

# **SCIENCE**

## **Part - II**

### **Grade 8**

Educational Publications Department

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## **The National Anthem of Sri Lanka**

Sri Lanka Matha

Apa Sri Lanka Namo Namo Namo Namo Matha  
Sundara siri barinee, surendi athi sobamana Lanka  
Dhanya dhanaya neka mal palaturu piri jaya bhoomiya ramya  
Apa hata sepa siri setha sadana jeewanaye matha  
Piliganu mena apa bhakthi pooja Namo Namo Matha  
Apa Sri Lanka Namo Namo Namo Namo Matha  
Oba we apa vidya  
Obamaya apa sathya  
Oba we apa shakthi  
Apa hada thula bhakthi  
Oba apa aloke  
Apagae anuprane  
Oba apa jeevana we  
Apa mukthiya oba we  
Nava jeevana demine, nithina apa pubudukaran matha  
Gnana veerya vadawamina regena yanu mana jaya bhoomi kara  
Eka mavakage daru kela bevina  
Yamu yamu vee nopama  
Prema vada sema bheda durerada  
Namo, Namo Matha  
Apa Sri Lanka Namo Namo Namo Namo Matha

அபி வெறு லிக் மலக்கே டரைவு  
லிக் திவசெனி வெசெனா  
லிக் பாடை லிக் ரைரய் வீ  
அப கய தூல் டூவினா

லிலைதி அபி வெறு சொய்ரை சொய்ரியே  
லிக் லேச லீகி வைசெனா  
கீவத் வந அப மேம் திவசே  
சொடின சிரிய யூது வீ

சூமோ ம மேத் கர்ணோ ரூஞெநி  
வெலை சுமாரி டுதினி  
ரந் மினி மூது நோ வ லிய ம ய சூபதா  
கிகி கல நோம் டீரநா

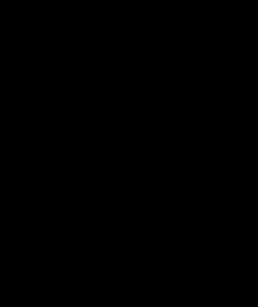
ஆனந்தி சுமரகோன்

ஓரு தாய் மக்கள் நாமாவோம்  
ஒன்றே நாம் வாழும் இல்லம்  
நன்றே உடலில் ஒடும்  
ஒன்றே நம் குருதி நிறம்

அதனால் சகோதரர் நாமாவோம்  
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ஆனந்த சமரக்கோன்  
கவிதையின் பெயர்ப்பு.



Being innovative, changing with right knowledge,  
Be a light to the country as well as to the world.

### **Message from the Hon. Minister of Education**

The past two decades have been significant in the world history due to changes that took place in technology. The present students face a lot of new challenges along with the rapid development of Information Technology, communication and other related fields. The manner of career opportunities are liable to change specifically in the near future. In such an environment, with a new technological and intellectual society, thousands of innovative career opportunities would be created. To win those challenges, it is the responsibility of the Sri Lankan government and myself, as the Minister of Education, to empower you all.

This book is a product of free education. Your aim must be to use this book properly and acquire the necessary knowledge out of it. The government in turn is able to provide free textbooks to you, as a result of the commitment and labour of your parents and elders.

Since we have understood that the education is crucial in deciding the future of a country, the government has taken steps to change curriculum to suit the rapid changes of the technological world. Hence, you have to dedicate yourselves to become productive citizens. I believe that the knowledge this book provides will suffice your aim.

It is your duty to give a proper value to the money spent by the government on your education. Also you should understand that education determines your future. Make sure that you reach the optimum social stratum through education.

I congratulate you to enjoy the benefits of free education and bloom as an honoured citizen who takes the name of Sri Lanka to the world.



**Akila Viraj Kariyawasam**  
**Minister of Education**

## **Foreword**

The educational objectives of the contemporary world are becoming more complex along with the economic, social, cultural and technological development. The learning and teaching process too is changing in relation to human experiences, technological differences, research and new indices. Therefore, it is required to produce the textbook by including subject related information according to the objectives in the syllabus in order to maintain the teaching process by organizing learning experiences that suit to the learner needs. The textbook is not merely a learning tool for the learner. It is a blessing that contributes to obtain a higher education along with a development of conduct and attitudes, to develop values and to obtain learning experiences.

The government in its realization of the concept of free education has offered you all the textbooks from grades 1-11. I would like to remind you that you should make the maximum use of these textbooks and protect them well. I sincerely hope that this textbook would assist you to obtain the expertise to become a virtuous citizen with a complete personality who would be a valuable asset to the country.

I would like to bestow my sincere thanks on the members of the editorial and writer boards as well as on the staff of the Educational Publications Department who have strived to offer this textbook to you.

**W. M. Jayantha Wickramanayaka,**  
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# 9 Human organ systems

## 9.1 Human excretory system and excretory products

The biological processes that take place within the cells, produce different products that are useful to the body as well as useless to the body.

As an example, let us consider the respiration reaction. In respiration glucose react with oxygen and produce energy, carbon dioxide and water.

Energy is used for the biological processes in the body. But carbon dioxide and water may become harmful to cells when there is an excess amount.

The useless products that are produced during chemical reactions within the cells are known as **excretory products**. You can observe the Figure 9.1 to study about the excretory products in human body.

Excretory products can damage the cells when accumulated in excess amount. Some products may be toxic. Therefore, it is very important to remove the excretory products from the body. The process that remove the excretory products from the body is known as **excretion**.

Waste matter remaining after food has been digested is known as faeces. As it is not produced by chemical reactions within the cells in the digestive system, it is not considered as an excretory product.

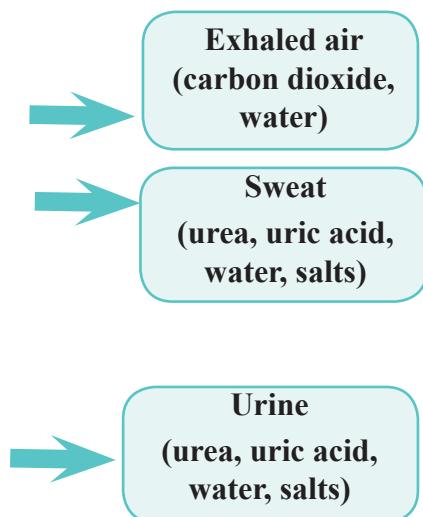


Figure 9.1 ▲ Excretory products of a human

There are organs and systems that are specialized to perform the function of excretion in human body.

Table 9.1 shows the excretory products, where they are produced and how they are excreted.

Table 9.1

Excretory organ	Excretory products	The form they are excreted
Lungs	Carbon dioxide, water	As exhaled air
Kidneys	Urea, uric acid, salts, water	As urine
Skin	Little amount of urea, uric acid, salts, water	As sweat

### Human urinary system

During the chemical reactions which take place in human body cells, nitrogenous by-products are produced. These nitrogenous by-products are excreted from the body through kidneys as urine. Therefore, the urinary system is considered as the main nitrogenous excretory system of human body.

Let us do Activity 9.1 to identify the parts of the human urinary system.



#### Activity 9.1

**You will need:-** A model/ diagram of the human urinary system

**Method: -**

- Observe the parts of the urinary system.
- Draw a diagram and name the parts.

The labelled diagram of urinary system of human is shown in Figure 9.2.

Urinary system consists of four main parts.

- Kidneys
- Ureter
- Bladder
- Urethra

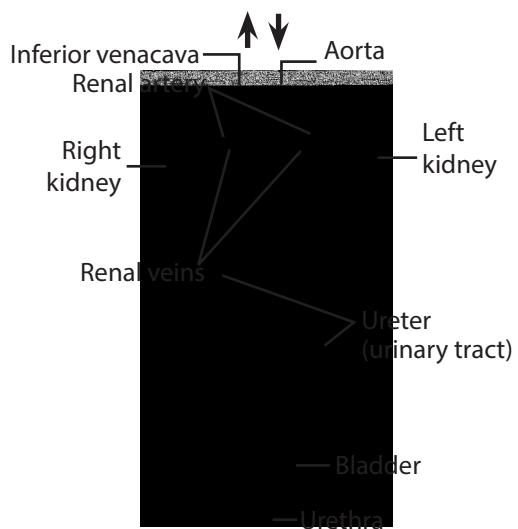


Figure 9.2 ▷ Human urinary system

As shown in Figure 9.3 place your hands on your hips. Then the tips of your thumbs give an indication of the location of the lower end of kidneys.

Kidneys reside against the back muscle in the upper abdominal cavity. They sit opposite each other on either side of the spine. The right kidney is little bit lower than the left kidney to accommodate the liver.

Figure 9.3 ▲ The way to observe the location of kidneys externally

In an adult each kidney is about 13 cm long and 6 cm wide. Kidneys are bean-shaped organs. Observe Figure 9.4 to get an idea about the external structure of a kidney.

The renal artery supplies blood to the kidney while the renal vein carries away the blood from kidneys.

Renal artery —  
Renal vein —  
Ureter —

Figure 9.4 ▲ External structure of human kidney

Do Activity 9.2 to study about the internal structure of a kidney.



### Activity 9.2

**You will need:-** A model/photograph of a kidney

**Method: -**

- Study the internal structure of a kidney using a model/ photograph of a kidney in your laboratory.
- Get the assistance of your teacher.

The labelled diagram of human kidney is shown in Figure 9.5.

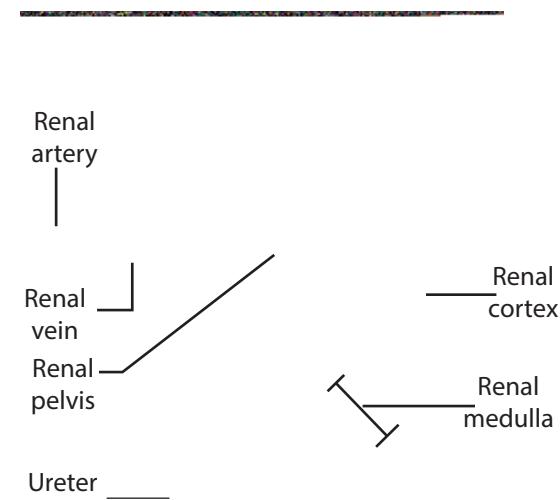


Figure 9.5 ▲ Longitudinal section of human kidney

A kidney consists of two major parts.

- Cortex
- Medulla

Renal cortex consists of lot of blood capillaries. Therefore, it is dark in colour. Within the renal medulla there are triangular shaped structures called renal pyramids. The tips of these renal pyramids are directed to the renal pelvis. The renal pelvis narrows and open into the upper end of the ureter.

Blood with excretory products

transported by renal arteries is filtered in the kidneys. The filtered excretory products are carried by the ureter to the bladder and they are temporarily stored in the bladder. The fluid with excretory products is known as urine.

### Components of urine

- Water              • Salts (more sodium chloride)
- Urea              • Uric acid



### For extra knowledge

Components of urine of a healthy person is given below as percentages;

Water	- about 96%
Urea	- about 2%
Salts	- about 2%
Uric acid	- trace amounts

Above mentioned values and colour of urine are important in diagnosing kidney diseases.

When the bladder is full, a person urinates through the urethra to eliminate the waste.

**If the kidneys are damaged, the process of excretion does not happen the way they should. Some examples of kidney diseases and the reasons are given below.**

---

- **Kidney stones**

Salts such as calcium oxalate deposit in kidneys and form crystalline structures. These structures are known as kidney stones (Figure 9.6). Kidney stones may occur, due to following reasons.

- Not drinking enough water
- Taking salty diets regularly
- Not passing urine at proper time (when wanted)

Figure 9.6 ▷ How kidney stones are formed

- **Kidney failure**

Functioning of kidneys get disordered and it is called kidney failure. Kidney failure may occur due to following reasons.

- Entering of heavy metals and toxic chemicals into the body
- Suffering from diabetes for a long time
- Using drugs for a long time period for certain diseases
- Smoking and consuming alcohol

- **Kidney infection**

The urethra can be infected by microorganisms and it may cause kidney damage.

Excretory process should be carried out efficiently in the body. For this purpose maintaining healthy kidneys is very important. Following are some tips that should be considered to maintain healthy kidneys.

- Drinking enough pure water daily
- Limit consuming too much salty and sour food (pickle, lime pickle, food with vinegar)
- Quit smoking and consuming alcohol

- There is a risk of kidney failure for the persons who are suffering from diabetes. Therefore, it is important to control the blood sugar levels.
- If a person takes medications regularly over a prolonged period, he should take them to the prescribed dosage by the physician and should have regular tests to check kidney functions.
- One should concern about the cleanliness of the surrounding area of the urethra because this area can be infected very easily.

## 9.2 Nervous system

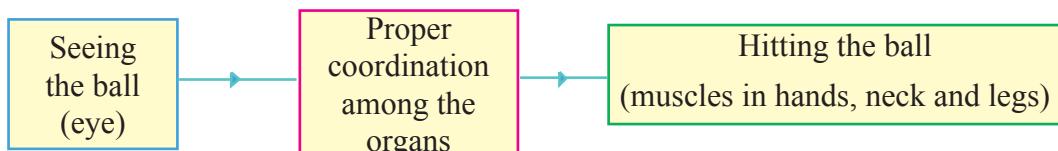
Imagine how a cricketer hits a ball. We know that he coordinates many organs in the body/ body parts to hit the ball in the proper way. Mainly, he coordinates the eyes, hands, legs and neck to hit the ball properly. If these organs do not coordinate in the proper manner his hit will not be successful.

---

Figure 9.7 ▷ A cricketer hits the ball

Think about which body organs coordinate when you drive or put a thread to a needle.

Following flow chart shows the relevant process of hitting the ball.



According to the above, seeing the ball is a sense. It occurs through the sensory organ called the "eye". The eye is the receptor. Hitting the ball is the reaction. Muscles in the eye, neck, hands and legs are used for the reaction.

Let us focus on how the organs are coordinated in seeing and hitting the ball.

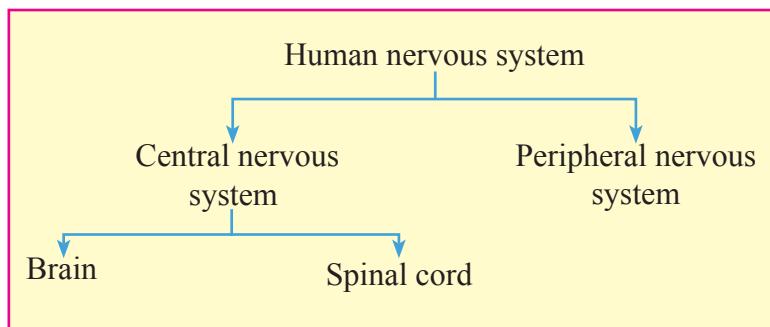
Many changes occur within the internal body of humans as well as in his surrounding environment. Body should react for these changes. To react, there should be a very good interaction between the receptors (eye, ear, nose, tongue, skin) and the effectors (muscles and glands). This process is known as **coordination**.

The nerves and hormones are very important in coordination. Coordinating and controlling the various functions of our body by the nervous system is known as **nervous coordination**. Coordinating the body organs through hormones is known as **chemical coordination**.

## Nervous coordination

Let us study about the human nervous system.

Major parts of the human nervous system is given below.



### Central nervous system

The two main organs of the central nervous system are the brain and the spinal cord. The central nervous system is better protected in the body. Its main line of defense is the bones. The bones around the brain is known as the skull and spinal cord is surrounded by the vertebral column. Both the skull and vertebral column create a hard physical barrier to injury.

Both the brain and the spinal cord are protected by layers of special connective tissues called the **meninges**.

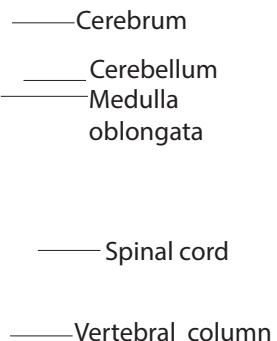
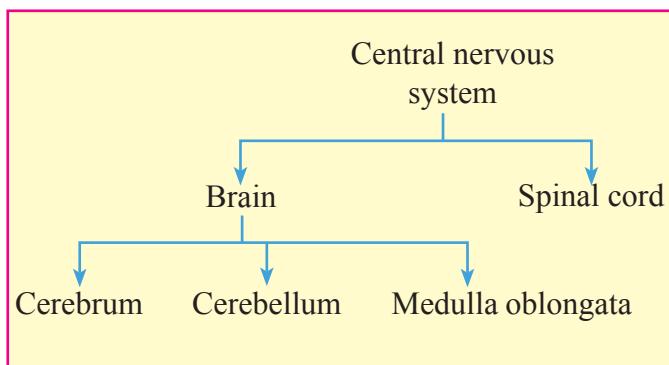


Figure 9.8 ▲ Central nervous system

The meninges are filled with a special fluid called **cerebrospinal fluid**. Some functions of cerebrospinal fluid are given below.

- Absorb shocks
- Supply nutrients
- Prevents the central nervous system from microbial infections



The functions of each part of the central nervous system differs.

- **Cerebrum/cortex** - Controls higher brain functions such as thought, intelligence  
Recognition of senses  
Controls the movements of muscles with the intent to perform a specific action (controlling the voluntary actions)
- **Cerebellum** - Regulation and coordination of body balance
- **Medulla Oblongata** - Controls the autonomic functions (non-voluntary functions) such as heart beat, breathing
- **Spinal cord** - Relays messages from the brain to different parts of the body

## Peripheral nervous system

Cranial nerves

Spinal nerves

All the nerves that lie outside the spinal cord and brain are known as the peripheral nervous system.

The nerves that lead directly from the brain are called cranial nerves. There are 12 pairs of cranial nerves.

The nerves that arise from the spinal cord are called as spinal nerves. In humans there are 31 pairs of spinal nerves.

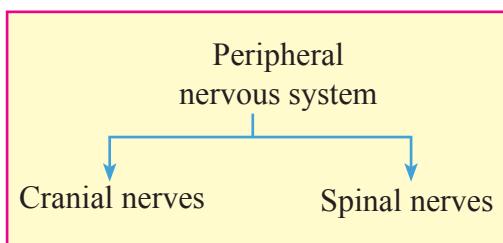


Figure 9.9 ▲ Peripheral nervous system

### Functions of peripheral nervous system

- Transmitting impulses from receptors to the central nervous system
- Transmitting impulses from central nervous system to the effectors

An electrical signal that travels along a nerve is called an impulse.

Engage in Activity 9.3 to study the speed of impulses in human nerve.

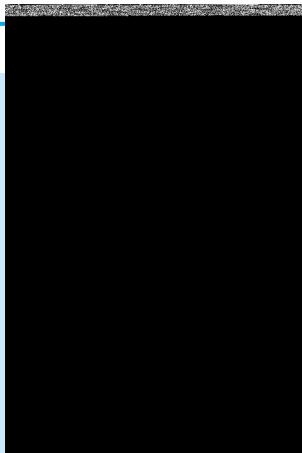


## Activity 9.3

**You will need:-** 30 cm ruler

### **Method:-**

- As shown in Figure 9.10 take the 30 cm ruler to your hand vertically (the “0” of the ruler towards the ground)
  - Free the ruler from the hand and ask your friend to catch it.
  - Get the reading of the ruler where your friend touched with the hand.
  - Repeat this activity with different students.



## Figure 9.10 ▲

You will notice that each student gets different readings.

The dropping of the ruler is received from the eyes. The message is transmitted to the brain and is returned to the effector, the muscles of the right hand. Then, the right hand responds.

According to the results of Activity 9.3 the speed of impulses differ from person to person. The most important part of our body are the brain and spinal cord. So, it is very important to take necessary protective measures in day-to-day activities since the nervous system is very fragile.

**Some protective measures are given below.**

- Maintaining a balanced nutrition from childhood
  - Prevent children facing accidents
  - During pregnancy, mother should get proper nourishment, considering the baby's physical and mental development
  - Be sure to get the correct posture during sports, exercises in daily life and lifting a burden to force
  - Control mental stress
  - Avoid excessive keeping awake sleepless
  - Engage in intelligence development activities
  - In an accident there is a possibility for spinal cord injuries. Never move anyone

Wrong      Right

Figure 9.11 ▲



Figure 9.11 ▲

who you think have a spinal injury unless it is very necessary. Keep the person absolutely still and safe. Do not allow the body to bend or twist. Keep the person on a wooden flat surface and rush to the nearest hospital.

### 9.3 Human skin

Skin is the largest organ of the body. It weighs about 4.5 kg and 1-2 mm thick in an adult. Skin mainly consists of two layers.

- Epidermis
- Dermis

Let us engage in Activity 9.4 to study about the structure of the human skin.



#### Activity 9.4

**You will need:-** A diagram/model of the human skin

**Method:-**

- Identify the main parts of the human skin.
- Draw a cross sketch of the human skin and name the parts.

Structure of the human skin is shown in Figure 9.12.

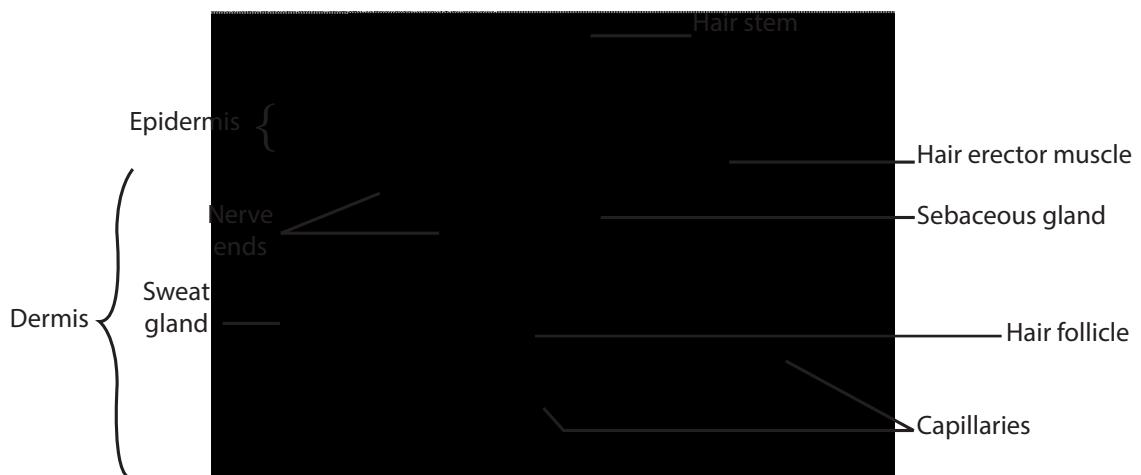


Figure 9.12 ▷ Structure of the human skin

## **Epidermis**

The outer most layer of skin is epidermis. The epidermis is made up of several layers of cells. The epidermis is shedding thousands of dead cells and replenishing daily. Skin colour is due to melanin- a pigment produced in the epidermis to protect from the sun's ultraviolet rays.

## **Dermis**

The dermis beneath the epidermis contains hair follicles, sweat glands, sebaceous glands, muscles, nerve endings and blood vessels (capillaries). The dermis is thicker than the epidermis.

Hypodermis lies beneath the dermis.

## **Functions of the human skin**

- **Protective layer of the body**

The layers of the epidermis minimize water loss from the body and prevent from dehydration.

Melanin pigments in the cells of the skin protects the body from ultra violet rays.

The secretion from sebaceous gland act as a barrier against microorganism infections. This is a natural defense mechanism.

- **Regulation of body temperature**

When the temperature increases in the environment than the body temperature, the sweat glands secrete sweat to release heat.

When the atmospheric temperature is lower than the body temperature, the blood supply to the surface of the skin is decreased and the body temperature is regulated. The secretion of sweat is minimized.

- **Acting as a sensory organ**

In the dermis, there are nerve endings which detect the pressure, touch and temperature.

- **Synthesis of vitamin D**

Using the energy of sunlight, vitamin D is synthesized in the cells of the skin.

- **Excretion**

The sweat glands secrete sweat which consists of urea, uric acid, and ammonium salts. Therefore, skin can be considered as an excretory organ.

As the skin is exposed to the environment, there is a possibility to the skin to be infected by microorganisms and waste materials.

Wipe your face with a tissue paper. You will notice that your face becomes clean and there is dust in the tissue paper. Cleanliness and protection help to maintain a healthy skin.

**Following are some tips that help to maintain a healthy skin.**

- Have nutritive diet

- Vitamin A and E are essential for a healthy skin. Consuming fresh fruits and vegetables helps to supply vitamin A and E to the skin.
- Drink adequate amount of fresh water daily.

- Be gentle to your skin

- Bath daily (if the person is not sick).
- Use a mild soap which does not wipe the oil on your skin.
- After wash or bath, gently blot the skin with a towel and do not rub against the skin.

- Protection from sun

- If you are exposing to the sun for a long period of time wear clothes that covers your skin well.

- Avoid smoking and smokers

- Smoking narrows the blood vessels in the skin and reduce the circulation of blood. The skin cells get less oxygen and nutrients. Therefore, the skin loses its strength and elasticity and develops wrinkles and looks older.

- Other factors
  - Wearing cotton dresses
  - Do not share your dresses with others
  - Get medical advices for skin disorders such as pimples and warts
  - Manage stress and always try to maintain a good mental health



### For extra knowledge

Dirty skin is easily infected by microorganisms. Also lack of nutrients lead for skin disorders. Following figures show some skin disorders.



### Assignment 9.1

Prepare a booklet on “The importance of taking protective measures for the excretory system, nervous system and skin in day-to-day life.”



## Summary

- Many biological processes take place in the human body.
- We should maintain proper functioning of the organs and the organ systems in order to maintain biological processes efficiently.
- The harmful products that are produced during the chemical reactions within the cells of living organisms, are known as excretory products.
- The process which pass the excretory products from the body is known as excretion.
- Kidneys, lungs and skin are the main excretory organs in the human body. The basic nitrogenous excretory organs are the kidneys.
- Other than the kidneys, the lungs and skin are also function as excretory organs.
- The urinary system is considered as the nitrogenous excretory system of the human body.
- Eye, ear, nose, tongue and skin are the sensory organs of the human body.
- The effectors of the body response for the senses detected from the sensory organs.
- The process of adjusting the body for the changes in the external and internal environment by inter connecting the receptors and effectors is known as coordination.
- Nerves and hormones are important in coordination.
- Coordination by nervous system is known as nervous coordination.
- The two major parts of the human nervous system are central nervous system and peripheral nervous system.
- Central nervous system consists of brain and spinal cord.
- All the nerves in the body outside the brain and spinal cord are known as peripheral nervous system.
- Central nervous system controls the higher brain functions such as muscle movements, carrying impulses etc.
- Skin is the largest organ in the human body. It consists of two layers called epidermis and dermis.
- It is important to lead a healthy life in order to maintain the proper functioning of the body organs.

## Exercise

1. Give short answers.

- i) What do you mean by excretion?
- ii) What are the main excretory organs in the human body?
- iii) Why is faeces not considered as an excretory product?
- iv) What is the main component in urine?
- v) Write three instances that can damage the kidneys.

2. Underline the correct answer.

- i) The nerve endings are present in (epidermis/ dermis).
- ii) Inter-connection between the receptors and effectors is known as (homeostasis /coordination).
- iii) There are (meninges layers/pleura) for the protection of central nervous system.
- iv) The cerebrum/cortex (controls higher brain functions/regulates and coordinates of body balance).
- v) All the nerves in the body that lie outside the brain and spinal cord are called as (central nerves/ peripheral nerves).

3. Match the correct answer

A

B

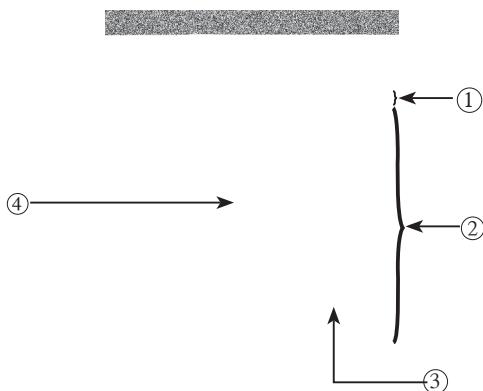
- |                         |   |
|-------------------------|---|
| i) Cerebrum             | Controlling the heart beat  |
| ii) Cerebellum          | Controlling the movements of muscles with the intent to perform a specific action |
| iii) Medulla oblongata  | Transmitting messages between the body and brain                                  |
| iv) Cerebrospinal fluid | Absorbing shocks  |
| v) Spinal cord          | Balancing the body  |

4. Fill in the blanks using suitable words.

Skin is the ..... organ in the human body. It consists of two layers called ..... and ..... There are ..... cells in the epidermis. In some epidemic cells there is a special pigment called ..... that determines the skin colour. It protects the skin from sun's ..... rays. There are ..... glands and ..... glands within the dermis. When there is sunlight skin synthesizes vitamin ..... In the skin there are ..... that detect pressure, touch and temperature.

5. Write a list of protective measures that can be taken to maintain a healthy skin.

6. Name the parts 1-4 given in the cross section of the skin.



## Technical Terms

Excretion	- எஃபீசீஸ்டாவய	- கழிவகற்றல்
Excretory products	- எஃபீசீஸ்டாவிய லில	- கழிவுப்பதார்த்தங்கள்
Urinary system	- மோனு பட்டினிய	- சிறுநீரகத்தொகுதி
Kidney	- வங்க்கிய	- சிறுநீரகம்
Nervous system	- சீஞாயூ பட்டினிய	- நரம்புத்தொகுதி
Nervous coordination	- சீஞாயூ சுமாயேஞ்சனய	- நரம்பு இயைபாக்கம்
Central nervous system	- மதிங் சீஞாயூ பட்டினிய	- மைய நரம்புத்தொகுதி
Peripheral nervous system	- பர்யந்த சீஞாயூ பட்டினிய	- சுற்றியல் நரம்புத் தொகுதி
Brain	- மொலிய	- மூளை
Spinal cord	- ஸிழுமினாவ	- முண்ணான்
Impulse	- ஆவேஇய	- கணத்தாக்கம்
Dermis	- உர்மூய	- மேற்தோல்
Epidermis	- அபிலர்மூய	- உட்ரோல்
Hypodermis	- அதங்உர்மூய	- அடித்தோல்
Sweat gland	- சீவேட் ருங்கீய	- வியர்வைச் சுரப்பி
Sebaceous gland	- சீஞேஸ்டாலீ ருங்கீய	- நெய்ச்சுரப்பி
Hair follicles	- ரேஃம் ஸ்டாநிகாவ	- மயிர்ப்புடைப்பு

# 10 Electricity

You may have used an electric torch when you are going out at night. You can get more light when using an electric torch with more cells.

