GOVERNMENT OF TAMIL NADU

STANDARD EIGHT

TERM - II

VOLUME 3

SCIENCE

SOCIAL SCIENCE

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Department of School Education

Untouchability is Inhuman and a Crime

Government of Tamil Nadu

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PREFACE

This book is developed in a holistic approach which inculcates comprehending and analytical skills. It will be helpfull for the students to understand higher secondary science in a better way and to prepare for competitive exams in future. This textbook is designed in a learner centric way to trigger the thought process of students through activities and to make them excel in learning science.

HOW TO USE THE BOOK

- This Science text book for the second term has 7 units.
- Each unit has simple activities that can be demonstrated by the teacher and also few group activities for the students to do under the guidance of the teacher.
- Infographics and info-bits are added to enrich the learner's scientific perception.
- The "Do you know?" and "More to know" placed in the units will be an eye opener.
- Glossary has been introduced to learn scientific terms.
- ICT corner and QR code are introduced in each unit for the digital native generation.

How to get connected to QR Code?

- Download DIKSHA app from the Google Play Store.
- Tap the QR code icon to scan QR codes in the textbook.
- Point the device and focus on the QR code.
- On successful scan, content linked to the QR code gets listed.
- Note: For ICT corner, Digi Links QR codes use any other QR scanner.

QR GUIDE

UNIT 1

HEAT

I8X5R1

Learning Objectives

After completing this lesson students will be able to:

- understand the effects of heat.
- explain the transfer of heat.
- know about calorimetry.
- calculate heat capacity and specific heat capacity of substances.
- list out the functions of thermostat.
- know about the working of thermos flask.

Introduction

All the substances in our surrounding are made up of atoms and molecules. These atoms and molecules are always at vibratory motion. Due to this motion substances have an energy known as heat energy. This energy flows from hot substances to cold substances or from hot region to cold region of a substance. When heat energy is supplied to any substance it increases the energy of the atoms and molecules in it and so they start to vibrate. These atoms and molecules which vibrate make other atoms and molecules to vibrate. Thus, heat energy is transferred from one part of the substance to other part. We can see this heat energy transfer in our daily life also. Heat energy brings about lot of changes. You will learn about this in this lesson. You will also study about transfer of heat and measurement of heat change.

1.1 Effects of Heat

When heat energy is supplied to any substance, it brings about many changes. There are three important changes that we can see in our daily life. They are:

- Expansion
- Increase in temperature
- Change in state

1.1.1 Expansion

Activity 1

Take a metal ball and a metal ring of suitable diameter. Pass the metal ball through the ring. You can observe that the metal ball can easily go through it. Now heat the metal ball and then try to pass it through the ring. It will not pass through the ring. Keep the metal ball on the ring for some time. In few minutes, it will fall through the ring.

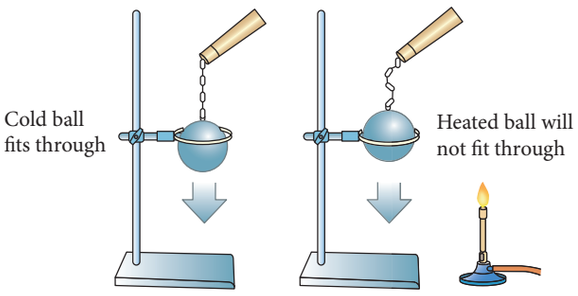


Figure 1.1 Expansion in Solids.

Why didn't the ball go through the ring initially but went through it after some time? When the ball is heated the atoms in the ball gain heat energy. They start vibrating and force each other apart. As a result an expansion takes place. That's why the ball did not go through the ring. After some time, as the ball lost the heat energy to the surrounding it came back to its original size and it went through the ring. This shows that heat energy causes expansion in solids. This expansion takes place in liquids and gases also. It is maximum in gases.

DO YOU KNOW?

You would have noticed some space being left in railway tracks. Why? It is because railway tracks which are made up of iron metal expand during summer. When there is a gap, there will not be any damage in the track due to expansion of the metal rod.

1.1.2 Rise in Temperature

Activity 2

Take a cup of water and note its temperature. Heat the water for few minutes and note the temperature again. Do you find any increase in the temperature? What caused the temperature change?

When the water is heated, water molecules receive heat energy. This heat energy supplied increases the kinetic energy of the molecules. When the molecules receive more energy, the temperature of the water increases. This shows that heat energy causes increase in temperature.

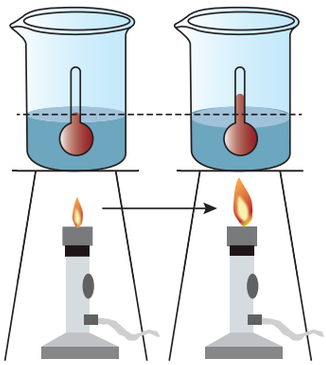


Figure 1.2 Heat energy changes the Temperature

1.1.3 Change of State

Activity 3

Take few ice cubes in a container and heat them for some time. What happens? The ice cubes melt and become water. Now heat the water for some time. What do you observe? The volume of water in the vessel decreases. What do you understand from this activity?

