note by verifying the validity of your opinion.

Mechanism of the Action of Vaccines

Vaccines act as antigens in our body. It stimulates our immune system and helps to produce antibodies against the pathogens. These antibodies remain in the body and provide long-term protection against diseases. By taking the doses accurately vaccines help to gain protection from a disease for many years or even for a lifetime.

Are there vaccines which are taken by other means than by injection ? Find out.

Analyse the National Immunisation Table collected from the Primary Health Centre and find more examples for vaccines. Prepare a wall magazine and display in the classroom.

You have understood the immune mechanisms in humans. What all things can be done to strengthen immune system? Discuss.

-
-

Diseases

Malfunction of the immune system, genetic defects, unhealthy lifestyle, abundance of pathogens etc. disrupt the homeostasis of the body and cause diseases.

There are diseases that occur during a person's lifetime and also diseases that are inherited.

Acquired diseases

Diseases which occur during the course of one's life are called acquired diseases. Environmental factors, pathogens, lifestyle etc. may cause these diseases.

There are communicable and Non communicable diseases.

Haven't you learned that the cause for most of the communicable diseases are microorganisms? Such diseases are called contagious diseases.

How do these spread?

Analyse illustration 5.6 and prepare a note on different modes of disease transmission.

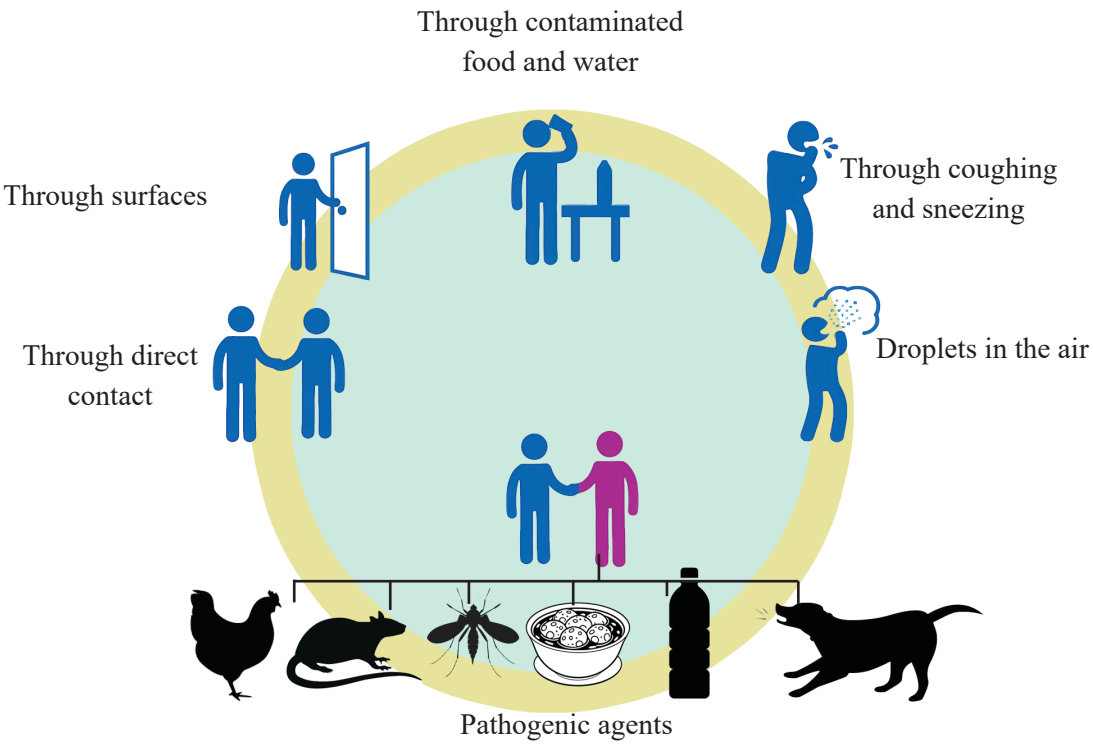


Illustration 5.6 Modes of disease transmission

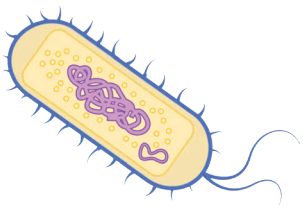
What are the ways to prevent the spread of diseases? Discuss.

Which are the microorganisms that cause diseases in humans?

Let's examine how they cause disease.

Bacteria

When bacteria enter the body and multiply, the toxins released by them destroy the host tissues and disrupt bodily functions. Some produce enzymes which damage cell membrane and destroy cells.

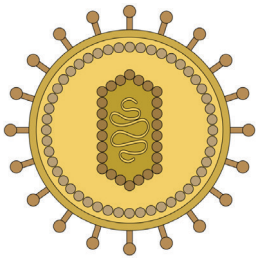


Analyse illustration 5.7 given below and prepare a note.

	Tuberculosis	Rat fever (Leptospirosis)
Pathogen	*Mycobacterium tuberculosis*	*Leptospira*
Mode of transmission	By breathing the tiny droplets released into the air when the patient is coughing, sneezing or talking	Through wounds or through the mucous membranes of the eyes and nose from the water contaminated with rat urine
Part of the body affected	Although it mainly affects the lungs, it can also affect other parts of the body, such as the kidneys, bones, and the brain	Kidneys, Liver, Lungs
Symptom	The main symptoms are a persistent cough for more than two weeks, fever, loss of appetite, weight loss, and fatigue. Sometimes blood may be seen in the sputum.	Sudden onset of fever, headache, muscle pain, redness of the eye, vomiting
Prevention , treatment	BCG vaccination. Long-term treatment by using multiple antibiotics (DOTS) simultaneously	Use preventive medicines Treatment using antibiotics

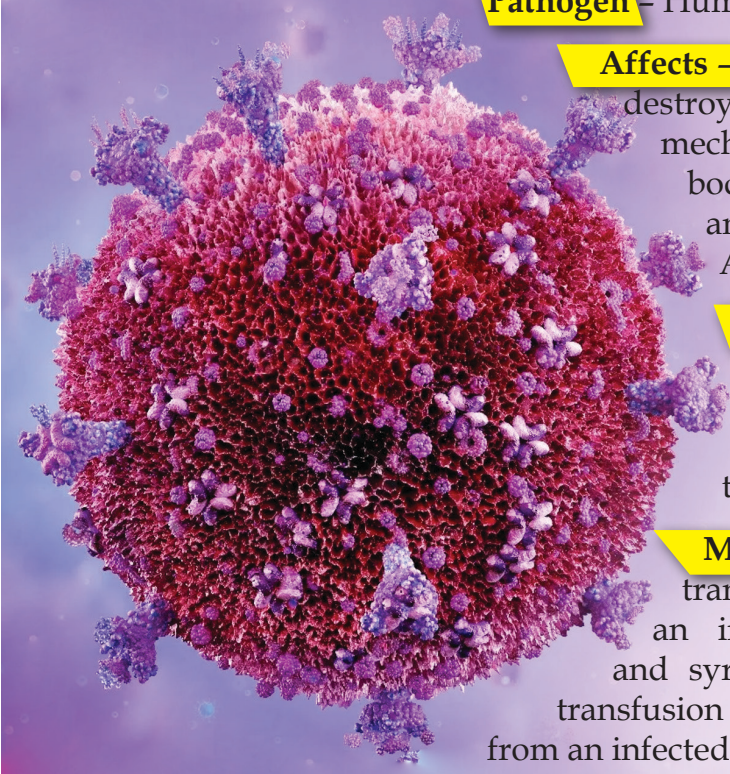
Illustration 5.7 Bacterial diseases

Virus



Virus enter the body and multiply using the genetic mechanism of the host cells. Thereby, they destroy the cells and cause diseases. The illustration 5.8 of various viral diseases is given below. Analyse it based on the indicators and prepare a note.

AIDS - Acquired Immuno Deficiency Syndrome



Pathogen – Human Immunodeficiency Virus (HIV)

Affects – T lymphocytes. The virus attacks, and destroys them by multiplying using the genetic mechanism of T lymphocytes. As a result, the body's ability to fight diseases is reduced and gradually the condition reaches to AIDS.

Symptoms – Primary symptoms are similar to other viral diseases but when the immunity decreases, fatal diseases such as Pneumonia, Tuberculosis, some types of cancer, etc. may develop.

Mode of Transmission - HIV can be transmitted through sexual contact with an infected person, by sharing needles and syringes that are not HIV-free, through transfusion of blood or organs containing HIV, and from an infected mother to the foetus.

Treatment - Currently, there is no medicine to completely cure AIDS. However, through Antiretroviral Therapy (ART), it is possible to control the multiplication of the virus and maintain the patient's immunity

Illustration 5.8(a) AIDS Virus infection

Scientists are working on technologies like CRISPR gene editing to cut and remove the HIV virus gene from cells. Along with this, efforts are also under way to develop medicines that can activate and destroy the hidden HIV in the body, as well as to discover an effective HIV vaccine.

Discuss how this disease can be prevented from transmission and what should be the approach towards people affected by such diseases.

People infected with COVID-19 lose their ability to taste and smell? Find out the reason.

Indicators

- Disease – pathogens
- Mode of transmission
- Precautions to prevent the disease

Nipah

Pathogen – Nipah virus

Symptoms - Fever, head ache, muscular pain, cough, and vomiting are the initial symptoms. As the disease becomes severe, disorientation, epilepsy, and loss of consciousness may occur.