You can use a line of bulbs to illuminate the environment in ceremonial occasions. In such occasions, colour bulbs can be used to increase the attraction. The bulbs illuminate because an electric source sends a flow of electric charges through them. Such a flow of electric charges is known as an **electric current**. The path of an electric current is called an **electric circuit**. A voltage should be supplied to a circuit for the flow of current. Voltage is supplied by an electric source.

Electric current flows only when an electrical source is connected in a closed circuit with conductors. A switch can be used to open or close a circuit when necessary.

Let us find out about making circuits using various electric components and how they work.

## 10.1 Various methods of connecting cells and bulbs

- **Series cell systems**

Let us find out methods of lighting a bulb, using several 1.5 V dry cells.



### Activity 10.1

**You will need :-** Three identical filament bulbs (6.0 V), six dry cells (1.5 V), a switch, connecting wires, a voltmeter

**Method :-**

- First connect one dry cell with the bulb and the switch as shown in Figure 10.1. Connect the voltmeter to measure the voltage across the bulb.

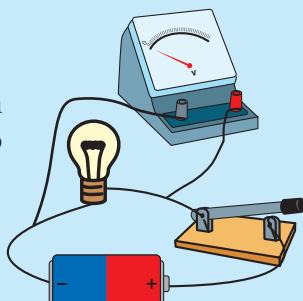


Figure 10.1 ▲

- Then connect two dry cells with another bulb and the switch as shown in Figure 10.2.

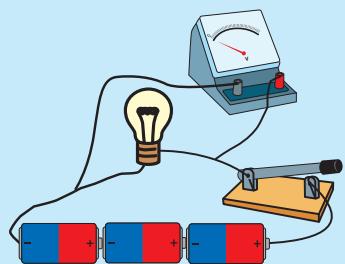


Figure 10.3 ▾

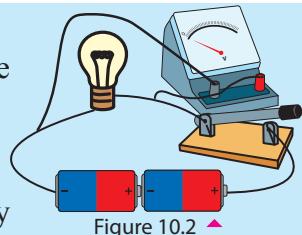


Figure 10.2 ▾

- After that connect three dry cells with the third bulb and the switch as shown in Figure 10.3.
- Now close the switches of all three circuits at the same time.
- Compare the brightness of the bulbs and record the voltmeter reading.
- Fill Table 10.1 according to your observation above.

Table 10.1

Occasion	Number of cells connected	Voltmeter reading	Brightness (comparatively)
Circuit in Figure 10.1			
Circuit in Figure 10.2			
Circuit in Figure 10.3			

It can be observed that the brightness of a bulb increases when more cells are connected as in Figure 10.1, 10.2 and 10.3 respectively. When the number of cells are increased, the voltage increases, and the current also increases accordingly.

When the required voltage for an electrical equipment cannot be supplied by a single cell, several cells are connected as in Figure 10.4.

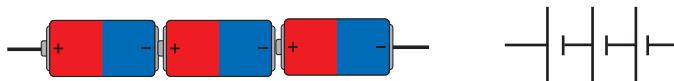


Figure 10.4 ▾

In this connection the negative terminal of one cell is connected to the positive terminal of the next one. The negative terminal of the second cell is connected to the positive terminal of the third one and so on.

**When two or more cells are connected one after the other as described above it is called a series connection.**

Therefore, such a cell system is known as series cell system. A combination of multiple cells is known as a battery. Two and three cell combinations shown in figure 10.5 are examples for batteries.

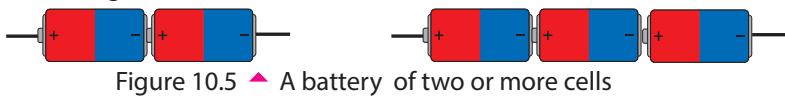


Figure 10.5 ▾ A battery of two or more cells

## ● Parallel cell systems

Another method of connecting the cells in a cell system (battery) is shown in Figure 10.6 (a) and 10.6 (b).

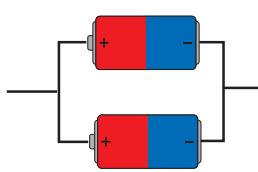


Figure 10.6 (a) ▲

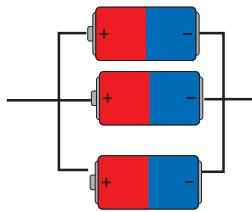


Figure 10.6 (b) ▲

In this connection, positive terminals of all the cells are connected to one point and the negative terminals of them are connected to another point. A connection like this is called a parallel connection. Such a cell system is known as a **parallel cell system**. Let us do Activity 10.2 to study about parallel cell systems.



### Activity 10.2

**You will need:-** Six dry cells (1.5 V), three identical filament bulbs (2.5 V), three switches, connecting wires

#### Method:-

- First, connect one dry cell with a bulb and a switch as shown in Figure 10.7.
- Close the switch and observe the brightness of the bulb.
- Then, connect other cells to bulbs and switches as shown in Figure 10.8 and 10.9. Close the switches in each instance and observe the brightness of the bulbs.

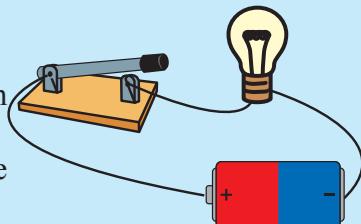


Figure 10.7 ▲

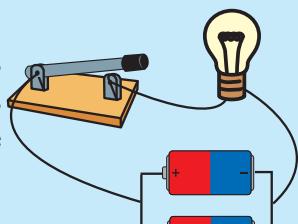


Figure 10.8 ▲

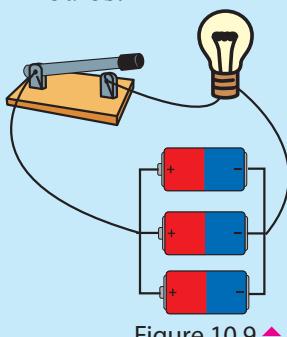


Figure 10.9 ▲

- Close the switches of the circuits as shown in Figure 10.7, 10.8 and 10.9 .
- Compare the brightness of the bulbs.

The bulbs will light with, more or less the same brightness in all the three instances mentioned above. Thus the current flowing through the bulbs should be equal. When cells are connected in this manner, each cell supplies less current. But, the collection of current supplied by cells is equal to current supplied by one cell. Therefore, when cells are connected parallelly bulb can light for a longer time thus cells can last a longer time.

When current should be supplied for a long time to an electrical equipment parallel cell systems are used.

## Systems of bulbs

Two simple methods of connecting several bulbs to a circuit are given in Figure 10.10 (a and b) below.

When bulbs are connected as in Figure 10.10 (a) it is called a **series** connection. When the connection is as in Figure 10.10 (b) it is a **parallel** connection.

### Series bulb system

Let us do Activity 10.3 to study about series bulb systems.

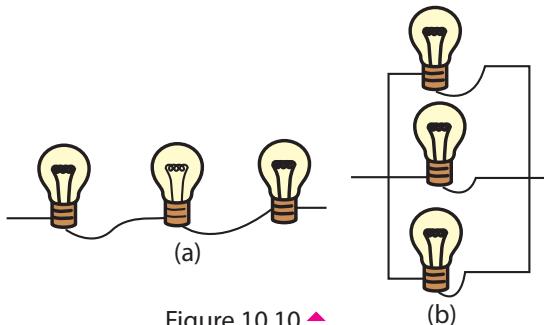


Figure 10.10 ▾



### Activity 10.3

**You will need:-** Five filament bulbs (2.5 V), four dry cells, three switches, connecting wires

#### Method:-

- Connect one bulb with a switch and a cell as shown in Figure 10.11.

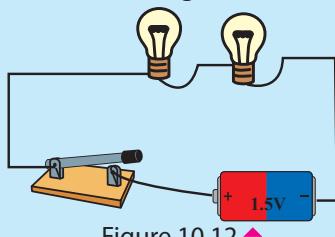


Figure 10.11 ▾

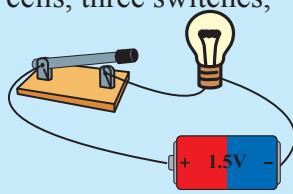


Figure 10.11 ▾

- Connect two bulbs with a switch and a cell as shown in Figure 10.12.

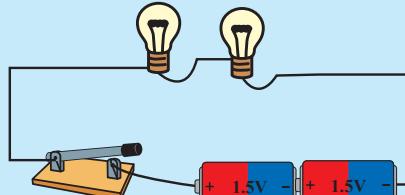


Figure 10.12 ▾

- Connect two bulbs, joined in series to a switch and two cells as shown in Figure 10.13.
- Switch on all the three circuits at the same time and observe the brightness of the bulbs.
- Discuss with the teacher about the conclusion that you can come to, according to the observations.

According to Activity 10.3 it is clear that the brightness of the bulbs decreases, with the increase of bulbs connected in series across a voltage supply. But the initial brightness can be obtained by increasing the number of cells. Thus, several low voltage bulbs can be lit from a high voltage supply, when they are connected in series.

### Parallel bulb system

Let us do Activity 10.4 to study about parallel bulb systems.



#### Activity 10.4

**You will need:-** Six filament bulbs (2.5 V), three dry cells (1.5 V), three switches, connecting wires

##### Method:-

- First, connect one bulb to a cell and a switch as shown in Figure 10.14.

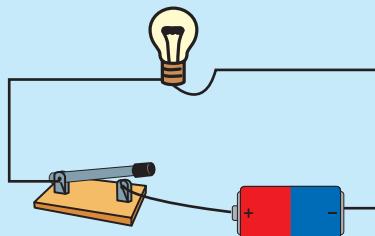


Figure 10.14 ▶

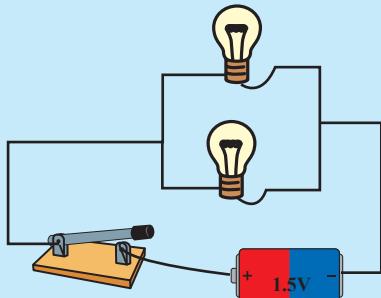


Figure 10.15 ▶

- Connect two parallelly connected bulbs to a switch and a cell as shown in Figure 10.15.
- Connect three parallelly connected bulbs to a switch and a cell as shown in Figure 10.16.

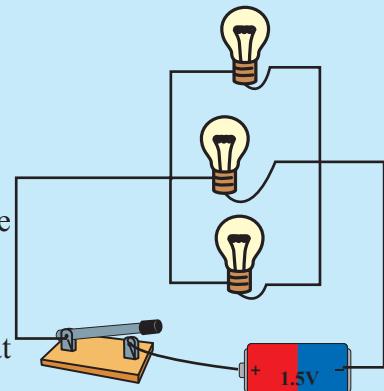


Figure 10.16 ▶

- Now switch on all the three circuits at the same time.
- Observe the brightness of the bulbs.
- Discuss with your teacher, the conclusions that you can make according to the observations.

The brightness will not significantly change even though the number of bulbs, connected in parallel are increased. They all will light with almost the same brightness.

## 10.2 Simple electric circuits

### • Electric torch

Electric torch is an essential equipment when we are going in dark at night and when we are in search of something in dark.

There are electric torches with only one dry cell or with several dry cells connected in series. The Figure 10.17 shows such an electric torch.

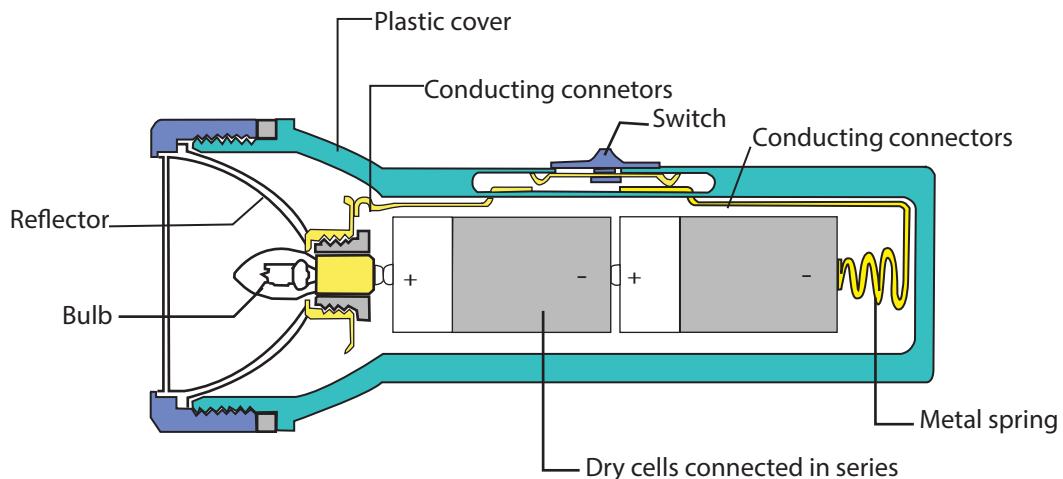


Figure 10.17 ▷ Electric torch

As shown in Figure 10.17, dry cells, bulb, metal spring and conducting connectors of this torch are connected with each other. But the circuit is open because of the switch. Therefore, the bulb does not light. When the switch is pushed forward, the gap between the conducting connectors is closed and the bulb is lit.



### Assignment 10.1

- Using the circuit symbols for bulb, electric cell, switch and connecting wires, draw the circuit diagram for electric torch in Figure 10.17.
- Explain the advantages of using a reflector in an electric torch.

### • Light decoration

You may have seen that light decorations are used to decorate various ceremonial occasions.

Let us do Activity 10.5 to make a light decorating circuit.



### Activity 10.5

**You will need:-** Power supply (6 V) or four dry cells, six colour LEDs (two red, two blue and two green), connecting wires, copper strips

**Method:-**

- Draw a diagram for the circuit shown in Figure 10.18. Indicate where the switches should be connected to light blue LEDs, only red LEDs, only green LEDs, and both blue and green LEDs at the same time.
- Make the circuit on a board. Take all switches to one place of the board. Supply power to the circuit.
- By opening and closing the switches, try to build a simple pandol.

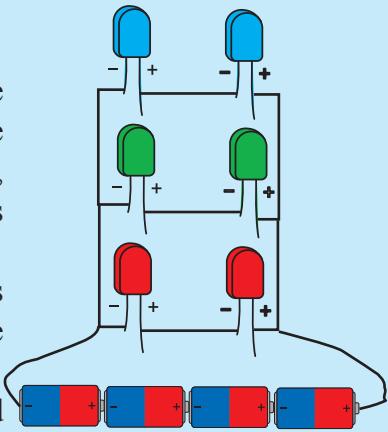


Figure 10.18 ▾



### Assignment 10.2

- Make some light decorating circuits using dry cells, LEDs, switches and connecting wires. Get the assistance of your teacher for this.

## 10.3 Current controlling components

On various occasions it is necessary to control the amount of current flowing through an electric circuit. There are several components that can be used for this purpose. We can use those components according to the situation. Let us consider, how some of such components can be used.

### Switches / Keys

Switches or keys are used to turn on or turn off an electric current flow through a circuit when necessary. There are various types of keys. Some simple keys are mentioned below.

## Tap key

Diagram of a Tap key is shown in Figure 10.19 (a). P and Q are the terminals connected to the circuit. When the B end of the metal strip is pressed with your finger, X and Y ends contact each other. Then, the circuit between P and Q is completed. When the finger is released B end of the AB metal strip lifts up as a spring. Hence, circuit is disconnected.

This is called one way tap key because it is used to let the current to flow one direction.

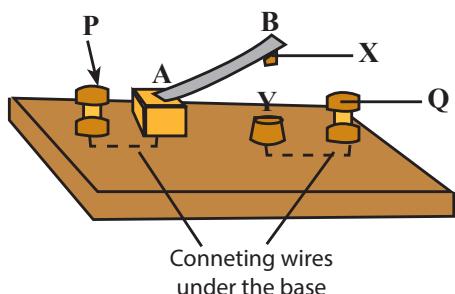


Figure 10.19 (a) ▲ Tap key

## Plug key

Diagram of a Plug key is shown in Figure 10.19 (b). P and Q are the terminals connected to the circuit. There is a gap between the metal blocks made of brass. When the plug rod is inserted into the hole between the gap, the circuit is closed. When the plug rod is removed, circuit is disconnected.

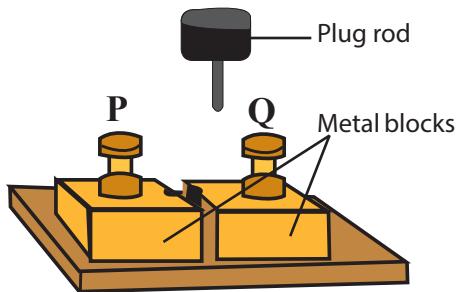


Figure 10.19 (b) ▲ Plug key

Obstacle to flow an electric current through a conductor is called the **resistance**. Components that have the property of resistance are known as **resistors**.

Copper wires are used to connect circuits because their resistance is very low. Resistance of wires made of nichrome and manganin is very high. Therefore, wires made of metals like nichrome and manganin are used to make resistors.

There are resistors made to certain fixed values in the laboratory. They are known as **fixed resistors**.

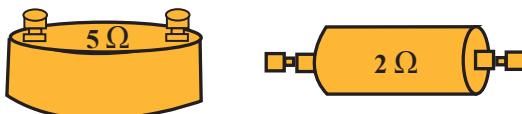


Figure 10.20 ▲ Several types of fixed resistors

**Every electric component has an exact resistance value. Therefore, they also can be considered as permanent resistors.**



## Activity 10.6

**You will need :-** A permanent resistor of  $2\Omega$ , a permanent resistor of  $5\Omega$ , a Filament bulb of  $2.5\text{ V}$ , two dry cells, an ammeter or milliammeter, a switch, connecting wires

### Method:-

- Connect the bulb, the switch, the ammeter or milliammeter and dry cells as shown in Figure 10.21.
- Close the switch and record the ammeter reading. Observe the brightness of the bulb also.
- Then, connect the extra fixed resistor of  $2\Omega$  to this circuit as shown in Figure 10.22.

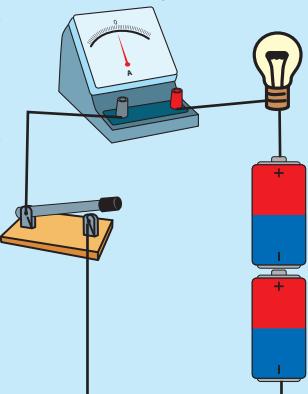


Figure 10.21 ▾

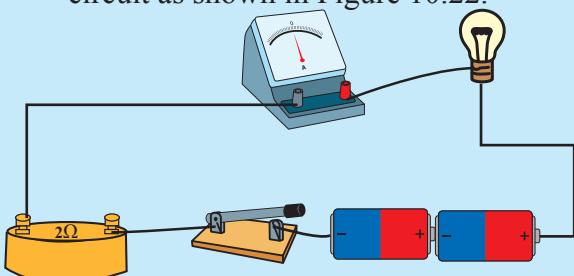


Figure 10.22 ▾

- Close the switch, observe the brightness of the bulb and record the ammeter reading.
- Open the switch of the circuit shown in Figure 10.22 and replace the fixed resistor of  $5\Omega$  instead of  $2\Omega$  resistor
- Close the switch again. Then, observe the brightness of the bulb and record the ammeter reading.

- Complete Table 10.2 according to the observations you made

Table 10.2

Instance	Brightness of the bulb	Ammeter reading
Without permanent resistor		
With permanent resistor of $2\Omega$		
With permanent resistor of $5\Omega$		

- What is the conclusion that you can reach according to your observations?

When an extra resistor is connected to an electric circuit, electric current flowing through the circuit is reduced. When the resistance of the circuit increased further current flowing decreases. Therefore, it is clear that the current flowing through a circuit can be reduced by connecting fixed resistors to increase the resistance.

### Variable resistor

The above mentioned fixed resistor has a definite resistance. There are resistors made by connecting several resistors to vary the current flowing through a circuit. They are called variable resistors. Figure 10.23 shows such a variable resistor.

Figure 10.23 ▲ Variable resistor



### Activity 10.7

**You will need:-** A Filament bulb, two dry cells, a switch, a milliammeter, a variable resistor, connecting wires

**Method:-**

- Connect the bulb, the switch, the dry cells, the milliammeter and the variable resistor as shown in Figure 10.24.
- Turn the adjustable key of the variable resistor to the maximum value.
- Close the switch and let the current flow through the circuit.
- Observe the brightness of the bulb and record the milliammeter reading.
- Shift the adjustable key of the variable resistor to decreasing resistance values. Observe how the brightness of the bulb and the milliammeter reading change.

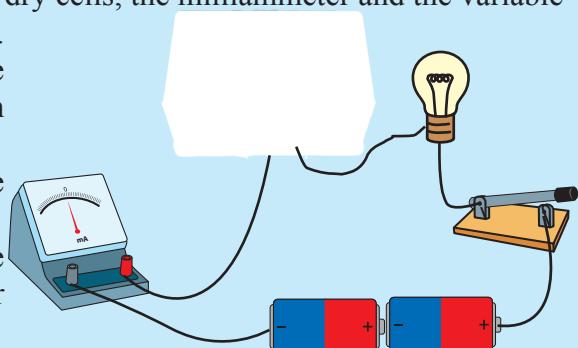


Figure 10.24 ▲

According to the observations of Activity 10.7, current flowing through the circuit decreases when the resistance is increased.

### Rheostat

It is revealed in the activity above, that the current flowing through a circuit can be changed using a variable resistor.

However, in a variable resistor like the one shown in Figure 10.23, by changing the resistance a current with a necessary value cannot be obtained.

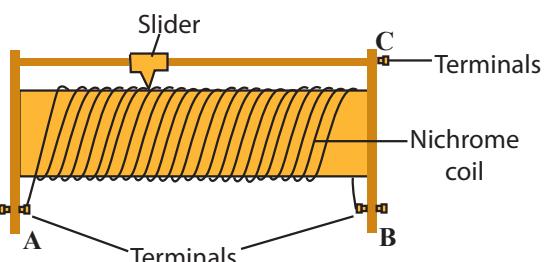


Figure 10.25 ▲ Rheostat

A rheostat is a variable resistor in which the current with a necessary value can be obtained. Such a rheostat is shown in Figure 10.25.

A rheostat is connected to the circuit by the terminals A and C or B and C. Necessary value of the resistance can be adjusted by moving the slider.



## Activity 10.8

**You will need:-** A rheostat, a filament bulb, two dry cells or any other current supply, a switch, an ammeter or a milliammeter, connecting wires

**Method:-**

- Connect the bulb, the rheostat, the switch, the milliammeter and the cells to construct the circuit as shown in Figure 10.26.
- Close the switch. The bulb lights and the milliammeter shows the reading relevant to the current flow.
- Then, shift the slider of the rheostat to and fro. You can observe the change of the brightness of the bulb and milliammeter reading.
- Now, shift the slider of the rheostat to read the values of current you selected, in milliammeter (such as 100 mA, 200 mA, 500 mA)
- According to this activity, it is clear that the current flowing through a circuit can be changed to our requirement using a rheostat.

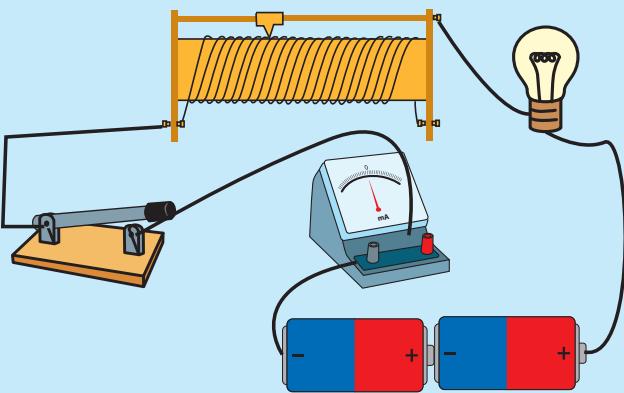


Figure 10.26 ▾

## Light dependent resistor

There are resistors that change their resistance when the intensity of light falling on them changes. Such resistors are known as **Light dependent resistors (LDR)**.

Figure 10.27 shows light dependent resistor.

Figure 10.27 ▾ Light dependent Resistor



## Activity 10.9

**You will need:-** A light dependent resistor, a filament bulb, a milliammeter, two dry cells (1.5V), a switch, an electric torch

### Method:-

- Construct the circuit connecting the bulb, the milliammeter, the light dependent resistor, the switch and the dry cells as shown in Figure 10.28.
- First, cover the light dependent resistor, so that no light falls on it. Record the observations.
- Then, remove the cover and let light in the environment falls on the light dependent resistor. Record the observations.
- Next, light the electric torch and direct its light on the light dependent resistor. Record the observations.
- Discuss the reasons for your observations.

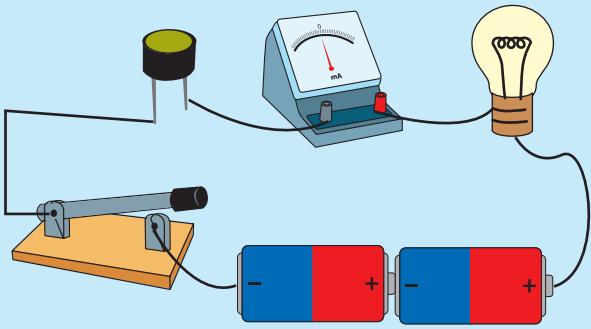


Figure 10.28 ▾

When light falls on a light dependent resistor its resistance decreases. Therefore, current flowing through the circuit increases.

When the intensity of light falling increases, the resistance decreases. Therefore, current flowing through the circuit increases further.

Hence, the light dependent resistor can be used to control the electric current flowing through a circuit.

### Soldering tools

Have you ever constructed an electrical circuit ? In those instances what is the method you used to connect the components to the circuit. Most probably you may have used a type of adhesive tape. Sometimes the joints are not properly connected when adhesive tapes are used. Then, the circuit does not work properly. As a solution to those problems, the joints are soldered when components of circuits are assembled.

Let us find out how this soldering is done. A tool, shown in Figure 10.29 (a) is used for this purpose. When electricity is supplied to the tool the tip of this tool gets heated. So, the melted soldering lead is applied to the joints of the circuit. Then joints are firmly connected by soldering lead and are not disconnected.

(a) Soldering tool  
(Soldering iron)

(b) Soldering lead

(c) Soldering

Figure 10.29 ▷ How soldering is done



### For your attention

The tip of the soldering tool gets highly heated, therefore some materials that come into contact, can be burnt.

Therefore, soldering tool should not be kept on things that are damaged by heat. So this tool should be carefully handled.

## 10.4 Household electrical appliances

Electricity is very important for various day-to-day work. Electricity is one of the ways used to gain energy. Electrically powered equipment can be used to ease our work and do it efficiently and economically. Those electrically powered equipment are known as **electrical appliances**.



### For your attention

The voltage in Volts (V) that should be supplied and the power in Watts (W) of an appliance at that voltage is mentioned on it. If a voltage, higher than that is mentioned is supplied, the appliance will be damaged.



### Assignment 10.3

- List out the electrical appliances used in your home and in your school.
- Tabulate those appliances according to their use.

Table 10.3

Use	Name of the appliance	Voltage (V) used	Power (W)
Lighting	1.		
	2.		
	3.		

Cooking	1.		
	2.		
	3.		
	4.		
Air conditioning	1.		
	2.		
Communication	1.		
	2.		
	3.		
Other (mention the use)			

There are some important facts that should be considered when using electrical appliances.

### 1. Selection of an appliance to suit the need

e.g. 1 :- When reading books at night, you can use a table lamp with a bulb of 5W/ 10W instead of 40 W bulb.

e.g. 2 :- A rice cooker of 240 V/ 700 W is suitable to cook rice for a few people, and a rice cooker of 240V/ 2000W is suitable to cook rice for a group.

The number of electrical units used, can be reduced by selecting appliances appropriately. Hence, the expenses for household electric bill can be reduced.

### 2. Selection of an efficient appliances

The efficiency of appliances is indicated on some of them. such information is useful to select more efficient appliances.

e.g.: - CFL of 240 V/14 W gives an intensity of light equal to a filament bulb of 240V/ 60 W or LED of 240V/ 7W. Therefore, it is suitable to use a 240 V / 14 W of CFL or 240V/ 7W of LED instead of a filament bulb.

### 3. Safe use of appliances, so that user and the others are out of danger

Some examples are given below.

e.g. 1:- It is important to operate electrical appliances away from water taps, places of leaking water, hearths and fire.

e.g. 2:- Test whether the connecting wires are damaged before using the appliances.

e.g. 3:- Refrain from wrong practices when connecting plug tops to plug bases.

### 4. Usage of household electric circuit and the appliances without getting damaged

Household electric circuits may be short circuited when they are being used. Then, the circuit may fuse and the components may be damaged. Therefore, care should be taken before using electrical appliances.

It is not suitable to use several high power electrical appliances when they are connected to the same socket. For instance, when several appliances like electric iron, refrigerator, electric ovens, washing machine and grinder are connected to the same socket it draws a large current from the household electric circuit. This causes heating of the connecting wires and as a result they can catch fire. Usage of such a high current is called over loading.

## 10.5 Heating effect of electric current

When an electric current is flowing through a wire, electric energy is transformed to heat. Therefore, the conducting wires get heated. This is called the **heating effect** of electric current.



### Activity 10.10

**You will need:-** A filament bulb (2.5 V), two electric cells, a switch, connecting wires

#### Method:-

- Connect the bulb, two electric cells and the switch as shown in Figure 10.30.
- Touch the glass cover of the bulb.
- Close the switch and let electric current flow for few seconds.
- Touch the glass cover of the bulb again. (As it is dangerous to touch an electric bulb or a part of a circuit, refrain from touching electric circuit without the teacher's instructions.)

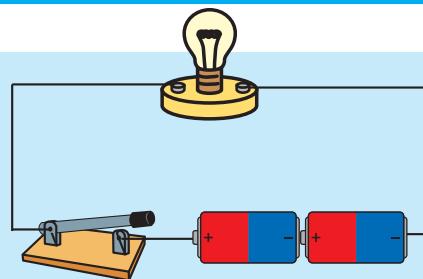


Figure 10.30 ▾

You will feel that the bulb has heated after the flow of electricity for some time. This reveals the heating effect of current.



## Activity 10.11

**You will need:-** A nichrome wire and a copper wire of same length (30 cm) and thickness, a piece of plank, three nails, a dry cell, a switch, connecting wires, a hammer

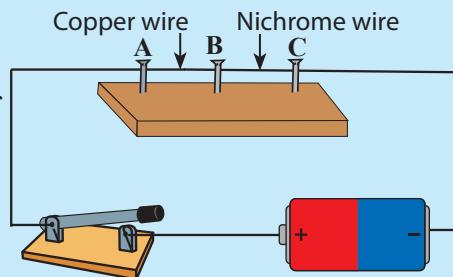


Figure 10.31 ▶

### Method:-

- Fix the three nails A,B and C on the plank, keeping 30 cm gap between each other as shown in Figure 10.31.
- Tie the copper wire between A and B nails and nichrome wire between B and C nails. Both wires should be well stretched.
- Then, connect the nails A and C of the plank to the switch and the dry cell with connecting wires as shown in Figure 10.31.
- Touch the copper and nichrome wires. Then, close the switch for about one minute to allow current to flow and touch the two wires again. (As it is dangerous to touch a part of a circuit, refrain from touching electric circuits without the teacher's instructions.)
- Discuss the observations.