In ice cubes the force of attraction between the water molecules is more. So they are close together. When we heat them the force of attraction between the molecules decreases and the ice cubes become water. When we heat the water, the force of attraction decreases further. Hence they move away from one another and become vapour. Since water vapour escape to the surrounding, water level decreases further. From this we understand that heat energy causes change in the state of the substances. When heat energy is removed, changes take place in reverse direction.

If heat energy is supplied to or taken out from a substance, it will undergo a change from one state of matter to another. One of the following transformations may take place due to heat energy.

- Solid to Liquid (Melting)
- Liquid to Gas (Vapourisation)

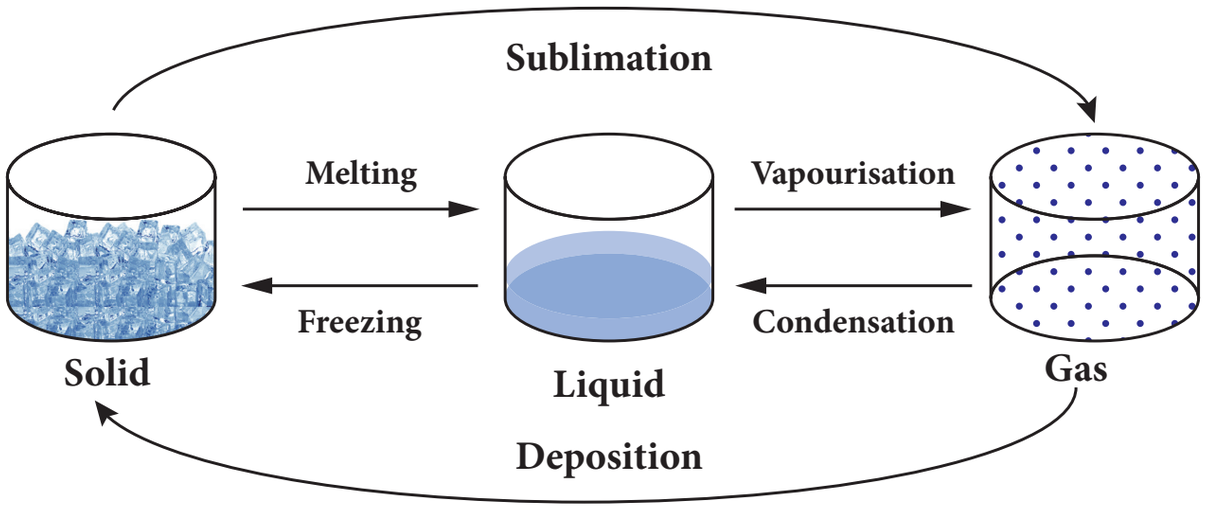


Figure 1.3 Change of state in Water.

- Solid to Gas (Sublimation)
- Gas to Liquid (Condensation)
- Liquid to Solid (Freezing)
- Gas to Solid (Deposition)

Water is the only matter on the Earth that can be found naturally in all three states - Solid, Liquid and Gas.

1.2 Transfer of Heat

If heat energy is supplied to any substance, it will be transferred from one part of the substance to another part. It takes place in different ways depending on the state of the substance. Three ways of heat transfer are:

- Conduction
- Convection
- Radiation

1.2.1 Conduction

Activity 4

Take hot water in a cup and put a silver spoon in it. Leave the spoon inside the water for some time. Now touch the end of the spoon. Do you feel the heat?

How did the other end of the spoon become hot? It is because heat in the hot water is transferred from one end to other end of the spoon. In solid substances such as silver spoon, atoms are arranged very closely. Hot water molecules which are vibrating transfer the heat energy to the atoms in the spoon and make them vibrate. Those atoms make other atoms to vibrate and thus heat is transferred to the other end of the spoon.

In conduction heat transfer takes place between two ends of the same solid or through two solid substances that are at different temperatures but in contact with one another. Thus, we can define conduction as the process of heat transfer in solids from the region of higher temperature to the region of lower temperature without the actual movement of atoms or molecules.

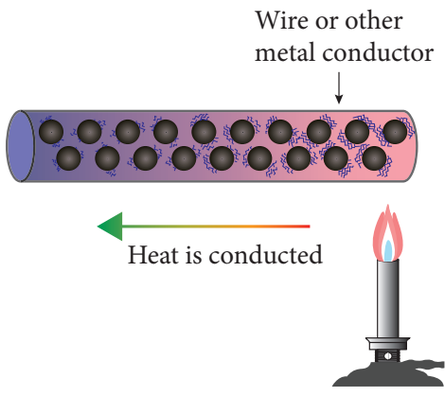


Figure 1.4 Conduction in Solids

DO YOU KNOW?