Mode of transmission

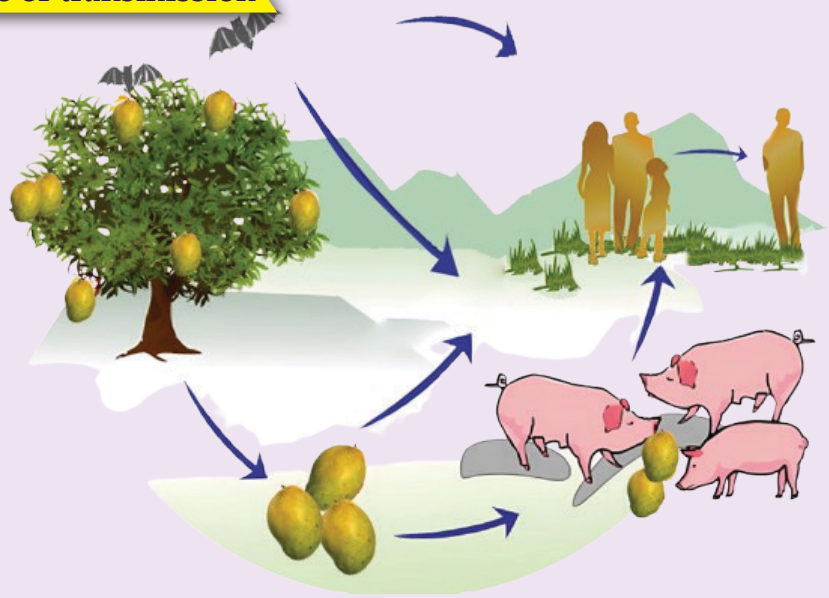


Illustration 5.8(b) Nipah Virus infection

Only supportive care is available to reduce the symptoms and complications of the disease. There are currently no antiviral medicines or vaccines.

Indicators

- Disease – pathogens
- Mode of transmission
- Precautions to prevent the disease

Fungus

Fungi can also cause various types of diseases in humans. These may directly infect the skin and nails, or produce toxins, leading to different diseases.

Analyse the table and description given below and gain understanding of fungal diseases.

Ringworm

Candidiasis

Disease	Mode of infestation	Symptom
Ringworm	Through the infected persons, contact, contaminated objects and from animals	Circular reddish rashes, itching
Candidiasis	Direct contact, through sharing of clothes, through sexual contact	White patches in the mouth, itching

Table 5.4 Fungal diseases

Protozoa

They are unicellular eukaryotes. Some protozoa infect the red blood cells, multiply inside them and destroy them. Some others release harmful substances that affect the physiological activities.

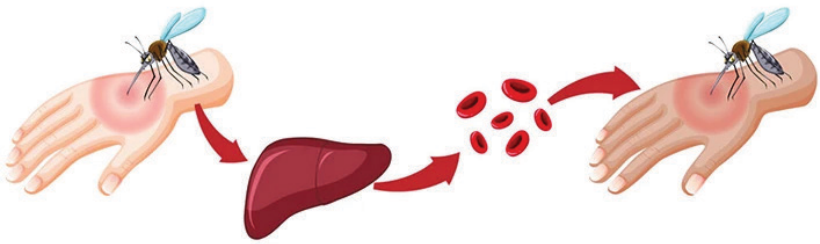
Let's learn more about protozoan diseases.

Malaria

Plasmodium

The protozoan named *Plasmodium* is the pathogen. Female Anopheles mosquito transmits this pathogen from one person to another.

Analyse illustration 5.9 and the description and prepare a note on Malaria infestation.



Plasmodium reaches the body	Multiplies	Destroys the red blood cells.

Illustration **5.9** Malaria infection

Anopheles mosquito

Intermittent fever, chills and shivering, head ache, vomiting, muscular pain, body pain and fatigue are the symptoms. Antimalarial medicines are used for the treatment.

The following is a newspaper report related to a protozoan disease that recently appeared in our region. Discuss it based on the indicators and draw inferences.

Amoebic encephalitis cured: child discharged

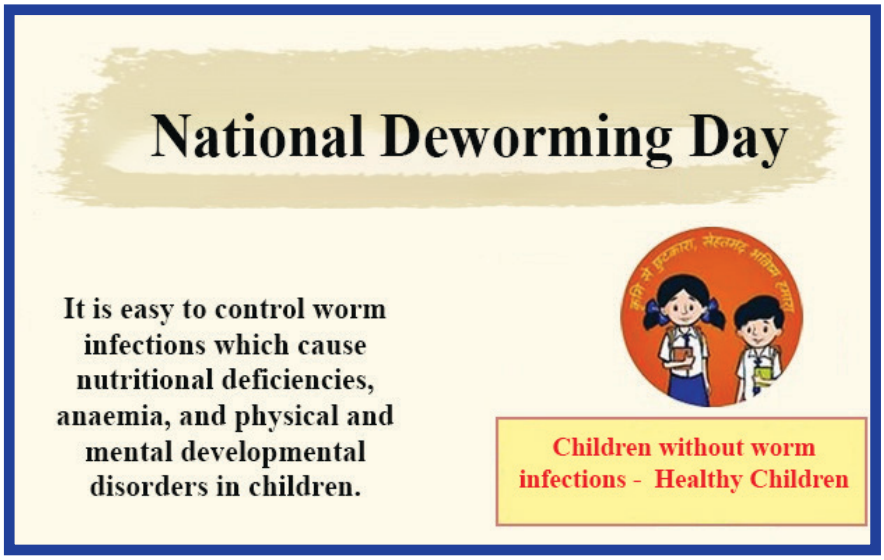
The complete recovery of a seven-year-old boy in Thiruvananthapuram who was infected with the rare amoebic encephalitis has become a matter of pride for the health sector. The deadly disease is caused by an amoeba called *Naegleria fowleri*. It is mainly found in stagnant and warm fresh water. Infection occurs when contaminated water enters the nose and the pathogens reach the brain through the nose. Therefore, the health department has informed that this disease can be prevented by avoiding bathing in or washing the face with stagnant and dirty waterbodies.

Indicators

- Disease – pathogen
- Mode of transmission
- Precautions for the prevention of disease

Worms

Worms also cause diseases. Let's get to know some of those diseases.



Didn't you notice the poster?

What is the importance of observing such a day?

Analyse the description below and prepare a note.

The parasitic worms such as pin worm, round worm etc. cause diseases. These diseases are generally known as worm infestations. The infection spreads through habits like nail-biting, eating without washing hands, or drinking contaminated water. Worm infestation causes fatigue, lack of enthusiasm, tiredness, lack of concentration, nutritional deficiency, loss of appetite, weight loss, stomach pain, dizziness, and vomiting. Albendazole destroys various types of worms and helps prevent worm infestation. Albendazole tablets are effective in preventing the spread of worm infestation too.

Filariasis

Filarial worm

Culex mosquito

Filariasis occurs when filarial worms lodge in the lymphatic vessels and obstruct the normal flow of lymph. Female culex mosquitoes transmit these pathogens from one person to another. When a mosquito bites, the larvae of the worms enter the bloodstream, grow, and reach the lymphatic vessels and settle there. As a result, lymphatic fluid accumulates, and over time, body parts such as legs, arms, and genital organs become excessively swollen and enlarged.

Indicators

- Disease – pathogen
- Symptoms
- Prevention

Discuss the methods to prevent the disease.

Along with Chikungunya, Dengue fever, Cholera, COVID-19, Hepatitis, and Rabies collect information of the diseases recently reported in your area. Prepare a presentation using this information and display it in your class.

Many of these diseases are spread by mosquitoes and rats. What all can we do to prevent such diseases? Discuss and include the findings in a pamphlet and distribute it.

All the diseases discussed so far are transmitted from one person to another. Are all diseases like that?

Discuss.

Cancer

Cancer is a non contagious disease.

Based on the indicators, analyse illustration 5.10 and the description and prepare a note .

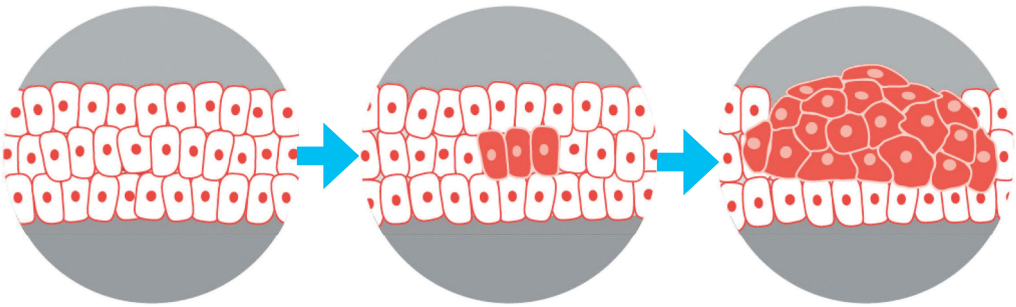


Illustration **5.10** Cancer cell growth

Cancer is a condition in which abnormal and uncontrolled cell division leads to the multiplication of cells. This spreads to other parts of the body. When the control mechanisms of the cell division process fail, normal cells turn into cancer cells. Cancer cells spread to other parts of the body through blood and lymph.

Causes of Cancer

Genetic changes, Environmental factors, Viral infections, Lifestyle

Treatment Methods

Surgery, Chemotherapy, Radiation therapy, Immunotherapy, Targeted therapy, Hormone therapy etc. are the treatment methods.

Indicators

- The disease condition called cancer
- Reasons
- Peculiarity of cancer cells
- Treatment methods

Didn't you understand that there are diseases that do not spread from one person to another?. Do you know any disease like that? Collect information and complete table 5.5.

Type	Disease	Reason
Lifestyle diseases	• Diabetes Mellitus • Hypertension	
Occupational diseases	Silicosis	
Autoimmune disorders	Rheumatoid arthritis	
Nutritional disorders	Anaemia	

Table 5.5 Non – Contagious diseases

Hereditary diseases

Diseases caused by genetic defects are called hereditary diseases. Let's try to understand some of those diseases. Analyse the given illustration 5.11 and prepare a note.

