15. Life Processes in Living Organisms

- Transportation in Plants
- Excretion: Plants, Animals and Humans.
- Co-ordination: Plants and Humans

Can you recall? How do the digestive system and respiratory system work?

We have studied how digested food or oxygen inhaled by lungs is transported to every cell of the human body. The farmer also tries to transport the water from wells or dams through a main channel to every plant. The food absorbed by the digestive system is converted into energy. This energy and oxygen are both transported via blood throughout the body.

Transportation

By the process of transportation, a substance either synthesised or absorbed in one part of the body reaches another.

Transportation in plants

Discuss

1. Why do we eat fruits and vegetables? Do the plants also need minerals like we do?
2. From where do the plants get inorganic substances other than carbon dioxide and oxygen?

Most animals move from place to place but plants do not. There are many dead cells in the plant body. They need less energy as compared to animals. Plants need inorganic substances like nitrogen, phosphorus, magnesium, manganese, sodium, etc. Soil is the nearest and richest source of these substances. Roots of plants absorb these substances from the soil and transport them. There are specific types of tissues to perform this function. The xylem conducts the water whereas the phloem conducts the food. All parts of the plant are connected with these conducting tissues.

Use your brain power !

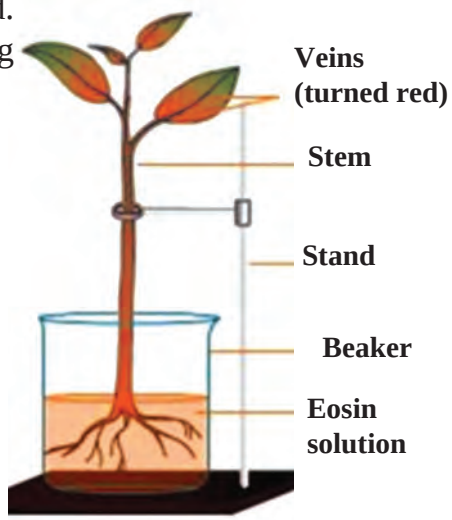
Which types of plant tissues are xylem and phloem?

Transportation of water in plants :

Try this

Root pressure

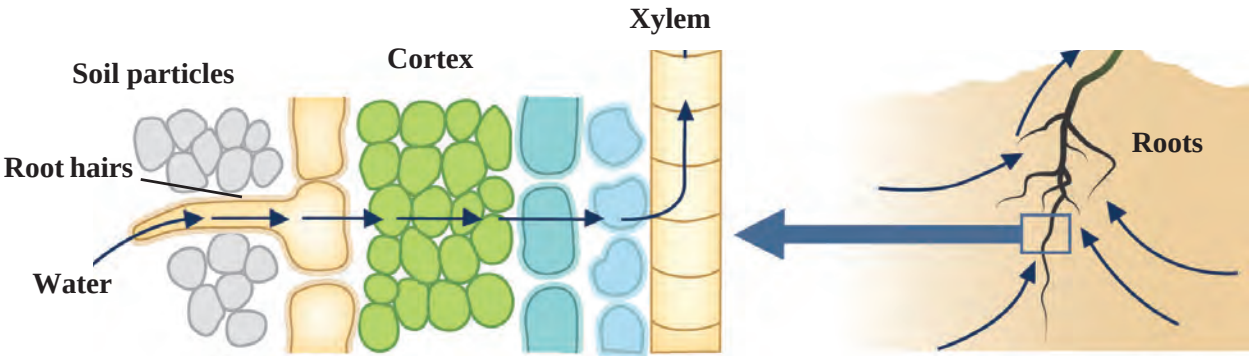
Take a small plant like balsam or tuberose with its roots intact. Wash and clean its roots. As shown in the fig. 15.1, keep it in the water containing a stain like safranin or eosin. Observe the stem and the veins of the leaves after 2 – 3 hours.



15.1 Root pressure

Observe

Take a transverse section of the stem of a plant and observe the stained xylem under a compound microscope.



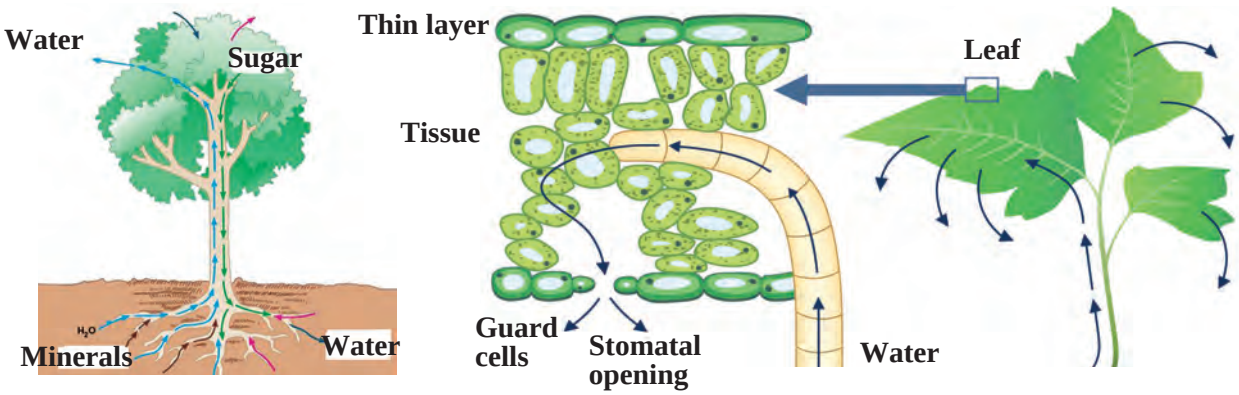
15.2 Absorption with the help of roots

Root cells are in contact with water and minerals in the soil. Water and minerals enter the cells on the root surface due to differences in concentration. As a result, these cells become turgid. These turgid cells exert pressure on the adjacent cells. This is called 'root pressure'. Under the effect of this pressure, water and minerals reach the xylem of the roots and to reduce this difference in concentration they are continuously pushed forward. As a result of this continuous movement, a water column is formed, which is continuously pushed ahead. This pressure is sufficient to lift the water up in shrubs, small plants and small trees.

Transpiration pull

Can you recall?