All metals are **good conductors** of heat. The substances which does not conduct heat easily are called **bad conductors or insulators**. Wood, cork, cotton, wool, glass, rubber, etc are insulators.

Conduction in daily life

- We cook food in vessels made up of metals. When the vessel is heated, heat is transferred from the metal to the food.
- When we iron dresses heat is transferred from the iron to the cloth.
- Handles of cooking utensils are made up of plastic or wood because they are poor conductors of heat.
- The temperature inside igloo (snow house) is warm because snow is a poor conductor of heat.

1.2.2 Convection

Activity 5

Take some water in a vessel and heat it on a stove. Touch the surface of the water. It will be cold. Touch it after some time. It will be hot now. How did the heat which was supplied at the bottom reach the top?

When water in the vessel is heated, water molecules at the bottom receive heat energy and move upward. Then the molecules at the top comes down and get heated. This kind of heat transfer is known as convection. This is how air in the atmosphere is also heated. Thus the form of heat transfer from places of high temperature to places of low temperature by the actual movement of molecules is called convection. Convection takes place in liquids and gases.

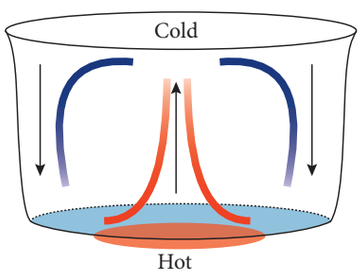


Figure 1.5 Convection in liquid

Convection in daily life

- Formation of land breeze and sea breeze is due to convection of air.
- Wind flows from one region to another region by convection.
- In hot air balloons heat is transferred by convection and so the balloon raises.
- In refrigirators, cool air moves downward and replaces the hot air because of convection.

1.2.3 Radiation

Radiation is the third form of heat transfer. By conduction, heat is transferred through solids, by convection heat is transferred through liquids and gases, but by radiation heat can be transferred through empty space even through vacuum. Heat energy from the Sun reaches the Earth by this

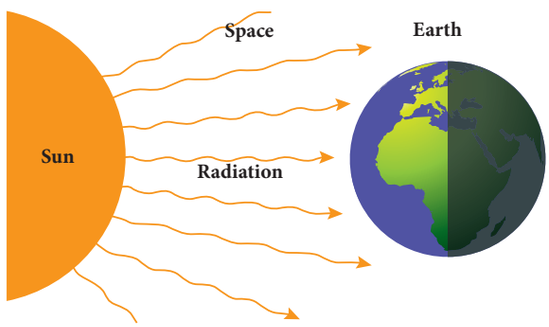


Figure 1.6 Heat transfer by radiation

DO YOU KNOW?

Heat transfer by radiation is visible to our eyes. When a substance is heated to 500°C the radiation begins to become visible to the eye as a dull red glow, and it is sensed as warmth by the skin. Further heating rapidly increases the amount of radiation, and its perceived colour becomes orange, yellow and finally white.

form of heat transfer. Radiation is defined as the way of heat transfer from one place to another in the form of electromagnetic waves.

Radiation in daily life

- Heat energy from the Sun reaches the Earth by radiation.
- While standing near fire we feel the heat which is transferred as radiation.
- Black surfaces absorb heat radiation. So that the bottom of the cooking vessels are painted black.
- White colour reflects heat radiation. That's why we are advised to wear white cloth during summer.

1.3 Calorimetry

We studied about the effects of heat energy. When heat energy is supplied to substances, physical changes take place in them. Solid form of water (ice) is changed to liquid form, and liquid form of water is changed to gaseous form. These are all the physical changes due to heat energy. Similarly, heat energy produces chemical changes also. To know more about the physical and chemical changes that take place in substances, we need to measure the amount of heat involved. The technique used to measure the amount of heat involved in a physical or a chemical process is known as calorimetry.

1.3.1 Temperature

Temperature is a physical quantity which expresses whether an object is hot or cold. It is measured with the help of thermometer. There are three scales to measure the temperature. They are:

- Celcius scale
- Fahrenheit scale
- Kelvin scale

Among these three scales, Kelvin scale is the most commonly used one. You will study about this in detail in Standard IX.

1.3.2 Unit of Heat

We know that heat is a form of energy. The unit of energy in SI system is joule. So, heat is also measured in joule. It is expressed by the symbol J. The most commonly used unit of heat is calorie. One calorie is the amount of heat energy required to raise the temperature of 1 gram of water through 1°C. The relation between calorie and joule is given as, 1 calorie = 4.186 J.

The amount of energy in food items is measured by the unit kilo calorie.

1 kilo calorie = 4200 J (Approximately).