Here, same electric current flows through both wires. But nichrome wire is heated more than the copper wire.



### For extra knowledge

Resistance of wires made of nichrome and manganese is higher than that of wires made of copper or aluminium.

Heating effect of an electric current depends on the resistance and the current flowing through a conductor.

When the resistance of the conductor is high, more heat is generated. When the current flowing through the conductor is high, more heat is generated.

Resistance of a conductor depends on the material it is made of, its length and its thickness (area of cross section).

Therefore, very thin, long nichrome wires are used in electrical appliances in which, heat is generated using heating effect of electricity. In our day-to-day life there are electrical appliances that use heating effect of electricity as well as the appliances where the same effect is disadvantageous.



## Assignment 10.4

- List out some day-to-day appliances in which the heating effect of electricity is effectively used.
- Tabulate the appliances, you identified according to their use.

Table 10.4

Name of the appliance	Purpose

Heating effect of electricity is a disadvantage in some electrical appliances. Various methods are used to avoid damages that happen due to the heat generated in them.

e.g.:-

- Heating effect of electricity is a disadvantage in some electrical appliances such as computers. Cooling fans are used to cool such appliances.
- Heavy duty semi conductors such as transistors produce heat. Therefore, heat sink is used to cool the appliance.

Cooling fans

Heat sink

Figure 10.32 ▲



## For extra knowledge

Nichrome is an alloy. It is made by mixing nickel, chromium and iron.

## 10.6 Light effect of electric current

Junctions of most junction diodes get heated when electric current flows through them. It happens because part of the electric energy is emitted as heat energy at the junction.

In some junction diodes, part of the electric energy is emitted as light energy at the junction. Then, the junction is illuminated. This emission of part of the electric energy as light energy is known as the **light effect** of electric current. Such diodes that emit light are known as **Light emitting diodes (LED)**.



### Activity 10.12

**You will need:-** Several LEDs of various colours (red, green, blue), a multicolour LED, connecting wires, a switch, two dry cells

#### Method:-

- Prepare the circuit by connecting an LED, the switch and two dry cells using connecting wire as shown in Figure 10.33.
- Close the switch and observe the LED.
- Connect each LED to the circuit and observe the colour of light emitting.

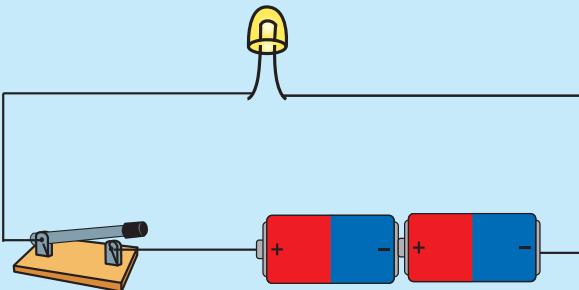


Figure 10.33 ▾

### Various light emitting diodes

Light emitting diodes emit various colours of light. Colour of the light emitted depends on the compound used to make the junction of LED.

Some LEDs emit several colours. They are known as multi colour LEDs.

LEDs are used for light decorative purposes as well as indicators to show whether circuit equipment are in active mode.

There is a high demand for lamps made of LEDs than for other types of electric lamps and bulbs because of the prevailing energy crisis. The reason for this is the higher efficiency of LED lamps, than the other types of lamps.

Figure 10.34 shows an LED and its circuit symbol.

When an LED is being connected to a circuit the positive and negative terminals should be connected correctly.

There is a minimum voltage that should be supplied to an LED to light it. Voltage supplied should exceed that minimum value for the LED to light it up.

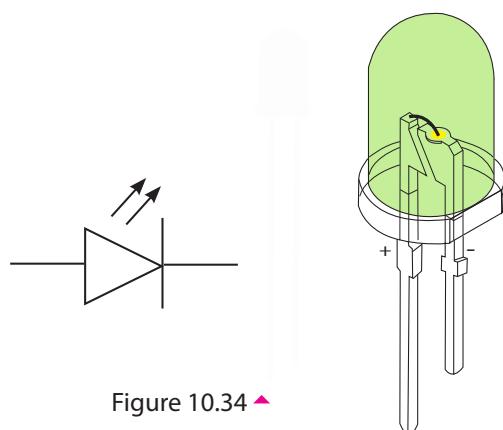


Figure 10.34 ▶

## 10.7 Magnetic effect of electric current

You may have seen that iron nails and pins are attracted to a magnet. Same way you can see that the indicator is deflected when a compass is brought close to a magnet.

When a compass is kept close to a current carrying conductor also, its indicator deflects. When the current flowing through the conductor is stopped, indicator of the compass returns to its initial position. It happens because a magnetic field is generated by an electric current carrying conductor. This phenomenon is known as the **magnetic effect** of electric current.



### Activity 10.13

**You will need:-** A compass, a piece of plank 20 cm x 5 cm, two iron nails, copper wire, a dry cell, a bulb, a switch

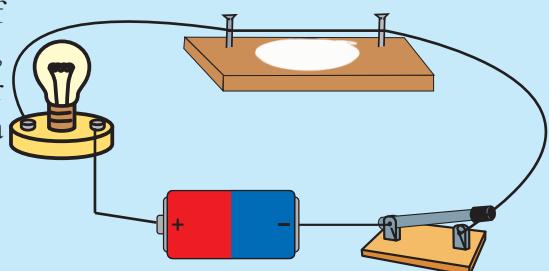


Figure 10.35 ▶

#### Method:-

- Fix two iron nails at the corners of the piece of plank as shown in Figure 10.35.
- Stretch well and tie the copper wire to the nails. Connect the two ends of the copper wire to the bulb to the dry cell and to the switch as shown in Figure.
- Place the compass under the stretched copper wire. Turn the wire to north-south direction of the earth. So, that the copper wire and the compass needle will be parallel to each other.

- Now, close the switch. The bulb will light and a deflection of the compass needle can be observed.
- Open the switch again. The bulb will not illuminate and the compass needle will turn back to its initial position.

This activity shows that a magnetic field is generated by a conductor which carries current and such a conductor acts as a magnet. In the chapter about magnets, it is magnetic effect of electricity that you used to make temporary magnets.



### Activity 10.14

**You will need:-** Two iron nails of 10 cm length, enamel plated copper wire, two dry cells, an ammeter, a switch, some pins

**Method:-**

- Make a coil by winding enamel plated copper wire round a nail.
- (Step 1) Connect the coil to the ammeter, switch and one dry cell in series as shown in Figure 10.36. Close the switch. Bring the coil close to the pins. You will find that the pins are attracted to the nail. Count the number of pins attracted and record.
- (Step 2) Open the switch and remove the iron nail from the coil carefully as shown in Figure 10.37. Then, close the switch and bring the coil close to pins. The pins will be attracted. Count the number of pins attracted and record.
- (Step 3) Connect two dry cells in series to the circuit as shown in Figure 10.37, instead of one cell. Then, close the switch and bring the coil closer to the pins. It will be observed that the ammeter reading is increased and more pins are attracted. Count the number of pins attracted and record.

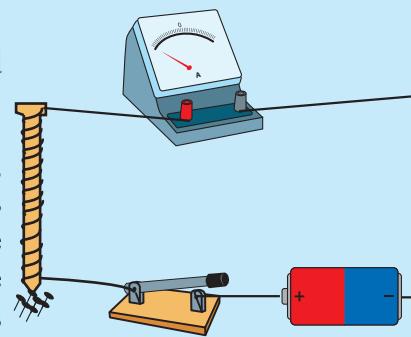


Figure 10.36 ▲

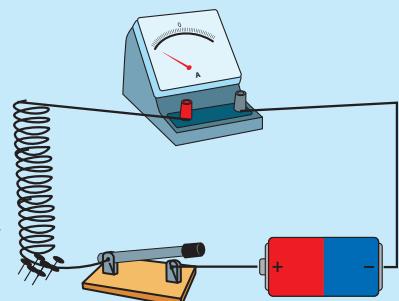


Figure 10.37 ▲

- (Step 4) Make another coil by winding more number of turns of copper wire round an iron nail as shown in Figure 10.38. Connect this coil with the nail to the circuit as before. Connect only one dry cell as shown in Figure 10.38. Close the switch and bring the nail closer to the pins. Count the number of pins attracted and record. Record the ammeter reading also.

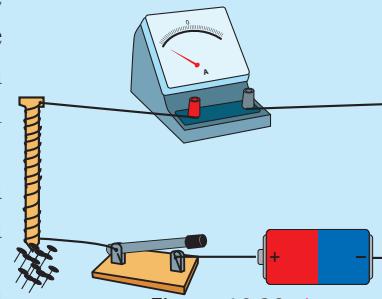


Figure 10.38 ▲

Table 10.5

Occasion	Number of pins attracted	Ammeter reading
Step 1		
Step 2		
Step 3		
Step 4		

- Identify the factors affecting the strength of an electromagnet by comparing the number of pins attracted.

According to the activity above, it is revealed that the strength of an electromagnet depends on;

- The type of core in the coil
- The electric current flowing through the coil
- The number of turns of the coil

Thus, the strength of an electromagnet;

- increases when there is a magnetic medium as the core of the coil.
- increases when the electric current flowing through the coil is increased.
- increases when the number of turns of the coil is increased.

### Uses of electromagnets

Have you ever dismantled any electrical appliance which are out of use ? With the guidance of your teacher or an adult, do so and examine what is inside.

In some electrical appliances, electro magnets are used.

e.g.: - Electric fans, electric bells, electric grinders, electric water pumps, washing machines, some automatic switches

Electromagnets are used to separate iron from metal wastes. Such an instance is shown in Figure 10.39.

Figure 10.39 ▲  
Usage of an electromagnet



### Assignment 10.5

- Use a bell cup, a hacksaw blade, a bolt of 1 cm with a nut, metal rods of 4 cm length, enamel plated copper wire, a wooden strip to the size 12 cm x 10 cm x 1cm, Two bolts of the length of 1.5 cm, conducting wires, two dry cells and a sand paper
- Make an electric bell using the above items. Get the assistance of your teacher when necessary.

## 10.8 Chemical effect of electric current

You can see a gas bubbling around a piece of zinc, dipped in diluted hydrochloric acid. It happens because of the chemical reaction between zinc and hydrochloric acid.

Acidulate about 200 ml of water in a beaker with a few drops of hydrochloric acid. Dip two copper plates or rods which are connected to the terminals of a dry cell into this beaker. You can see a gas bubbling near the plates. Here the electrical energy is converted to chemical energy. This phenomenon is known as the **chemical effect** of electric current.



### Activity 10.15

**You will need:-** A beaker of 250 ml, two dry cells, two carbon rods with metal caps taken from worn out dry cells, 150 ml of acidulated water, connecting wires

#### Method:-

- Clean the carbon rods using a sand paper.
- Connect two wires to the caps of cleaned carbon rods securely.
- Connect the other ends of the wires to the set of two dry cells joined in series.
- Then, dip the carbon rods in the beaker of acidulated water, as shown in Figure 10.40.
- Bubbling of a gas can be observed near the carbon rods.

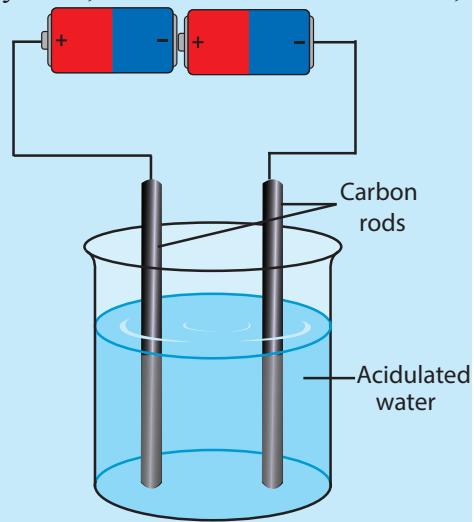


Figure 10.40 ▶

- When the dry cells are removed and both ends of the wires are connected together while the rods are still in acidulated water, no bubbling can be observed.

This activity reveals that when an electric current flows, a chemical reaction occurs at the electrodes (carbon rods).

### Electroplating

A metal can be plated on metallic object a using the chemical effect of electric current. This is known as electroplating. Some examples of its usage are given below.

- Plating gold or silver on jewellery
- Plating metals like chromium or nickel on equipment like spoons, forks, knives, bath room sets made of iron to prevent rusting and to give them an attractive appearance
- Plating tin inside iron containers, used for canning food



#### Activity 10.16

**You will need:-** A beaker of 250 ml, two dry cells, 100 ml of concentrated copper sulphate solution, a cleaned copper plate of 6 cm x 1cm, an iron spoon

##### Method:-

- Add copper sulphate solution to the beaker.
- Connect two connecting wires to the copper plate and iron spoon securely. Connect the free ends of the two connecting wires to a set of two dry cells joined in series.
- Then dip the copper plate and the spoon in the beaker of copper sulphate solution, at the same time.
- Observe the spoon after about 10 minutes.

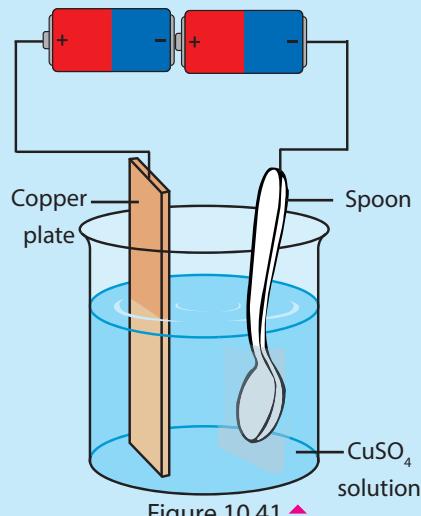


Figure 10.41 ▶

It can be seen that the part of spoon dipped in copper sulphate solution has turned copper colour. This happens because a thin layer of copper is deposited on the spoon. This is known as electroplating.



## Summary

- Bulbs can be connected in series or in parallel in circuits.
- Cells can be connected in series or in parallel to supply electricity to the circuits.
- There is a simple electric circuit in the electric torch.
- Switches and resistors are current controlling components.
- Tap key and plug key are two types of switches.
- Fixed resistors, variable resistors, rheostat and light dependent resistors are also current controlling components.
- Equipment used to perform useful tasks using electricity are called electric appliances.
- Some electrical appliances use heating effect of electric current to generate heat.
- Light emitting diode is a component that uses the lighting effect of electric current.
- Electromagnet is a component that uses the magnetic effect of electric current.
- The strength of an electromagnet depends on the type of core in the coil, the electric current flowing through the coil and the number of turns of the coil.
- Electroplating is an instance where the chemical effect of electric current is used.

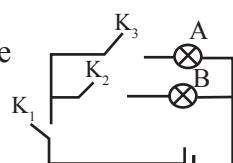
## Exercise

### Multiple choice questions

1) Select the most suitable answer.

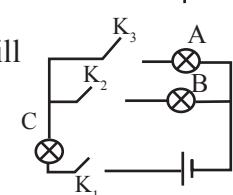
1. What are the keys (switches) in the circuit that should be closed to light bulb A only ?

1. K<sub>3</sub> only                  2. K<sub>3</sub> and K<sub>2</sub> only  
3. K<sub>1</sub> and K<sub>3</sub> only            4. K<sub>1</sub>, K<sub>2</sub> and K<sub>3</sub> keys



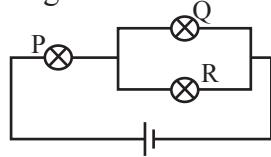
2. There are four answers about the key combinations that will turn on bulb C on what is the **false** answer out of those ?

1. All the keys                  2. K<sub>1</sub> and K<sub>2</sub> only  
3. K<sub>1</sub> and K<sub>3</sub> only            4. K<sub>1</sub> only



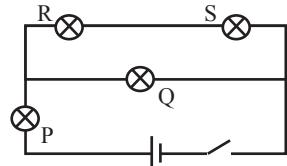
3. P, Q and R are identical bulbs in the circuit given in the diagram. Which bulb/bulbs give the brightest illumination ?

- 1. Bulb P
- 2. Bulb Q
- 3. Bulb R
- 4. Bulbs Q and R



4. What is the correct answer about the brightness of the bulbs, when the switch is closed ?

- 1. P gives the brightest illumination.
- 2. Q gives the brightest illumination.
- 3. R and S give the brightest illumination.
- 4. Any bulb does not illuminate.



5. The device, that can be used to vary the electric current of circuit continuously is,

- 1. Switch
- 2. Variable resistor
- 3. Rheostat
- 4. Fixed resistor

6. Which one below is an observation of heating effect of electric current ?

- 1. Light emitting when an electric current is flowing through a LED.
- 2. Heating of the bulb, when a current is flowing through a filament bulb.
- 3. Bubbling near the copper plates due to chemical reaction
- 4. Attraction of pins to the coil due to electromagnetism.

7. Several phenomena are given below.

- A. Emission of light when an electric current flows through a LED.
- B. Attraction of pins to a copper coil when a current is flowing through it.
- C. Flow of an electric current when sunlight falls on an LDR connected to a circuit.
- D. Plating gold on jewellery in electroplating.

Which one above is **not** an effect of electric current ?

- 1. A
- 2. B
- 3. C
- 4. D

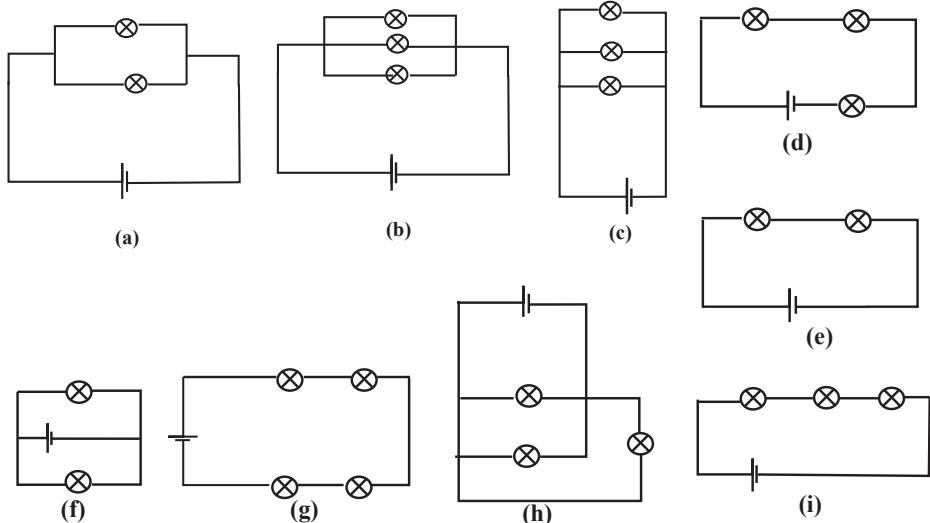
8. When the electric current flowing through a conductor is reduced the strength of the magnetic field generated;

- 1. Increases
- 2. Decreases
- 3. First decreases and then increases
- 4. Does not change

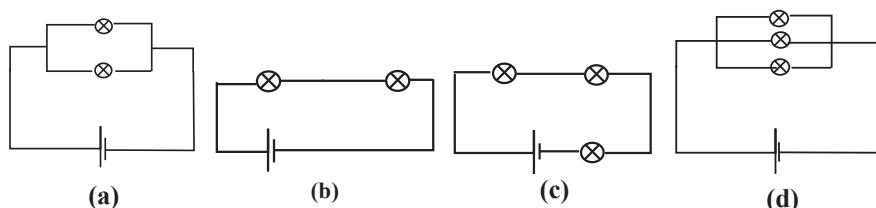
9. What are the factors below, on which the strength of the magnetic field, generated in a current - flowing coil depends ?
- A. Amount of electric current flowing      C. Number of turns of the coil  
 B. Type of core in the coil                  D. Direction of the current flowing
1. A and B only                                2. B and C only  
 3. C and D only                                4. A, B and C only
10. Which of the following electrical appliance does **not** use an electromagnet ?
1. Electric bell                                2. Electric fan  
 3. Immersion heater                            4. Hand drill

### Essay questions

- 1) Circuits below show different ways of connecting several bulbs with a cell.

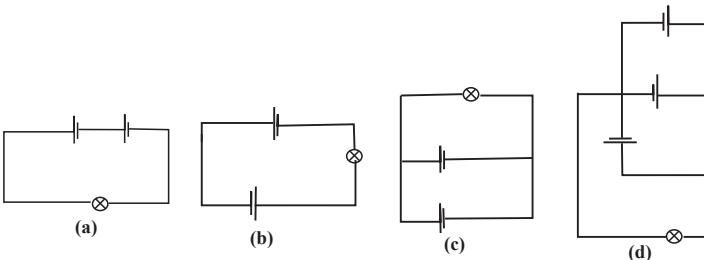


- a) What are the circuits here in which the bulbs are connected in series ?  
 b) What are the circuits here in which the bulbs are connected in parallel ?
- 2) In the circuits below all the cells are identical and all the bulbs also are identical.

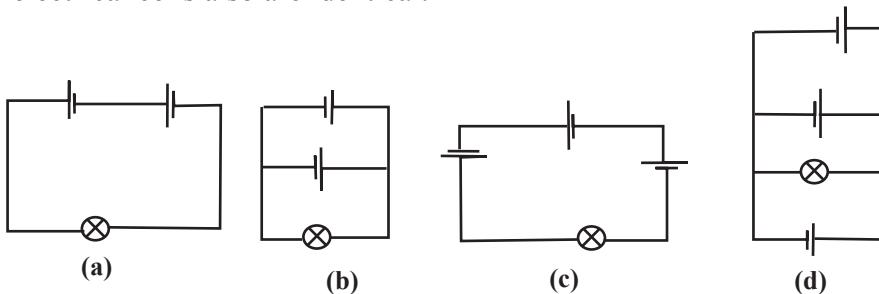


- a) Out of those given above, in which circuits have the bulbs with maximum brightness?  
 b) In which circuits have the bulbs with minimum brightness ?

3) Circuits given below show different ways of connecting several cells with a bulb.



- a) Out of those given above, which circuit contains dry cells connected in a series manner?
- b) Select the circuits in which dry cells are connected in parallel.
- 4) Several electric circuits are given below. All bulbs used, are identical and all the electrical cells also are identical.



- a) Which circuit has the bulbs with maximum brightness ?
- b) Which circuits have the bulbs with minimum brightness ?

**Write down the answers for the following questions.**

- 5) What are the components which can be used to control the electric current ?
- 6) Explain briefly, how the electric current is controlled by a light dependent resistor in a circuit.
- 7) What are the points that attention should be paid when using electrical appliances ?
- 8) i. Name some of the effects of electric current ?  
ii. State the energy transformation that occurs in each effect you mentioned.  
iii. Mention one electrical appliance found in daily usage with using each effect of electric current mentioned above.

- 9) i. Using diagrams describe briefly, the way of making a simple electromagnet.  
ii. What are the factors on which the strength of an electromagnet depends ?
- 10) i. What are the effects of electric current used in the LED and in the filament bulb ?  
ii. Discuss the importance of using an LED instead of a filament bulb.

## Technical Terms

Series circuit	- குறைகிடக் பரிபல்	- தொடர்ச்சுற்று
Parallel circuit	- சமாந்தரத்தை பரிபல்	- சமாந்தரமான சுற்று
Electrical appliance	- விழுது உலாரண்	- மின்சாதனம்
Tap key	- வகுக யநூர்	- தட்டு சாவி
Plug key	- தீங்கு யநூர்	- செருகு சாவி
Resistance	- புதிரேஷ்ய	- தடை
Resistor	- புதிரேஷ்யகை	- தடையி
Rheostat	- வாரு நியாமகை	- இரையோதற்று
Light dependent resistor (LDR)	- ஆலோக சு.வீ.பி.புதிரேஷ்யகை	- ஒளிடணித்தடையி
Compact fluorescent lamps	- சு.ங.கித புதிரேஷ்யப்பகுதி	- புளோரசன் விளக்கு
Short-circuit	- பரிபல் ஓலைக்கு வீல்	- மின்கசிவு
Overloading	- அதிகரணய	- மிகையோட்டம்
Nichrome	- நிக்ரோம்	- நிக்குரோம்
Electromagnet	- விழுது விழுதுகை	- மின்காந்தம்
Electroplating	- விழுது லேப்ஹாலேப்பனய	- மின்முலாமிடுதல்
Magnetic field	- விழுது கெத்துய	- காந்தப் புலம்
Heating effect	- தாபன லிலை	- வெப்ப விளைவு
Light effect	- புகாட லிலை	- ஒளி விளைவு
Magnetic effect	- விழுது லிலை	- காந்த விளைவு
Chemical effect	- ரஸாயனிக் லிலை	- இரசாயன விளைவு
Light emitting diode (LED)	- ஆலோக விளேஷ்வக வியேஷ்வய	- ஒளிகாலும் இருவாயி
Electric bell	- விழுதி சீஞ்வ	- மின்மாணி
Compass	- மாலிமால்	- திசைகாட்டி
Deflection	- உத்துமனைய	- திரும்பல்
Electrode	- ஓலெக்ஸ்டிரேஷ்வய	- மின்வாய்
Terminal	- ஆகுய	- முடிவிடம்

# 11 Main biological processes in plants

Plants are considered as the main living component that contributes much for the proper existence and security of environment.

Plants carryout a number of biological processes for their existence. Let us study about such biological processes taken place inside plants.

## 11.1 Photosynthesis

Plants are autotrophic; which means they can produce their own food. Hence, plants contribute for the existence of themselves as well as animals.

Observe Figure 11.1 to study about photosynthesis, that is the biological process carried out by the plants to produce food.

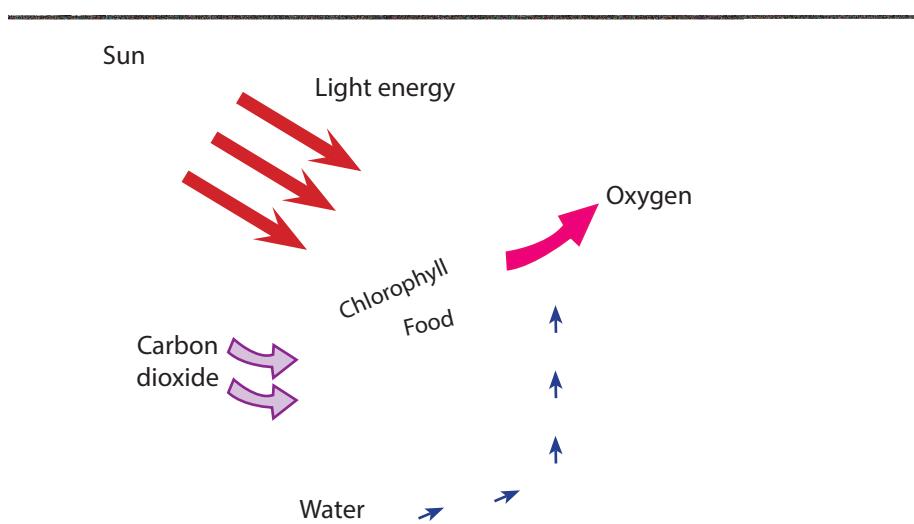


Figure 11.1 ▶ The essential factors and the products of photosynthesis

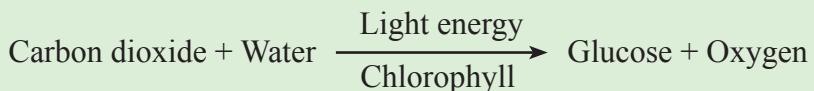
Leaf is the main organ, which produce food. The factors necessary for photosynthesis and the method of obtaining these factors are given below.

- Carbon dioxide :- Enters into the leaf through stomata from atmosphere
- Water :- The root hairs absorb water from soil. Then, it is transported to the leaf through the xylem.
- Chlorophyll :- A green colour pigment which is found within the chloroplast in cells. They absorb light.
- Light energy :- Chloroplast absorb the light energy from the sunlight fallen on the surface of the leaf.

Food is produced in an organ called chloroplasts, which can be found in plant cells.

**Photosynthesis** is the process of producing food in chlorophyl containing cells, using  $\text{CO}_2$  and water by absorbing light energy from the light. The products of photosynthesis are glucose and oxygen.

The reaction of photosynthesis can be given as the following word equation.



Glucose, produced in leaves is converted into starch in the leaves. Later this starch is converted to sucrose and transported to the necessary places of the plant (growing parts and storage organs).

Let us do the Activity 11.1 to test whether photosynthesis has taken place in leaves. If the leaves contain starch and thus we can come to a conclusion that photosynthesis has taken place in leaves.

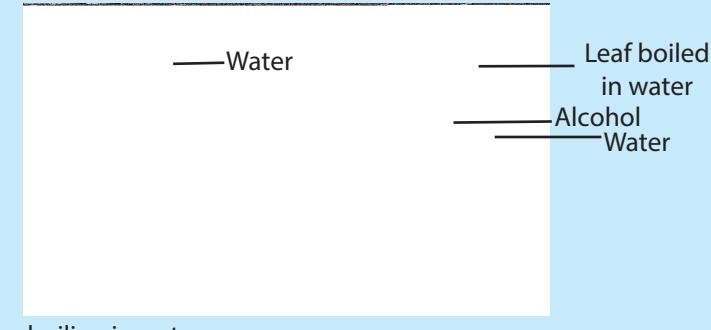


## Activity 11.1

**You will need:-** A beaker, watch glass, tripod, bunsen burner, some leaves that are exposed to the sun light well (sun flower/chilli/drumstick), alcohol, boiling tube, iodine solution, forceps

### Method :-

- Dip the leaves in hot water and boil.
- Then put them into a boiling tube with alcohol and boil them in a water bath as shown in Figure 11.2 b until the leaves become colourless.



a - boiling in water      b - boiling in alcohol in a water bath

Figure 11.2 ▲ Preparing the leaves for the test

- Take the leaves away and wash well. Keep them on the watch glass and put some iodine drops on to the leaves.
- Note the observations.

Iodine

You will observe that the leaves turn into dark blue colour when iodine is added. Iodine is an indicator that turns to dark blue in the presence of starch. So, this experiment demonstrates that the leaves perform photosynthesis and produce starch, when necessary conditions are supplied.

Let us do the Activity 11.2 to study that oxygen is produced during photosynthesis.