Previously you have performed the activity of observing a branch covered in a plastic bag. What did you observe in that activity?



15.3 Transpiration through Leaves

Plants give out water in the form of vapour through the stomata on their leaves. Two cells called guard cells are present around the stomata. These cells control the opening and closing of stomata. Transpiration occurs through these stomata. Water is released into the atmosphere by leaves through the process of evaporation. As a result, water level in the epidermal layer of the leaf decreases. Water is brought up to the leaves through the xylem so as to compensate for the lost water. Transpiration helps in absorption of water and minerals and distribution to all parts of the plant whereas root pressure performs the important role of pushing the water up during the night time.

Do you know?

The oak tree releases about 1,51,000 litres of water into the air by the process of transpiration in one year whereas a maize crop in an area of one acre gives out about 11,400 to 15,100 litres of water per day.

Transportation of food and other substances in plants :

The food produced in leaves is transported to each cell in the plant body. Excess food, except amino acids, is stored in roots, fruits and seeds. This process is called 'translocation' of materials. It is carried out in both the upward and the downward directions by the phloem. Translocation of materials is not a simple physical process; it requires energy. This energy is obtained from ATP.

Whenever food material like sucrose is transported towards a part of a plant via the phloem with the help of ATP, the water concentration decreases in that part. As a result, water enters the cell by the process of diffusion. The pressure on the cell wall increases due to the increase in cellular contents. Due to the increased pressure, food is pushed into the neighbouring cells where the pressure is low. This process helps the phloem to transport the materials as per the need of the plant. During flowering season, the sugar stored in roots or stem is transported towards the floral buds to make them open and blossom.

Excretion

Think about it

At least a small quantity of garbage or waste is produced every day in each house. What will happen if you keep this garbage for many days in your house?

Many harmful and waste substances like urea, uric acid, ammonia, etc. are produced in living organisms. If these substances accumulate in the body or are retained in the body for long, it can lead to serious harm or even death. Hence, it is necessary to remove such harmful and waste substances from the body. Different organisms have different methods of doing this. Removal of waste or harmful substances from the body is called excretion. In unicellular organisms, waste materials are directly eliminated across the cell surface whereas the process of excretion in multicellular organisms is complex.

Always remember

Retention of unwanted and harmful substances in the body is dangerous. Hence, just as the process of excretion occurs in living organisms, similarly, proper disposal of the garbage produced in our locality and home is also necessary. This will help you lead a healthy life.

Excretion in plants

Can you tell? Why does this happen?

1. Leaves of plants fall off in a particular season.
2. Fruits, flowers fall off after a certain period of time.
3. Substances like resin, gum, etc. are given out of the plant body.

15.4 Leaf fall

Excretion is a simpler process in plants than in animals. There is no special organ or system for excretion in plants. Gaseous substances are given out by diffusion. Most of the waste substances of plants are stored in vacuoles of leaf-cells and in flowers, fruits and the bark of the stem. After some time these parts fall off. Some other waste materials are stored in old and worn xylem in the form of resin and gum. Some waste materials are also given out through roots into the surrounding soil.

Observe and find out.

Observe your mother while she cuts elephant's foot (*Amorphophallus*) or arum leaves. Your hands may also begin to itch if you try to cut those leaves. Why does this happen? Try to find out. Ask your mother what she does to prevent the itching.

15.5 Gum and latex

In some plants, waste materials are present in the form of crystals of calcium oxalate. They are called raphides. As they are needle-shaped, they prickle and cause irritation of the skin.

Some waste materials of plants are useful to humans, for example, gum, resin, latex of rubber, etc.

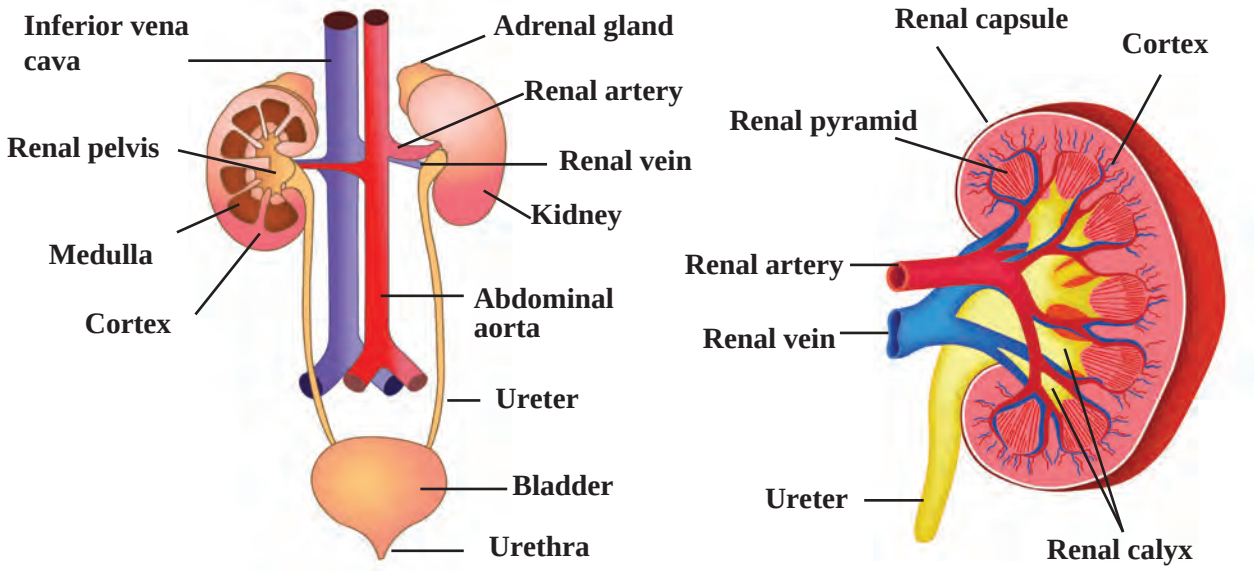
Excretion in human beings

Can you tell?

1. Which waste materials are produced in our body through metabolic activities?
2. How does the process of excretion take place in humans?