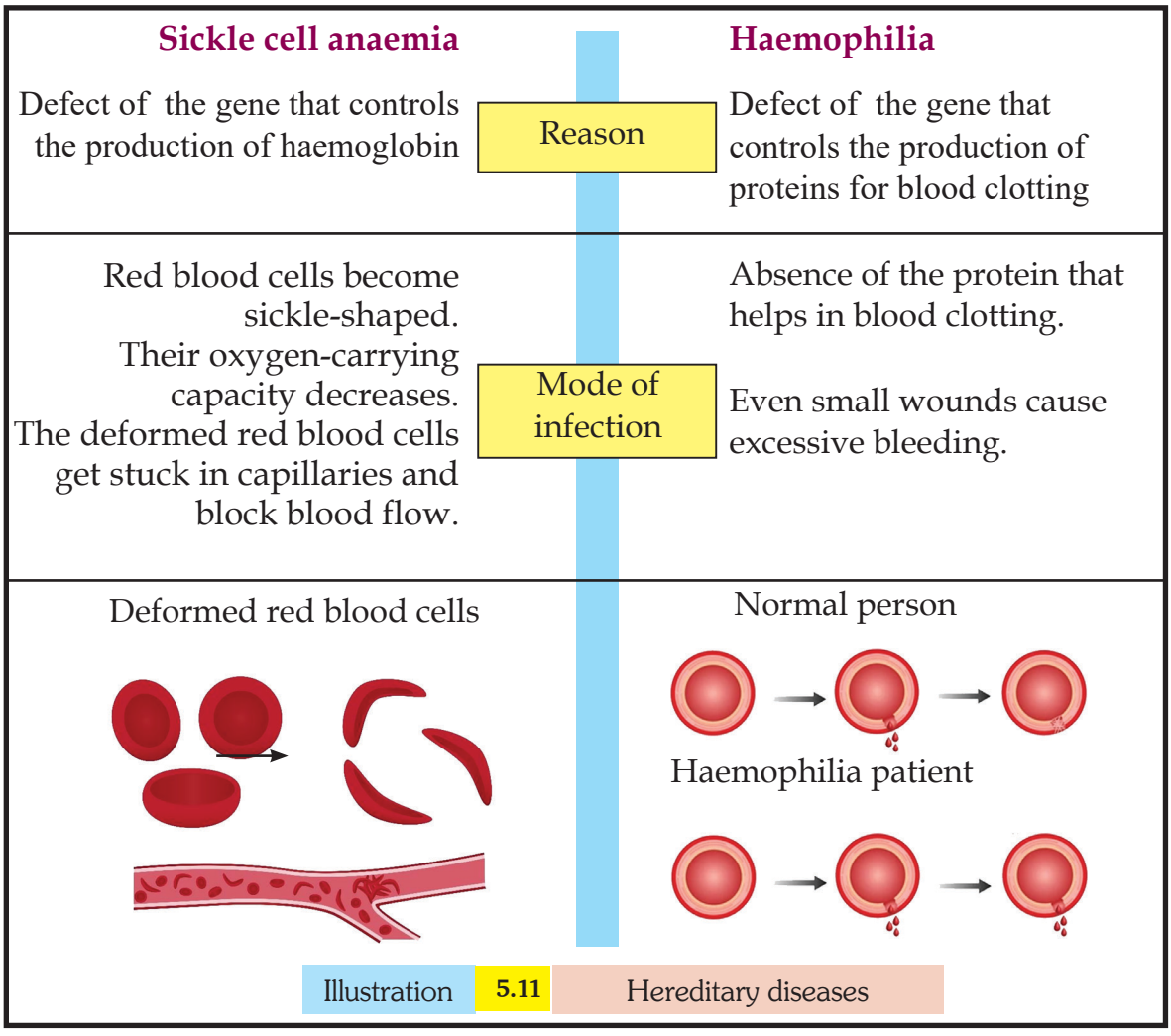


Illustration 5.11 Hereditary diseases

Collect information about other hereditary diseases and prepare a wall magazine.

Haven't you understood about various diseases? Based on this, complete illustration 5.12

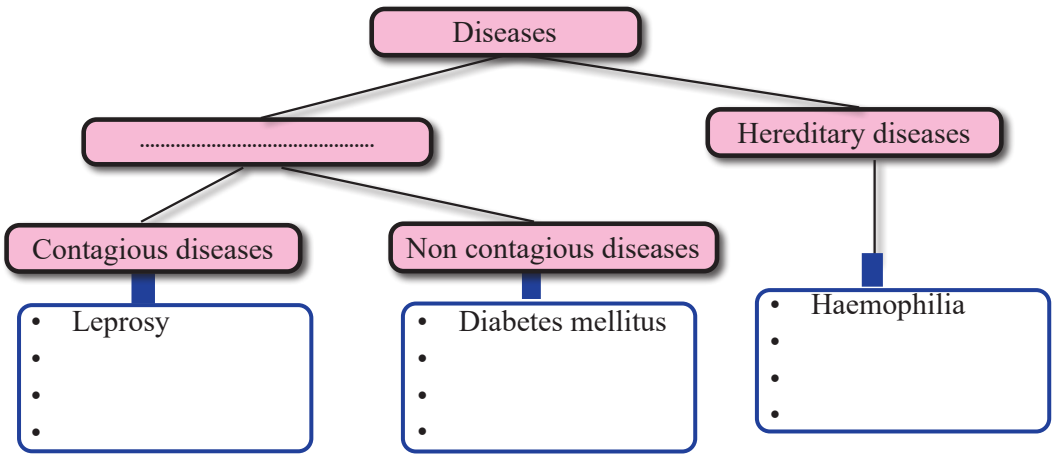


Illustration **5.12** Diseases

Treatment

When should one seek treatment?

-
-
-

What are the common systems of treatment in our country?

Analyse the description given below, discuss the points based on indicators and prepare a note.

In different parts of the world, systems of treatment have evolved according to the lifestyle, culture, and available natural resources of those regions. Ayurveda, Unani and similar practices are traditional systems of medicine that developed in this manner.

Ayurveda: Ayurveda is a world-renowned system of treatment that originated in India. It aims at maintaining the balance of bodily functions through diet regulation, herbal medicines and exercise. In Ayurveda, plant and animal based substances are used as medicines. Charaka is known as the Father of the Ayurvedic system of treatment.

Homeopathy: Homeopathy is a system of treatment introduced by the German doctor Samuel Hahnemann. This is a method of treatment that uses diluted doses of natural substances that cause symptoms in a healthy person to prevent disease.

Modern Medicine: The foundation of modern medicine was laid by the Greek physician Hippocrates. This system corrected superstitions related to diseases and give importance to pathogens, diagnosis and the medicines.

Collect information about other recognised systems of treatment prevalent in our country and prepare a presentation.

Indicators

- Medicines used in Ayurveda
- Treatment method in Homeopathy
- Modern medicine

Observe the illustration of the methods followed by modern medicine for diagnosis and treatment. Prepare a note based on it.

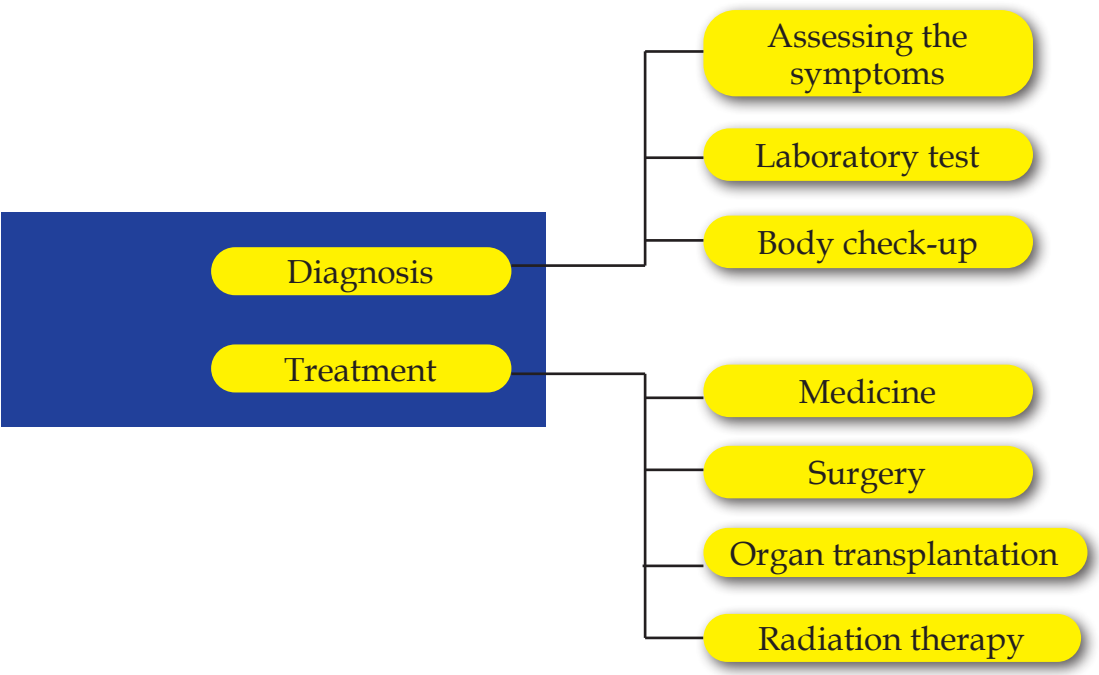


Illustration 5.13 Methods followed by modern medicine

Indicators

- Stages of modern medical treatment
- Diagnostic measures
- Methods of treatment

Haven't you understood that diagnosis is as important as the assessment of symptoms?

Among the devices used for diagnosis, list those that you know.