## Activity 11.2

**You will need:-** A funnel, some aquatic plants, water, a trough, boiling tube, a glowing splinter

### Method :-

- Fill the jar with water and keep some *Hydrilla* plants. Place the funnel as shown in Figure 11.4. Close the free end of the funnel with the boiling tube filled with water.
- Expose the set-up to sunlight.
- Note your observations.
- Take the boiling tube out carefully and insert a glowing splinter into the boiling tube.
- Observe what happens.

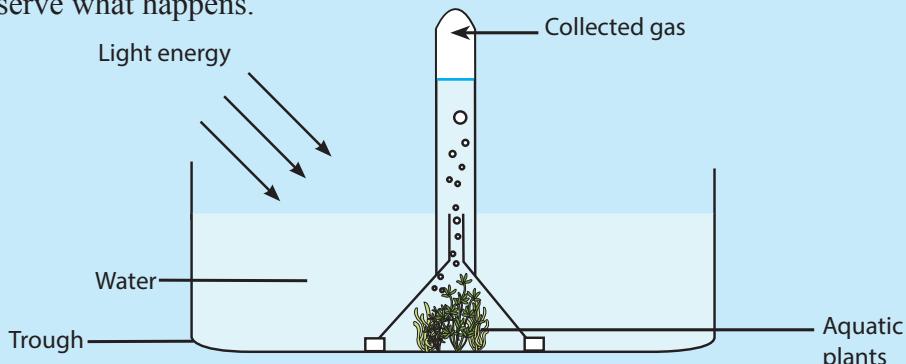


Figure 11.4 ▲

You will observe that air bubbles released from the plants and get collected in the upper part of the test tube. You must take the test tube out very carefully and insert the glowing splinter. You will see the glowing splinter reignite and bursting into flame indicating the presence of oxygen inside the test tube. So, you can come to conclusion that oxygen is produced during photosynthesis.

Have you seen air bubbles coming out from a fish tank during the day time?

The air bubbles are oxygen, a product of photosynthesis. Now you can understand the importance of growing aquatic plants in fish tanks.

Figure 11.5 ▲ Releasing oxygen gas from submerged aquatic plants

Photosynthesis is important for the existence of the living world. Let us engage in Assignment 11.1 to study the importance of photosynthesis.

### Assignment 11.1

Collect and compile a report on the global importance of photosynthesis to display on your wallpaper.

Figure 11.6 shows the description of the global importance of photosynthesis.

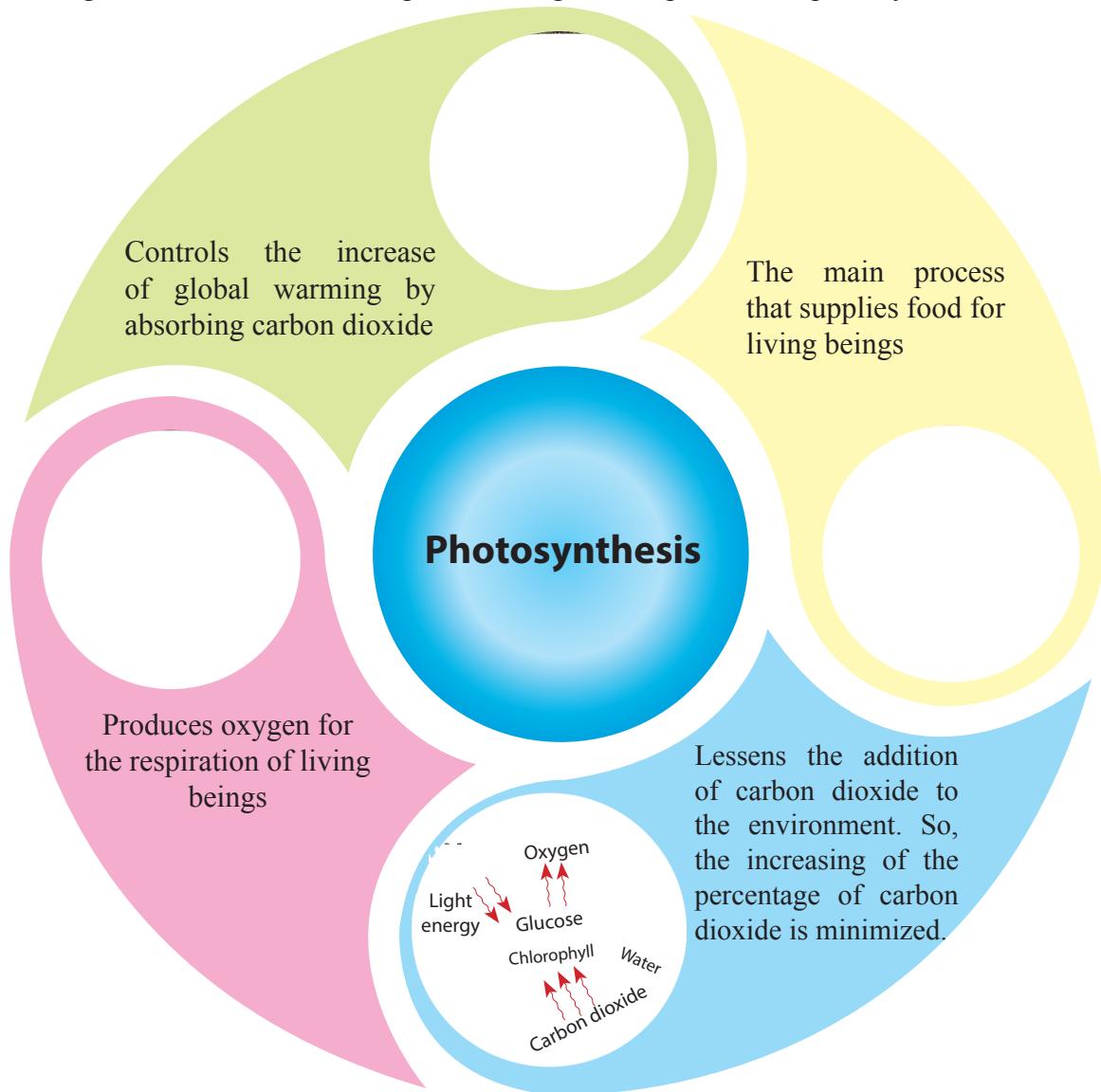


Figure 11.6 ▶ Global importance of photosynthesis

Have you ever thought about the ways that plants intake the raw materials for photosynthesis and how the products are transported to the different parts of the plant? You will understand how it happens with further studies.

## 11.2 Transportation

Plants in taking the raw materials for different biological processes and taking the products of these processes to the appropriate places of the plant is known as **transportation**. Some examples are given below.

- Transportation of atmospheric air through the stomata to the cells of the leaves.
- Transportation of water and minerals from soil to the leaves through root hairs.
- Transportation of food produced by photosynthesis from leaves to the other parts of the plant.

There should be a mechanism within the plants for transportation. Let us do Activity 11.3 to study about it.

### 11.2.1 Diffusion



#### Activity 11.3

You will need :- Condis, water, a beaker

**Method:-**

- Fill the beaker with water.
- Put some condis into it.
- Observe how the particles spread throughout water.

Figure 11.7 ▲ How condis particles spread throughout water

Spreading of condis in water can be described using Figure 11.8

Condis  
Low concentration

Condis  
High concentration

Figure 11.8 ▲ Spreading of condis particles in water

When the cube of condis is put into water more particles of condis can be seen around the cube. That is the concentration of condis particles is high around the cube, which means there are more condis particles within a unit volume. There is less amount of condis particles in the upper part of the water beaker. Condis particles move randomly from a region of higher concentration to a region of lower concentration. This movement of particles occur not only in the liquid but also in the gas medium.

When skin of an orange is peeled off, the smell can be felt for a person who is even a little far away. That is because the orange skin contains volatile materials. These volatile materials randomly move through the air from the higher concentrated area to the low concentrated area. Spreading the smell of joss sticks and the smell of perfumes is also done according to the above method.

**The process in which a movement of a substance from an area of higher concentration to an area of lower concentration is called diffusion.**

Diffusion is one of the main processes in plants that helps for the transpotation of substances.

Following are some instances where diffusion takes place.

- Diffusion of carbon dioxide from atmosphere to the plant leaves through stomata for photosynthesis.
- Diffusion of oxygen through stomata to the leaves for respiration.
- Oxygen, a product of photosynthesis diffusing out of the stomata to the atmosphere.
- The products of respiration, carbon dioxide and water vapour diffusing from stomata to the atmosphere.

### 11.2.2 Osmosis



#### Assignment 11.2

Uproot a Balsam plant carefully without breaking the roots. Wash soil in the roots. Put some water into a container and dissolve some red ink in it. Now, dip the plant in the water you prepared with ink. Observe after few hours.

Figure 11.9 ▲ Ink solution goes up through the stem

You will see that roots absorb the red ink solution and it goes up to the stem. There is a mechanism that water particles and ink particles travel through the root cells and enter the xylem tissue.

Thus, there is a mechanism that water particles travel from cell to cell. To study about this mechanism let us do Activity 11.4.



## Activity 11.4

**You will need:-** A thistle funnel, a piece of colourless cellophane, 500 ml beaker, rubber bands threads, salt solution, water, condis solution

### Method :-

- Fill the beaker with water.
- Cover the mouth of the funnel with the piece of cellophane.
- Place the funnel in the beaker and put condis solution and salt solution into the funnel.
- Mark the starting level in the thistle funnel.
- Note your observations after a few minutes.

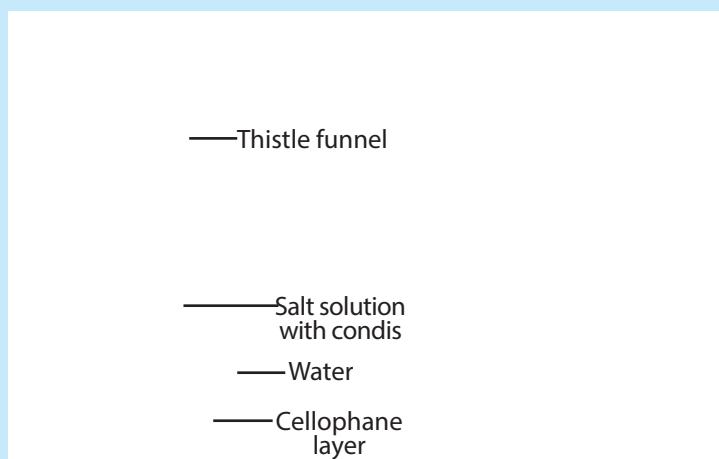


Figure 11.10 (a) ▲ before

Figure 11.10 (b) ▲ after

After few minutes, you will observe that the level of the liquid in the funnel rises up and the colour of the condis is faded.

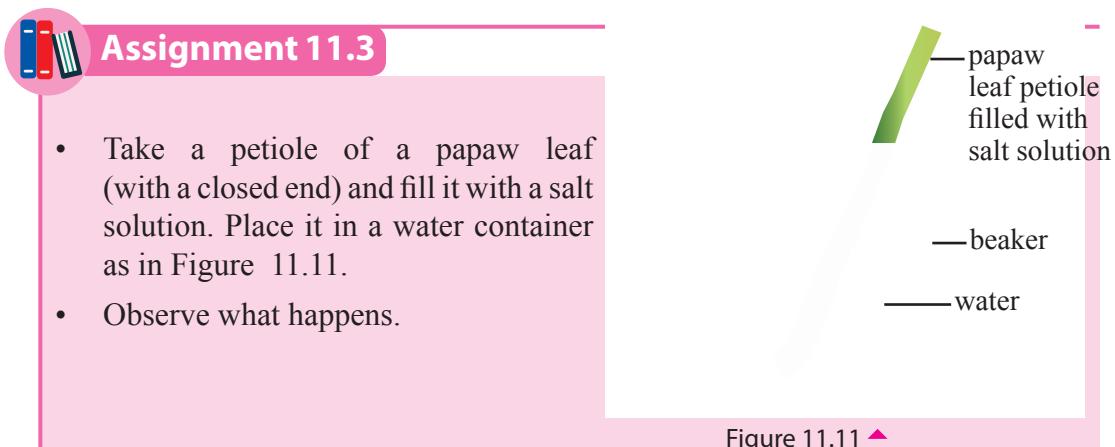
The reason for the rising up the level of liquid can be explained as below.

The concentration of water molecules is higher in the beaker compared to the solution in the thistle funnel. So, water molecules tend to move from area of higher concentration (beaker) to area of lower concentration (thistle funnel) across the cellophane. Cellophane allows only the water molecules to pass through and prevents salt and condis molecules to get in. Such membranes are called **semipermeable membranes**.

A semipermeable membrane allows only some selected molecules to pass through. You can do the same experiment using an egg membrane instead of the cellophane. Egg membrane is also considered as a semipermeable membrane.

**Diffusion of water molecules through a semipermeable membrane from an area of higher water concentration to an area of lower water concentration is known as osmosis.**

To study about the osmosis let us do Assignment 11.3.



Many minerals are dissolved in soil water. The root hairs of plants absorb these water particles by osmosis. From root hair up to the xylem, water particles move from cell to cell by osmosis. The cell membrane inside the cell wall act as a semipermeable membrane.

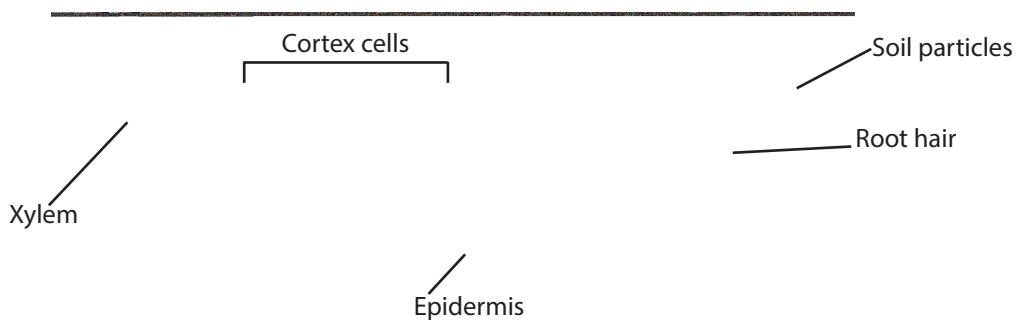


Figure 11.12 ▾ Transportation of water absorbed by the root hairs to the xylem

Root hairs absorb water by osmosis. Energy is not needed for this. But energy is needed to absorb minerals. Food produced in leaves are also transported to the other parts of the plant through the phloem tissues. These photosynthetic products are transported as a unit along the phloem tissues and that process is known as **mass flow**.

Some methods of transportation in plants are given below.

- Diffusion
- Osmosis
- Mass flow

### 11.3 Transpiration

Let us engage in Activity 11.5 to identify another important biological process that takes place in the plants.



#### Activity 11.5

**You will need:-** A potted plant, transparent polythene bag, rubber bands

**Method :-**

- Cover a branch of the plant using a polythene bag.
- Observe after one hour.

Figure 11.13 ▶

You will notice that there are droplets inside the polythene bag. When some anhydrous copper sulphate crystals are put on the droplets the crystals turn from white to blue. So, that you can conclude that the droplets were water droplets.

These water droplets mainly come out from the leaves.

**The process of evaporation of water through the aerial parts of a plant is termed as transpiration.** This happens mainly through the stomata in leaves.

Engage in Activity 11.6 to show that plants absorb water to fill the gap of water due to transpiration.



## Activity 11.6

**You will need:-** A leafy shoot (you should cut this under water), coconut oil, rubber cork, grease/paraffin, "U" tube, water

### Method :-

- Fill the "U" tube with water.
- Cut a leafy shoot under the water and fix it to the rubber cork and fix the cork to the one arm of the "U" tube.
- Seal it using grease and put some coconut oil to the other arm of the "U" tube and mark the level of water.
- After an hour observe the water level in the arm with coconut oil.

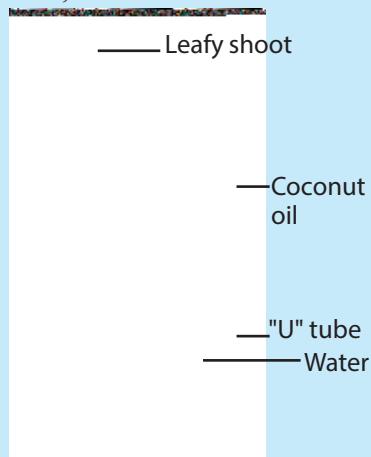


Figure 11.14 ▶

You will observe that the water level in the free arm of the "U" tube decreases. The shoot loses water through transpiration. Therefore, it absorbs the same amount of water from the "U" tube. This is the reason for the decreasing of water level in the free arm of the "U" tube.

The speed of the transportation within the plants increases due to transpiration. In addition to this there are some other functions of transpiration. They are,

- The transpiration pull is responsible for the continuous ascent of water and nutrients from the roots to the top most parts of the plants.
- As the water is evaporated, transpiration helps the plant in cooling.
- Maintains the water cycle by evaporating water.

Therefore, transpiration is a process, favourable not only for the plants but also for the environment.

Severe heat, strong wind, strong light increase the rate of transpiration. Transpiration during dry condition may affect the plant to dry. There are many adaptations of plants that live in such weather conditions to conserve water. Recall what you have studied in chapter 3.

Some adaptations are given below.

- Thick epidermis in aerial parts e.g. - Temple trees
- Leaves reduced to spines e.g. - Cactus
- Leaves turned to scale leaves e.g. - 'Kasa'/'Savukku'
- Reducing the size of leaves e.g. - 'Navahandi'/'Kally'
- Hairs on epidermis e.g. - Sun flower, Pumpkin
- Sunk stomata e.g. - Oleander
- Leaves fall during the dry season e.g. - Rubber, Teak
- Fleshy leaves e.g. - *Aloe*
- Rolled leaves during dry seasons e.g. - 'Maha ravana reula'/'Ravanana meesai'  
- 'Bim thamburu' / 'Vatralai'

## 11.4 Guttation

---

When the humidity is high at nights the margins and tips of leaves in some plants such as anthurium, acacia ooze liquid drops. Think for a while the reason for these droplets.

At night the percentage of water vapour in the atmosphere is high and transpiration occurs very rarely. Therefore, the margins and the tips of leaves in small plants secrete water in the liquid form. They are exuded from the hydathodes.

The process of water being exuded in the liquid form through hydathodes of the leaves is known as **guttation**.

Figure 11.15 ▲

Guttation occurs from the tips of the plants such as 'habarala'/'nersshembu', anthurium, grass etc. and from the margins of the plants such as potato, tomato etc. The water in the droplets, release from guttation gets evaporated during the day time. But the salt get left behind and can burn the tips of the leaves. You would have seen such burns in the plants such as 'habarala'.

The differences between transpiration and guttation are shown in Table 11.1

Table 11.1

Transpiration	Guttation
1. Water release in the form of water vapour	Water release in the form of drops/liquid.
2. Occurs mainly through stomata.	Occurs through hydathodes
3. Only pure water is released.	Water and salts are released
4. Occurs during both day and night time.	Mostly occurs during night.
5. When humidity in the atmosphere is increased, rate of transpiration is decreased.	When humidity in the atmosphere is high, it increases the guttation.

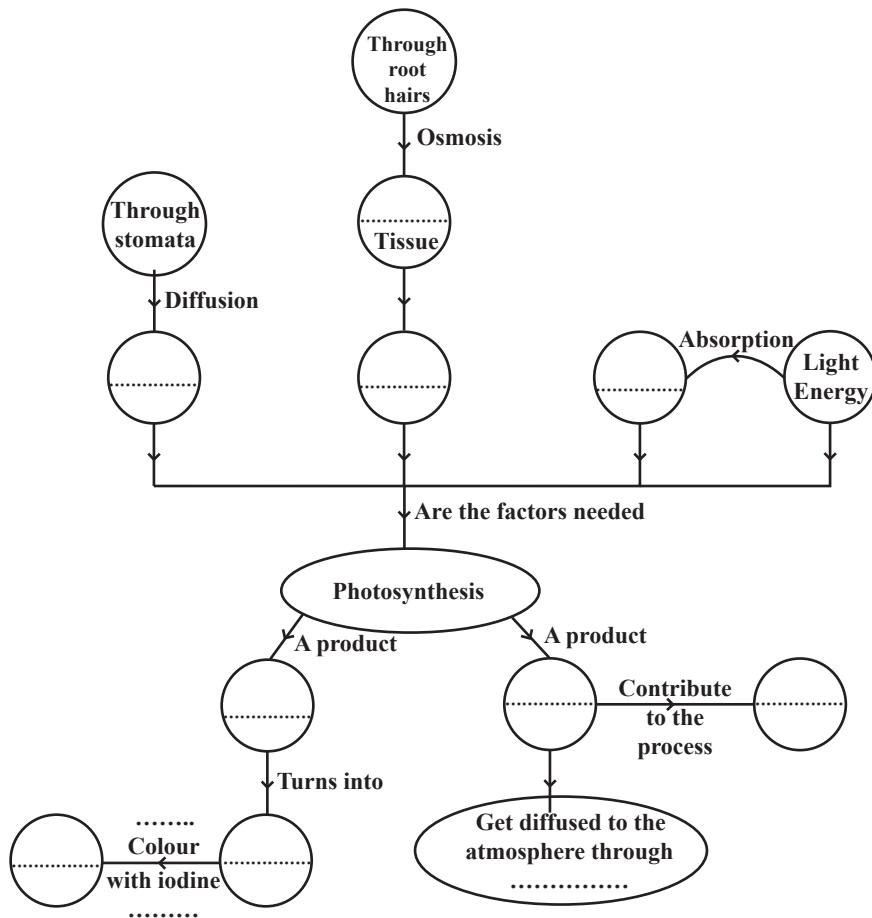


## Summary

- Plants are considered as the main living component that contributes much for the proper existence and security of environment.
- Plants ensure their existence by the biological processes.
- Some biological processes carried out by the plants are photosynthesis, transportation and transpiration.
- It is important to transport water, a raw material of photosynthesis to the leaves and also starch, a product of photosynthesis to the necessary parts of the plant.
- The mechanisms such as diffusion, osmosis, help for the plant to absorb water from soil by the root hairs.
- Mass flow is the mechanism used to transport produced food along the phloem.
- Transpiration and guttation are important for the efficiency of transportation within the plants.
- The plants in xeric environments show many adaptations to minimize transpiration.
- The existence of plants ensures the conservation of environment.

## Exercise

- 1) The following is a concept map prepared by a grade eight student. Fill the blanks using suitable words.



- 2) Select the correct answer.

1. Following are three statements that a student wrote about transpiration.

- A - Loss of water as vapour to the atmosphere.
- B - Occurs only during night.
- C - Mainly occurs through stomata

Out of these three the correct statement/s are,

- 1. A and B Only
- 2. A and C Only
- 3. B and C Only
- 4. A, B and C

2. The leaves of a plant that grows in a certain area has reduced to scale leaves. An example for such a plant is,

1. cactus      2. 'nawahandi'      3. 'kasa'      4. oleander

3. The biological process demonstrated by the following figure is,

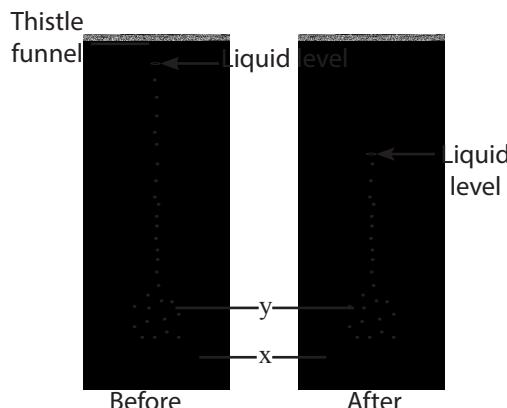


1. photosynthesis  
2. mass flow  
3. osmosis  
4. transpiration

4. The group of plants that shows the guttation is,

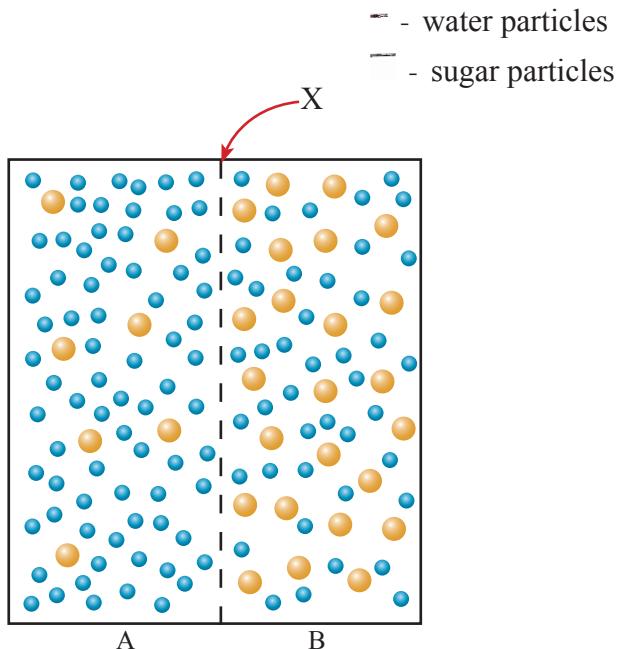
1. acacia, potato, temple tree      2. anthurium, tomato, acacia  
3. cactus, temple tree , potato      4. aloe, oleander, pumpkin

5. It can be observed the levels of liquids in thistle funnel has been changed after few minutes in the set-up. According to the difference of liquid levels in thistle funnel, x and y are respectively,



1. sugar solution and water      2. water and sugar solution  
3. water and water      4. sugar solution and sugar solution

6) Following is a model of a method of transportation in plants.



- What is denoted by X ?
- What is the method of transportation in the model ?
- What is the direction of net movement ?
- What are the other methods of transportation in plants ?

## Technical Terms

Photosynthesis	- புதையல்லேங்கை	- ஒளித்தொகுப்பு
Transportation	- அரிவுனாய்	- கொண்டு செல்லல்
Osmosis	- ஆஸூதிய	- பிரசாரணம்
Diffusion	- விசரணய	- பரவல்
Mass flow	- சீகந்தி புவாயை	- திணிவுப்பாய்ச்சல்
Transpiration	- உறிச்சேவினாய்	- ஆவியுயிர்ப்பு
Guttation	- விந்டைய	- கசிவு

# 12 Life cycles of living organisms

By observing the environment carefully you will notice that all living beings are born from an egg / a seed or as a small creature, and they pass through many different stages. A grown-up organism produces offspring of its own by the reproductive process. These stages are repeated in each generation through and it ensures the survival of living organisms in the environment.

**The sequence of events in stages of development as a cyclic process, which a living organism passes from its birth to death is termed as a life cycle.**

Let us do Activity 12.1 to study about the life cycles of living organisms.



## Activity 12.1

**You will need :-** Some pictures of animals with the stages of life cycles

Frog

Rat

Cockroach

Mosquito

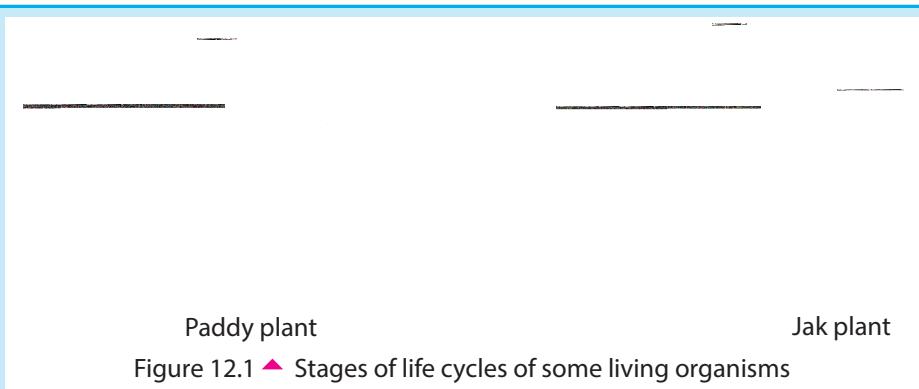
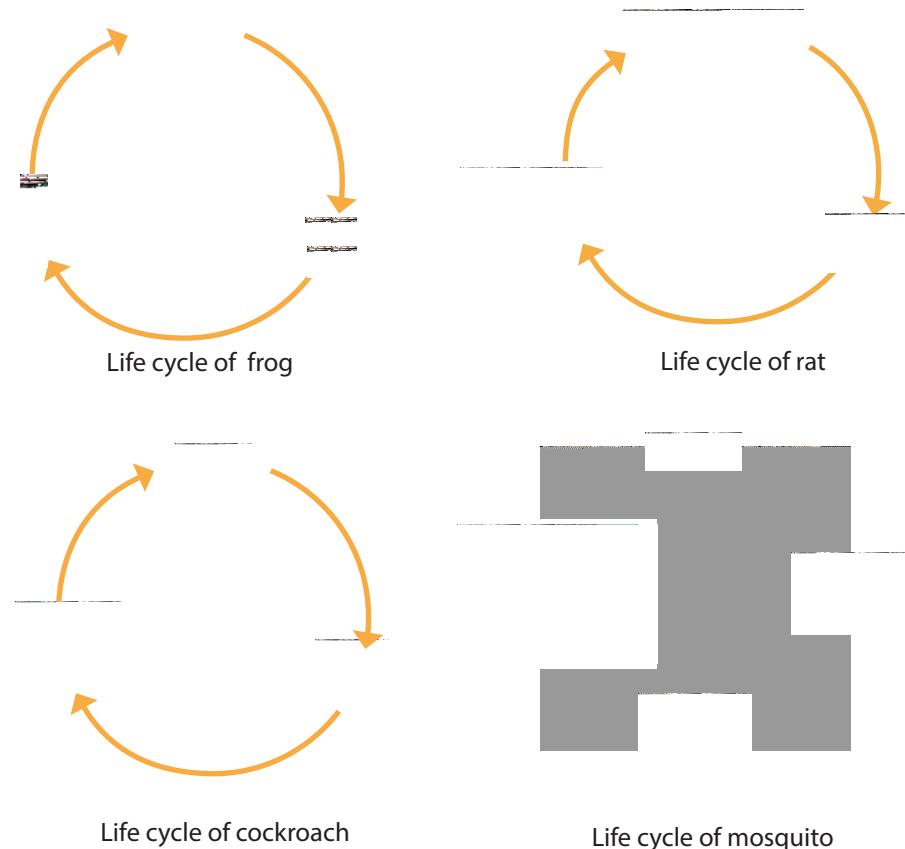


Figure 12.1 ▶ Stages of life cycles of some living organisms

### Method :-

- Observe the pictures given in Figure 12.1 and identify the different stages of each organism.
- Make the different stages in order and write the life cycle of each organism.

Compare the life cycles you prepared with the following.