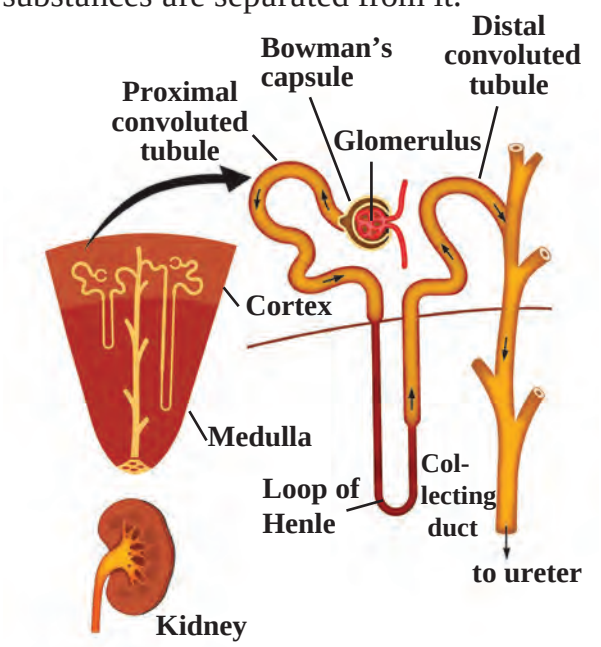
There are different organ systems in the human body to bring about the different life processes, such as the digestive system for digestion of food, respiratory system for respiration, etc. The process of digestion leading to energy production is an important process of our body. Various waste materials are formed during this process. Removal of these wastes from the body is very important and it is the **excretory system** that carries out this function.

The human excretory system consists of a pair of kidneys, a pair of ureters, the urinary bladder and the urethra. Urine is formed by the kidneys by separating the waste and unwanted excess substances from the blood.



15.6 Excretory system and kidneys

The two bean-shaped kidneys are situated one on either side of the vertebral column, on the posterior side of abdomen. The functional unit of the kidney that performs the basic function of filtration is called a nephron. Each nephron has a cup-like, thin-walled upper part called the Bowman's capsule. The network of capillaries in it is called a glomerulus. The urea produced in the liver comes into the blood. When the urea-containing blood comes into the glomerulus, it is filtered through its capillaries and urea and other similar substances are separated from it.

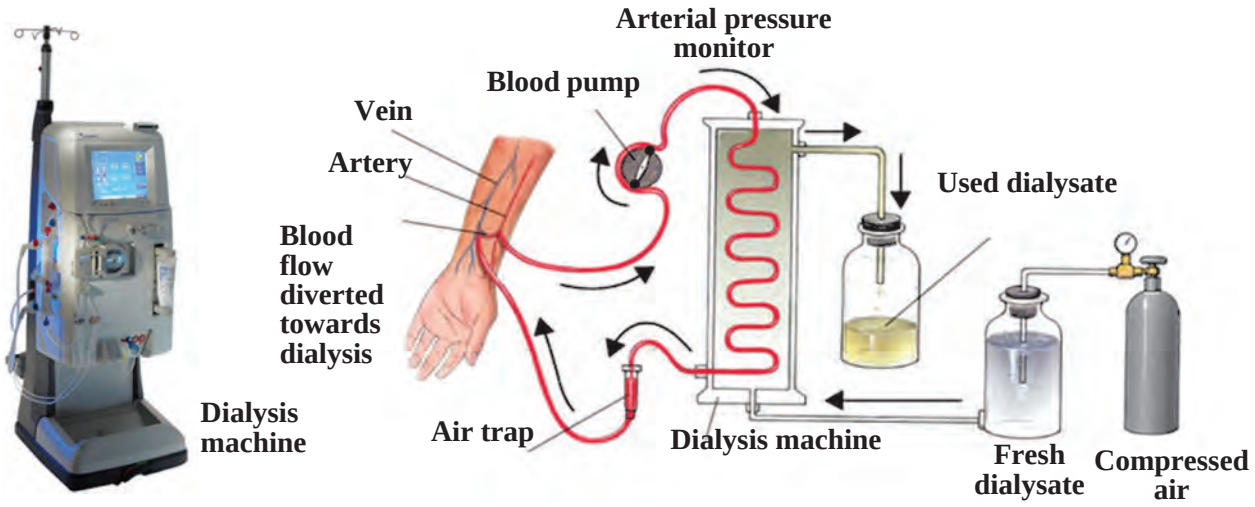


15.7 Nephron

Water molecules and small molecules of some other substances can cross the semipermeable membrane of Bowman's capsule. The solution accumulated in the cavity of Bowman's capsule passes into the tubular part of the nephron. Here, molecules of water and some other useful substances are reabsorbed into the blood. Urine is formed from the remaining solution which is full of waste materials. The urine is carried by the ureters and stored in the urinary bladder. Afterwards, urine is given out through the urethra. The urinary bladder is muscular and it is under the control of nerves. Hence, we are able to keep a control on urination. Though the kidneys are the main organs of excretion in human beings, the skin and lungs also help in the process of excretion.

The right kidney is in a slightly lower position than the left. Each kidney has approximately 10 lakh nephrons. The approximately 5 litre of blood which is present in a normal healthy person's body is filtered by the kidneys about 400 times every day. Thus, every day, the kidneys filter about 190 litres of blood from which about 1 to 1.9 litres of urine is formed. The remaining liquid is reabsorbed.

Dialysis



15.8 Dialysis of blood

The efficiency of kidneys can be adversely affected by injury, infection or decreased blood supply. In case this happens, an excess of toxic substances accumulates in the body and it can lead to death. If kidneys fail, nitrogenous wastes are separated from the blood with the help of a man-made machine. The process of separating the nitrogenous waste from blood with the help of this machine is called dialysis. About 500 ml of blood is sent at one time through this machine. Purified blood is reinfused into the body of the patient.

Use your brain power !

1. As compared to the monsoons and winter a very small quantity of urine is produced in the summer season. Why is it so?
2. In adults, the process of urination is under their control but not in infants. Why is it so?