1.3.3 Heat capacity

Activity 6

Take some amount of water and cooking oil in two separate vessels. Heat them till they reach a particular temperature (Caution: Heat the oil under the supervision of your teacher). Which one is heated first? Water will take more time to get heated. Why?

In general, the amount of heat energy gained or lost by a substance is determined by three factors. They are:

- Mass of the substance
- Change in temperature of the substance
- Nature of the material of the substance

Different substances require different amount of heat energy to reach a particular temperature. This nature is known as heat capacity of a substance. Heat capacity is defined as the amount of heat energy required by a substance to raise its temperature by 1°C or 1 K. It is denoted by the symbol C'.

$$\text{Heat capacity} = \frac{\text{Amount of heat energy required (Q)}}{\text{Raise in temperature } (\Delta T)}$$

$$\text{Therefore, } C' = Q / \Delta T$$

The unit of heat capacity is cal / °C. In SI system, it is measured in JK^{-1}.

Problem 1

The temperature of a metal ball is 30° C. When an energy of 3000 J is supplied, its temperature raises by 40° C. Calculate its heat capacity.

Solution

Heat capacity, $C' = Q / \Delta T$

Here, $Q = 3000$ J

$\Delta T = 40°C - 30°C = 10°C = 10$ K

$C' = 3000 / 100 = 300$ JK^{-1}

The heat capacity of the metal ball is 300 JK^{-1}.

Problem 2

The energy required to raise the temperature of an iron ball by 1 K is 500 JK^{-1} . Calculate the amount of energy required to raise its temperature by 20 K.

Solution

Heat capacity, $C' = Q / \Delta T$

$Q = C' \times \Delta T$

Here, $C' = 500$ JK^{-1}

$\Delta T = 20$ K

$Q = 500 \times 20 = 10000$ J.

The amount of heat energy required is 10000 J.

1.3.4 Specific heat capacity

When the heat capacity of a substance is expressed for unit mass, it is called specific heat capacity. Specific heat capacity of a substance is defined as the amount of heat energy required to raise the temperature of 1 kilogram of a substance by 1°C or 1 K. It is denoted by the symbol C.

Specific heat capacity

$$= \frac{\text{Amount of heat energy required (Q)}}{\text{Mass} \times \text{Raise in temperature } (\Delta T)}$$

Therefore, $C = Q / m \times \Delta T$

The SI unit of specific heat capacity is J Kg^{-1} K^{-1}.

Problem 3

An energy of 84000 J is required to raise the temperature of 2 kg of water from 60° C to 70° C. Calculate the specific heat capacity of water.

Solution

Specific heat capacity, $C = Q / m \times \Delta T$

Here, $Q = 84000$ J

$m = 2$ kg

$\Delta T = 70° C - 60° C = 10° C = 10$ K

$C = 84000 / 2 \times 10 = 4200$ J Kg^{-1} K^{-1}

The Specific heat capacity of water is 4200 J Kg^{-1} K^{-1}.

Problem 4

The specific heat capacity of a metal is 160 J $Kg^{-1}K^{-1}$. Calculate the amount of heat energy required to raise the temperature of 500 gram of the metal from 125° C to 325° C.

Solution

Specific heat capacity, $C = Q / m \times \Delta T$

$Q = C \times m \times \Delta T$

Here, $C = 160$ J Kg K^{-1}

$m = 500$ g $= 0.5$ kg

$\Delta T = 325° C - 125° C = 200° C = 200$ K

$= 160 \times 0.5 \times 200 = 16000$ J.

The amount of heat energy required is 16000 J.

1.4 Calorimeter

A calorimeter is a device used to measure the amount of heat gained or lost by a substance. It consists of a vessel made up of metals like copper or aluminium which are good conductors of heat and electricity.

Q9C5H3

The metallic vessel is kept in an insulating jacket to prevent heat loss to the environment. There are two holes in it. Through one hole a thermometer is inserted to measure the

temperature of the contents. A stirrer is inserted through another hole for stirring the content in the vessel. The vessel is filled with liquid which is heated by passing current through the heating element. Using this device we can measure the heat capacity of the liquid in the container.

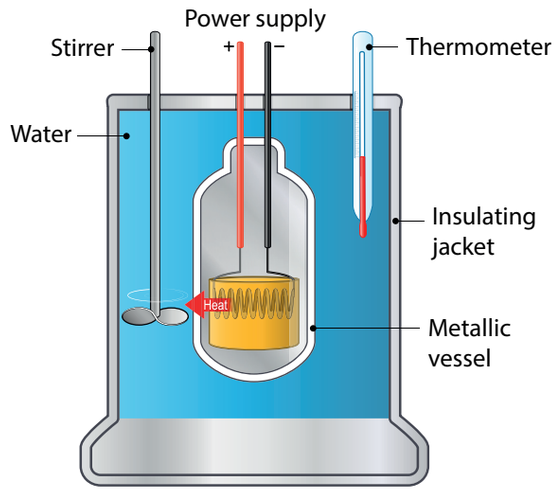


Figure 1.7 Calorimeter

DO YOU KNOW?