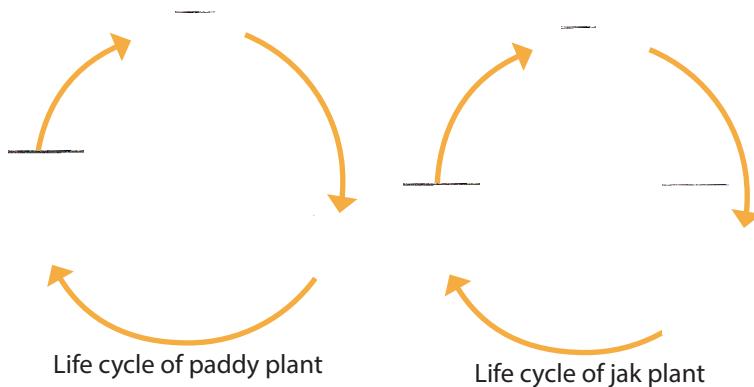


Figure 12.2 ▷ Life cycles of some organisms

When you have completed arranging the stages of life cycles of plants and animals in order you would have understood that life cycles of organisms can be build up.

## 12.1 Life cycles of animals

To study about the life cycles of animals engage in Activity 12.2



### Activity 12.2

**You will need:-** Life cycles of butterfly, frog, cockroach, mosquito, rat, human  
**Method :-**

- Observe the life cycles well and identify the special characteristics of each stage of animals.
- Tabulate your observations depending on the differences of shapes/ patterns of the different stages.

Table 12.1

With different morphological forms of stages	Without different morphological forms of stages

You would have noticed that there are no different morphological forms in different stages of rat and human, while there are morphological changes in different stages of cockroach, butterfly, mosquito and frog.

Some animals (e.g. :- rat) born morphologically similar to their parents, but smaller in size. Some species have slightly complicated life cycles. That is, they go through different morphological forms before becoming an adult.

Some animals such as butterfly, mosquito, cockroach, frog etc, are hatched from an egg. As the nutrients in the eggs are not sufficient for them to become an adult, they go through different stages. During these stages most of the feeding is done for them to become an adult. Going through different stages in the life cycles ensures their survival.

Also the adaptations of these stages for different environments secure their survival.

There are different stages in human life cycle. Although the infant is differ in body size, he has similar appearance of the adult. The infant goes through the life stages childhood, adolescence and becomes an adult. Stages of human life cycle have approximately the similar morphological features that they will have as human adults.



Figure 12.3 ▲ Some stages of human life cycle

Hence, you may have noticed that some organisms who undergo changes with different morphological features while some have similar morphological features in their different stages of life cycle.

Would you have noticed that the egg of the butterfly hatch and a larva is born ? After some days larva becomes a pupa and later becomes a beautiful butterfly with colourful wings. These stages of life cycle have different morphological features.

The process with different morphological changes in different stages of life cycle that some living organisms go through to become adults is referred to as **metamorphosis**.

Animals like rat and man who do not show morphological differences in life cycles do not have metamorphosis in their development.

Are the morphological changes of different stages of every organism that undergo metamorphosis, significant ? Let us do Activity 12.3 to study about it.



### Activity 12.3

**You will need:-** Some pictures that show the life cycles of frog, cockroach, butterfly, mosquito, grasshopper, white ant

#### Method :-

- Observe the pictures well.
- Are the morphological changes of different stages of every creature significant ?
- Tabulate your answer.

Table 12.2

The creatures that have significant differences in stages of life cycle	The creatures that do not have significant differences in stages of life cycle

The organisms hatched from eggs of cockroach, grasshopper, termite are smaller in size but they resemble adult in appearance. The creatures hatched from eggs of butterfly, mosquito, frog are completely different from the adult.

Metamorphosis is commonly exhibited by insects and amphibians. Metamorphosis is a reason for successful existence of insects.

There are two common forms of metamorphosis.

- **Complete metamorphosis**
- **Incomplete metamorphosis**

Metamorphosis with significant morphological differences in the different stages, is known as **complete metamorphosis**.

The feeding mechanism and locomotion are different in each stage. As an example butterfly larva feeds on plant leaves while moves using legs. The adult butterfly feeds on nectar and flies using wings.

e.g. :- Mosquito, butterfly

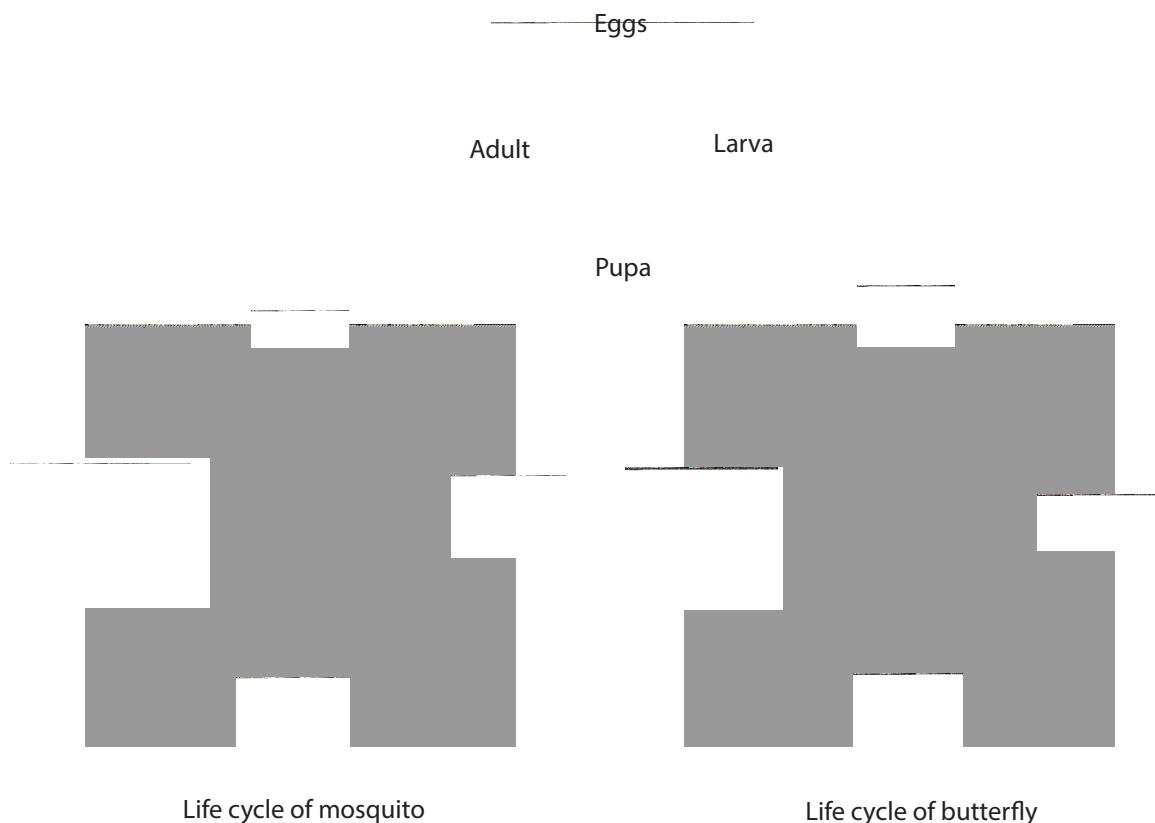


Figure 12.4 ▲ Life cycles of mosquito and butterfly showing complete metamorphosis

Metamorphosis that does not show any significant morphological changes in the stages of life cycle is known as **incomplete metamorphosis**.

The young hatched from the egg, is known as the nymph. Nymph is morphologically similar to the adult with only slight changes. Nymph does not have wings. They are small in size and not sexually matured.

e.g :- Cockroach

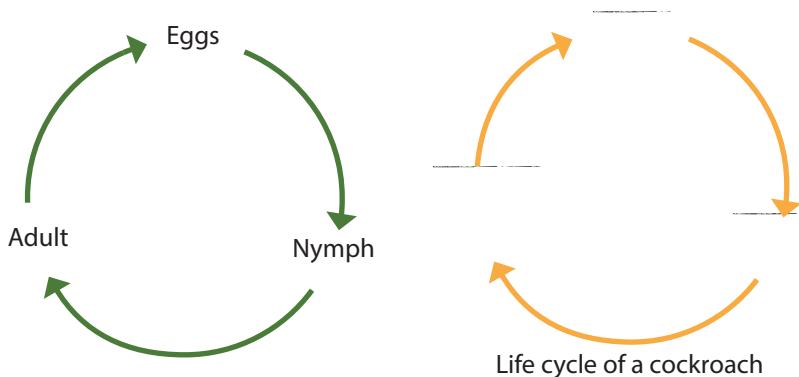


Figure 12.5 ▲ Life cycle of a cockroach that shows incomplete metamorphosis

### Assignment 12.1

- List separately creatures that exhibit complete metamorphosis and incomplete metamorphosis.

Frog is a vertebrate that exhibits metamorphosis. Let us study the life cycle of a frog.

#### 12.1.1 Life cycle of a frog

The female frog lays eggs in water. The eggs are covered with a jelly type layer. A tiny tadpole emerges from a hatched egg. It is similar to a fish. It can swim in water and breaths using gills. It feeds on aquatic plants as a herbivore.

Several morphological changes take place within water in the tadpole to become an adult (Figure 12.6).

Figure 12.6 ▲ How a tadpole becomes a frog

Adult frog has completely different morphological features compared to the stages of tadpole. It has legs for locomotion and lungs for respiration. They feed on small insects. They are insectivores.

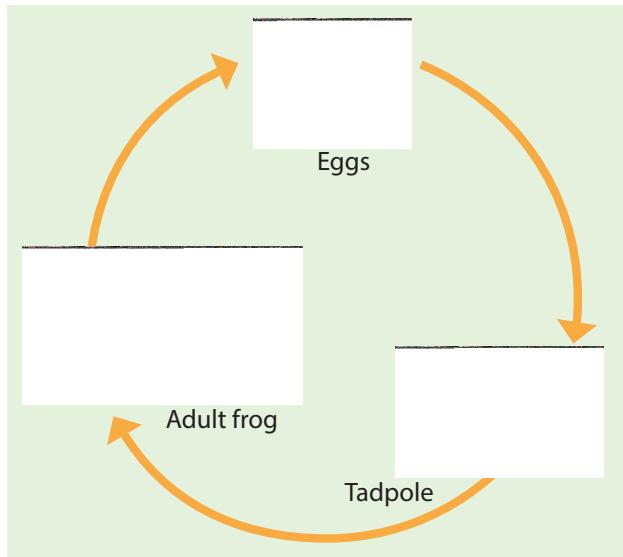


Figure 12.7 ▷ Life cycle of a frog



## Assignment 12.2

- Conduct a field visit to a nearest aquatic environment. Eg :- A pond.
- Observe the different stages of frog; eggs, tadpoles and adult frog.
- Identify the special characteristics of those stages.

Let us study the life cycle of a butterfly, an insect that goes through complete metamorphosis.

### 12.1.2 Life cycle of a butterfly

Butterfly shows complete metamorphosis. The adult butterfly lays eggs. These eggs hatch and larva emerge. This larva is called a caterpillar. Caterpillar becomes a pupa after sometime. Pupa stays inside a cocoon. It stays inactively without feeding. However there are some changes take place in the body to become an adult.

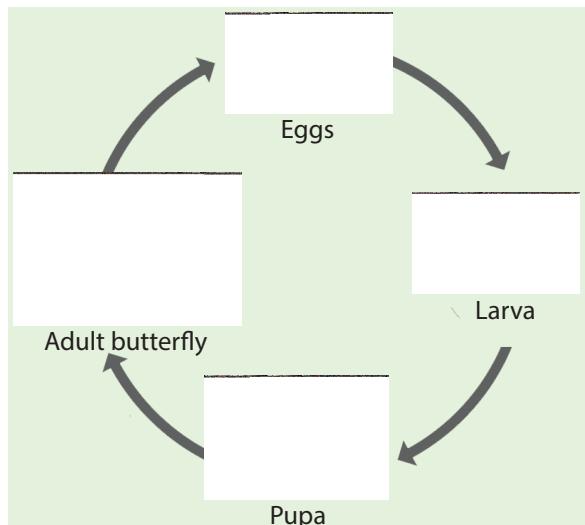


Figure 12.8 ▷ Life cycle of a butterfly

Specific features in each developmental stage of butterfly is given in Table 12.3.

Table 12.3

Eggs of butterfly	Larva	Pupa	Adult
<ul style="list-style-type: none"><li>• Eggs stick on the lower surface of plant leaves.</li></ul>	<ul style="list-style-type: none"><li>• Caterpillar is the larva of butterfly.</li><li>• Caterpillars are normally match with the surface they attach to. They use legs for locomotion.</li><li>• Caterpillar feed on tender leaves and grow. There are specified mouthparts for it.</li><li>• There are hairs containing venom to protect from predators.</li></ul>	<ul style="list-style-type: none"><li>• Pupa is an inactive stage in a pupal cocoon. It does not feed.</li><li>• Body parts of the butterfly form in the pupal cocoon.</li><li>• Pupa stick on to a surface.</li></ul>	<ul style="list-style-type: none"><li>• Adult emerges breaking the cocoon.</li><li>• Adult feeds on nectar. There is a specialized organ called proboscis to suck nectar.</li></ul>

Let us study the life cycle of a cockroach, an insect that goes through incomplete metamorphosis.

### 12.1.3 Life cycle of a cockroach

After hatching the eggs nymphs are emerged. Although the nymph is smaller in size, it is morphologically similar to the adult. They do not possess wings. Nymphs are not sexually matured. Nymphs become adults by passing through number of nymphal stages (by shedding their exoskeleton).

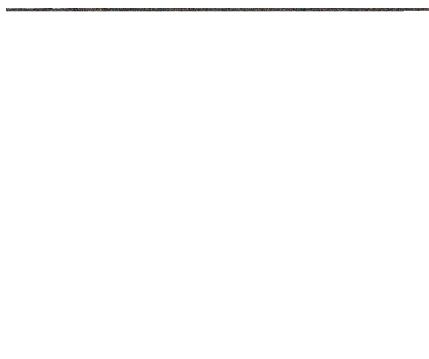


Figure 12.9 ▪ Some nymphal stages of cockroach

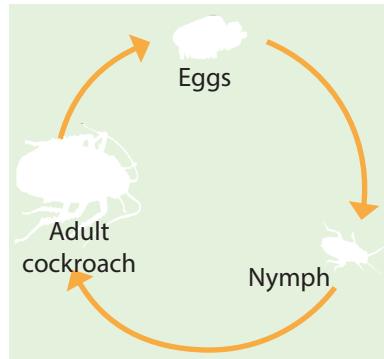


Figure 12.10 ▪ Life cycle of a cockroach

## 12.2 Life cycles of plants

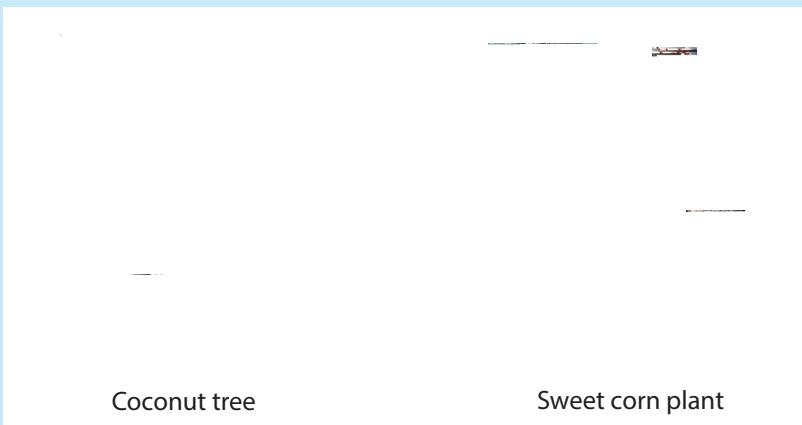
Flowering plants also pass different stages from seed germination to growing to a mature plant.

Let us do Activity 12.4 to find out more about the life cycles of flowering plants.



### Activity 12.4

**You will need:-** Some pictures showing the life cycles of flowering plants



Coconut tree

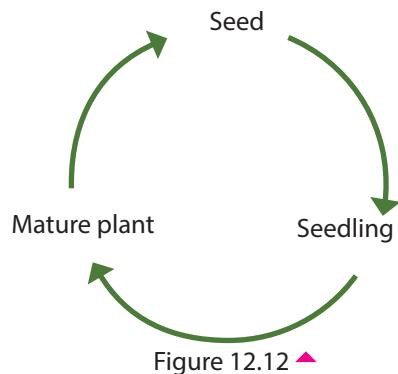
Sweet corn plant

Figure 12.11 ▪ Stages of life cycles of flowering plants

#### Method :-

- Observe the pictures well. (Get the help of your teacher)
- Write the stages of the life cycles in order.

The stages of a life cycle of a flowering plant can be represented as follows (Figure 12.12).



### Assignment 12.3

- Collect some seeds and fruits of some plants, that can be easily found (grass, love grass, chillies, tomato)
- Collect the flowers of those plants.
- Press them keeping between the pages of a paper, for some days.
- Use them and try to present the life cycle of each plant.

## 12.3 Importance of learning the life cycles

The importance of learning about the life cycles are;

- For pest control
- For control of disease vectors
- For conservae of biodiversity

### 12.3.1 Pest controlling

An organism that harms or destroys crops, garden plants or trees that are useful for human is known as a pest.

It is important to study the life cycles and the behaviour of these pests in order to control them.

Let us study the life cycle of a fruit fly, a pest insect that involves in destroying the crops a lot (Figure 12.13).

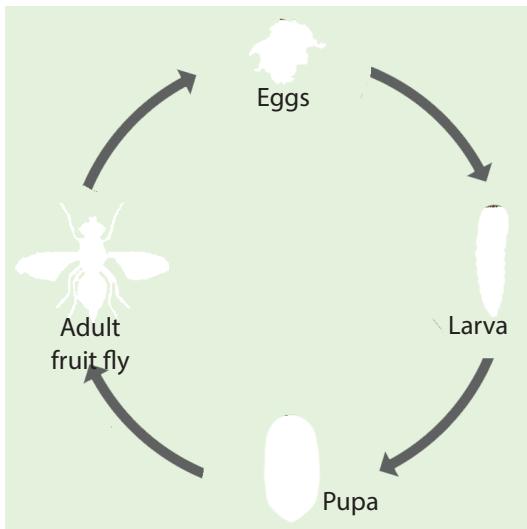


Figure 12.13 ▪ Life cycle of a fruit fly

The adult female fruit fly lays eggs by pricking the fruits such as mango, guava etc. The larva feeds on the flesh of the fruit, gradually moving in by making tunnels in the fruit. So, the fruits get rotten and become unsuitable for human consumption. The value of the fruit also gets reduced.

Figure 12.14 ▪ The damage of the fruit fly

The larval stage is the most likely and easiest way to control the fruit fly.

- Regular inspection of the fruit is important to can control the fruit fly. If larvae are found in fruits the fruits must be destroyed.
- The fallen fruits that are infected by larvae should be collected and destroyed.



### Activity 12.5

**You will need:-** Articles or magazines written on pests that destroy crops and their life cycles

**Method :-**

- Make a list of pests that destroy crops.
- Tabulate your findings in Table 12.14.

Table 12.4

Pest insect	Crop/crops affected	Mostly affected part of the crop	Stage of life cycle that destroy the crop
Fruit fly			
Coconut red weevil			
Paddy bug			
Mealy bug			

Compare your answer with the following.

Table 12.5

Insect pest	Crop/crops affected	Mostly affected part	Stage of life cycle that destroy the crop
Fruit fly	Mango, banana	Fruit	Larva
Coconut red weevil	Coconut	stem	Larva and adult
Paddy bug	Paddy plant	milky, seed	Adults and nymph
Mealy bug	Mango, rose apple, guava, papaya, brinjal, chillies	Leaves, fruits	Adults and nymph

The actual methods you can use to control pests and the ways these methods can be used together is based on an understanding of their life cycles. The method used to control the larval stage can not be used to control the adult stage of the pest insect or its any other stage.

Therefore, controlling of pests can be achieved effectively by controlling different stages of their life cycle. Pests can be pest insects and also pest plants that destroy the crops.

e.g. :- 'Bajiri', 'Kudametta', 'Thunessa' are pest plants of rice crop

Many pest controlling methods are used to prevent the harm of pests on crops / harvest. It is our duty and the responsibility to protect the living beings in the environment. This will help to conserve the biodiversity and the environmental equilibrium.

The traditional methods of controlling pests used by our ancestors are eco-friendly and nowadays farmers tend to use these methods to control pests.

Engage in Assignment 12.4 to study about the traditional methods.



#### Assignment 12.4

- Find and list out the traditional methods used in the past to control different stages of pests.
- Write your ideas on the importance of those traditional methods.

Nowadays, there is a special attention on eco-friendly pesticides. Obtaining knowledge about the preparation and usage of such pesticides causes environmental protection.

Engage in Assignment 12.5 to study about eco-friendly pesticides.



### Assignment 12.5

- Make a list of eco-friendly pesticides that can be used to control the pest insects pests.
- Write the raw materials needed to prepare these pesticides.

Use of chemical pesticides can damage the environment by destroying beneficial organisms. This can throw the whole eco-system out of balance. So, chemical control should be applied when the pests cannot be controlled by biological or by simple mechanical methods.

Excessive and unsafe use of chemical pesticides may affect the water bodies. These chemicals can accumulate in water. Consuming this contaminated water may cause cancers and kidney diseases.



### For extra knowledge

- When chemical pesticides are used in fruits and vegetables it is very important not to harvest them until the recommended period. If they are harvested before the safe period the toxic chemicals enter the human body. Accumulation of these toxic chemicals for a long time in the body leads to diseases such as cancer, kidney diseases.
- Therefore, it is very important to wash the fruits and vegetables well before consuming.

Let us do Assignment 12.6 to study the adverse effects of chemical pesticides.



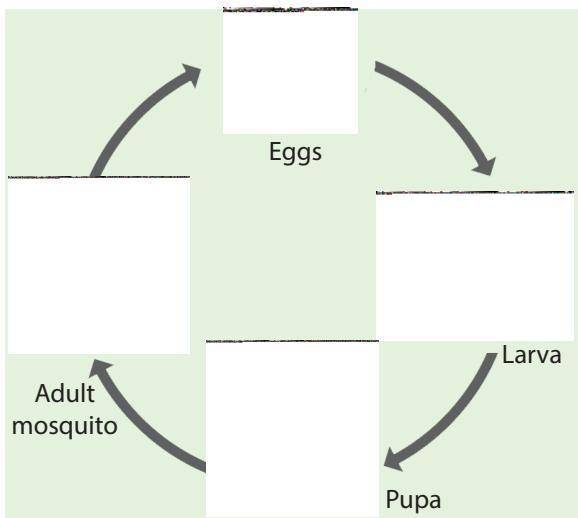
### Assignment 12.6

- Design a poster to show the adverse effects of using chemical pesticides.

### 12.3.2 Control of disease vectors

An agent that carries and transmits pathogens (virus, protozoa) from an infectious organism to a healthy organism is called a disease vector. Mosquito is a disease vector. It acts as the vector of different diseases that human suffers such as dengue, malaria etc.

To control the disease vector it is important to know about the life cycle of the organism.



Fish species that feed on mosquito larva can be bred in water bodies in order to control mosquito larva. This is considered as a biological control. This way of controlling pests are eco-friendly than spraying chemical to control mosquito.

Figure 12.15 ▲ Life cycle of mosquito



### Assignment 12.7

- List out some diseases that are transmitted by mosquito.
- Collect information about fish species that prey on mosquito larvae.
- List the most suitable methods that can be used to control the adult mosquito.
- What are the precautions that can be taken to prevent mosquito breeding ?
- Design a poster about controlling mosquito breeding.

### 12.3.3 Life cycles for conservation of biodiversity

Some stages within the life cycles of some animal species have become threatened within their habitat. Some growth stages of animals can be completely destroyed due to becoming victims of animals, unfavourable environmental conditions and scarcity of food. Such stages can be considered as the **sensitive stage** of the particular organism. A species may face total extinction if the sensitive stage is destroyed.

Valuable stages of some animals are given below.

- Some insects - Larvae
- Fishes - Eggs
- Turtles - Eggs and young turtles
- Frogs - Eggs and tadpoles

To protect the biodiversity it is important to understand about sensitive stages of particular organisms. If pay special attention about the sensitive stages of organism, it would be easier to conserve those organisms. Then, it will help to protect biodiversity.



## Summary

- Every living organism has a life cycle with different stages.
- Some organisms have significant differences in the stages of life cycle, but some do not have significant differences in the stages.
- The process with a sequence of morphological changes that some living organisms go through to become an adult is known as metamorphosis.
- Metamorphosis with significant morphological changes in the stages is known as complete metamorphosis.
- Metamorphosis without significant morphological changes in the stages is known as incomplete metamorphosis.
- Flowering plants too go through different stages from growth of the seed till becoming an adult plant in its life cycle.
- The creatures that harm the crops and harvest of human is called as pests.
- For a successful pest control there should be a knowledge about the harmful stage of the particular pest.
- It is important to protect the valuable stages of the life cycle of organisms for conservation of biodiversity.
- In conservation of endangered species is important to consider about the sensitive stage of the endangered organism.

## **Exercise**

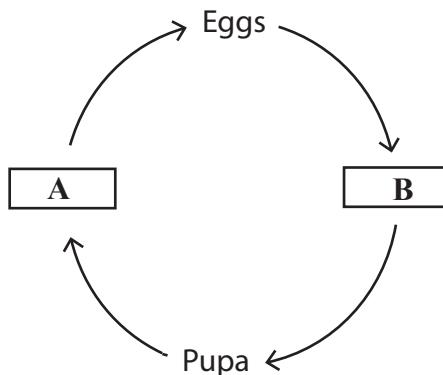
01. Select the most suitable answer.

- 1) The animal that goes through a complete metamorphosis is,  
1. human      2. mosquito      3. cockroach      4. rat
  
- 2) The order of different stages of the life cycle of mosquito is,  
1. egg, pupa, larva, adult      2. egg, nymph, larva, adult  
3. adult, larva, pupa, egg      4. egg, larva, pupa, adult
  
- 3) The organism that go through an incomplete metamorphosis is,  
1. butterfly      2. cockroach      3. mosquito      4. fruit fly
  
- 4) What is the stage that can not be seen in the life cycle of the cockroach?  
1. eggs      2. larva      3. nymph      4. adult
  
- 5) It is not important to know about the life cycles of animals for,  
1. controlling pests  
2. conservation of biodiversity  
3. controlling non-infectious diseases  
4. controlling disease vectors

02. Place a tick (✓) if it is correct and a cross (✗) if it is incorrect.

1. Rat does not go through metamorphosis. ( )
2. The stages of life cycle of cockroach are egg, nymph and adult. ( )
3. The frog spends some stages of its life cycle in water. ( )
4. The best method to control pests is use of chemical pesticides. ( )
5. Going through many different stages in a life cycle ensures the survival ( ) of the organism.

03. Answer the questions using the diagram given below.



- 1) What are A and B?
  - 2) Name two insects that go through a similar life cycle as above.
  - 3) Is the above insect go through a complete metamorphosis or incomplete metamorphosis ? Give reasons for your answer.
04. State three factors of importance of studying about animal life cycles.

### Technical Terms

Life cycle	- தீவன விதம்	- உருமாற்றம்
Metamorphosis	- ரைபான்தரணம்	- நிறையுருமாற்றம்
Complete metamorphosis	- சமில்லரண ரைபான்தரணம்	- குறையுருமாற்றம்
Incomplete metamorphosis	- அசமில்லரண ரைபான்தரணம்	- பூக்கும் தாவரம்
Flowering plants	- சப்ளேப் மூலக் கூறு	- பீடைகள்
Pests	- பலிவெர்க்கின்	- உணர்திறன்மிக்க பருவம்
Sensitive stage	- சுல்லீடி அவधி	- எதிர்ப்புப் பருவம்
Biological control	- தேவை பாலனம்	- இரசாயனக் கட்டுப்பாடு
Chemical control	- ரஸாயனிக் பாலனம்	- உயிரிப்பல்வகைமை
Biodiversity	- தேவைவிவி஦ங்கள்	- வாழ்க்கைச் சுக்கரம்

# 13 Food preservation

## 13.1 Need of food preservation

Food spoils mainly due to the growth and action of microorganisms on food.  
e.g. :- Coagulation of milk, growth of mould on bread, spoilage of fish, rancid of coconut oil

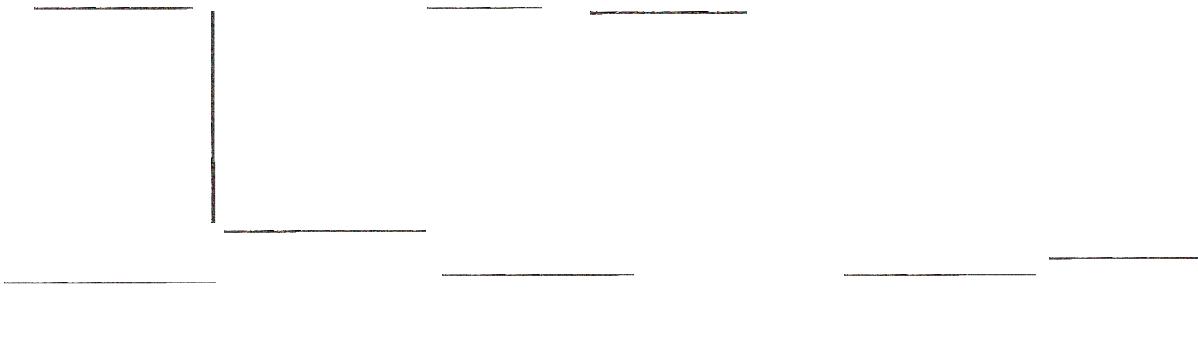


Figure 13.1 ▷ Fresh food and spoiled food

In addition to the microbial activity food is also spoiled by the damage caused by macroorganisms such as weevils and grain borers growing on food.

e.g. :- Weevils spoil cereals and pulses such as paddy, gram and green grams

Food, such as vegetables, fruits and cereals become unsuitable for human consumption due to not following the correct technological methods during processing. From harvesting to market they are subjected to bruises, cuts, lacerations, squashes and bumpt. Therefore, such food becomes unconsumable. As microorganisms readily act on such damaged food, they spoil fast.

Natural changes in food occur because of the action of various chemical substances such as enzymes present in food. It is called self degradation.

e.g. :- **Maturation, ripening and putrefaction of fruits**

Different methods are used to preserve food, and it will help to fulfill the nutrient requirements of man.

**The process of making food stay longer by artificially controlling the factors affecting food spoilage is called food preservation.**

Hence, attempts are made to preserve the nutritional value and other characteristics of the food item during the food preservation.

Aims of food preservation are reduction of food spoilage, prevention of food poisoning and use of excess food by processing to use in off seasons.