-
-
-

Analyse and discuss the given collage and complete table 5.6

Equipment	Use
Stethescope	
Sphygmomanometer	
Digital B.P apparatus	
Pulse oximeter	
Thermometer	
Endoscope	
US scanner, CT scanner, MRI scanner	

Table 5.6 Diagnostic equipment

Prepare a digital album on other such modern equipment and present it in the class.

Proper treatment can be given following the diagnosis. There are various specialisations to make treatment more effective.

Analyse the board displayed in the hospital, identify more departments and find out what each one is related to.

- General medicine
- Cardiology
- Paediatrics
- Gynaecology
- Urology
- Nephrology
- Neurology
- ENT

Medicines

Following the diagnosis, various medicines are used for treatment.

These may be derived from plants, animals or microorganisms or they may be artificially synthesised. Among these, antibiotics deserve special mention.

Have you ever had to use antibiotics? Based on the description given, prepare a note on how these differ from other medicines.

Antibiotics

Antibiotics are medicines that are either derived from microorganisms or produced synthetically, and are used against bacteria. Although they are the most effective medicines available to treat bacterial diseases, their unscientific and excessive use can lead to several side effects.

Some of these side effects include:

- Problems in the digestive system such as diarrhoea, vomiting and stomach pain
- Allergy
- Damage to the liver and kidneys
- Destruction of beneficial bacteria in the intestine
- Resistance against antibiotics (Antibiotic resistance)

A major concern is the antibiotic resistance, which is developed in bacteria. This makes treatment more complicated.

Use antibiotics only as prescribed by a doctor.

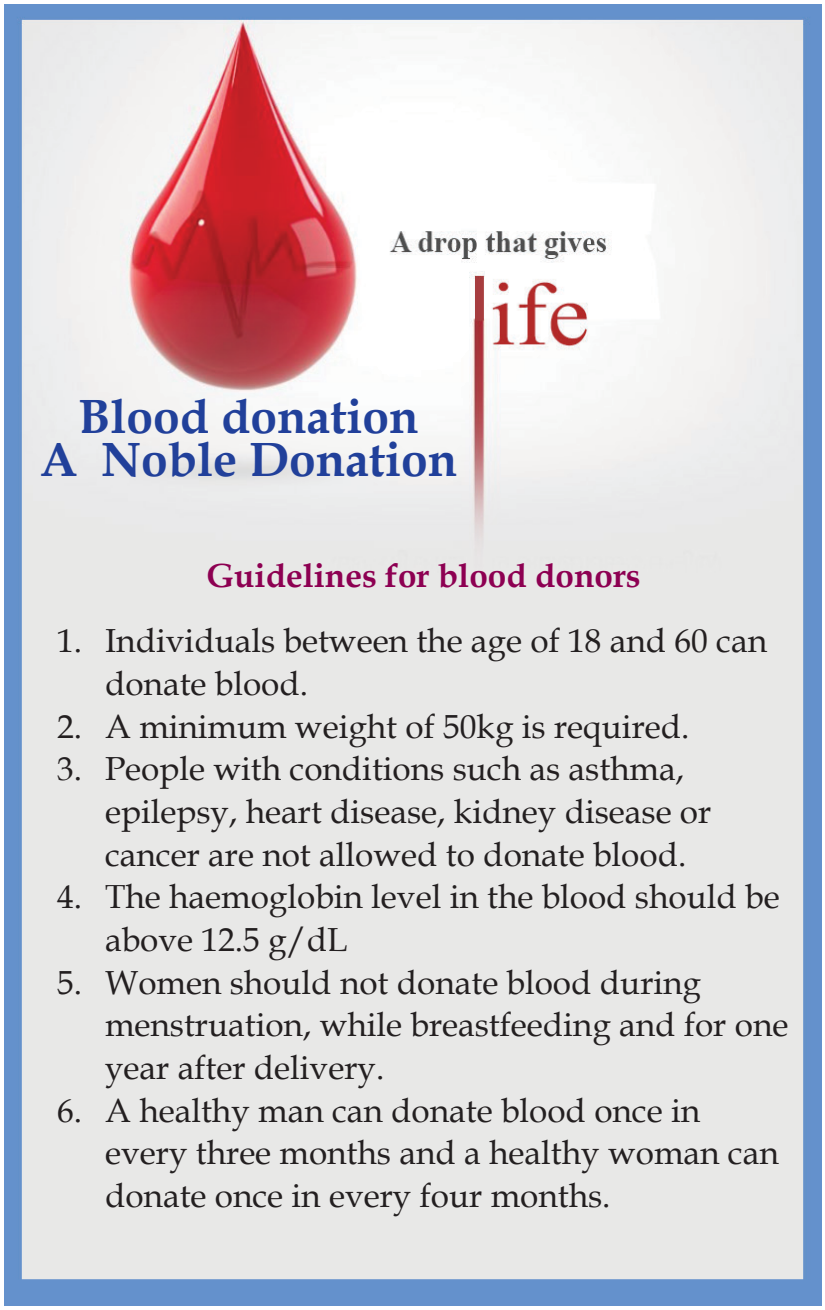
Alexander Fleming and Penicillin

Scottish bacteriologist Alexander Fleming accidentally discovered penicillin in 1928. While examining a petri dish containing *Staphylococcus* bacteria, he noticed that a fungus called *Penicillium notatum* had grown on it and was destroying the bacteria. This was the first antibiotic in the world that could kill bacteria without harming human cells.

Although Fleming could not purify penicillin himself, after a decade, Howard Florey and Ernst Boris Chain succeeded in purifying it and began large-scale production during the Second World War. This discovery revolutionised medical science. In 1945, Fleming, Florey, and Chain were awarded the Nobel Prize for this work. This led to the beginning of the antibiotic era.

Similarly, antiviral drugs against viruses, antifungal drugs against fungi, antiprotozoal drugs against protozoa and antihelminthic drugs against worms (Helminths) are used. Antipyretic drugs are used to reduce fever.

Observe the poster displayed in the blood bank and discuss the ideas presented in it.



Do other animals have blood groups? Find out.

Blood transfusion

The process of transferring blood or its components from one person to another is called blood transfusion. The person who gives blood is known as the **donor**, and the person who receives blood is called the **recipient**.

Is it necessary to consider the blood group in blood transfusion?

Note your guess.

Analyse the description based on the indicators and complete table 5.7.

Blood groups are determined by the presence of A antigen and B antigen present on the surface of RBCs. The type of antigen present in the blood determines the blood group. The antibodies present in the plasma also play an important role in blood transfusion. In addition to A and B antigens, some individuals have another antigen called the D antigen. If D antigen is present, the blood group is called positive; if absent, it is called negative. Since the D antigen was first discovered in Rhesus monkeys, it is also known as the Rhesus factor (Rh factor).If the donor's blood contains an antigen that is naturally absent in the recipient's blood, the antibodies present in the recipient's plasma may act against it, leading to agglutination of the blood. Therefore, it is essential to consider blood groups in blood transfusion.

Blood group	Antigen	Antibody
A	**A**	
B		**a**
AB		
O		

Table 5.7 Blood group

Indicators

- Basis of blood groups
- Antibodies present in each blood group
- Rh factor and blood groups
- Importance of determining blood group in blood transfusion

Bombay blood group

The Bombay blood group was discovered in 1952 by Dr. Y. M. Bhende in Mumbai. The 'H' antigen present in all blood groups is not seen in Bombay group. As a result, standard blood tests may indicate them as type O. However, they cannot receive blood from normal O group donors. They can only receive blood from another person with the Bombay blood group. This rare blood group is found approximately 1 person out of 10,000 people in India and about 1 in 10 lakh people worldwide.

Animal Diseases

You might have heard that not only humans but animals too suffer from various diseases. Let us try to understand some of these diseases.
Observe the given table 5.8. Collect more information and expand this table.

Disease	**Pathogen**	Affects	Prevention
Foot and Mouth Disease	Virus	Cattle	Vaccine
Anthrax	Bacteria	Cattle	Vaccine
Mastitis	Bacteria	Cattle	Vaccine
Ranikhet disease	Virus	Chicken, duck	Vaccine

Table 5.8 Animal diseases

Plant Diseases

Plants too are affected by various diseases.
Analyse the given table 5.9, find out more diseases and prepare a note.

Disease	Pathogen	Symptoms
Wilt of Brinjal	Bacteria	The young leaves wilt quickly. Gradually, the leaves turn yellow, growth becomes stunted and the branches are reduced in number.
Blight disease of paddy	Bacteria	Round yellow spots on the leaves, spots on the rice grain
Bunchy top of Banana	Virus	Leaves become short, narrow and stand upright, growth become stunted.
Mosaic disease in Tapioca	Virus	Initially light yellow coloured patches are formed on the leaves. Gradually these become white. Growth retards and the size of tapioca decreases.
Bud rot of coconut	Fungus	The tender leaves turn into yellow, and the crown of the coconut tree droops and falls.
Quick wilt of pepper	Fungus	Wet marks on the leaves and stem. Leaves fall and the plant wilts quickly.

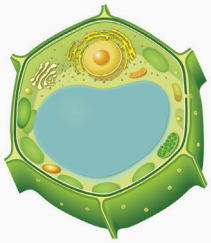
Table 5.9 Plant diseases

Is there a threat of plant diseases in your area? Prepare a project report by interviewing local farmers and the agricultural officer about the diseases and the control measures they have adopted, and present in the class.

Do plants have an immune system like animals?

Analyse the given description and find the answer to clear the child's doubt.

Immunity in Plants



- A rigid cell wall, epidermis and waxy coating on leaves and stems prevent the entry of pathogens.
- Antimicrobial substances either kill pathogens or inhibit their growth.
- Enzymes break down the cell walls of pathogens.
- The cells in the infected area undergo autolysis to prevent the spread of the disease.
- When one part of the plant is attacked, it sends warning signals from cell to cell about the disease.
- If pathogens cross the cell wall and enter, a polysaccharide called callose prevents their spread.