The world's first ice-calorimeter was used in the year 1782 by Antoine Lavoisier and Pierre-Simon Laplace, to determine the heat generated by various chemical changes.

1.5 Thermostat

A thermostat is a device which maintains the temperature of a place or an object constant. The word thermostat is derived from two Greek words, 'thermo' meaning heat and 'static' meaning staying the same. Thermostats are used in any device or system that gets heated or cools down to a pre-set temperature. It turns an appliance or a circuit on or off when a particular temperature is reached. Devices which use thermostat include building heater, central heater in a room, air conditioner, water heater, as well as kitchen equipments including oven and refrigerators. Sometimes, a thermostat functions both as the sensor and the controller of a thermal system.

Figure 1.8 Thermostat

1.6 Thermos Flask (Vacuum Flask)

The thermos flask (Vacuum flask) is an insulating storage vessel that keeps its content hotter or cooler than the surroundings for a longer time. It is primarily meant to enhance the storage period of a liquid by maintaining a uniform temperature and avoiding possibilities of getting a bad taste.

DO YOU KNOW?

The vacuum flask was invented by Scottish scientist Sir James Dewar in 1892. In his honour it is called Dewar flask. It's also known as Dewar bottle.

Working of Thermos flask

A thermos flask has double walls, which are evacuated. It is silvered on the inside. The vacuum between the two walls prevents heat being transferred from the inside to the outside by conduction and convection.

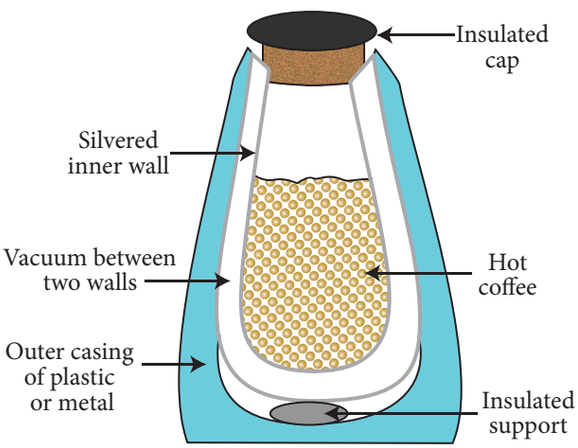


Figure 1.9 Thermos flask

With very little air between the walls, there is almost no transfer of heat from the inner wall to the outer wall or vice versa. Conduction can only occur at the points where the two walls meet, at the top of the bottle and through an insulated support at the bottom. The silvered walls reflect radiated heat back to the liquid in the bottle.

Points to Remember

- Heat is a form of energy which is transferred from one part to another part of a substance.
- Heat transfer causes expansion, increases temperature and changes the state of the substance.
- When thermal energy is supplied to a solid, the atoms or molecules present in it gain energy and vibrate more vigorously about their fixed positions, forcing each other further apart.
- Melting, vapourisation, sublimation, condensation, freezing and deposition are the change of states that take place due to heat energy.
- Heat transfer takes place in three ways: conduction, convection and radiation.
- Conduction occurs in solids, convection in liquids and gases, and radiation takes place in vaccum.
- Capacity of substances to gain or loose heat energy is determined by three factors: mass of the substance, change in temperature and nature of the substance.
- There are three scales to measure temperature: Celcius scale, Fahrenheit scale and Kelvin scale.
- Calorimeter measures the heat capacity of water.

A-Z GLOSSARY

Calorimeter	A device which measures the heat capacity of liquids.
Calorimetry	The technique used to measure the amount of heat involved in a physical or a chemical process.
Conduction	The process of heat transfer in solids from a region of higher temperature to a region of lower temperature without the actual movement of molecules.
Convection	The form of heat transfer from places of high temperature to places of low temperature by the actual movement of liquid or gas molecules.
Heat capacity	Amount of heat energy required to raise the temperature of a substance by 1° C or 1 K.
Radiation	The form of heat transfer from one place to another in the form of electromagnetic waves.
Specific heat capacity	Amount of heat energy required to raise the temperature of 1 kilogram of a substance by 1° C or 1 K.
Temperature	Physical quantity which expresses whether an object is hot or cold.
Thermos flask	An insulating storage vessel that keeps its content hotter or cooler than the surroundings for a longer time.
Thermostat	A temperature sensing device that turns an appliance or circuit on or off when a particular temperature is reached in it.