Let us engage in Activity 13.1 to distinguish preserved food from several food types.



### Activity 13.1

**You will need:-** Cow milk, rice, fresh fish, a bottle of sterilized milk ('kalkiri'), a packet of dried sprats, dried jak fruit ('atukos'), lime pickle ('lunudehi'), dried fish

Figure 13.2▲

**Method:-**

- Keep the samples of food provided to you exposed to air.
- Observe the colour and texture of those samples everyday for about a week under the guidance of your teacher.
- Tabulate your observations as follows.

Table 13.1

Food type	Observation

From the observations, it is clear that properties like colour, odour and texture change within a few hours in food items such as cow milk and fresh fish.

It can be observed that in sealed bottled milk ('kalkiri'), 'atukos', dried fish, 'lunudehi' and dried sprats had no observable change in properties such as colour, odour and texture. It is because those food items are preserved.

## 13.2 Methods of food preservation

In order to preserve food, mainly the factors causing food spoilage should be controlled. Some measures that can be taken are as follows.

- Preventing microorganisms getting to the food
- Controlling the temperature and water content of food to minimize the microbial activity
- Prevention of damage caused by macroorganisms

There are modern methods as well as traditional methods for food preservation.

### Traditional methods of food preservation

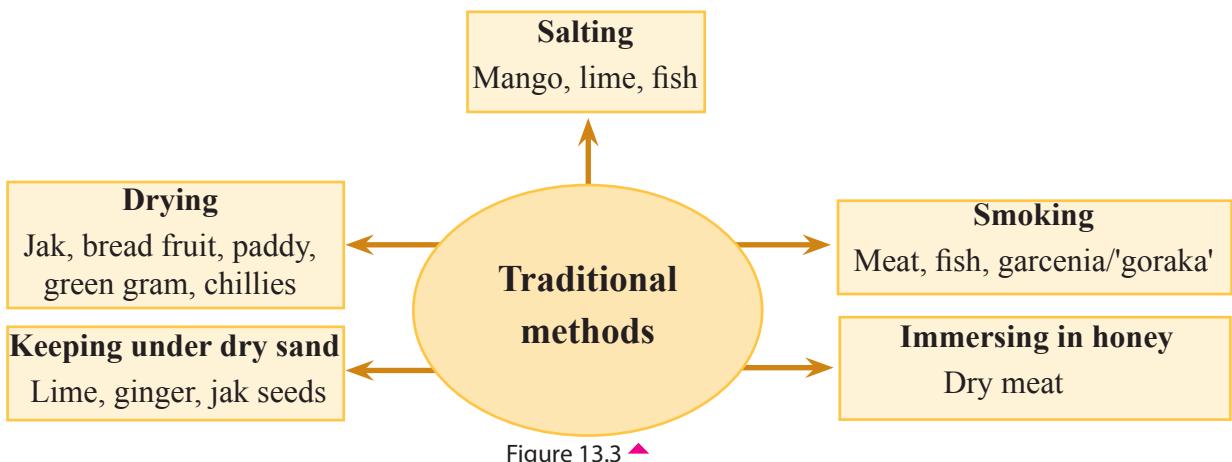
From the distant past humans have adopted various methods to preserve food. Even today they are used with minor changes.



#### Assignment 13.1

- Collect information about the traditional methods used to preserve food.
- List traditional methods you discovered and provide examples for each of them separately.

Some traditional methods used to preserve food and examples for them are given in Figure 13.3.



Salting - mango      Smoking - fish  
Figure 13.4 ▾



## Assignment 13.2

- Collect information about the modern methods which are used to preserve food.
- Present how those methods help to preserve food. Along with examples.

### Modern methods of food preservation

Given below are modern methods of food preservation some examples for each of the method.

#### • Drying

##### Drying by solar heat

Like in the past solar heat is used to dry food. At present the solar heat drier is used for this purpose (Figure 13.5). Since a closed condition prevails within the drier, more pure and dry food can be obtained within a shorter period of time. Mixing of wastes, damages caused by animals and rain can also be prevented by this.

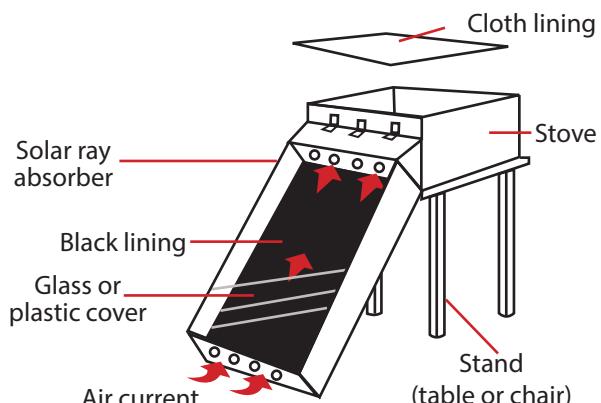


Figure 13.5 ▾ Drying food using a solar heat drier

This method can be used to preserve food items such as chillies, fruits, vegetables etc.

## **Stove drying**

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Ability to give the appropriate temperature for the food that is dried is an advantage of this method. Stoves which use electricity, gas and mineral oil are used for drying food.

This method can be used to preserve food items such as chillies, fruits, mushrooms etc.

Figure 13.6 ▷ A stove drying food

## **Spray drying**

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When water is removed, milk becomes a dry powder. Hot milk is sprayed onto a heated cylinder with high pressure. Microorganisms do not grow due to lack of water.

### • **Temperature control**

A favourable temperature ( $40^{\circ}\text{C}$ ) is essential for the growth of microorganisms. The growth of microorganisms could be controlled by reducing the temperature to a value that is unfavourable for their growth.

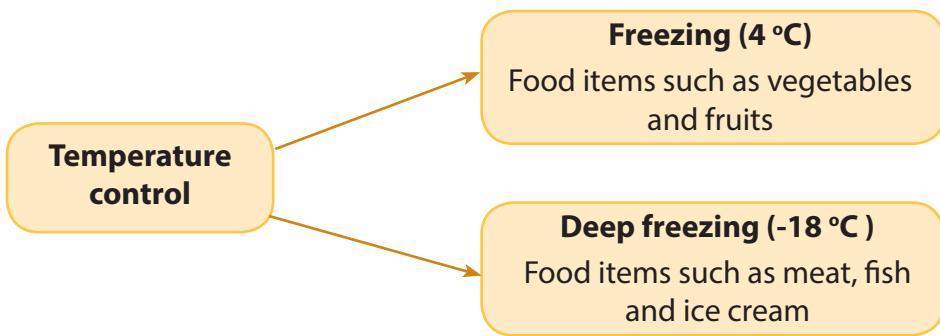
Figure 13.7 ▷ A machine producing milk powder

## **Freezing**

The temperature of the food material is kept at a low value than the surrounding temperature. It is important to maintain the temperature of ordinary freezing chambers always below  $4^{\circ}\text{C}$ .

## **Deep freezing**

The temperature below  $-18^{\circ}\text{C}$  prevailing in deep freezers is adequate to prevent the growth of most microorganisms. By deep freezing the natural colour, taste and nutritive value of food can be protected to a large extent.



-18 °C

4 °C

Figure 13.8 ▶ Domestic method of preserving food by controlling temperature



### Assignment 13.3

- State some types of food that can be preserved by keeping in a refrigerator.
- Make a list of food that should be kept in a deep freezer for preservation.

### ● Concentration

In canning and bottling, water in food is removed. Hence, the concentration of the food is increased. This controls the growth of microorganisms. The microbial activity is further suppressed by the addition of preservatives.

This method can be used to preserve food items such as jam, cordial etc.

Figure 13.9 ▲ Concentrated food

Let us summarize the reasons why it is possible to prevent spoilage of food and keep them longer by various preservation methods.

Table 13.2

<b>Preservation method</b>	<b>Reason for preservation</b>
Drying	Microorganisms do not grow on food due to removal of water
Control of temperature (freezing and deep freezing)	Control of the growth of microorganisms due to a favourable temperature for their growth is not available
Concentration/ immersing in honey	Control of the growth of microorganisms due to removal of water in food and destruction of microorganisms due to removal of water from them
Smoking	Minimizing microbial activity due to chemicals in smoke and removal of water from food due to drying
Adding chemicals (preservatives)	Control of the growth of microorganisms due to removal of water in food and destruction of microorganisms due to removal of water from them



## For extra knowledge

- Liquid milk can be kept longer by pasteurization. In this method pathogenic bacteria in milk causing diseases are destroyed by heating milk for about 15 seconds at the temperature of 72 °C. Pasteurized milk can be kept for about two weeks in a refrigerator (a).
- Milk packets you drink have been pasteurized by subjecting to a temperature as high as 138 °C for about 1-2 seconds (Ultra pasteurization). Milk pasteurized by this method can be kept in refrigerators for about 2-3 months when stored in closed containers (b).
- Milk available in the market under the name 'Kalkiri' is sterilized milk. During sterilization all the microorganisms and the stages are destroyed. In sterilization, milk is heated for about 15 - 20 minutes at the temperature of 120 °C. This milk need not to be kept in a refrigerator for storage. But once opened, it should be kept in a refrigerator (c).

(a)

(b)

(c)

### 13.3 Food preservatives

The chemical substances added to the packaged food in preservation are called additives. Figure 13.10 shows some additives

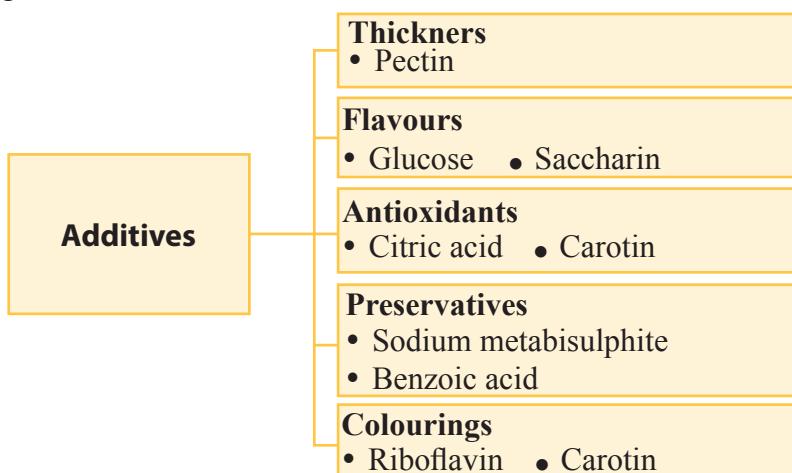


Figure 13.10 ▲

The substance used to prevent the action of microorganisms causing food spoilage and the effect of other external and internal factors are known as **preservatives**. Preservatives are a type of additives.

The code (E number) is adopted by the European Union to symbolise the food additives approved for use and are experimentally confirmed as safe.

The preservatives from E 200 to E 299 have been allowed to add to the food as synthetic food additives. Mainly acids and salts can be seen among these.

A few chemical substances prescribed to be used as synthetic food additives are given below.

- Sodium metabisulphite
- Sodium bisulphite
- Benzoic acid
- Sodium chloride
- Sodium nitrite and sodium nitrate
- Acetic acid

The additives mentioned above should be those prescribed by the food act in Sri Lanka and it is important that they are added in prescribed quantities. Any preserved food items that are not suitable for children should be clearly stated in the label.



### For extra knowledge

Flavours are added to food such as instant food and soup cubes available in the market. But giving flavoured food to children under the age of three years is not safe as far as their health is concerned. Monosodium glutamate (MSG) added to food is a flavour and is not a preservative. Use of these beyond the prescribed dose is not favourable for health. Some food colourings are carcinogenic.

Let us engage in Activity 13.2 to study the preparation of jam as a preserved type of food.



## Activity 13.2

**You will need:-** 500 g of fruits (mango, pineapple, orange), 500 g of sugar, 1g of citric acid, 10-15 g of pectin, about 0.25 g of sodium metabisulphite

### Method:-

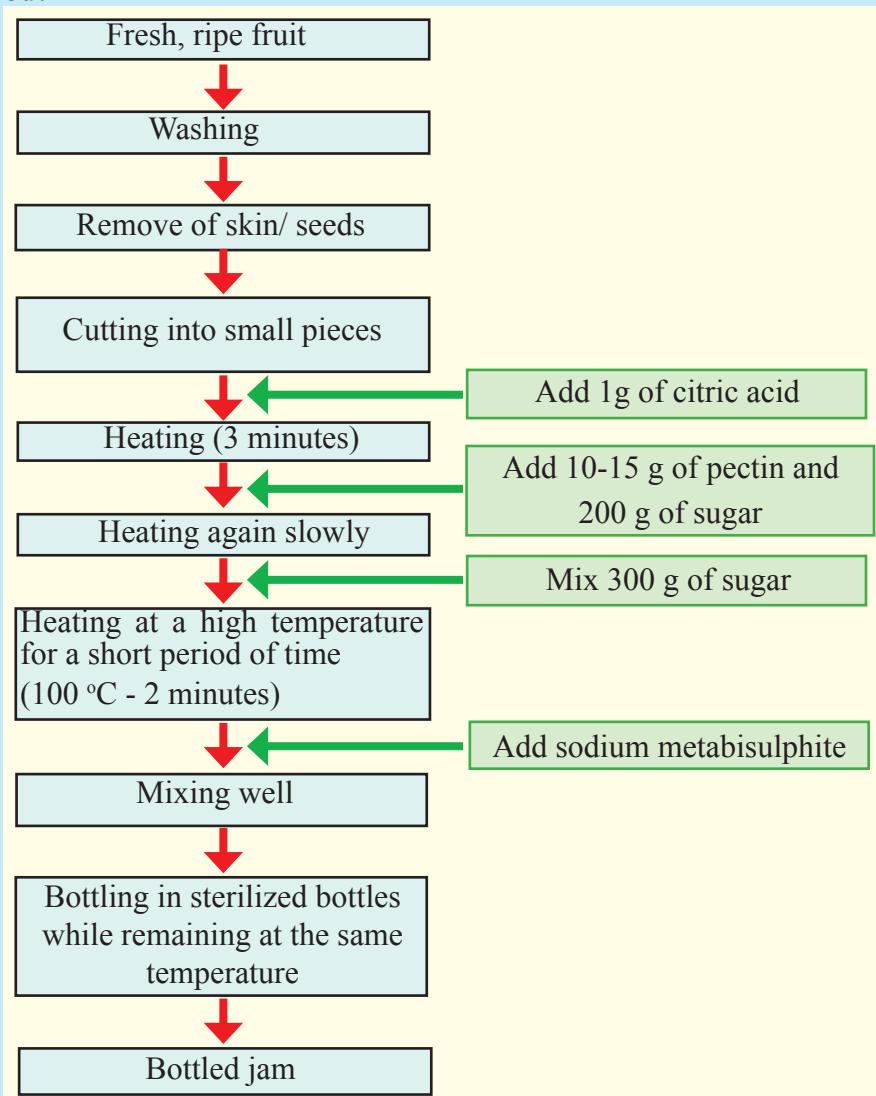


Figure 13.11 ▲



## Assignment 13.4

- If there is a food processing factory in your area (such as canned fish, sauce, cordial, jam etc.) arrange a field trip to observe it.
- Observe the manufacturing process.
- Draw a flow chart to present the process.
- Prepare a booklet about your field trip.

### Various types of preserved food

- Some preserved food can be directly consumed.  
**e.g.: Chutney, jam, sauce, fruit drinks etc.**
- Some preserved food can be consumed after instant preparation. Those are food types packed after subjecting to a complex process and addition of preservatives. They are known as processed (pre-cooked) food.  
**e.g.: Meat balls, sausages, noodles, macaroni, coconut milk powder, cordial etc.**
- Some preserved food needs to be cooked before consumption.  
**e.g.: Dried fish, cereals etc.**



## Assignment 13.5

- Prepare a list of processed food available in the market.
- Investigate how food items such as fruit cordial, 'lunudehi', tomato ketchup are prepared.
- Make those food and taste them either in the classroom in groups or at home.
- Indicate by flow charts how those food items are prepared.

## 13.4 Advantages and disadvantages of food preservation

Let us do Assignment 13.6 to study advantages and disadvantages of food preservation.



### Assignment 13.6

- Study well about preserved or processed food and non preserved food.
- List separately the advantages and disadvantages of the consumption of preserved food and processed food.

Compare the advantages and disadvantages mentioned with the following facts.

#### Advantages of food preservation and processing

- Ability to prevent food spoilage  
Food poisoning and ailments caused by the consumption of spoiled food can be prevented.
- Ability to select according to appetite because the same source of food is prepared in different ways
- Ability to impart an attractive look for food
- Ability to increase the nutritional value of some food types (yoghurt, cheese) by changing their existing nature
- Utilize the surplus effectively
- Ability to keep them for off season consumption
- Minimize the damage caused by insects and other animals

#### Disadvantages of food preservation

- Running a risk of being prone to diseases for the addition of non permitted additives and addition beyond prescribed limits.
- Increase in the risk of causing diseases (e.g. :- cancer, diabetes, heart diseases) due to artificial additives such as flavours and colourings
- Possibility of destroying vitamins and other nutrients
- Tendency to change the characteristic flavour, smell and colour of the food.
- Reduce the desire for natural food and getting used to consumption of instant food

## 13.5 Information in a label of a food package

Let us do Activity 13.3 in order to study further about the facts we need to take into consideration as customers when buying packaged food items.



### Activity 13.3

**You will need:-** A few labels of packaged food items

**Method:-**

- Study well the packets/cartons of the food items and their labels well and list the information relevant to ensure their quality.

Table 13.3

Number	Packaged Food	Method of preservation	Additives	Date of manufacture	Date of expiry

Compare the information you collected with the following.

Some important information given on the label of a packed food item are as follows.

- Date of manufacture and date of expiry
- Net weight / Total weight
- Standard
- Producer (Institution / Country)
- Environment friendliness / Consumer friendliness of the packet/ wrapper

#### Date of manufacture and date of expiry

Food can be packed only for a limited period of time protecting their nutritional quality. As time elapses, physical and chemical changes may take place in food. Moreover, food may get spoiled due to microbial activity.

#### Net weight / Total weight

The consumer should be aware of the amount of the substance in the package.

## **Standard**

If the food item is prepared according to the standards prescribed by the Sri Lanka Standard Institute, the cover of the package should have the SLS logo along with the relevant numbers. If the food item is prepared according to the International standards the package should have the ISO logo along with the relevant numbers.

Figure 13.12 ▷ Quality certificate logos of standards

Food items with the standard certification are considered to be high in quality.



## **Assignment 13.7**

- There are instances where quality of the food is adulterated by adding various substances for the purpose of making profit. Be cautious about such instances.
- Make a list of food items which are adulterated.
- In each example you mentioned, state the substance added to the food.

## **Details of the manufacturer**

Information about the manufacturer or the country that produces the food item is important for taking legal action in case unexpected results are caused due to consumption of food.

## **Environment friendly/ consumer friendly nature of the wrapper**

Since some food items contain flavours, colourings and preservatives, with time they may react with the packing and form substances injurious for health. These wrappings are harmful for personal health as well as the environment.

Therefore, when buying packaged food, it is very important to pay attention not only to the quality of food but also to all the information given in their labels. Proper packaging is essential to minimize wastage of food during transport. Some of its advantages are:

- Prevention of the entry of microorganisms and macroorganisms
- Protection of food from external factors such as air, water (moisture), light and heat
- Maintenance of quality and quantity of food
- Facilitation of transport and storage



## For extra knowledge

Only prescribed varieties of plastics can be used to pack food. They are known as super grade plastics.

- The symbols given in the packaging which are suitable for food are given here.
- Recycled plastics should never be used as food wrappers.
- Plastics used to pack other materials should not be used to pack food.
- Oily or basic food types should not be packed in non-prescribed plastic containers.
- Strongly heated food is not suitable for packaging.

During food preservation synthetic flavours and colourings are added very often. Therefore food is subjected to a complex mode of processing. Hence, it is very important to get used to consume natural food.



## Summary

- Food spoilage is mainly caused by the growth and action of microorganisms on food.
- Food preservation, is keeping food for a longer period of time by artificially controlling the factors affecting food spoilage.
- Minimizing food spoilage, utilization of surplus food, ability to consume some food types in the off-season and prevention of food poisoning are the advantages of food preservation.
- Food preservation descends from the past. At present, food is preserved by modern technological methods.
- When buying packed food, it is very important to that quality of food as well as the information given in the label, are taken into consideration.
- It is always favourable to consume natural food whenever possible, in order to maintain good health.

## **Exercise**

1. Select the correct answer.

1. Which one of the following is a novel method of food preservation ?

- 1. Salting                            2. Smoking
- 3. Freezing                         4. Immersing in honey

2. Some aims of adding additives to food are given below.

- A - Adding a flavour to food
- B - Keeping food viscous
- C - Preventing food from reacting with oxygen

Which one of the above statements are correct ?

- 1. A and B    2. B and C    3. A and C    4. A, B and C

3. An example for a pre-cooked food is,

- 1. Powdered coconut milk    2. Chutney
- 3. Jam                              4. Fruit drink

4. Which of the following is a disadvantage of food preservation ?

- 1. Prevention of food spoilage
- 2. Imparting an attractive appearance for food
- 3. Increasing nutritional value of food
- 4. Reducing appetite for natural food

5. Which of the following is a food that does not spoil fast ?

- 1. Cow milk    2. Bread    3. Dry green gram    4. Fish

2. Place a tick (✓) if it is correct and a cross (✗) if it is incorrect.

- 1. Cow milk is a food which spoils faster. ( )
- 2. Use of food added with synthetic colourings or flavours is not very appropriate, for consumption. ( )
- 3. It is not faulty to wash and reuse food wrappings. ( )
- 4. It is compulsory to state the date of preparation of food in the label of a bottled food. ( )
- 5. Change in the nutritional quality of food due to drying, prevents microbial action. ( )

3. State the method/methods used in the preservation of following food types.

- Dried fish
- Chutney
- Jam
- Sterilized milk ('kalkiri')

4. State separately the reasons why food does not get spoiled in the following methods of preservation.

- Drying
- Salting
- Keeping in the refrigerator
- Smoking

## Technical Terms

Food preservation	- ஆரார் பரிரக்ஷனைய	- உணவு நற்காப்பு
Preservatives	- பரிரக்ஷக	- நற்காப்புப் பதார்த்தங்கள்
Processed foods	- சிரிசைஸ்டும் ஆரார்	- பதப்படுத்தப்பட்ட உணவுகள்
Traditional methods	- சாலிப்புடிக குழு	- பாரம்பரிய முறைகள்
Technological methods	- தாக்ஷனிக குழு	- தொழில்நுட்ப முறைகள்
Artificial colourings	- கால்டி வர்ணக	- செயற்கை நிறமுட்டிகள்
Standards	- புள்ளிய	- தரம்
Food flavours	- ரஸ பூலர்கை	- உணவுச் சுவையுட்டிகள்
Natural foods	- சீவாராலிக ஆரார்	- இயற்கை உணவுகள்
Additives	- ஆகலன டிலை	- சேர்மானங்கள்
Quality	- ஒருங்கள்கலவ	- பண்புத்தரம்
Date of expiry	- கலே ஓங்கு வீமே தீய	- காலாவதித் திகதி
Date of manufacture	- நிதீபாடித் தீய	- உற்பத்தித் திகதி
Net weight	- ஒட்டு வர	- நிகர நிறை
Constituents	- அவிங் சங்ஸுக	- அடங்கியுள்ள பதார்த்தங்கள்
Nutrients	- பெர்ஷக	- போசனை

# 14 Phenomena and exploration associated with the solar system

## 14.1 The solar system

A large number of celestial objects can be observed in the night sky. From ancient time people were curious about those celestial objects. They gathered information by observation of those objects.

Ancient people observed celestial objects with their naked eyes. Later on various instruments were used for this purpose. Telescopes, manned and unmanned space crafts and space stations are some of them.

Due to the information collected since ancient time, now we have the ability of understanding the solar system, which is a large system including the earth. Still the explorations are being carried out about this.

Sun

Figure 14.1 ▲ The solar system

Planets rotate around their own axis, while revolving around the sun. Rotational time of a planet is the time taken by the planet to turn once, around its own axis. It is the time span of a day of that particular planet.

e.g. :- The rotational time of the earth is 24 hours. So, that is a day of the earth.

Sun

Figure 14.2 ▲ Rotation and revolution of the earth

Time of revolution of a planet is the time taken by the planet to revolve once around the sun. That is the year of that particular planet.

e.g.: - The time of revolution of the earth is 365.25 days. That is the year of the earth.

Consider a dancing event by a dancer to understand the concept of rotation and revolution. A dancer rotates around its own axis. It is called rotation. At the same time the dancer revolves around an imaginary point on the stage. This is called as revolution. (Figure 14.3).

Figure 14.3 ▲



A planet rotates around its rotating **axis**. The path, along which a planet revolves around the sun is its **orbit**. All planets have a tilt to its orbital plane, when revolve.

e.g.: - The earth has a tilt of  $23.5^{\circ}$  the perpendicular axis of its orbital plane (Figure 14.4)

There are sub-planets around most of the planets. They also rotate around their axis while revolving around the planet.

Mercury and Venus have no sub-planets. Information about the planets of our solar system are given in Table 14.1.

Table 14.1 ▲

Planet	Distance from the sun (million km)	Diameter (km)	Rotational Time (earth days)	Revolutional time (Earth years)	Tilt to the orbital plane (degrees)	No. of sub planets (till 2016)
Mercury	57.9	4 879	58.65	0.24	0.1	0
Venus	108.9	12 104	243.00	0.62	177.4	0
Earth	149.6	12 756	1.00	1.00	23.4	1
Mars	227.9	6 792	1.03	1.88	6.7	2
Jupiter	778.6	142 984	0.41	11.86	25.2	67
Saturn	1433.5	120 536	0.44	29.46	3.1	62
Uranus	2872.5	51 118	0.72	84.01	26.7	27
Neptune	4495.1	49 528	0.72	164.80	97.8	14

Let us do Activity 14.1 to build up a model of solar system and to study about it.

### Activity 14.1

**You will need:-** Styrofoam balls of suitable sizes to represent planets, suitable paints in given colours to apply on styrofoam balls, wooden strip to the length of 75 cm, black thread, glue, small styrofoam sheet

#### Method:-

- Select styrofoam balls to the sizes given below and paint them with colours indicated.

Table 14.2 ▲

Object	Diameter of the ball (cm)	Colour
Sun	15.0 cm	Yellow
Mercury	1.0 cm	Orange
Venus	2.0 cm	Bluish green
Earth	2.0 cm	Dark blue
Mars	1.5 cm	Red
Jupiter	10.0 cm	Orange
Saturn	9.0 cm ring 12.0 cm	Yellow Orange
Uranus	5.0 cm	Light blue
Neptune	4.0 cm	Dark blue

- Cut a ring for Saturn from the styrofoam sheet.
- When the paint is dry, fix balls to the wooden strip using glue.
- Paint the wooden strip black
- Make the model as shown in Figure 14.5
- Write the names of the planets.

Compare the model which you have made with the model shown in Figure 14.5.

---



Figure 14.5 ▲ Simple model of solar system

Real ratio of the sizes of planets is not indicated in the model you made in the Activity 14.1. The real ratio of the sizes of them is given in Figure 14.6.

---

Figure 14.6 ▲ Comparison of the sizes of planets

Carry out Activity 14.2 to understand about the distances of planets from the Sun.



## Activity 14.2

**You will need :-** Name boards of planets, measuring tape (in meters), a large yellow coloured balloon

**Method:-**

- Mark a point at the centre of the school play ground.
- Take that point as the centre. Draw circles taking the radius according to the ratio given in the table below. (Use the measuring tape for this purpose)
- Get the assistance of your teacher for this.

Table 14.3

Planet	Ratio of distance from the sun
Mercury	0.58 (0.5)
Venus	1.08 (1.0)
Earth	1.50 (1.5)
Mars	2.28 (2.2)
Jupiter	7.78 (7.8)
Saturn	14.24 (14.2)
Uranus	28.67 (28.7)
Neptune	44.89 (44.9)

- Place the inflated yellow balloon at the centre of the ground.
- Apply slaked lime on the circles marked on the ground. Place the name boards of each planet on each circle. Position a student at each name board.
- Give each student at the name board, a leaflet with information of that planet.
- Direct students in your class at a time to each name board.
- Direct the student at the name board to describe about the planet that he is responsible of .

Now you have a comprehensive knowledge about the planets. Figure 14.7 shows a model of solar system in the school laboratory.

Figure 14.7 ▲ The model of solar system in the school laboratory

Engage in Activity 14.3 to study about the revolution of planets around the sun.

### Activity 14.3

**You will need :-** A ball, a strong string of 50 cm in length

**Method :-**

- Tie the ball at one end of the strong string of 50 cm long.
- Take the other free end of the string to hand and rotate the ball fast enough above your head.
- Now observe, the manner ball rotates around you without falling, until you rotates it.

In this activity you might have observed that the ball rotates in a circular path without attract towards you.

This rotation can be explained as below.

When the speed increase

When the speed decrease

When the speed is constant

Here a force is exerted from your arm to the ball. Therefore, ball is rotating in circular path at a constant speed.

Figure 14.8 ▲ Motion of objects around the earth

Corresponding to the example given in Figure 14.8, revolution of planets around the sun also, can be explained. Comparative to the force applied by the arm towards the ball, a force is applied by the sun towards the planet that is called **gravitational force**. The planet should fall on the sun and be destroyed, due to this force. But, this does not happen because of the constant speed of revolution of the planet around the sun.

## 14.2 Occurance of seasonal changes

Seasonal changes is a phenomenon that occur due to the revolution of the earth around the sun, with a tilt to its orbital plane.

When it is the winter in England which is in the northern hemisphere of the earth it is the summer in Newzealand which is in the southern hemisphere. Let us find out how this happens.

It is known that the earth's axis has a tilt of  $23.5^{\circ}$  to its orbital plane. Revolution of the earth with this tilt is the reason for seasonal changes on earth. Let us study how this happens.



Figure 14.9 ▷ Occurance of seasonal changes on earth

Consider the position of the earth (Figure 14.9) on 21<sup>st</sup> of June. Here, rays of the sun fall perpendicular to the northern hemisphere.

Hence, it is summer to northern hemisphere. Same time rays of the sun fall with an inclination to the southern hemisphere. Therefore, it is cold and is winter to southern hemisphere.

Consider the position of the earth on 22<sup>nd</sup> of December (Figure 14.9). Rays of the sun falls perpendicular to southern hemisphere, and with an inclination to northern hemisphere. Therefore, winter occur in northern hemisphere and summer to the southern hemisphere.

Seasonal changes are distinct in polar regions. Countries like Sri Lanka, which are closer to equator, have no distinct seasonal changes.