Co-ordination

Think about it

1. Sometimes, while eating we bite our own finger or tongue by mistake.
2. Sometimes, we choke while eating in a hurry.

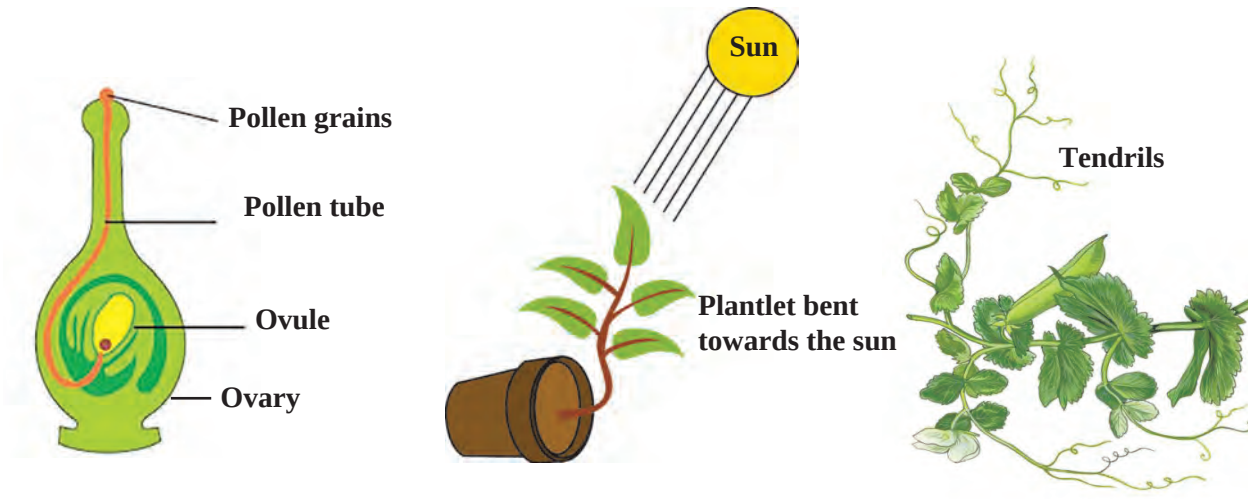
Several different organ systems function in multicellular organisms. Their life goes on smoothly if there is co-ordination between the different organ systems or organs and the stimuli in the surrounding. Depending upon this, we can say that systematic regulation of different processes can be called control and bringing about the different processes in the proper sequence can be called co-ordination.

If any activity in the body is to be completed successfully, proper co-ordination between different systems and organs participating at different steps of that activity is necessary. If due to lack of co-ordination or some other factor, there is confusion at any step the activity may not get completed. There should not be any randomness at any step. There needs to be proper co-ordination between internal activities of the body resulting from various factors like body temperature, water-level, enzyme-level, etc. or stimuli arising in the surrounding environment. Proper co-ordination between various systems of an organism helps to maintain a state of equilibrium called 'homeostasis' which is necessary for the optimal efficiency of the body.

Co-ordination in plants

Plant do not have systems like the nervous system or muscular system of animals. Then, how do plants bring about movements? In plants, movements are mainly in the form of responses given to the stimuli.

Observe Observe the following figures carefully.



Pollen tube growing towards the ovule | **Phototropic response** | **Thigmotropic response**

15.9 Co-ordination in plants

Movement or growth of any part of the plant in response to an external stimulus is called 'tropism' or 'tropic movement'.

The shoot system of any plant responds to the light stimulus i.e. it grows towards the source of light. The movement shown by plants towards the source of light is called 'Phototropic movement'.

The root system of plants responds to stimuli like gravitation and water. These responses are called 'gravitropic movement' and 'hydrotropic movement' respectively.

Movement shown by plants in response to specific chemicals is called 'chemotropic movement'. For exmaple, the growth of the pollen tube towards the ovule.

All the above-mentioned movements of plants are related with growth; hence all such movements are collectively called 'growth relevant movements'.

Do you know?

* Tendrils of climbers are sensitive to touch.
* A hormone called auxin produced in the apical part of the shoot helps in enlargement of cells.
* Hormones like gibberellins help in stem elongation and cytokinins help in cell division.
* The hormone, abscisic acid, is effective in prevention and retardation of growth, leaf wilting, etc.

Observe Observe the pictures carefully and think about them.


Touch-me-not


Venus fly trap


Lotus


Balsam

15.10 Various plants

On careful observation it is seen that in plants like touch-me-not (*Mimosa*), movement also occurs at the places other than where it has been touched. Hence, we can infer that the information about the touch must have been relayed within the plant from one place to another. Plants use electro-chemical impulses for transfer of information from one place to another. Plant cells change their shape by increasing or decreasing their water content and thereby bring about the movements of plants.

Some specific movements of the plants do not lead to the plant's growth. Such movements are called 'growth-irrelevant movements'. As a response to changes in the surroundings, plant hormones bring about various movements in plants.

Do you know?

In the plant called Venus fly trap, there is a trap that appears and smells like flowers and deceives insects. When an insect visits that flower-like trap, the trap closes up and the trapped insect is digested by the plant.

The lotus flower opens during day-time while that of the tuberose (*Polyanthus*) opens at night.

Fibrils present on the leaves of the insectivorous plant *Drosera*, bend inwards as soon as an insect lands on the leaves and surround the insect from all sides.

In Balsam, the ripened fruit dehisces (bursts-open) at the right time to disperse the seeds.