TEXT BOOK EXERCISES

L6I2M4

I. Choose the best answer.

1. Heat is a form of _____.
   a) electrical energy
   b) gravitational energy
   c) thermal energy
   d) None of these
2. If you apply some heat energy to a substance, which of the following can take place in it?
   a) Expansion
   b) Increase in temperature
   c) Change of state
   d) All the above.
3. Which of the following substances will absorb more heat energy?
   a) Solid b) Liquid
   c) Gas d) All the above
4. If you apply equal amount of heat to a solid, liquid and gas individually, which of the following will have more expansion?
   a) Solid b) Liquid
   c) Gas d) All of them
5. The process of converting a liquid into a solid is called_____.
   a) sublimation b) condensation
   c) freezing d) deposition
6. Conduction is the heat transfer which takes place in a_____.
   a) solid b) liquid
   c) gas d) All of them

II. Fill in the blanks.

1. A calorimeter is a device used to measure the_____.
2. _____ is defined as the amount of heat required to raise the temperature of 1kg of a substance by 1°C.
3. A thermostat is a device which maintains _____.
4. The process of converting a substance from gas to solid is called_____.
5. If you apply heat energy, the temperature of a system will _____.
6. If the temperature of a liquid in a container is decreased, then the interatomic distance will _____.

III. State True or False. If false, correct the statement.

1. The applied heat energy can be realized as an increase in the average kinetic energy of the molecules.
2. The dimensions of a substance are increased if the temperature of the substance is decreased.
3. The process of converting a substance from solid to gas is called condensation.
4. Convection is the process by which the thermal energy flows in solids.
5. The amount of heat gained by a substance is equal to the product of its mass and latent heat.
6. In a thermos flask, the silvered walls reflect and radiate the heat to the outside.

IV. Match the following.

1. Conduction	a) Liquid
2. Convection	b) Gas to liquid
3. Radiation	c) Solid to gas
4. Sublimation	d) Gas
5. Condensation	e) Solid

V. Read the directions given below and answer the questions.

a. If both assertion and reason are true and the reason is the correct explanation of the assertion.

b. If both assertion and reason are true, but reason is not the correct explanation of the assertion.

c. If the assertion is true, but the reason is false.

d. If the assertion is false, but the reason is true.

1. **Assertion:** Radiation is a form of heat transfer which takes place only in vacuum.
   Reason: The thermal energy is transferred from one part of a substance to another part without the actual movement of the atoms or molecules.
2. **Assertion:** A system can be converted from one state to another state.
   Reason: It takes place when the temperature of the system is constant.

VI. Answer briefly.

1. What are the applications of conduction in our daily life?
2. What are the effects of heat?
3. Name three types of heat transfer.
4. What is conduction?
5. Write a note on convection.
6. Define specific heat capacity.
7. Define one calorie.

VII. Answer in detail.

1. With the help of a neat diagram explain the working of a calorimeter.
2. Write a note on thermostat.
3. Explain the working of thermos flask.

VIII. Higher Order Thinking Questions.

1. Why does the bottom of a lake not freeze in severe winter even when the surface is all frozen?
2. Which one of the following statements about thermal conductivity is correct? Give reason.
   a) Steel > Wood > Water
   b) Steel > Water > Wood
   c) Water > Steel > Wood
   d) Water > Wood > Steel

IX. Problems.

1. An iron ball requires 1000 J of heat to raise its temperature by 20°C. Calculate the heat capacity of the ball.
2. The heat capacity of the vessel of mass 100 kg is 8000 J/°C. Find its specific heat capacity.

REFERENCE BOOKS

1. Fundamentals of Statistical and Thermal Physics - F.Reif
2. Statistical Thermodynamics and Microscale Thermo -physics - Carey
3. Heat, Thermodynamics and Statistical Physics - BrijLal and Dr. N. Subramaniyam
4. Thermodynamics and an Introduction to Thermos-statistics byHerbert Hallen
5. Fundamentals of Engineering Thermo dynamics by Michael Moran