### 14.3 Occurance of phases of moon

Phases of moon occur because of the revolution of moon around the earth. Half of the moon is always illuminated by the light of the sun. But that half is completely seen from the earth only on a full moon day. The part of the illuminated half of the moon, seen from the earth, changes daily due to its position. Thus, we can see various shapes or the phases of the moon.

Let us do Activity 14.4 to study how phase of moon occurred.



#### Activity 14.4

**You will need :-** An electric bulb, a styrofoam ball fixed to a rod

**Method:-**

- Use the electric bulb instead of the sun and the styrofoam ball fixed to a rod, instead of moon. This activity is to be done in a dark room.
- Holding the styrofoam ball, turn around yourself and observe the illuminated part of the ball as in Figure 14.10.

Figure 14.10 ▲ Demonstrating phases of moon

In a calendar there is only one full moon day for a duration of one month. But sometimes very occasionally, there are two full moon days for some months. Figure 14.11 shows the calendar and the phases of moon during such a month.

---

Mo	Tu	We	Th	Fr	Sa	Su
*	*	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Figure 14.11 ▶ The calendar and the phases of moon during a month that has two full moon days

Answer the questions given below on the Figure 14.11

1. What are the phases of moon on the 2<sup>nd</sup> and 31<sup>st</sup> of this month ?
2. What is the name used for the phase of moon on the 16<sup>th</sup> ?

Figure 14.12 ▶ How phases of moon occur

Studying the Figure 14.12 you will understand clearly, how phases of moon occur.

## 14.4 Important incidents associated with solar system

### Eclipses

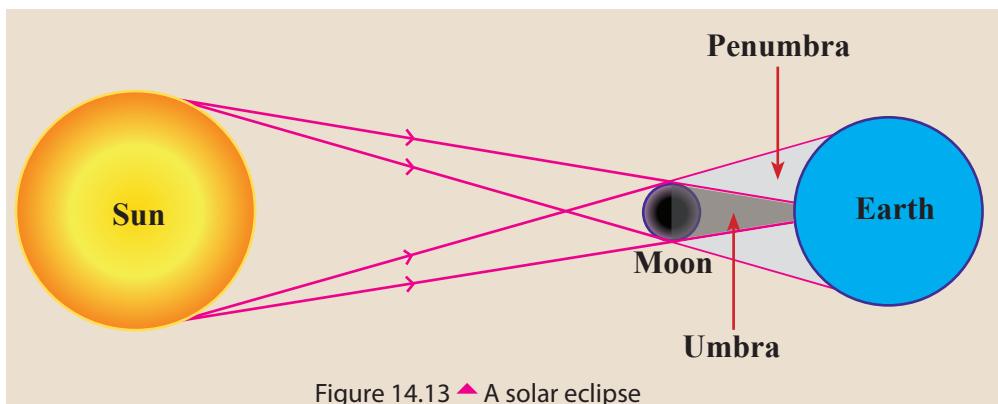
Marvellous scenes that can be observed in the sky are eclipses. There are two types of eclipses.

- Solar eclipses
- Lunar eclipses

### Solar eclipses

The moon revolves around the earth once every 27.3 days. During this journey in some occasions the shadow of the moon falls on the earth. The sun is invisible, fully or partially, to those who are in the shadow area for some time. This is called the solar eclipse. We see the sun and the moon equal in size, in the sky. The sun is a very large object. Moon is very small with respect to the sun. But, the sun is very far away from the earth and the moon. That is why we see them more or less equal in size.

Because of this reason the moon can totally cover the sun during a solar eclipse. Two areas can be identified in the shadow of moon, fallen on the earth. These areas are the umbra and the penumbra. (Figure 14.13)



Those who are in the umbra can see a total solar eclipse, while those who are in the penumbra can see a partial solar eclipse.

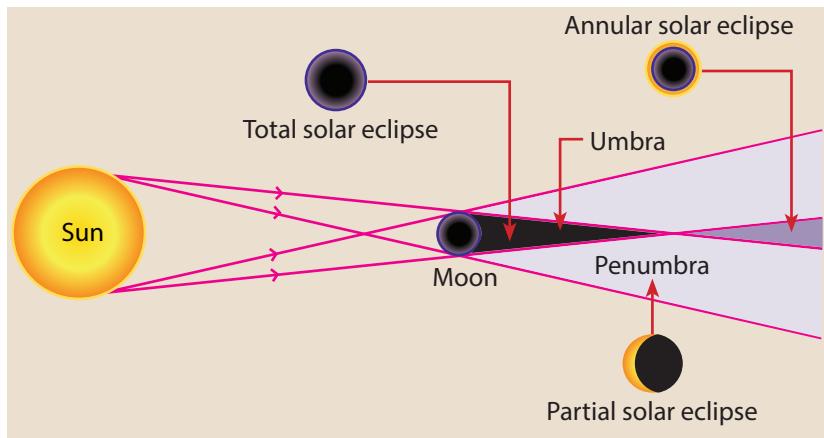


Figure 14.14 ▶ Types of solar eclipse

Umbra of moon covers an area of about  $160 \text{ km}^2$  of the earth. This area moves because of the rotation of earth. It means that the umbra travels along the surface of earth. The maximum time duration that a point of earth experiences a total solar eclipse is 7.5 minutes.

**Solar eclipse occurs on new moon days.**

### An experience of a solar eclipse

Sri Lanka experienced a total solar eclipse on 20<sup>th</sup> June 1955. The eclipse commenced at 8.11 in the morning and after 7 minutes it was over at 8.18.

A person who experienced that solar eclipse described it as follows.

"That day the sun was shining in the morning as usual. After eight in the morning it began to fall dark. Birds flew to their nests. Fowls settle on trees. Environment get cooled. Sky darkened completely. Stars began to twinkle. But moon was not there as it was a new moon day.

After sometime it dawned again. Birds come out of their nests. Fowl got down from the trees. Cattle came out from their lying places.

Meteorological department announced in advance, that a solar eclipse occurs on that day. Therefore, it was declared a school holiday."

I never forget this incident.

Again in 15<sup>th</sup> of January 2010, Sri Lanka experienced an annular solar eclipse.

## Observing solar eclipses

Solar eclipses should never be observed with naked eyes. Eye covers/goggles can be used for this purpose. Welders also use eye covers. Even using those aids, it is advisable not to watch the sun directly for a long time. If do not follow these instructions will result in the blindness of your eyes for ever.

It is safer to watch the image of the solar eclipse taken on to a screen using a mirror or a telescope.

Using goggles

Taking the image on to a screen using a telescope

Figure 14.15 ▲

Indicated below are some solar eclipses observable in future in Sri Lanka

December 26, 2019 - An annular eclipse

June 21, 2020 - An annular eclipse

## Lunar eclipses

The number of lunar eclipses we can observe is more than the number of solar eclipses. **Lunar eclipse occurs on a full moon day**. Lunar eclipses occur when the earth comes in between the sun and the moon, and are in a straight line (Figure 14.16).

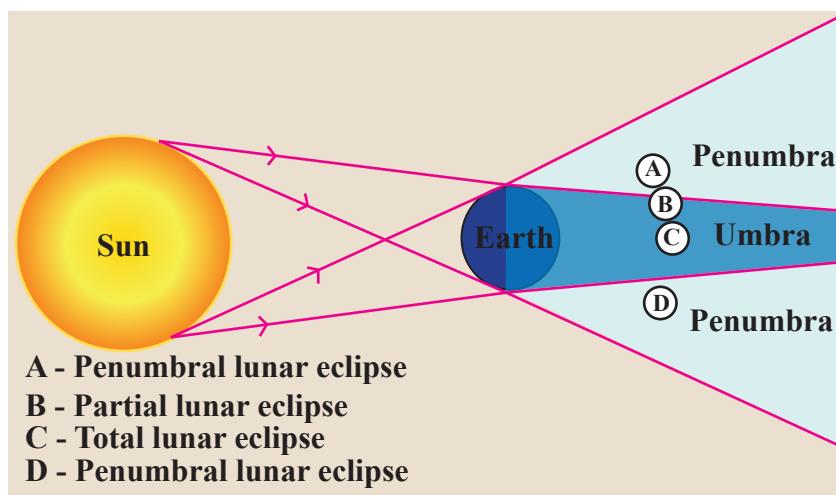
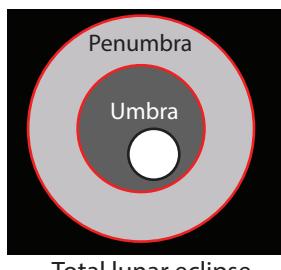


Figure 14.16 ▲ Occurrence of lunar eclipses

Shadow of the earth also has two areas, named umbra and penumbra. There are three types of lunar eclipses according to the type of shadow fallen on the moon.

- Total lunar eclipse
- Partial lunar eclipse
- Penumbral lunar eclipse

### Total lunar eclipse



Total lunar eclipse

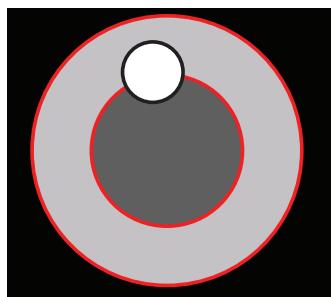
How the moon is seen during a total lunar eclipse

Figure 14.17 ▲

Total lunar eclipse occurs when moon enters completely into the umbra of the earth. This incident can be observed with your naked eyes. As a science student, it is very important for you to observe this. During a total lunar eclipse, moon can be observed in reddish brown colour. It lasts more than an hour (Figure 14.17).

### Partial lunar eclipse

Instance in which a part of the moon is in the umbra of the earth and other part is in penumbra is called partial lunar eclipse. Here, the part of the moon in the umbra is seen in reddish brown colour (Figure 14.18).



Partial lunar eclipse occurs

How the moon is seen during a parital lunar eclipse

Figure 14.18 ▲

## Penumbral lunar eclipse

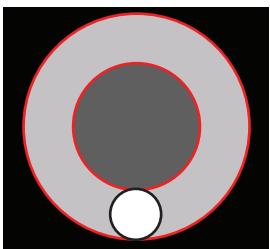


Figure 14.19 ▲ How a penumbral lunar eclipse occurs

When moon moves in the penumbra of the earth a penumbral lunar eclipse occurs. This is not easy to observe as the brightness of the moon does not reduce considerably (Figure 14.19).

Do Activity 14.5 to demonstrate the solar and lunar eclipses.



### Activity 14.5

**You will need :-** The sun, earth and moon models in the school (Figure 14.20 and 14.21)

#### Method :-

- Do this activity in a dark place.
- Demonstrate the motion of the earth and moon, and also the eclipses using the models.
- Get the assistance of your teacher for this.

Figure 14.20 ▲ The equipment to demonstrate the motions of the earth and the moon



Figure 14.21 ▲

The following motions and phenomena can be demonstrated using this equipment.

- Rotation of the earth
- Revolution of the moon
- Lunar eclipse
- Revolution of the earth
- Solar eclipse



### For extra knowledge

The lunar eclipses that can be seen in Sri Lanka in the coming years

February 10, 2017	- Penumbral lunar eclipse
January 10, 2020	- Penumbral lunar eclipse
November 30, 2020	- Penumbral lunar eclipse
November 08, 2022	- Total lunar eclipse
October 28, 2023	- Partial lunar eclipse

## 14.5 Exploring the universe

Air cover around the earth is called the **atmosphere**. The atmosphere extends up to about 500 km from the surface of the earth. But it becomes very thin after about 100 km. The area that starts about 100 km far from the earth is termed as the **space**.

Since ancient times man has been exploring the space. However, the limits of the space, what it contains and how much does it contain such things are the questions man has not been able to find complete answers so far. The objective of science is to find out answers to such questions.

Initially man could reach the higher levels of atmosphere using balloons. Balloons filled with gases like hydrogen or helium which are lighter than air, can rise up into the sky. Balloons filled with hot air also rise up. Both of those can take man higher levels in the sky.

A balloon filled with hydrogen or helium

A balloon filled with hot air

Figure 14.22 ▲

## Usage of rockets

Later man realised that the only way to reach the outer space is by using rockets. Tsiolkovsky, a Russian and Goddard, an American were the pioneers to work on rockets.



### Assignment 14.1

Find the facts about the work done by Tsiolkovsky and Goddard on rockets and make a report.

Let us do Activity 14.6 to make a simple rocket and to study how it works.



### Activity 14.6

**You will need :-** Megabottle of 1.5 l, a rubber stopper, a valve of a bicycle tube, an inflator, water

#### Method:-

- Bore a hole in the rubber stopper and fix the bicycle valve to it.
- Fill water up to 1/3 of the bottle and fix the rubber stopper with valve to it.
- Place the bottle with water as shown in the figure. Then, pump air into it using the inflator.
- Observe the reaction.

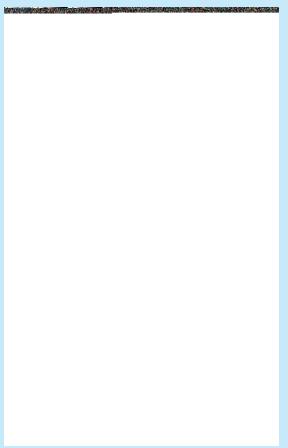


Figure 14.23 ▲  
Water rocket

While inflating at a certain moment the bottle with water unplugs and rise up in the air as a rocket.

This water rocket can be modified to rise higher up in the sky.

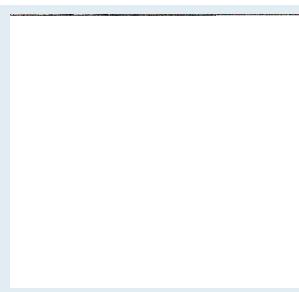


Figure 14.24 ▶ A modified water rocket

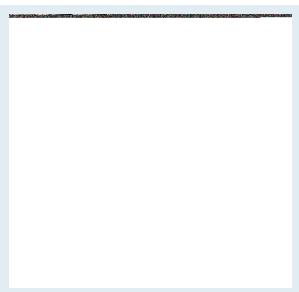
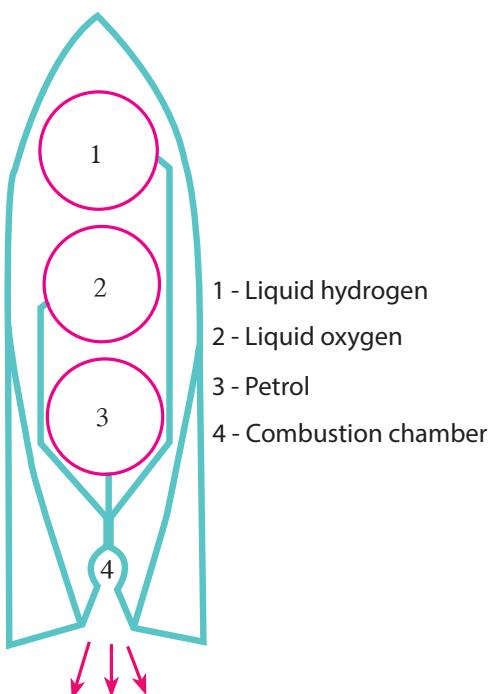


Figure 14.25 ▶ A student preparing to fly up a water rocket

You can obtain more details about water rockets from the Arthur C. Clarke center at Moratuwa. National and international competitions on sending water rockets are also being organised.

The first rocket which used liquid fuel was launched in 1926. The simplest rocket consists of a combustion chamber, a fuel tank, a liquid oxygen tank and a tank containing igniter.



- 1 - Liquid hydrogen
- 2 - Liquid oxygen
- 3 - Petrol
- 4 - Combustion chamber

Figure 14.26 ▶ A sketch of a liquid fuel rocket

Liquid hydrogen and liquid oxygen (as fuel) and petrol (as igniter) are well mixed and pumped into the combustion chamber. Gases produced by the combustion were pushed down speedily through the **nozzle**, giving the rocket an upward force. This makes the rocket rise up into the sky.

Rising up of a rocket can be compared with the rising of the fire work called skyer.

## 14.6 Artificial satellites

The moon is attracted by the earth but moon does not fall on to the earth because it revolves speedily around the earth. Celestial bodies, smaller than the moon, which are orbiting the earth are called satellites.

An object launched to revolve around the earth, using a rocket is known as an artificial satellite. The first artificial satellite named Sputnik-1 which was launched by Soviet union on October 4<sup>th</sup>, 1957. With this historical victory man entered into the space age (Figure 14.27).

The first American artificial satellite was Explorer-1 launched on January 31<sup>st</sup>, 1958.

Figure 14.27 ▲ The artificial satellite (Sputnik -1)

NASA was established in 1958 to carry out the American space programme.



### Assignment 14.2

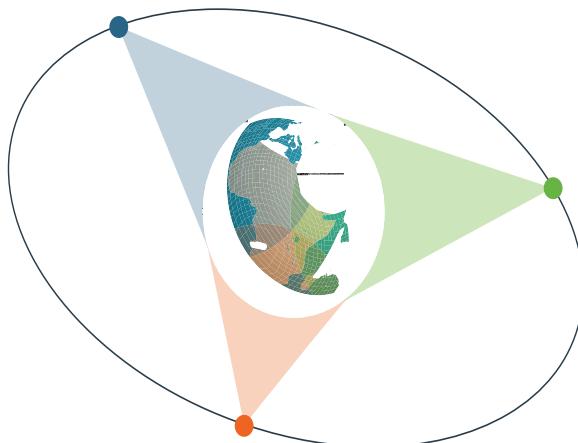
Make a booklet on the uses obtained by artificial satellites.

Observe the sky in a clear night between 7.00 pm and 8.00 pm. If you see a star-like object moving through the stars, it is a satellite. If you see a falling of star like object it may be a meteor.

### Communication satellites

World's first commercial communication satellite was launched on July 10<sup>th</sup>, 1962. It was the Telstar-1. Until today, there are thousands of communication satellites orbited around the earth to provide telephone, television and web facilities.

Sir Arthur C. Clerke came out with a new idea on communication by satellites. He said that if a satellite is orbited around the earth at the same speed as the speed of earth's rotation and at a certain height, it will be seen stationary from the earth. Such a satellite is called a Geo-stationary satellite. Sir Arthur C. Clerke clarified that if three of such satellites are positioned around the earth, the whole globe can be covered with communication facilities.



Now the world is converted to "a global village" by the orbited geo-stationary satellites using the idea presented by Sir Arthur C. Clarke in 1945.

Figure 14.28 ▷ Geo - Stationary satellite network



## For extra knowledge

### Space explorations

Launching of artificial satellites was commenced by Russia (then Soviet Union) in 1957 and by America in 1958. Some key points of space era, started since then, are given below.

Name of space craft	Year and country	Relevant historical incident/importance
Luna - 1 (unmanned)	1959 Russia	<ul style="list-style-type: none"> <li>The first moon exploration satellite to travel near the moon.</li> <li>Space craft that became the first artificial planet around the sun.</li> </ul>
Luna - 2 (unmanned)	year 1959 Russia	<ul style="list-style-type: none"> <li>The first unmanned space craft to land on moon.</li> <li>The first artificial object which reached to another world</li> </ul>
Luna - 3 (unmanned)	Year 1959 Russia	<ul style="list-style-type: none"> <li>Take photography of the other side of the moon's surface for the first time.</li> </ul>
Vostoc - 1 (manned)	Year 1961 Russia	<ul style="list-style-type: none"> <li>Yuri Gagarin became the first astronaut.</li> </ul>
Vostoc - 2 (manned)	Year 1961 Russia	<ul style="list-style-type: none"> <li>Consumed food in the space for the first time.</li> </ul>

Mercury - 1 (manned)	Year 1961 America	<ul style="list-style-type: none"> <li>Allen shephard became the first American astronaut.</li> </ul>
Mercury - 2 (manned)	Year 1962 America	<ul style="list-style-type: none"> <li>John Glenn became the first American astronaut to orbit completely around the earth.</li> </ul>
Vostoc - 3 Vostoc - 4 (manned)	Year 1962 Year 1962 Russia	<ul style="list-style-type: none"> <li>Two space crafts came closer to each other in the space.</li> </ul>
Vostoc - 6 (manned)	Year 1963 Russia	<ul style="list-style-type: none"> <li>Valentina Thereshkva became the first female astronaut.</li> </ul>
Ranger - 7 (unmanned)	Year 1964 America	<ul style="list-style-type: none"> <li>Sent detailed photographs of the moons surface for the first time.</li> </ul>
Ranger - 8 (unmanned)	Year 1965 America	<ul style="list-style-type: none"> <li>Sent photographs of a sea of tranquility which was a place expected to land appolo space crafts</li> </ul>
Voscod - 2 (manned)	Year 1965 Russia	<ul style="list-style-type: none"> <li>First man to walk in the space (Alex Liyanof)</li> </ul>
Gemini - 3 (manned)	Year 1965 America	<ul style="list-style-type: none"> <li>First computer to be taken to the space.</li> </ul>
Luna - 9 (unmanned)	Year 1966 Russia	<ul style="list-style-type: none"> <li>Soft landing of a moon exploring craft on moon for the first time.</li> </ul>
Gemini - 8 (manned)	Year 1966 America	<ul style="list-style-type: none"> <li>A manned space craft to join with a rocket in the orbit for the first time.</li> </ul>
Surveyer - 1 (unmanned)	Year 1966 America	<ul style="list-style-type: none"> <li>Soft landing of the first American moon craft on moon.</li> </ul>
Luna orbiter - 1 (unmanned)	Year 1966 America	<ul style="list-style-type: none"> <li>The first moon exploring craft to map the moon.</li> </ul>
Appolo - 8 (manned)	Year 1968 (America)	<ul style="list-style-type: none"> <li>The first manned moon exploring craft to orbit the moon.</li> </ul>
Appolo - 11 (manned)	Year 1969 July 21 (America)	<ul style="list-style-type: none"> <li>Neil Armstrong landed on moon. Michael Collins and Edwin Aldrin also joined this journey.</li> </ul>

Neil Armstrong declared this statement after landing on the moon.

"This is a small foot step for a man but a giant leap for man-kind."

Astronauts of Appolo-11 placed a memorial plate on the moon. It says;

---

"We are men from the planet earth,  
placed out foot on the moon. We  
came in peace for all mankind."

Appolo program was over in 1972.  
Twelve astronauts landed on various  
locations on the moon under this  
programme.

Mentioned below are some victories,  
in the field of space exploration,  
gained after landing on the moon.

Figure 14.29 ▲ The memorial plate placed by  
Appolo - 11 astronauts on moon

- An unmanned space craft was sent to the moon and rocks from its crust were brought to the earth by Russia.
- Important information on Jupiter, Saturn, Uranus and Neptune was gathered by the space ships Voyages and Pioneer. Information on Mars and Mercury was collected by Marriner crafts.
- Various space crafts were landed on Mars and information on its crust was gathered.
- 'Hubble' space telescope was launched to observe celestial bodies which are difficult to observe from the earth.
- Earlier Russia and America established space stations separately. But, now both above countries in collaboration with some other countries maintain the International Space Station jointly.



Figure 14.30 ▷ International space station



### Assignment 14.3

Prepare a booklet on the recent victories of space explorations.

## 14.7 Constellations

Ancient people who were watching stars in the night sky, imagined various star patterns by joining them.

Those ancient star patterns identified earlier and those named recently are called constellations. There are 88 constallations identified so far. Let us learn about a few of them.

It is important to identify the directions when observing the stars in the night sky. In the day time, directions can be found, using the direction of sun rise. Stretch your hands apart, and stand facing the direction of sun rise. Then, the front side is the east and back side is the west. Your right hand side is the south and left hand side is the north.

The buildings and tall trees can be used to find the directions at night, when you are watching night sky. The directions you identify in the day time will help you in this regard.

In the night sky, we see all the stars other than one star, apparently move from east to the west. But, actually what happens is that the earth rotates from west to the east. The star that does not change the position is the **Polaris**.

The position of Polaris does not change because it is located in line with the axis of the earth.

Figure 14.31 shows some constellations that can be seen in February - March in the sky about 8.00 pm.

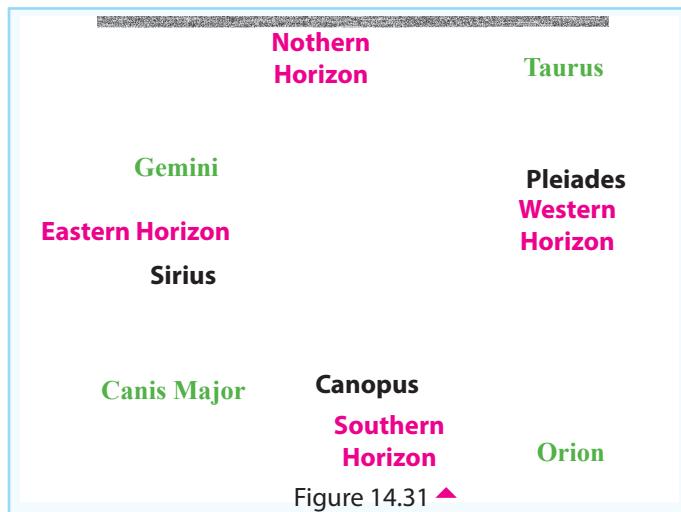


Figure 14.31 ▲

Orion or the hunter is a very popular constellation. Here, the head of the hunter is directed towards the north. So, it is useful to find north at night.

We see that all the stars in a constellation are in the same plane. But, the distance to each star from the earth are greatly varying.

The unit used to measure the distance between stars is light year. Light travels 300 000 km per second. Light year is the distance that light travels during a year.

The constellation Orion, and the distances to some stars of it from the earth are given in Figure 14.32.

Light years 1000

Figure 14.32 ▲ Constellation orion and the position of some of its stars

The constellation Orion is given with many other names.



## Assignment 14.4

Find out the other names given for the constellation Orion.

Constellation Canis major can be found close by to Orion. The brightest star in the night sky, Sirius is found in this.

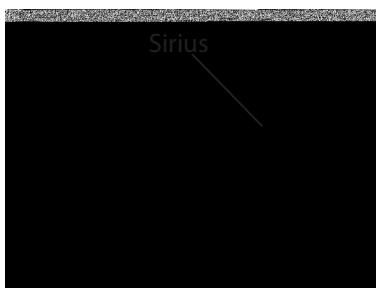


Figure 14.33 ▾

When you are learning about constellations it is not sufficient to study the diagrams in this book. **It is essential to observe night sky for constellations.** The book is only a guide line for that purpose (Figure 14.33).

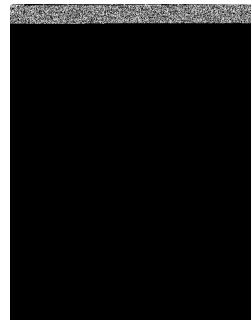


Figure 14.34 ▾

If you observe towards north-east from Orion, another constellation, Gemini can be found. It denotes twins. The brightest star in it is Pollux (Figure 14.34).

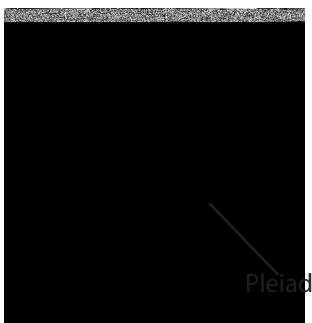


Figure 14.35 ▾

At this time the constellation Taurus can be seen in the north-west direction. There is a red star named Aldebaran for one of this bulls eyes (Figure 14.35).

Near the Taurus there is another constellation named Pleiades. Figure 14.35 shows some constellations that can be observed in the midnight during the February and March. All these constellation can be seen in May and June nearly 8.00 pm in the night.

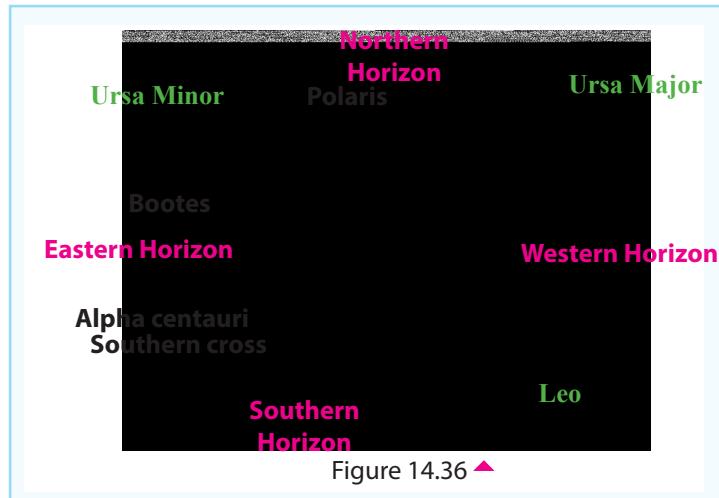


Figure 14.36 ▲



Figure 14.37 ▲

During this period constellation Leo can be seen near the Zenith. Brightest star in this constellation is Regulus (Figure 14.37).



Figure 14.38 ▲

During the same period constellation Ursa major can be observed  $45^{\circ}$  above northern horizon. This constellation helps to find the north at night. Seven sages and plough are two other names for the same constellation. There are seven bright stars in this (Figure 14.38).

Ursa minor can be seen below the Ursa major closer to its northern horizon. Polaris is at the tail end of this bear. This star is closer to the horizon, when watched in Sri Lanka. Therefore, it can be watched only in a large plain, sea shore or on a hill top.



## Assignment 14.5

Find out about the importance of the star Polaris and make a report.

During this period another constellation with the shape of tilted cross, can be seen in the southern sky towards the horizon. This is called the Southern cross. According to Figure 14.39, to the left of this constellation there are two bright stars, which are closer to each other. Out of these two, one which is very far away from the southern cross is called **Alpha Centauri**.

Figure 14.39 ▶



## Assignment 14.6

Find out about the importance of the star Alpha Centauri and make a report.

Constellation Southern cross can be used to find south and north directions

### Zodiac

The earth and the other planets revolve around the sun. Twelve signs in the outer space which are named as the zodiac from ancient times. Those 12 signs in the zodiac are as follows.

- |           |            |                |
|-----------|------------|----------------|
| 1. Aries  | 5. Leo     | 9. Sagittarius |
| 2. Taurus | 6. Virgo   | 10. Capricorn  |
| 3. Gemini | 7. Libra   | 11. Aquarius   |
| 4. Cancer | 8. Scorpio | 12. Pisces     |



## Assignment 14.7

There are 12 stamps in current usage which contain the diagrams of signs of the zodiac. Collect them and exhibit on a board.