Co-ordination in human being

Observe

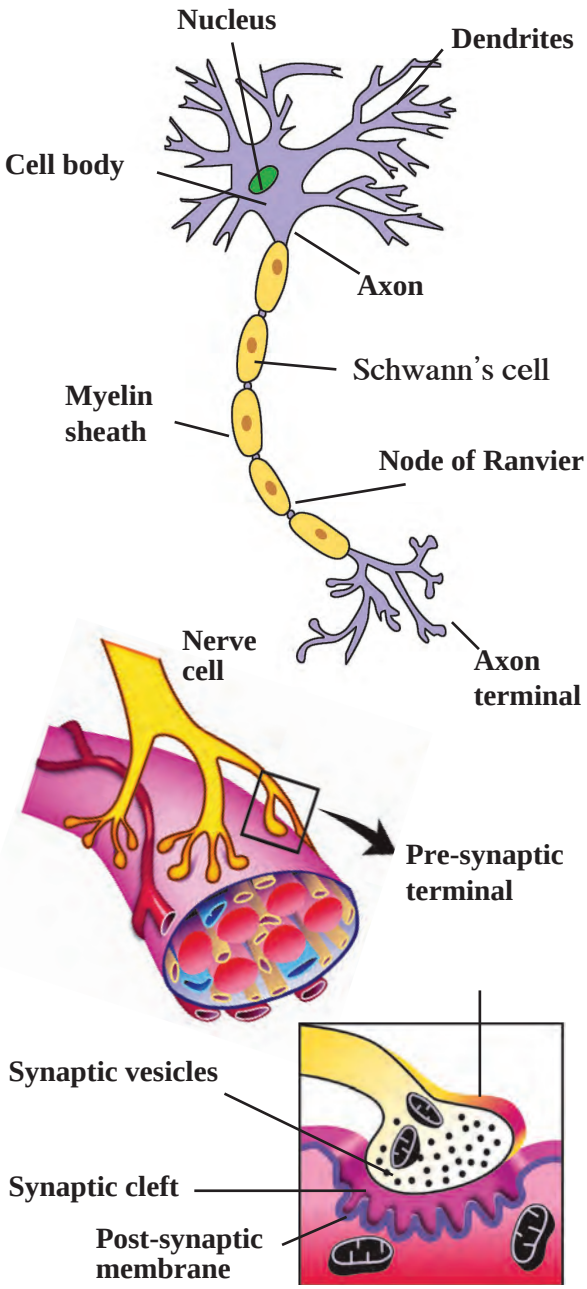
As you watch the match being played on your school ground, you will see the control and co-ordination among the movements of the players. Make a list of of all such different actions.

Different processes go on simultaneously in the human body. All these process need to be efficiently and effectively conrolled and co-ordinated. This is done with the help of two systems.

A. Nervous control : Humans can respond to changes in their surroundings due to nervous control. Impulses are generated in the human body, in accordance with changes in the surroundings. Nervous control plays the important role of empowering the body cells with ability to respond to these impulses. This ability depends upon the complexity of organization in the organism's body structure. Unicellular animals like the amoeba do not have a nervous system which produces such impulses and responses. However, multicellular animals like humans, have a nervous system to respond to the stimuli. Control and co-ordination is brought about with the help of a special type of cells called nerve cells or neurons.

Neurons (Nerve cells) : Special types of cells which conduct impulses from one place to another in the body are called neurons. Neurons are the structural and functional units of the nervous system. Nerve cells, the largest cells in the human the body, may measure up to a few metres in length. Nerve cells have the ability to generate and conduct electro-chemical impulses. The cells that support the nerve cells and help in their functioning are called neuroglia. Nerve cells and neuroglial cells together form the nerves.

All the information about our surroundings is collected by the ends or dendrites of the neuron. The chemical process begins at those ends and electric impulses are generated which are conducted from the dendrites to the cell body, from the cell body to the axon and from the axon to its terminal. These impulses are then to be transferred from this nerve cell to the next. Now the impulse that reaches the terminal of an axon, stimulates the nerve cell to secrete certain chemicals. These chemicals pass through a minute space, called the synapse, between two adjacent neurons and generate the impulse in the dendrites of next neuron. In this way, impulses are conducted in the body and these impulses are finally conveyed by nerve cells to muscle cells or glands.



15.11 Nerve cell and neuro-muscular junction

When an action or movement is to be brought about in the body, the work of the muscular tissue comes last in the sequence. Movement of muscle cells is essential to bring about any activity. When cells contract to change their shape, movement occurs at cellular level. Muscle cells have the ability to change their shape due to a special type of protein. Besides, due to these same proteins, cells become able to respond to electrical impulses of nerves.

Thus, we can say that the nervous system consists of a well-organized network of nerves which can conduct information in the form of electrical impulses from one part of the body to other.

Can you tell?

1. Which are the sensory organs of an organism? What is their function?
2. Where are the gustatory and olfactory nerves to be found?
3. Collect information about the function of all the above mentioned parts and present it in the class.

Types of nerve cells/neurons

According to their function, nerve cells are classified into three types.

1. **Sensory neurons :** Sensory neurons conduct impulses from sensory organs to the brain and the spinal cord.
2. **Motor neurons :** Motor neurons conduct impulses from the brain or spinal cord to effector organs like muscles or glands.
3. **Association neurons :** Association neurons perform the function of integration in the nervous system.

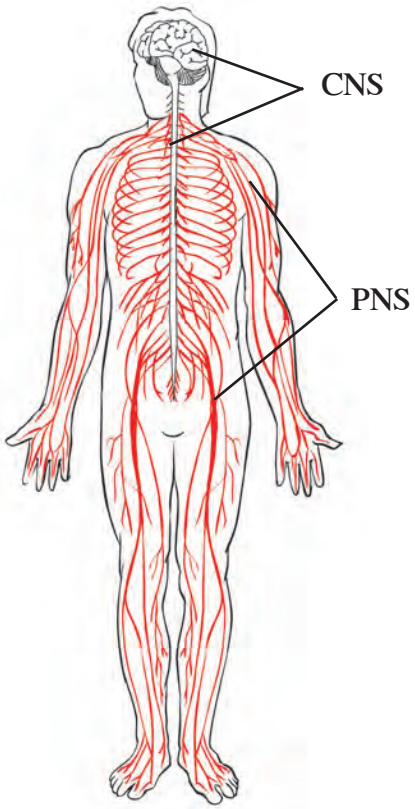
The human nervous system

The human nervous system is devided into the following three parts.