Diseases are inevitable in the biosphere. No living organism is exempted from them. All living beings, including humans, are naturally endowed with the ability to resist diseases. However, humans have developed their own methods to combat diseases. These include immunisation and treatment. The field of medicine has made remarkable advancement over the years. At the same time, due to unhealthy lifestyles, humans are inviting new diseases. Every individual should strive to achieve physical, mental, and social well-being by practising and adopting healthy habits. Along with this, maintaining the stability of the agricultural sector, which is the foundation of our livelihood is also essential for a smooth life. This is the knowledge and the right attitude that one should gain and cultivate.

Let's assess

1. From the sequence of activities related to phagocytosis, select the correct answer.
   a) Expulsion of waste materials
   b)Engulfment of pathogens in phagosome
   c) Enzymes destroy the pathogen
   d) Phagocyte approaches the pathogen
   e) Phagolysosome is formed
   i) d,c,e,b,a ii) d,b,e,c,a iii) b,c,e,a,d iv) b,e,c,a,d
2. Find out those related to B lymphocytes from the following and choose the correct option.
   a) Production of antibodies
   b) Destruction of cancer cells
   c) Maturation in the thymus gland
   d) Formation in the bone marrow
   i) a,b and d are correct ii) a,c and d are correct
   iii) b and c are correct iv) a and d are correct
3. Which of the following is the correct pair of phagocytes?
   - Eosinophil, Neutrophil
   - Neutrophil, Monocyte
   - Basophil, Neutrophil
   - Monocyte, Lymphocyte
4. Analyse the given table and find the one in which both the statement and the reason are correct.

Sl No.	Statement	Reason
(i)	The thymus gland has a role in the defence of cancer.	B lymphocytes mature in the thymus gland.
(ii)	Blood clotting is a defence mechanism.	Prevents the flow of blood as well as blocks the entry of pathogens when there is a wound.
(iii)	Fever occurs during infection.	Antibodies raise the body temperature.
(iv)	Thromboplastin is involved in the process of blood clotting.	Thromboplastin converts fibrinogen into fibrin threads.

5. From the following, select the statements that are correct, regarding vaccines:
   - Vaccines act as antigens.
   - The immunity produced by vaccines is innate immunity.

- Vaccines help to produce antibodies against pathogens.
- All vaccines contain deactivated pathogens.

6. The following text is from a placard prepared in connection with World AIDS Day:

   Change ourselves, Change the Perspectives

   Evaluate the text on the placard based on the following indicators:

   i) Social responsibility to stop the disease

   ii) Approach toward those affected by the disease

7. Analyse the table showing certain pathogens in an area and the number of people affected by them and answer the questions.

Pathogen	Number of infected people
Naegleria fowleri	23
Leptospira	12
Plasmodium	57
Filarial worm	35

   i) Which disease affected more people in the region?

   ii) Which bacterial disease affected the people?

   iii) Which pathogen affected the residents who bathed in stagnant fresh water?

   iv) Prepare a note on the precautions to be taken to prevent vectors in the region.

8. Give reasons.

   Although antibiotics are effective medicines, their irrational use is harmful.

Extended activities

1. Organise a blood group determination camp in the school under the auspices of the Health Club and prepare a Blood Group Directory.
2. Conduct a survey to find out the vaccination status of school children in your area and plan awareness programmes accordingly.
3. Prepare an action plan to eliminate mosquitoes at home and in your school and submit the report to the concerned authorities of the school and the Panchayath.
4. Conduct interviews with the agricultural officer, veterinary doctor and farmers to learn about plant and animal diseases in your area, prepare a presentation and present it in class.

6

Biology and Technology

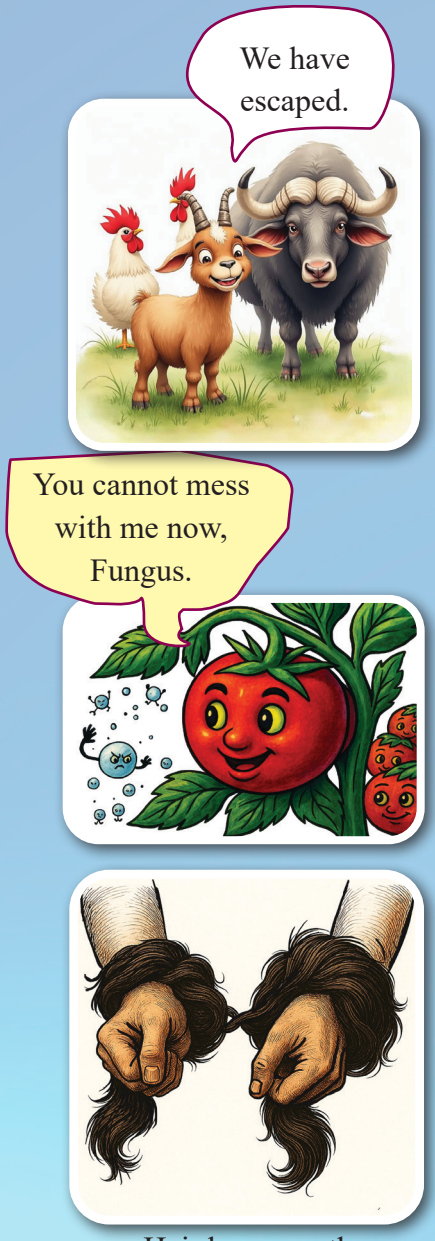
Genetic Revolution

Genetic technology has already become a part of human life. Its triumphant journey continues rapidly through new discoveries. Here are some examples!

We no longer need to slaughter animals for meat. Delicious meat is ready in the lab. Do you know how it can be done? Artificial meat is produced through a series of processes in labs by collecting stem cells from animals. Meat produced in this way is available in the markets in the USA, Israel and Singapore.

Efforts to produce plants with innate immunity through gene editing have been found to be successful. Many examples can be cited, such as the tomato plant which is naturally resistant to fungal disease. Very soon, chemical pesticides will be an old story.

In a murder that took place in Kerala in 2020, the body could not be found. But, a strand of hair was found in the car of the suspect. After subjecting the hair to DNA analysis, the murderer was identified and arrested. He was sentenced by a court of law.



Hair becomes the handcuff.

The given illustrations were prepared by a child who read the science article 'Genetic Revolution'. How are the article and illustrations related? Discuss and draw conclusions.

Along with the growth of humanity, science and technology has also developed. Analyse the illustration 6.1 along with the description, and present your findings.

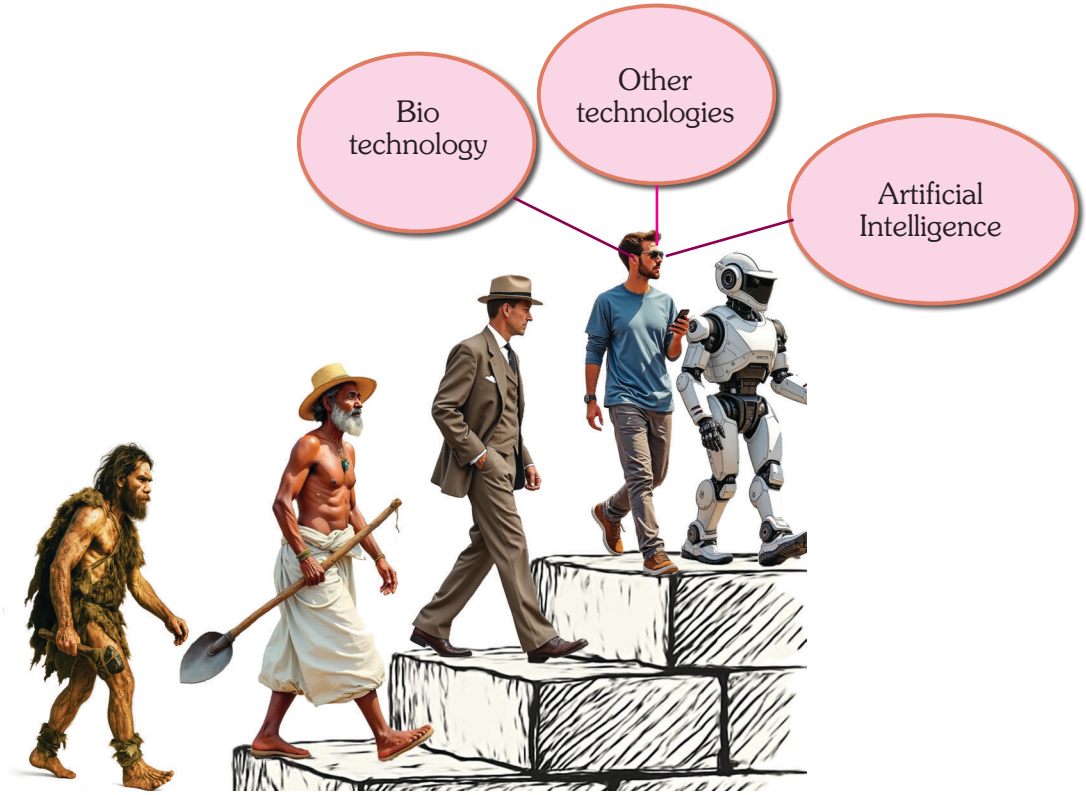


Illustration 6.1 Development of technology

From ancient humans who lived in harmony with nature, the human race has evolved and reached the modern era of biotechnology, genetics and Artificial Intelligence (AI). Starting from the use of fire, the beginning of agriculture, social life and animal domestication, man has been conquering new heights of knowledge through great discoveries such as cytology, genes, DNA analysis and synthetic biology. As seen in the illustration, humans are advancing from primitive man to modern man and from there to the heights of biotechnology, other technologies and Artificial Intelligence(AI). Through this, areas such as environment conservation, food security, agriculture, health, industry, etc. are all undergoing major changes.