When the earth is revolving around the sun, we see that the sun is apparently moving from sign to sign in the zodiac.

e.g.: In the instance given in Figure 14.40 people on the earth see as the sun is in the sign Aries of zodiac

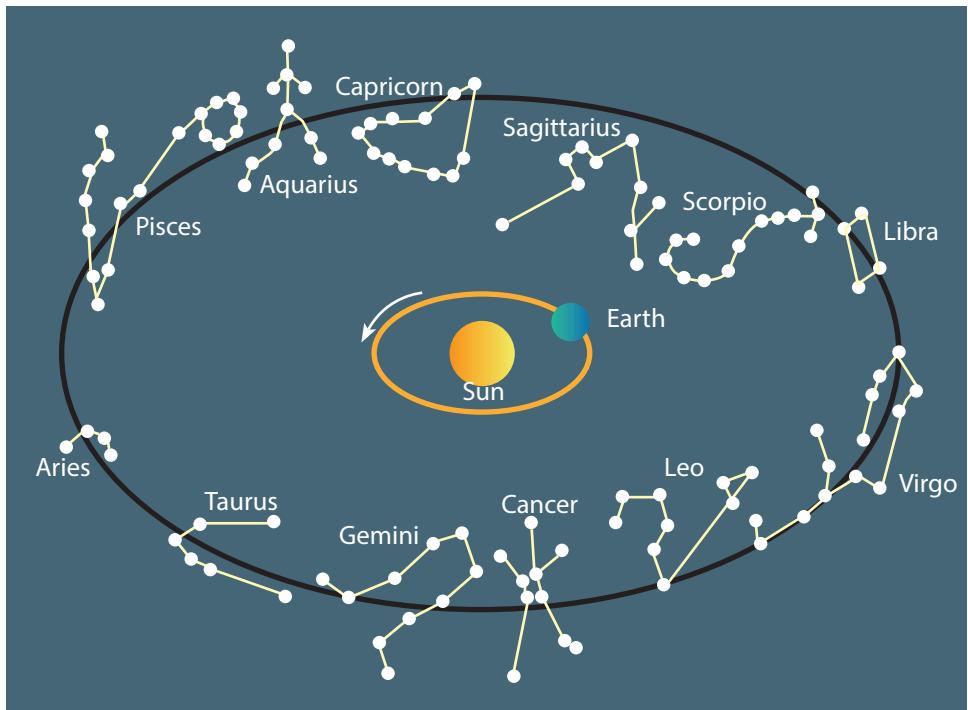


Figure 14.40 ▲ The Zodiac

According to the revolution of earth, the sun's next apparent destination is the sign Taurus.

### Observation of stars and planets

When the night sky is being observed it is realised that the relative position of stars does not change daily or monthly. But, there are some objects among the constellations in the zodiac the position of which changes with respect to the stars. Those objects are planets.

There are five planets which are observable with the naked eyes. They are mercury, venus, mars, jupiter and saturn. Mercury, venus, earth and mars are planets in solid nature and other planets occur in gaseous nature.

A star twinkles in the sky. But planets do not twinkle. Star is a bright point, even when observed through a telescope. But, when a planet is observed through a telescope it is seen as a disc.



## Assignment 14.8

Select a planet in the background of a certain sign in the night sky. Get the assistance of your teacher or an adult for this. (Planets Jupiter, Saturn or Mars is more suitable for this.) Note down how the position of the planet changes in the background of the sign, for about a month.

Let us do Activity 14.7 to construct an instrument to measure the altitude to a star or planet.



## Activity 14.7

**You will need :-** A protractor, a cardboard tube/ PVC tube

### Method :-

- Using a tube and a protractor, make the following instrument. It is called the clinometer.

Figure 14.41 ▲ Simple clinometer

The way of measuring the altitude to a star, using the clinometer is shown in Figure 14.42. The clinometer can be fixed as shown Figure 14.43 to turn on a horizontal plane.

Figure 14.42 ▲ Measuring the altitude to a star using clinometer

Figure 14.43 ▲ A clinometer that can be turned on a horizontal plane



## Summary

- Planets in the solar system show two types of motions, rotation and revolution.
- Seasonal changes occur because of the tilt of the earth's axis to its orbital plane.
- Illuminated portion of the moon, viewed from the earth changes while it revolves around the earth. Because of this incident phases of moon occur.
- Lunar eclipse occurs on a full moon day when the moon enters into the shadow of the earth.
- Solar eclipse occurs on a new moon day, when the shadow of the moon falls on the earth.
- Rockets and space crafts are used for this explorations of the space.
- Constellations are the imaginary patterns constructed in mind, connecting the stars in the night sky.

## Exercise

Select the most suitable answer.

1. What is the most suitable statement below to describe a solar system?

1. A cluster of stars revolving around an object.
2. A star revolving around a number of objects
3. A number of objects revolving around a star.
4. An object revolving around a cluster of stars.

2. Select the **false** statement about our sun.

1. Sun is smaller than the moon.
2. Sun is a source of energy.
3. Planets revolve around it.
4. Situated 150 million kilometers away from the earth.

3. In which constellation is the star Polaris that helps to find the north.

- |               |               |
|---------------|---------------|
| 1. Ursa major | 2. Ursa minor |
| 3. Sign Leo   | 4. Orion      |

4. What is the **false** statement given below?

- i. The brightest star in the sky, Sirius can be found in constellation Canis major.
- ii. Venus can be observed with naked eye.
- iii. Sun is the nearest star to the earth.
- iv. Polaris belongs to the constellation Ursa major.

5. What is the **false** statement given below ?

- i. The seasonal changes occur due to the earth's revolution.
- ii. The phases of moon occurs due to the moon's revolution.
- iii. Solar eclipse occur when the moon stays in between the earth and the sun.
- iv. Partial lunar eclipse occurs when moon enter to the penumbra of the earth.

**Give short answers.**

1. After observing the night sky, two students in grade eight came out with the following ideas.

Student A - When I was watching the night sky yesterday, I saw a star passed very speedily increasing its brightness and vanished at once.

Student B - I was watching the night sky yesterday at about 7.00 p.m. I saw a star travelling fast between other stars. It travelled from north to south.

In the above discussion;

- i      What can be the object that A student observed ?
- ii     What can be the object that B student observed ?

2. i Fill the blanks of the following diagrams with the given terms.

Sun, Moon, Earth, Umbra, Penumbra

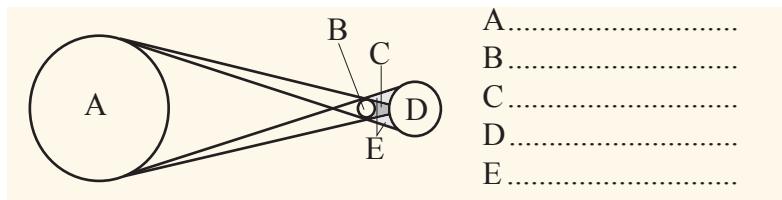


Diagram - 1

ii

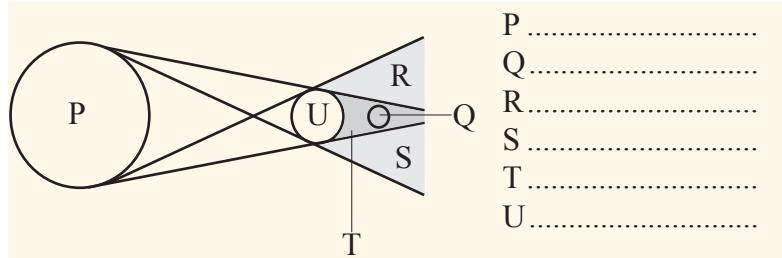


Diagram - 2

## Technical Terms

Rotation	- இழங்கல்	- சமூர்ச்சி
Revolution	- பரிசுமிழல்	- சுற்றுக்கை
Seasons	- வருடங்கள்	- பருவங்கள்
Lunar eclipse	- வந்து ஒளின்கை	- சந்திர கிரகணம்
Solar eclipse	- ஐர்ய ஒளின்கை	- சூரிய கிரகணம்
Solar system	- சௌராதீர்ய மன்றம்	- ஞாயிற்றுத் தொகுதி
Constellations	- தூர்கா மன்றங்கள்	- உடுத் தொகுதி
Zodiac	- ராசி வகை	- இராசி வட்டம்
Space explorations	- அனுஸ்வார கலெக்டிவங்கள்	- விண்வெளி ஆய்வு
Satellites	- காப்திம் வந்தீகா	- செயற்கைக் கோள்கள்

# 15 Natural disasters

Pay your attention to the news paper head lines shown in Figure 15.1



Figure 15.1 ▲ News on floods and landslides

Head lines given above are about some natural disasters that affected Sri Lanka.

**Natural disasters are naturally occurring destructive incidents, without the mediation of man, causing harm to human lives, property, environment and economy.**

Some such incidents are shown in Figure 15.2

Drought

Landslide

Flood

Lightning

Forest fire

Tsunami

Cyclone

Volcano

Earthquake

Figure 15.2 ▲ Some natural disasters

Some examples for natural disasters are drought, landslide, flood, lightning, forest fire, cyclone, earthquake, tsunami, tornado and glacier erosion. The way that natural disasters occur and their influence differ from region to region, and from country to country.

Reasons for the occurrence of natural disasters are the weather and climatic changes, changes occurring at the interior of the earth and the changes occurring in the biosphere. Human activities affect to increase the intensity of natural disasters.



### Activity 15.1

Make a collection of news paper head lines written on natural disasters.

With referring to the collection, prepare a list of natural disasters occurring all over the world.

Some of the natural disasters that affect Sri Lanka are mentioned below.

- Drought
- Landslide
- Flood
- Lightning and thundering

We will study about them in this lesson.

## 15.1 Drought

Long term decrease of rain fall, due to the change of the pattern of rain fall is known as drought. Way of definition and the nature of identification may change from country to country, region to region and from time to time.

Decrease of the amount of rain fall during a given time period, and as well as the change of the rain fall pattern cause droughts.

Thus, the reasons that affect the pattern of rain fall, affect the drought also.

Let us do Assignment 15.1 to study the change of pattern of rain fall.



## Assignment 15.1

Find the data of rain fall in Sri Lanka for past few years. Comparing those values, study the rain fall pattern. Data can be collected from the meteorological department or from internet. Ask the assistance of your teacher for this.

### Reasons for drought

Natural reasons as well as human activities may affect this.

Natural reasons cause to change rain fall pattern and the amount of rain fall.

Some natural reasons for drought are mentioned below.

- Lack of timely monsoon winds
- Dry air currents
- The phenomenon of EL-NINO

As Sri Lanka is an island, wind pattern basically affects the rain fall. Study the Table 15.1 given below.

Table 15.1 - Methods that bring rain fall to Sri Lanka

Method of rain fall	Time period	Region / Zone
South - West monsoon	May - September	Wet zone
North - East monsoon	November - February	Dry zone
Convectional / Intermonsoonal rain	March - April September - October	All regions

Dry air currents increase the rate of transpiration in plants. It increases the absorption of ground water by the roots of plants. Fountains dry up due to the reduction of ground water. This condition may cause a drought.

El-NINO is a phenomenon caused by the increase of temperature of the surface water in Pacific ocean. With the increase of the temperature of surface water in the ocean, normal circulation pattern of global air currents and oceanic water currents or the streams change.

---

Influence of the EL-NINO phenomenon may cause droughts as well as rain in Sri Lanka.

Drying up of water sources, decrease of water retention capacity in soil and global warming are the results of some human activities. These activities may cause the occurrence or further intensifying of droughts.

Figure 15.3 ▲ Wind pattern

### Some human activities that may cause drought are mentioned below.

- Seepage of rain water into soil decreases due to various constructions. This decreases the water retention capacity in the soil. Water sources dry out because of deforestation for construction work.
- Wastage of water by irregular and over use is a reason for drought.
- Decrease of water retention capacity in soil and accelerated soil erosion are the results of irregular cultivation of crops. Thus, water capacity of reservoirs decrease, resulting spillage.
- Deforestation influences the water cycle directly or indirectly. Convectional rains and rain fall are affected by this.
- Global warming also changes the pattern of rain fall. Gases like carbon dioxide released into the atmosphere due to human activities, leads to global warming. Such gases are known as greenhouse gases.

How droughts occur due to human activities and natural causes can be simply shown by Figure 15.4.

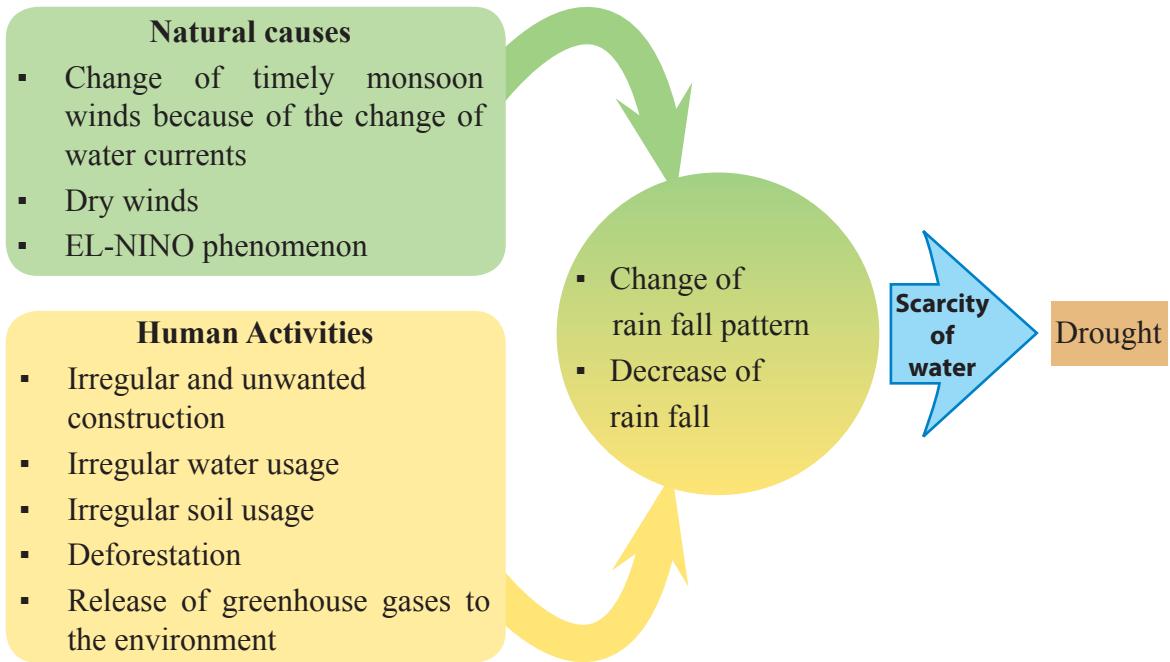


Figure 15.4 ▾

Drought basically affects the environment. Based on those environmental issues, various socio-economic issues also arise (Figure 15.5).

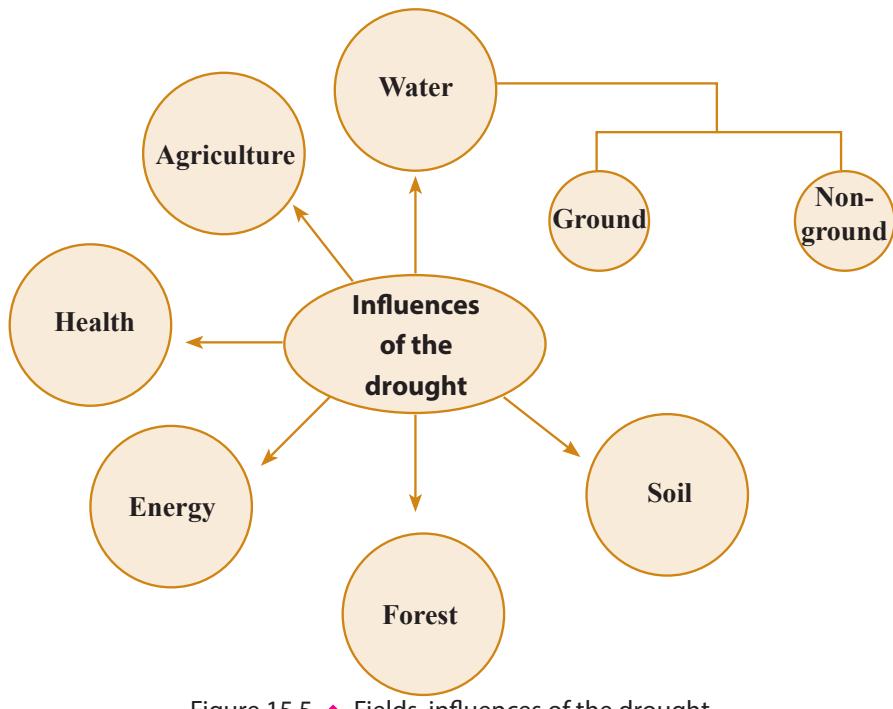


Figure 15.5 ▾ Fields, influences of the drought

## Drought disaster management

There are three main steps that should be followed when managing any disaster.

- Readiness to face the disaster
- Mitigation of the damages caused by the disaster
- Adaptation to live with the disaster

Droughts are unavoidable. In the process of disaster management, readiness to face the disaster, mitigation and adaptation can be followed to minimize the damage caused by the disaster.

Some of the measures that can be taken in drought disaster management are given below.

- Avoiding the wastage and pollution of water - Rules and regulations should be introduced and people should be made aware of using water economically and without polluting.
- Planning agricultural activities with the view of conservation of water.
  - Practising economic water supply methods
  - Cultivating drought resistant crops
  - Mulching
- Improving methods of collecting rain water.
  - Increasing the capacity of reservoirs
  - Usage of methods to collect rain water domestically
- Reforestation - Growing forests in lieu of cleared forests
- Usage of alternatives to hydropower for the generation of power.  
e.g.: Wind power, solar power etc.

Figure 15.6 ▲ Drought  
resistant corn plants

Figure 15.7 ▲ A method  
used to collect rain water  
domestically

## 15.2 Floods

Inundation of a usually uninundating area, due to heavy rain fall in a short period of time is known as a flood.

According to the way of occurrence, they can be categorised as below.

- **Floods due to over - flowing** - These floods occur due to the over flowing of rivers and other water ways.
- **Instantaneous floods** - This situation occurs due to the blockage of water drainage systems in urban areas

### Reasons for floods

- High rain fall
- Removal of forest cover
- Reduction of the capacity of reservoirs
- Irregular construction work
- Blockage of water drainage systems
- Irregular land use
- Irregular land filling

### Influences due to floods

- Loss of lives
- Failure of power supply, transportation and public services
- Damage to houses, property and roads
- Spread of communicable diseases after floods due to contamination of water sources

### Management of flood disaster

- Refraining from putting up houses in flood areas. If it is necessary to put up a house in such a place, it is advisable to build it on pillars.
- Leaving partially inundated houses as it is dangerous to stay in them.
- Disconnecting the electricity supply of the houses and refraining from touching electrical items while being in water.
- Having identified a place and a method to keep goods securely during a flood.
- Having identified an elevated place to reach for security.
- Having prepared a disaster kit, contains drinking water, dry food stuffs and other essential items to take in the case of leaving home.
- Having prepared with a battery-powered radio.

- Refraining from walking through fast-flowing water. One can be pushed down by running water of the depth of six inches (15 cm).
- Refraining from driving motor vehicles across flooded area. Leaving the vehicle and reach a higher land, if the vehicle is drowned.

### 15.3 Landslide / Earth slip

Slipping down of soil layers in slopy regions in highlands can be considered as a landslide.

Landslides are a common disaster in central hills of Sri Lanka. Places of landslide danger are identified in some other districts, also. Those areas are in Badulla, Nuwara Eliya, Mathale, Kandy, Kegalle, Monaragala, Kurunegala, Rathnapura, Kaluthara, Galle, Mathara and Hambanthota districts. Such areas are shown in Figure 15.9.

What is happening during a landslide is the slipping down of a lump of soil or a layer of soil upon another layer under gravity.

Continuous heavy rain causes landslides in risky regions. Soil, soaked in rain water becomes heavy. The bond between soil particles and the bed rock getting weak at the same time. Due to the weaken bond, there is a point that the bed rock can not hold the upper soil layer further. At that moment soil particles start to flow down suddenly and soil particles near by the activity region join with the flow.

Gravitational potential energy of the lumps of soil increases because of being in a higher elevation and absorption of water. This high potential energy is converted to kinetic energy while the layers of soil are slipping down. Because of this kinetic energy, lumps of soil and rocks collect everything in the route while flowing down. Sometimes the route of a landslide may be as long as 1 km.

Figure 15.8 ▲ A location of landslide

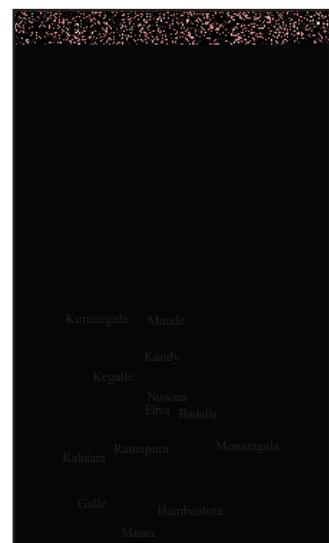


Figure 15.9 ▲ Regions which are subjected to the danger of landslides in Sri Lanka

## Pre-signs of a landslide

If the following incidents are occurring with continuous heavy rainfall, it indicates a close-by landslide.

- Receiving more than 100 mm of rainfall within 24 hours
- Appearing new cracks on the surface of the slope
- Appearing cracks on buildings
- Depressions on earth
- Dying or slanting of trees on slopes
- Sudden leaking of muddy water on slopes
- Sudden surface run-off of water or disappearing of springs
- Animals showing abnormal behaviours
- Appearing new water springs
- Entering water into cracks of the earth and oozing out from some other places with mud

## Management of landslides

- Removing the slide initiation area (slide initiation has a large rock or a thick layer of soil, under which there is an area of water or mud. That is the first place to collapse with a heavy noise during a landslide). Removing of slide initiation area is very difficult as it is not easy to reach the place. To avoid the destruction caused by landslide, the slide should be removed using cranes. This should be done by the relevant authorities.
- There are three main risk areas in a landslide namely initiation area, flow path and depositional area. Relevant authorities must be assigned power to take necessary measures to prevent landslides.
- Evacuating people from the areas subjected to landslides earlier and let the areas be stabilized.
- Bringing down water using pipe lines when it is collected in higher levels of a hill.
- Digging contour ditches to drain rain water down the slope without letting it soak into soil.
- If a slope of a hill is necessary to cut, it should be cut in cascade manner. Water drainage systems should be prepared. Cover crops should be grown.  
e.g.: - Vetiver

- Stability of the land should be considered, when selecting a land to build a house. It is not suitable to build houses in slopy areas by cutting the slope. A place of prior landslide is also not suitable for putting up houses.

If a construction is to be done in a district of landslide threats, consulting National Building Research Organisation (NBRO) is necessary. People can get necessary directions from the regional offices of the soil organisation. The web address is [www.nbro.gov.lk](http://www.nbro.gov.lk).

## 15.4 Lightning and thundering

There are tiny water droplets and ice crystals in cumulonimbus clouds. Because of air currents, those water droplets and ice crystals are rubbed each other. Thus, they become **charged**.

Figure 15.10 ▲ A cumulonimbus cloud and a lightning

Positive charges collect in the top layers of the cloud and negative charges collect in the bottom layer of the cloud. Positive charges are generated on the earth, right below the cloud. When the amount of charges reach a certain level, an electrical discharge occurs. It is known as lightning and thundering.

According to the way of electrical discharge, there are three types of lightning (Figure 15.11).

- **Earth-lightning** is an electrical discharge that transfer from a cloud to the earth.
- **Cloud-lightning** is an electrical discharge that transfer through the cloud or between two clouds.
- **Air-lightning** is an electrical discharge that transfer from a cloud into the air.

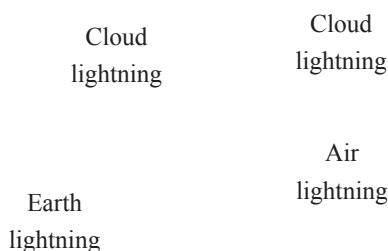


Figure 15.11 ▲ Types of lightning

Let us do Activity 15.2 to study about the discharging of electrical charges.



## Activity 15.2

**You will need :-** Two thin dry plastic strips

**Method:-**

- Keep two plastic strips, one over the other. Hold them from one end to hang down.
- Rub the two strips down firmly using your thumb and another finger.
- Observe what happens.
- Try this activity using strips of transparent sheets.

You can observe that the plastic strips shift apart at the lower ends. That is because the strips are electrically charged.

If you drag apart the strips, you can observe a sound.



## For extra knowledge

Voltage of a lightning stroke is about 100 million Volts. Electrical energy generated in lightning is very high. Electrical current of a lightning is about 25,000 amperes.

Current flowing through a bulb of 25 W is about 0.1 A and Voltage of house hold electrical supply is 230 V.

Lightning danger is common during the inter-monsoons in Sri Lanka. Maximum number of accidents due to lightning were reported during the month of April. Each year, more than 50 deaths are reported due to lightning.

(from science data)

Tall buildings and trees are easily subjected to the hazard of lightning. The reason for this is that tall places provide the shortest path for the discharge of lightning from the clouds.

## Management of Lightning hazards

Destruction of buildings by lightning can be avoided by fitting lightning conductors.

Lightning conductors should be fitted to the required standards. Some other protective measures from lightning are listed below.

- Avoid keeping the house connected to close-by trees with metallic wires. Metallic cloth lines and wires used to the trees that are slanted to the houses are some examples for this.
- Conducting wires in the environment (electricity supply wires, television antenna wires, protective wires, wire fences) help to conduct electric current of a lightning from place to place. Therefore, protective measures should be taken, when fixing them.

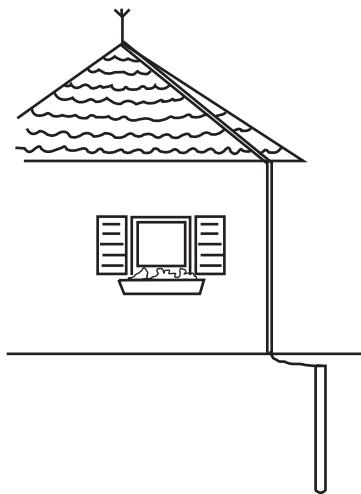


Figure 15.12 ▷ A building fitted with a lightning conductor

It is appropriate to follow the measures indicated below, when a lightning weather condition is forecast.

- Keeping the electrical appliances disconnected from the circuits.
- Keeping the disconnected plug of television antenna out of the house, near the ground.
- Refraining from using and touching metal equipments.
- Refraining from using telephones.

**The things that should be done before a lightning weather condition are mentioned below.**

- Going into a building or into a fully covered vehicle to minimize exposure to the environment.
- Going to a place of security, if the time interval between sight and the sound of the lightning thunder is less than 15 seconds.

**Things to avoid during a lightning weather condition**

- Avoid being in open places. If there is no time to go to a place of security, keep your legs close to each other and crouch to the ground.
- Refraining of being near tall trees and elevated places.
- Refraining from riding or driving open vehicles like cycles and tractors.
- Refraining from swimming, canoeing and walking on wet places.

## **Measures to be taken in connection with a person subjected to lightning hazard**

All lightning hazards are not fatal. First aids should be given to a person subjected to such a threat.

If the limbs of the victim are numbed or stiffed, massaging can be done to recover.

If breathing is stopped, artificial breathing should be given. Both massaging and artificial breathing have to be given according to the nature of harm. Giving first aids should be continued till breathing starts.

It is not dangerous to touch a person subjected to a lightning hazard.



### **Activity 15.3**

Construct a wall paper containing information on natural disasters that affect Sri Lanka. Pay your attention to the following points.

- Causes for the natural disasters
- Harms caused by disasters
- Measures that you can take to minimize the harms

Disasters and the reasons for their occurrence discussed in this chapter can be summarized as below (Table 15.2).

Table 15.2 - Disasters and the reasons for their occurrence

<b>Disaster</b>	<b>Reasons for the occurrence of disaster</b>
Drought	Accelerated evaporation and transpiration, deforestation and burning of forests, human activities like are pollution, global warming due to climatic changes
Landslides	Heavy rain, nature of rocks that the mountains are made of, irregular human activities
Floods	Heavy rain, influence of tides and stormy waves, irregular human activities
Lightning and thundering	Shifting / discharging of electrical charges to the earth from the clouds.

Damages caused by natural disasters can be minimized by acting in accordance with the instructions published over the media by relevant authorities. It is a current need to pay our attention to take necessary actions personally in protection of the environment.



## Summary

- Droughts, floods, landslides and lightning hazards are some of the natural disasters that Sri Lanka faces.
- Natural reasons as well as human activities influence the occurrence of droughts, floods and landslides.
- Though the natural disasters are unavoidable, the harm caused by them can be minimized by taking necessary measures for readiness, mitigation and adaptation.
- Adaptations make people to live with some disasters for a long period of time.

## Exercise

Select the correct answer.

1. Which of the following is **not** a human activity that affects the change of rainfall pattern ?
  1. Destruction of forests
  2. Reduction of forest cover
  3. Irregular soil management
  4. EL-NINO phenomenon
2. When is / are the cause of health problems that arise due to drought ?
  1. Scarcity of water
  2. Reduction of food supply
  3. Pollution of water sources
  4. All above

Answer following questions briefly.

1. Drought is one of the natural disasters that affects Sri Lanka.
  1. Mention three factors that contribute directly for drought.
  2. "Drought affects adversely for the generation of energy in Sri Lanka" Do you agree with the above idea? Describe reasons for your answer.
  3. Suggest three measures to be taken now to face the drought conditions that may occur in future.
2. From time to time, people of many countries have to face natural disasters like floods and landslides. One aspect of disaster management is to minimize the damages caused by such disasters.
  1. State two natural disasters that affect Sri Lanka other than those mentioned above.

2. What is the main reason for occurring floods?
  3. State two reasons for the occurrence of floods other than the one you mentioned above.
  4. Write four essential items that should be included in a disaster kit prepared to face floods.
  5. Name two communicable diseases that can spread after floods.
  6. What is landslide ?
  7. Write two human activities that affect landslides.
  8. Mention three pre-signs / foreruns seen in the associated environment before a landslide.
- 3.
1. What is known as a lightning ?
  2. How are the clouds charged to occur a lightning ?
  3. What are the three types of discharging that happen in the charged clouds ?
  4. What type of lightning, you mentioned above, is harmful to lives and property ?
  5. In which month, that the lightning hazards are maximum in Sri Lanka ?
  6. Mention three things that should not be done during lightning.
  7. State three protective measures that should be followed during a lightning weather condition.

## Technical Terms

Droughts	- தியக	- வறட்சி
Floods	- காலைர	- வெள்ளம்
Landslides	- நாயயேறி	- மண்சரிவு
Lightning and thundering	- அகங்கு	- மின்னலும் இடியும்
Mitigation	- அவம கிரிம	- இழிவளவாக்கல்
Readiness	- ஜில்லாம	- தயார் நிலை
Adaptation	- அனுப்பும் வீம	- இசைவாக்கம்