1. Central nervous system

2. Peripheral nervous system

3. Autonomic nervous system

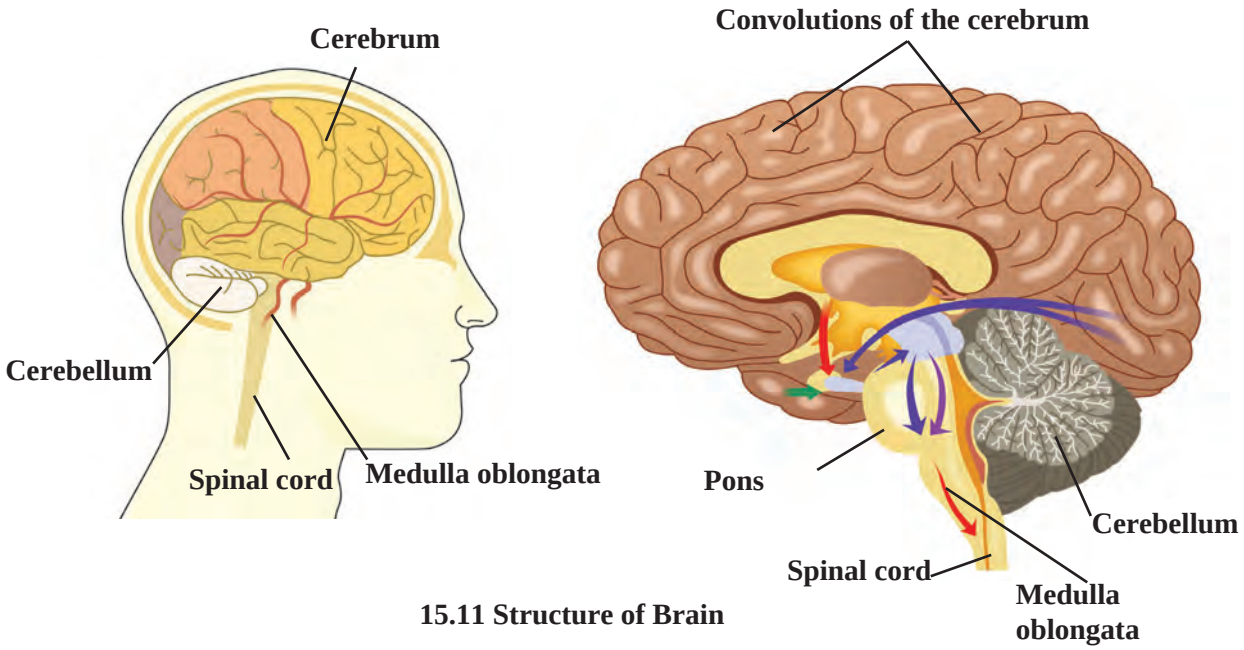


15.12 Human nervous system

Central Nervous System or CNS

The central nervous system consists of the **brain** and **spinal cord**.

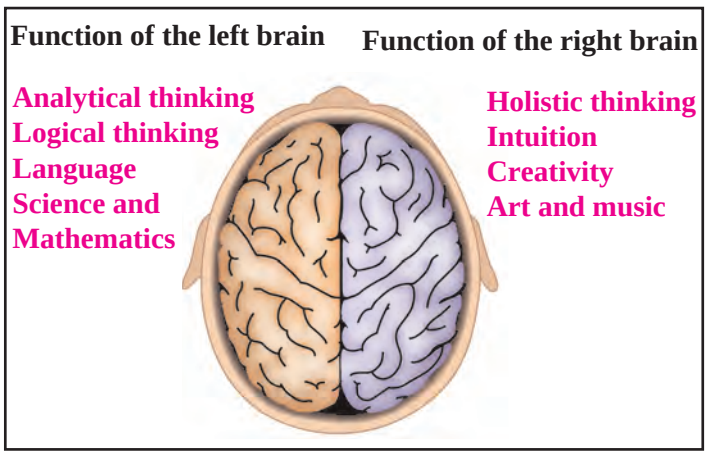
The organization of the brain is extremely delicate and highly evolved. The brain is the main controlling part of the nervous system and it is safely located in the cranial cavity. The spinal cord is protected by the vertebral column. In the space between the delicate central nervous system and its bony covering are the protective layers called the **meninges**. Cavities present in various parts of the brain are called **'ventricles'** whereas the long tubular cavity of the spinal cord is called the **'central canal'**. The ventricles, central canal and spaces between the meninges are filled with cerebro-spinal fluid. This fluid supplies nutrients to the central nervous system and protects it from shock.



15.11 Structure of Brain

The brain of an adult human weighs about 1300 – 1400 grams and consists of approximately 100 billion neurons.

The left side of our brain controls the right side of our body and right side of our brain controls left side of the body. In addition, the left side of the brain controls our speech and conversation, writing, logical thinking, etc. whereas the right side controls artistic abilities.



15.14 Left and right sides of brain

Cerebrum :

This is largest part of our brain and consists of two cerebral hemispheres. These hemispheres are joined with each other with the help of tough fibres and **nerve tracts**. The cerebrum occupies two-thirds of the brain. Hence, it is also called the large brain. Its surface has deep, irregular ridges and grooves which are called convolutions. Convolution increases the surface area of the cerebrum and therefore a large number of nerve cells can be accommodated.

Cerebellum :

This is the smaller part of the brain situated below the cerebrum at the back of the cranial cavity. Its surface shows shallow grooves instead of deep convolutions.

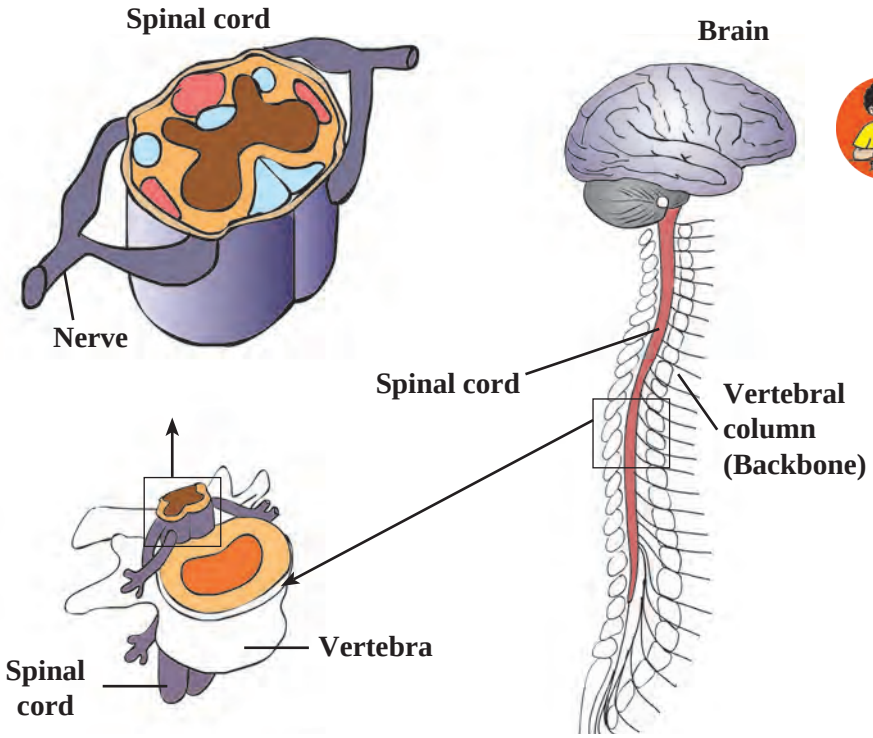
Medulla oblongata :

This is the hind-most part of brain. There are two triangular swollen structures called pyramids on the upper side of medulla oblongata. The medulla oblongata continues downwards as the spinal cord.