INTERNET RESOURCES

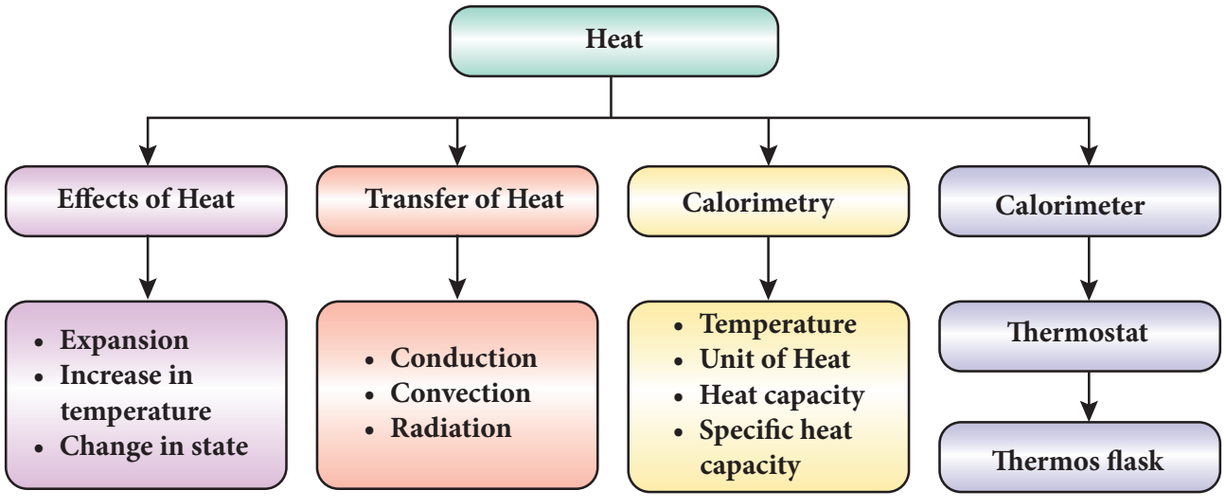
https://www.explainthatstuff.com/thermostats.html

https://youtu.be/8-nLHWpgDsM

https://youtu.be/rYwgsF_haAg

https://youtu.be/EwzkYTfHFbo

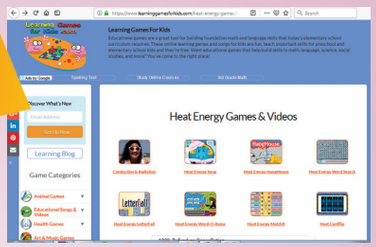
Concept Map



ICT CORNER

Heat

Through this activity you will learn about heat energy through Interactive games.

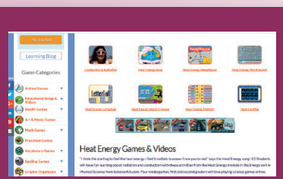


Step 1 Open the Browser and type the URL given below

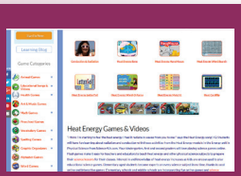
Step 2 You can see lot of games about heat energy.

Step 3 For example, click "Heat Energy match it" game. You will see the match words in the screen. Play and learn about heat energy.

Step 4 Likewise you can explore all the games.

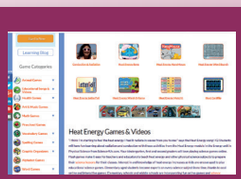


Step1



Step2

Step3



Step4

Browse in the link:

https://www.learninggamesforkids.com/heat-energy-games.html

B359_8_SCIENCE_EM

UNIT 2

Electricity

Learning Objectives

T6X2D6

After completing this lesson, students will be able to:

- know about the basic properties of electric charges.
- explain the transfer of charges between two objects.
- understand the working of Electroscope.
- recognise the effects of electric current.
- assemble different electric circuits.
- list out the applications of electricity.

Introduction

All things we use in our life are made up of elements. Each element is made up of atoms which is the smallest unit. John Dalton, the scientist considered that atoms cannot be divided further. But, it was found out later through Rutherford's gold foil experiment that atoms are made up of particles like proton, electron and neutron. Movement of electrons in a material constitutes electric current and generates an energy called electric energy or electricity. We use this energy in our life for various needs. Electric bulbs, fans, elctric iron box, washing machines and refrigirators are some of the appliances which work with the help of electricity. In this lesson we will study about electric charges and how they are transferred. This lesson will also cover electric circuits and the effects of electric current.

2.1 Atom

An atom consists of proton, electron and neutron which are called sub-atomic particles. Proton and neutron are found inside the nucleus which is at the centre of an atom. Electrons revolve around the nucleus in different paths called orbits. In an atom, the number of protons and the number of electrons will be equal. There is a force of attraction between the protons in the nucleus and the electrons in the orbits. Electrons in the inner orbits are strongly attracted by the protons and they cannot be removed from the atom easily. But, the electrons in the outermost orbits are loosely bound and they can be easily removed from the atom.

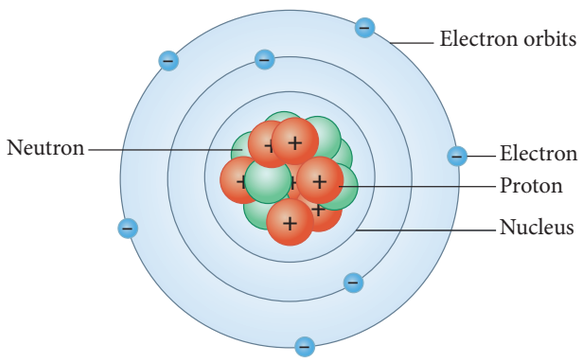


Figure 2.1 Atom model

2.2 Charges

Charge or electric charge is the basic property of matter that causes objects to attract or repel each other. It is carried by the subatomic particles like protons and electrons. Charges can neither be created nor be destroyed. There are two types of charges: positive charge and negative charge. Protons carry positive charge and the electrons carry negative charge. There is a force of attraction or repulsion between the charges. Unlike charges attract each other and like charges repel each other.