Biotechnology and Genetic Engineering

Biotechnology is the technology of using living things or their parts, to provide products and services that are useful to humans. The discovery of the structure of DNA has accelerated the growth of biotechnology.

Genetic engineering is the technology for creating desired traits in organisms by combining or deleting genes. How is it possible to bring about such changes in the genetic constitution? Let us get familiarised with some of the techniques used for this, in genetic engineering.

Recombinant DNA Technology

Recombinant DNA technology combines DNA segments from two or more different organisms to form recombinant DNA. This includes a Restriction Endonuclease Enzyme i.e., the genetic scissors that cuts a specific gene, a ligase enzyme i.e., genetic glue that joins two DNA segments, a vector that carries the genes, and a host cell into which the recombinant DNA is inserted. Plasmids, which are the circular DNA in bacteria, and some viruses are used as gene vectors.

How is genetic constitution altered through recombinant DNA technology?

Prepare a note after analysing the description and illustration 6.2 based on the indicators.

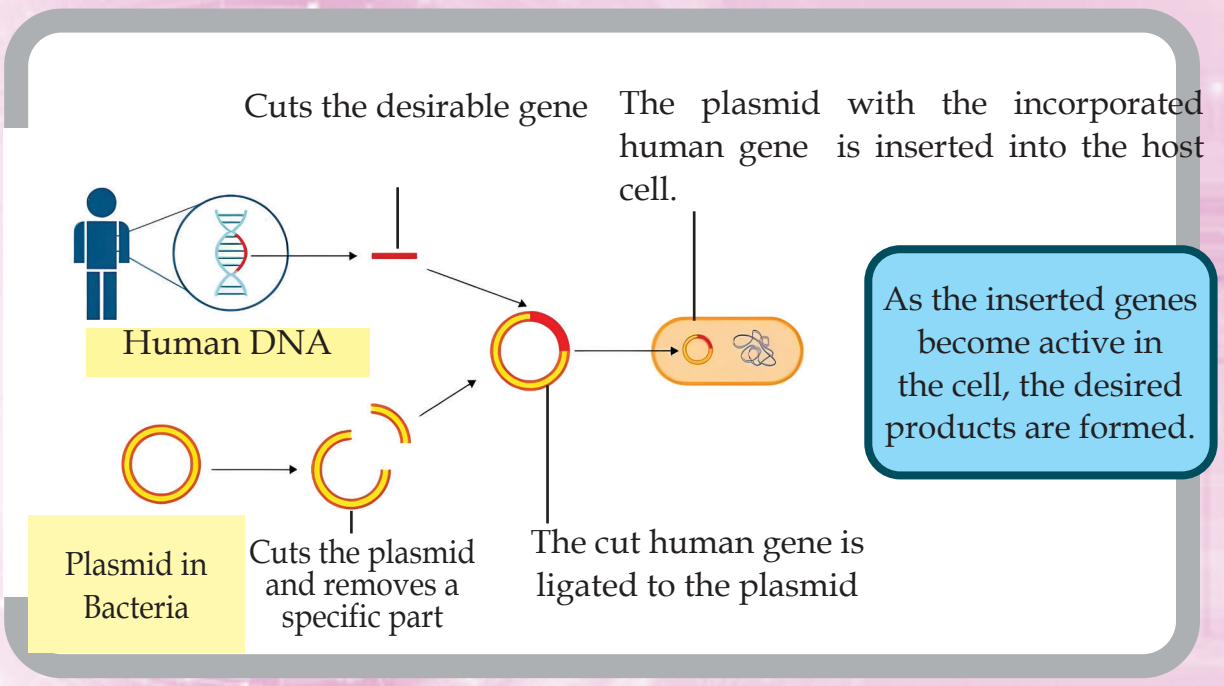


Illustration 6.2 Recombinant DNA technology

Indicators

- Recombinant DNA Technology
- Enzymes and their functions
- Vectors - function
- Various stages of recombinant DNA technology

This technology is widely used in various fields. An example for this is the production of human insulin using bacteria. What are the other fields in which this technology is used? Prepare a presentation by collecting data, and present it in the class.

CRISPR technology

You are familiar with many of the technologies used in video editing. Similarly, haven't you heard that gene editing can be done by using CRISPR technology?

CRISPR is a modern technology used to edit DNA with great precision.

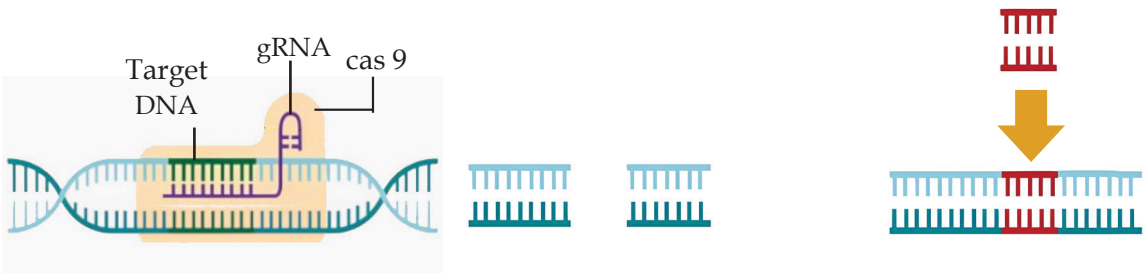
Is CRISPR technology the only one used in gene editing? Find out.

You already know those who invented this technology. Let us see how to use this, to edit genes.

The CRISPR technology was designed from a natural defence mechanism that bacteria use, to defend viruses. It uses an enzyme called **Cas9** as scissors to cut DNA. It also includes an RNA that identifies the DNA segment to be cut. This is called as guide RNA (gRNA).

How does this work?

Analyse the illustration 6.3 in accordance with the indicators, and prepare a note.



Identifying the target:
The guide RNA precisely identifies the DNA segment that needs to be cut.

Cutting:
The Cas9 enzyme cuts the DNA segment identified by the guide RNA.

Editing :
The sequence of nitrogen bases in DNA is edited so as to make changes in the characteristic of an organism. Through that, unwanted characteristics can be removed or new characteristics can be added.

Illustration 6.3 CRISPR technology

Indicators

- CRISPR technology
- Guide RNA, Cas9 enzyme
- Gene editing

You have understood how genetic engineering can alter the genetic constitution of organisms.

Genetically Modified Organisms - GMOs

There are plants, animals, and microorganisms whose genetic constitutions have been altered through genetic engineering. They are called Genetically Modified Organisms (GMOs). Critically analyse the following table 6.1 in accordance with the indicators, and prepare a note.

Indicators:

- The various fields in which benificial changes are brought about, and the resultant changes.
- The changes that can be brought about in nature by genetically modified organisms

Genetically Modified Organisms →

Group of organisms	Characteristics	Examples
Plants	Pest resistance	Bt. Cotton
	Weedicide resistance	Soya bean
	Nutrient – enriched	Golden rice
	Virus resistance	RSV resistant papaya
Animals	Fast growth Disease resistance High productivity	Salmon Fish
	Fluorescence	Glo fish
Micro-organisms	Ability to decompose waste	*Psuedomonas putida*
	Ability to produce insulin	*E.coli*
	Fermentation ability	Baker's yeast
	High nitrogen fixing ability	*Rhizobium*

Table 6.1 Genetically modified organisms

We have understood how changes are made in genes and what genetically modified organisms are. This was possible because of the precise identification of the genes responsible for each character and their exact location. How were the locations of human genes identified? Analyse the given description in accordance with the indicators and prepare a note.

Human Genome Project (HGP)

Genes control our characteristics and activities. Genome is the sum total of all the genetic materials in an organism. The human genome contains approximately 300 crore DNA base pairs.

The Human Genome Project was a global scientific initiative that began in 1990 and was completed in 2003, with the goal of completely understanding the information in the human genome. Gene mapping technology which identifies the location of genes in DNA has helped in this. The following facts were discovered through this project.

Has the genome information of other organisms been discovered? Find out.

- The exact sequence of 300 crore base pairs in the human genome. Humans have 20,000 to 25,000 genes.
- Functional genes make up approximately 1-2% of human genome. The remaining bulk part is known as 'junk DNA'. (Studies are going on about its exact functions.)

Indicators

- Genome
- Gene Mapping
- Human Genome Project

The Human Genome Project is a major milestone in biology. It is very helpful in understanding how genetic diseases occur, and in finding new treatment methods.

Gene Therapy

When the genes in our body become defective, many diseases can occur. Gene therapy is the method of treating diseases by removing the defective genes and replacing them with functional genes.

Let us analyse one example.

You have learned that sickle cell anemia is a hereditary disease. There was no effective treatment for this disease earlier. However, the World Health Organization has given approval for gene therapy to completely cure sickle cell anemia. This treatment method can be described as gene therapy or stem cell therapy, as it involves genetic modification of the stem cells of the patient and their injection back into the body.

Illustration 6.4 explains how sickle cell anaemia is treated using stem cells. Examine it and list out the various stages of stem cell therpy.