Think about it An injury to the medulla oblongata can lead to death. Why?

Spinal cord

The spinal cord is a part of the central nervous system and it is held within the vertebral column. It is slightly thick but gradually tapers towards the end. There is a thread-like fibrous structure at its end. It is called the Filum terminale.



15.15 Brain and spinal cord

Find out.

You may have seen how a drunken person struggles to maintain his body balance. An excess of alcohol in the body causes one to lose control over it. Why does this happen? Find out the reason with the help of the internet.

Brain: different regions and functions

Parts of the Brain	Functions
Cerebrum	Control of voluntary movements, concentration, planning, decision-making, memory, intelligence, and intellectual activities.
Cerebellum	1. Co-ordination of voluntary movements. 2. Maintaining the body's balance.
Medulla oblongata	Control of involuntary activities like the beating of the heart, blood circulation, breathing, sneezing, coughing, salivation, etc.
Spinal cord	1. Conduction of impulses from the skin towards the brain. 2. Conduction of impulses from brain to muscles and glands. 3. Functions as centre of co-ordination of reflex actions.

Peripheral nervous system

The peripheral nervous system consists of the nerves originating from the central nervous system. These nerves connect the central nervous system with all parts of the body. They are of two types.

A. Cranial nerves

Nerves originating from the brain are called cranial nerves. They are associated with various parts in the head, thorax and abdomen. There are 12 pairs of cranial nerves.

B. Spinal nerves

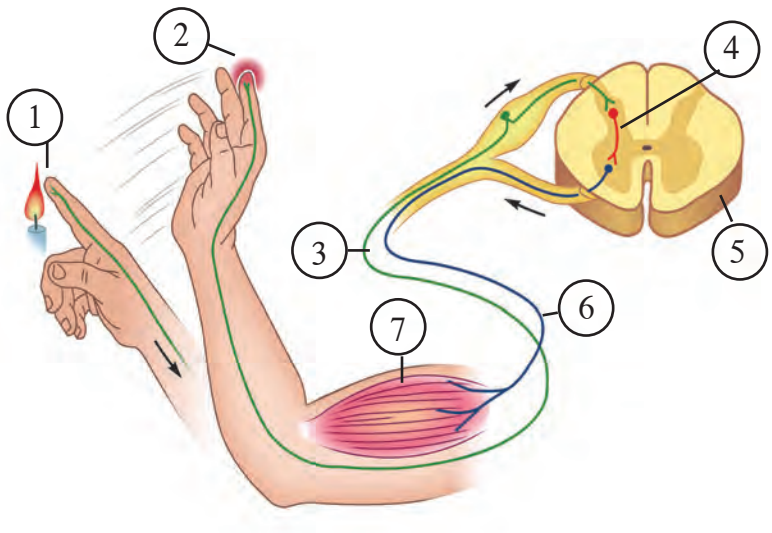
Nerves originating from the spinal cord are called spinal nerves. These are associated with arms, legs, skin and some other parts of the body. There are 31 pairs of spinal nerves.

3. Autonomic nervous system

The autonomous nervous system consists of the nerves of involuntary organs like the heart, lungs, stomach, etc. It is is not under the control of our will.

Reflex action

An immediate and involuntary response given to a stimulus from the environment is called a reflex action. Sometimes we react to an incident without any thinking on our part or control over the reaction. This is a response given to a certain stimulus from the surroundings. In such situations, proper control and co-ordination is achieved even without intervention of the brain.



15.16 Reflex action

Observe the above figure carefully and as per the numbers in that figure, answer the following questions.

a. What is happening at 1 and 2?
b. Which nerve carried the impulse to the point marked 3? In which direction is it conducting the impulse?
c. Which is the nerve shown by 4?
d. Which is the organ marked as 5?
e. At 6, which nerve is conducting the response impulse?
f. At 7, where has the impulse reached? What is its effect?

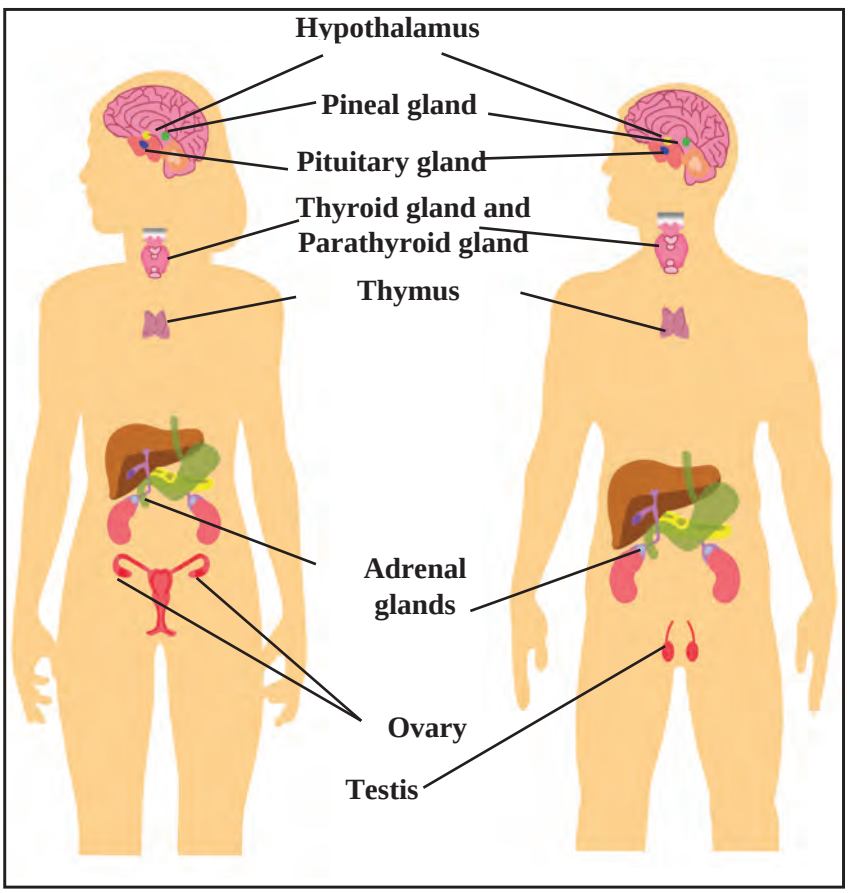
Try this

Sketch and label the above figure.
Try to sketch any other example of a reflex action.