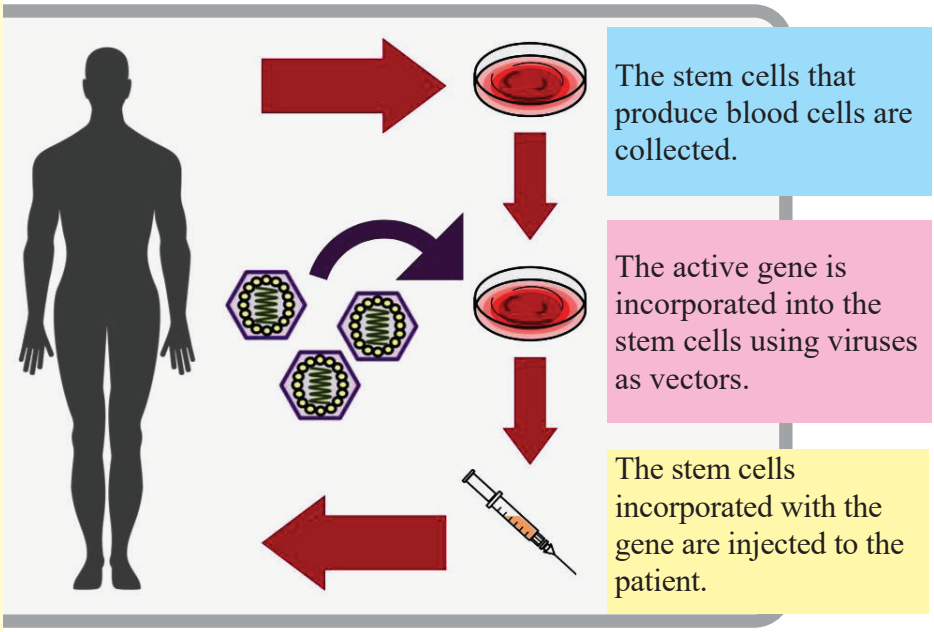


Illustration 6.4 Stem cell therapy

Like gene therapy in health sector, genetic technology has influenced other sectors also. One among them is the field of criminal investigation. In the article at the beginning of the chapter, it was mentioned that the culprit was identified using a strand of hair.

How does gene therapy work?

Somatic gene therapy delivers healthy genes to body cells. Examples: muscles, liver, blood cells. The effect of this therapy will be only in the person being treated; that is, these changes in genes will not be passed on to the next generation. However, in germline gene therapy, the genes are transferred into the reproductive cells. The genetic changes that occur in this way will be transmitted to the next generations. This raises so many ethical and social questions.

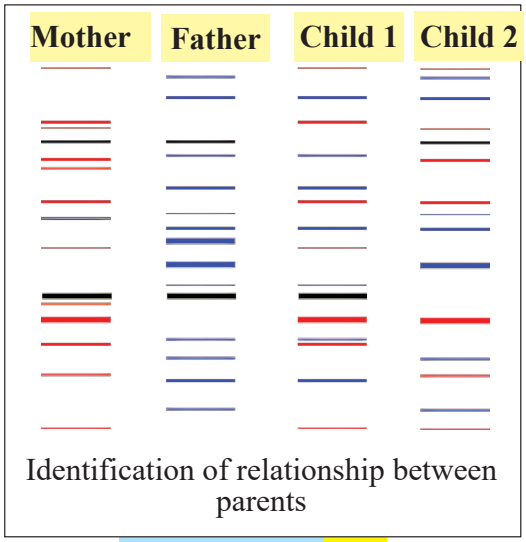
A sample of the victim's hair, blood, or saliva obtained from the scene of crime is sufficient to identify the perpetrator! Although it may sound unbelievable, this is possible through the technology of DNA fingerprinting. Prepare a note by analysing the description and illustration 6.5.

DNA Fingerprinting

99.9% of DNA is the same in all humans. Variations are seen in the remaining 0.1% of the DNA of individuals. The technology that is used to analyse the sequence of nucleotides in DNA and to identify individuals accordingly is called DNA fingerprinting. Just as fingerprints that vary from person to person, the sequence of nucleotides in each person also vary. This peculiarity helps to identify individuals. These differences are mainly seen in the parts of DNA that do not help to make proteins. In these parts, some DNA sequences are repeated. The number of repeats and their order differ in each individual. More resemblances can be seen in the DNA patterns of parents, their offspring and siblings. Analyse the illustration 6.5 a and find out how the relationship between parents and offspring is identified and also analyse illustration 6.5 b and identify the person to whom the sample resembles.

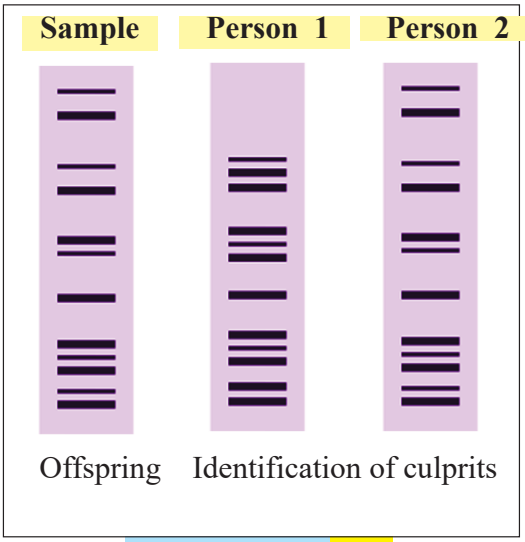
Know the scientists

British geneticist Sir Alex Jeffrey discovered DNA fingerprinting on 10 September, 1984, at the University of Leicester. While examining a DNA X-ray film, he realised that differences in the DNA patterns of individuals could be used to identify them. He also discovered that each individual has a unique DNA pattern, as unique as the fingerprint.



Identification of relationship between parents

Illustration 6.5 a

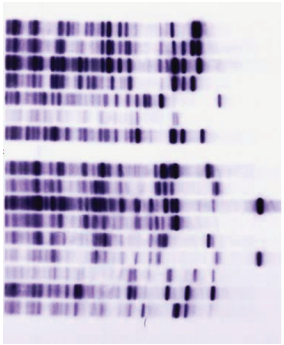


Offspring Identification of culprits

Illustration 6.5 b

DNA fingerprinting

Uses of DNA Fingerprinting

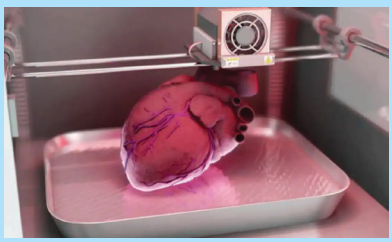


- To identify culprits
- To identify genetic disorders and learn about hereditary diseases
- To determine the biological relationship between parents and offspring
- To understand lineage by identifying fossils
- To identify victims of accidents or disasters
- To track endangered species

Indicators

- DNA Fingerprinting
- DNA Fingerprinting - basis
- Application possibilities of DNA Finger printing
- Match with the sample and the culprit in the illustration

Organoids and 3D printing



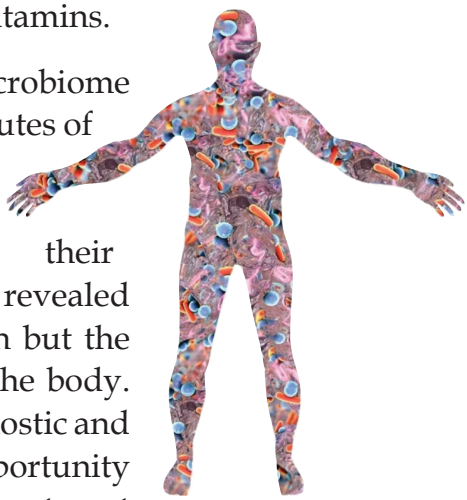
Organoids are tiny, three-dimensional tissue models that are grown in the lab. They help to study diseases, test new drugs, and develop regenerative therapies. Currently, the shortage of donors , infection, and the tendency of the body to reject the new organ are major challenges in organ transplantation surgery. 3D printing of organs is a technology that can help to overcome these challenges. By using M.R.I or C.T scan the image of organs are collected. These images and bioinks (consisting of living cells, other organic materials and growth factors) are sent to the 3D bioprinter. Using the bioinks, the 3D bioprinter creates organ models. This technology could effect major changes in organ transplantation surgery in future.

Various possibilities of biotechnology have been discussed so far. Humans are the only species that can make desirable changes to the genetic make up of other organisms. Even microorganisms are used for it. Microorganisms are most widely used in biotechnology. But we see them as pathogens. That attitude needs to be corrected. Even our body is protected by microorganisms.

Consolidate the concepts by analysing the part of an article given below, based on the indicators.

Human Microbiome Project (HMP)

The human microbiome is the collection of microorganisms and their genes that inhabit and interact within the human body. It is a community of microorganisms that includes bacteria, archaea, fungi and viruses. The number of microorganisms in our body is ten times more than the cells. They provide us many services, including immunity, digestion, and the production and absorption of vitamins.



To develop knowledge about those, the Human Microbiome Project (HMP) was launched by the National Institutes of Health (NIH) in the United States in 2007. HMP proved that the human body is not only composed of cells but also crores of microorganisms and their co-existence is essential for our well being. It also revealed that the cause of disease is not only the pathogen but the change in the equilibrium of microorganisms in the body. This knowledge has opened new avenues for diagnostic and treatment methods. This project opened a great opportunity to design personalised medicine and to arrange treatment according to each individual's microbiome.