B. Chemical control

Control and co-ordination in our body is also brought about with the help of certain chemical substances called hormones. Hormones are secreted by **endocrine glands**. These glands are also called ductless glands. These glands do not have any arrangement of their own to either store or carry their secretions. Hence, as soon as hormones are produced, they are directly released into the blood circulation. Thus, though these endocrine glands are present at specific locations in our body, their secretions reach all parts of the body via blood.

Endocrine glands along with the nervous system are responsible for the control and co-ordination in our body. These two systems help each other to control and integrate the various activities of the body. A marked difference between these two systems is that nerve impulses are fast but short lived whereas the action of hormones is very slow but long lasting.



15.17 Endocrine glands

It is very important that hormones are secreted only in the required quantity and there is a special mechanism which controls the quantity and timing of hormone secretion. For example, whenever there is an increase in blood-glucose level, certain cells in the pancreas get stimulated and as a response, they release a greater quantity of insulin.

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Using ICT :

Using the following websites and with the help of your teachers, prepare a power point presentation on the human excretory system and the structure of the human brain and present it in the classroom.

www.nationalgeographic.com/science/health-and-humanbody/humanbody

www.webmed.com/brain

www.livescience.com/humanbrain

Endocrine glands: Location and important functions

Glands	Location	Hormones	Functions
Hypothala-mus	Above the pituitary gland, in the forebrain	Secretes the hormones which control the activity of the secretory cells of the pituitary gland	- Controls the pituitary gland
Pituitary	At the base of brain	Growth Hormone Adrenocorticotropic hormone Thyroid stimulating hormone Prolactin Follicle stimulating hor-mone Luteinizing hormone Oxytocin Antidiuretic hormone	- Stimulates growth of bones - Stimulates adrenal gland - Stimulates thyroid gland - Stimulates milk production - Controls growth of gonads - Controls menstrual cycle and ovulation - Contracts uterus during parturition. - Regulates water-level in the body
Thyroid	Anterolateral sides of trachaea in neck region	Thyroxine Calcitonin	- Controls growth of body and metabolic activities - Controls calcium metabolism and calcium level in blood
Parathyroid	Four glands behind thyroid gland	Parathormone	Controls metabolism of calcium and phosphorus
Pancreas	Behind the stomach. Four types of cells Alpha-cells (20%) Beta-cells (70%) Delta-cells (5%) P.P. cells or F-cells (5%)	Glucagon Insulin Somatostatin Pancreatic Polypeptide	- Stimulates liver to convert glycogen into glucose - Stimulates liver to convert excess blood-glucose into glycogen - Controls levels of insulin and glucagon - Controls movements of intestine and thereby glucose absorption - Controls secretion of pancreatic juice
Adrenal Gland	Anterior end of each kidney	Adrenaline and Nor-adrenaline Corticosteroid	-Controls behaviour during crisis and emotional situations - Stimulates heart and its conducting tissue and metabolic processes. Maintains balance of Na^+ and K^+ and stimulates metabolism
Ovary	On either side of uterus in women	Oestrogen Progesterone	-Stimulates growth of endometrium -Stimulates growth of secondary sexual characterstics in women -Prepares the endometrium for conception and maintains the pregnancy.
Testis	In scrotum	Testosterone	Stimulates growth of secondary sexual characterstics like beard, mustache, hoarse voice, etc. in men
Thymus	In thoracic cage, near the heart	Thymosin	Controls the cells which give rise to immunity

Exercises

1. Match the pairs and explain.

'A'	'B'
1. Growth of pollen tube towards ovule	a. Gravitropic movement
2. Growth of shoot system	b. Chemotropic movement
3. Growth of root system	c. Phototropic movement
4. Growth towards water	d. Growth-irrelevant movement
	e. Hydrotropic movement

2. Complete the paragraph.

The milk was on the stove. Rasika was engrossed watching television. She smelled something burning. She ran towards the kitchen. The milk was boiling over. She held the vessel with her bare hands but, screaming, she let it go at once. This activity was controlled by ..... cells. Special ends of ..... in these cells collected the information, from where it was transferred to the ..... and then towards the terminal end of the ..... The chemicals produced at the terminal end passed through the minute space i.e. ..... . In this way, ... were conducted in the body and the process of ..... was completed by conducting the impulses from ..... to .....

(Nerve, muscle cell, impulse, dendrite, synapse, axon, reflex action, cell body)

3. Write notes on-

Root pressure, Transpiration, Nerve cell, Human brain, Reflex action

4. Name the hormones of the following endocrine glands and the function of each.

Pituitary, Thyroid, Adrenal, Thymus, Testis, Ovary.

5. Draw and label the diagrams.

Human endocrine glands, Human brain, Nephron, Nerve cell, Human excretory system.

6. Answer the following.

a. Explain chemical co-ordination in humans and give the names and functions of some hormones.
b. Explain the difference between the excretory system of humans and plants.
c. Explain co-ordination in plants with the help of suitable examples.

7. Explain in your own words with suitable examples.

a. What is meant by co-ordination?
b. How does excretion occur in human beings?
c. How is excretion in plants useful to human beings?
d. Describe the transportation system in plants.

Activity :

1. Collect information about the evolution of the brain of vertebrates and present it in the classroom.
2. Explain the functions of various endocrine glands by presenting an act like 'Why I Am Important?'
3. Collect the information to justify the statement 'Human beings are intelligent and different from other animals' and present it in the classroom.