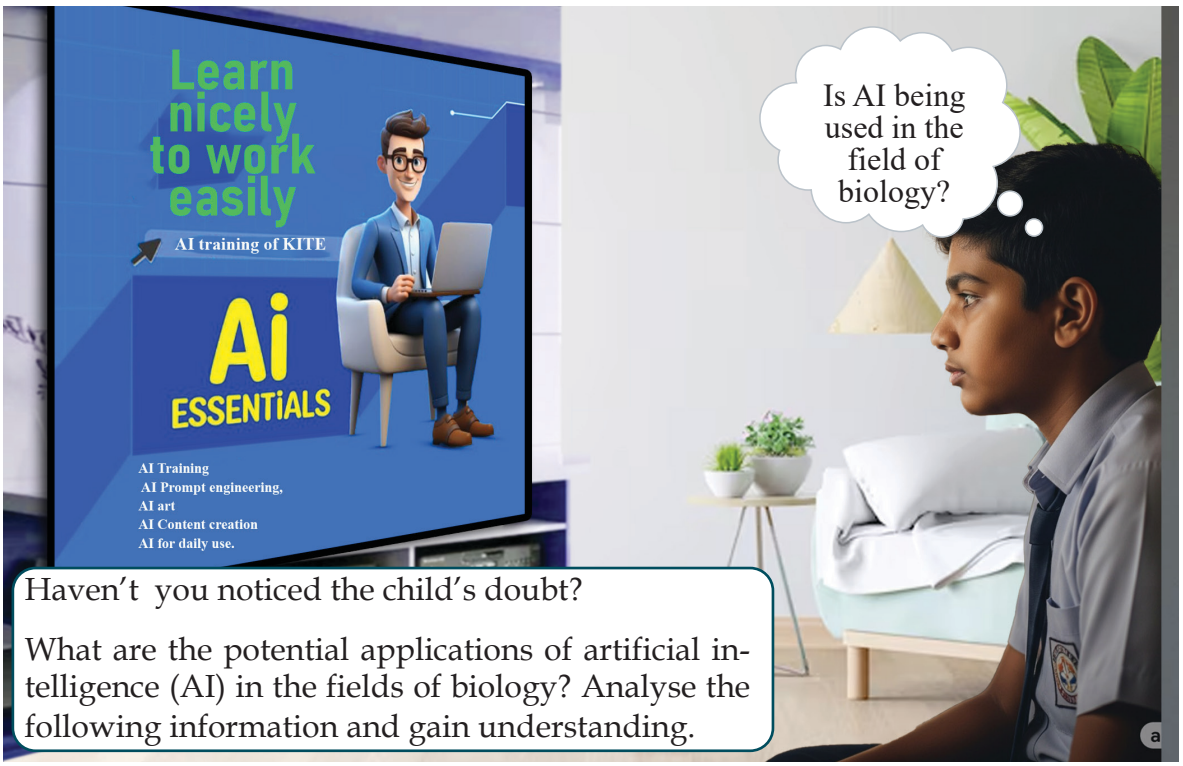
Indicators

- Microbiome
- Microbiome Project
- Services provided by Microbiome

The science that converts even feces to medicine

Oh! Are even faeces medicine? Don't frown. That's true. We have already learned about the crores of microorganisms that work for us in our body. Majority of them are bacteria. Antibiotics are ineffective for serious infections caused by drug -resistant *Clostridium difficile* bacteria. It is at this point that a new treatment using faeces as medicine becomes effective. For this treatment, beneficial bacteria are collected from the faeces of a healthy person and are converted into capsules. When these poop pills are given to patients, the number of good bacteria increases and they can resist *Clostridium difficile* infection. The World Health Organization has approved the poop pill treatment. Though it may sound strange, it is an example to show that science will adopt any means to solve problems by its own methods.

Biology and Artificial Intelligence (AI)



Haven't you noticed the child's doubt?

What are the potential applications of artificial intelligence (AI) in the fields of biology? Analyse the following information and gain understanding.

AI plays a major role in many areas of biological study, including disease diagnosis, drug discovery and genetic engineering. Bioinformatics is a new scientific discipline of science that analyses biological data by combining the latest technological disciplines such as computer science, mathematics and statistics.

Diagnosis, treatment
For discovering new drugs, for predicting the effectiveness of chemical substances and recommendation of the most suitable treatment

Personalised medicine
analyses each individual's genetic makeup and health information and recommends the most suitable treatment regimens for them.

Genome sequencing
Utilised in gene editing technology for the treatment of genetic disorders

Improving agriculture
Monitors the health of the soil, predicts the diseases that might affect crops

Pollution
Predicts air and water pollution levels and recommends mitigation strategies

Bioinformatics
Analyses large amounts of genetic data and suggests simplification strategies

Find out more potentials of AI in the study of biology and prepare a presentation.

Technological possibilities in environmental conservation

Numerous biological techniques have been developed to help conserve the ecosystems and biodiversity. Prepare a note on how technology can be used to protect the environment by analysing the following illustration.

Wildlife Tracking Sensors: These help wildlife conservationists and researchers to plan conservation strategies by monitoring the movement, behaviour, and location of wild animals.

Global Biodiversity Data Sensors: A technology that collects information about biodiversity using satellite remote sensing, acoustic analysis and camera traps

Cryopreservation:

This is the process of preserving living cells, tissues and organs at very low temperatures (-196°C). It is used for long-term preservation in fields such as medicine, agriculture and research.

Bioremediation:

Uses microorganisms and plants to remove pollutants from contaminated environments such as soil, water and air. This converts the pollutants into harmless compounds.

You have understood the modern techniques related to biology.

Organise a seminar on the topic 'Biotechnology: Opportunities and Challenges.'

Sub-topics

- Biotechnology
- Artificial Intelligence
- Possibilities
- Challenges

The growth of scientific technology helps humanity to move forward rapidly on the path of progress. As a result, many problems arise. Plastic, which was discovered at the beginning of the 20th century, has positively changed our lives. But today, plastic is the main cause of pollution. Plastic materials that we carelessly throw away are clogging up the largest living environment, the ocean. Along with plastic pollution, we are facing serious environmental problems today, including global warming, climate change and biodiversity depletion.

Figure **6.1** The great Pacific Garbage Patch

In the Pacific Ocean, plastic has accumulated and formed a floating region covering 16 lakh square kilometers- that is a region thrice the size of France (The Great Pacific Garbage Patch). To find solutions such environmental problems,

it is essential to bring together the potential of scientific technology and the collective efforts of humanity. For that, numerous activities such as climate change summits and the Paris Agreement are being held under the auspices of the United Nations. One among them is the Day Observations which you are acquainted with.

World Environment Day, observed on 5 June, and World Ocean Day, observed on 8 June, aim to create knowledge and awareness about environmental conservation.

Let us prepare a report on both Day Observations that took place this year. Its format is given below. Prepare the report and evaluate by exchanging each other.

	Environment Day (June 5)	**World Ocean Day (June 8)**
History (in brief)		
This year's main theme		
Activities that took place at your school		

Format **6.1** Report of the Day Observations

History is the record of the development of mankind, who lived in the forest like animals. Scientific technology, the main driving force of it which originated in the human brain, has now reached up to gene editing and artificial intelligence. We began our discussion mentioning gene editing. You have already understood its details. There are two faces for the development of such technologies. The first one is the welfare and well-being of humanity. The second one is that, if it is handled with greed and selfishness, the very existence of humanity will be in danger. Along with the use of scientific technology for the improvement of living conditions, it should be also planned and utilised in such a way as to benefit the environment and all humans.

Let's assess

1. Which of the following statements about recombinant DNA technology is correct?

   I. Restriction enzymes are used to cut the DNA of an organism.

   II. Ligase enzymes join the cut DNA fragments together.

   III. Vectors are usually bacterial plasmids.

   IV. When recombinant DNA enters a host cell, it does not replicate.

   a) I and II only b) I, II, III only

   c) I, III, IV only d) I, II, III, IV all

2. Identify A, B, and C and choose the correct option.

   A: A technology that joins together DNA segments from two or more different organisms

   B: A technology used to locate genes in DNA

   C: A technology used to identify individuals by analysing the arrangement of nucleotides in DNA

   i) A - Recombinant DNA Technology, B - Gene Mapping, C - DNA Fingerprinting

   ii) A - Human Genome Project, B - Gene Therapy, C - CRISPR Technology

   iii) A - Recombinant DNA Technology, B - DNA Fingerprinting, C - CRISPR Technology

   iv) A - Gene Therapy, B - Gene Mapping, C - Human Genome Project

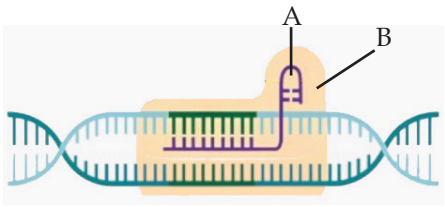
3. What is the importance of the host cell in recombinant DNA technology? Analyse how this technology would be limited if there were no host cells.

4. Analyse how the information provided by the Human Genome Project will help in the future development of recombinant DNA technology, CRISPR editing technology and AI in biology.

5. How can the use of genome data be helpful in prescribing drugs that are appropriate for the patient?

6. Analyse the fundamental similarities and differences between recombinant DNA technology and gene therapy.

7. Observe the illustration and answer the questions.



a) Name the technology indicated in the illustration.
b) Identify and name A and B.
c) What is the role of A and B?

8. Imagine that you have received a DNA fingerprinting report in a forensic case. Explain how the perpetrator can be identified by analysing the patterns in this report. How can this technology be used to identify the unidentified deadbodies found in natural disasters?

9. How does artificial intelligence (AI) help data analysis and discoveries in biological research?

10. Prepare a note on the following concepts to present in a seminar on the possibilities of technology for environmental conservation:

i) Data Collection ii) Biodiversity Conservation iii) Pollution Control

Extended activities

1. Prepare a short video on the topic 'The Role of the Microbiome in a healthy lifestyle' by including the Human Microbiome Project, the importance of microorganisms in our body as well as their relationship with health and diseases, and present it under the leadership of Little KITES.

2. Organise a debate to discuss on the topic 'The Social and Ethical Aspects of Biotechnology including Genetic Engineering' by involving experts and the general public.

3. Conduct a publicity campaign in schools and nearby areas, by using posters and pamphlets prepared on the importance of bio technology.

4. Prepare a science article exploring the possibilities and problems that could arise if gene editing were applied to humans.

CONSTITUTION OF INDIA

Part IV A

FUNDAMENTAL DUTIES OF CITIZENS

ARTICLE 51 A

Fundamental Duties- It shall be the duty of every citizen of India:

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievements;

(k) who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between age of six and fourteen years.