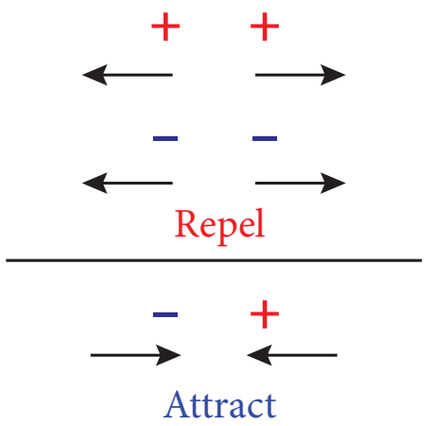


Figure 2.2 Attraction and repulsion between charges.

Electric charge is measured in coulomb (C). Small amount of charge that can exist freely is called elementary charge (e). Its value is 1.602×10^{-19} C. This is the amount of charge possessed by each proton and electron. But, protons have positive elementary charge (+e) and electrons have negative elementary charge (-e). Since protons and electrons are equal in number, an atom is electrically neutral.

2.3 Transfer of Charges

As we saw earlier, electrons (negative electric charges) in the outermost orbit of an atom can be easily removed. They can be transferred from one substance to another. The substance which gains electrons become negatively charged and the substance which looses electrons becomes positively charged. Transfer of charges takes place in the following three ways.

E5F2F1

- Transfer by Friction
- Transfer by Conduction
- Transfer by Induction

2.3.1 Transfer by Friction

Activity 1

Take a comb and place it near some pieces of paper. Are they attracted by the comb? No. Now comb your dry hair and place it near them. What do you see? You can see that the paper pieces are attracted by the comb now. How is it possible?

Comb rubbed with hair gains electrons from the hair and becomes negatively charged. These electrons are accumulated on the surface of the comb. When a piece of paper is teared into bits, positive and negative charges are present at the edges of the bits. Negative charges in the comb attract positive charges in the bits. So, the paper bits are moving towards the comb. While combing hair charges are transferred from the hair to comb due to friction. If the hair is wet, the friction between the hair and the comb reduces which will reduce the number of electrons transferring from hair to comb. Hence, rubbing certain materials with one another can cause the build-up of electrical charges on the surfaces. From this it is clear that charges are transferred by friction.

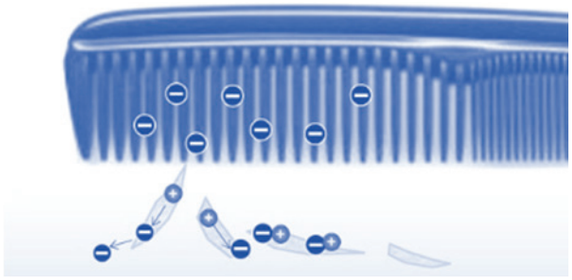


Figure 2.3 Charges in comb.

DO YOU KNOW?

A neutral object can become positively charged when electrons get transferred to another object; not by receiving extra positive charges.

Similar effect can be seen when we rub few materials with one another. When a glass rod is rubbed with a silk cloth the free electrons in the glass rod are transferred to silk cloth. It is because the free electrons in the glass rod are less tightly bound as compared to that in silk cloth. Since the glass rod looses electrons, it has a deficiency of electrons and hence acquires positive charge. But, the silk cloth has excess of electrons. So, it becomes negatively charged.

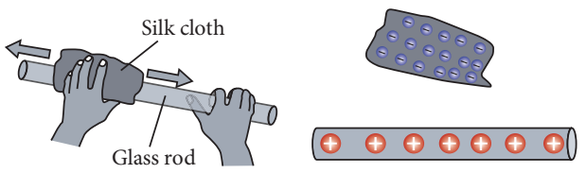


Figure 2.4 Transfer of charges in glass rod.

When an ebonite rod (rod made by vulcanized rubber) is rubbed with fur, the fur transfers electrons to the ebonite rod because the electrons in the outermost orbit of the atoms in fur are loosely bound as compared to the ebonite rod. The ebonite rod which has excess electrons becomes negatively charged and the fur which has deficiency of electrons is positively charged.

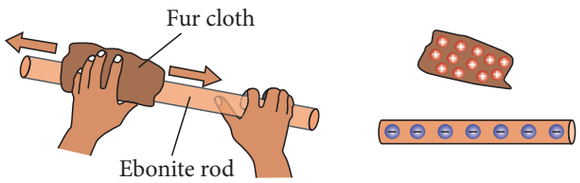
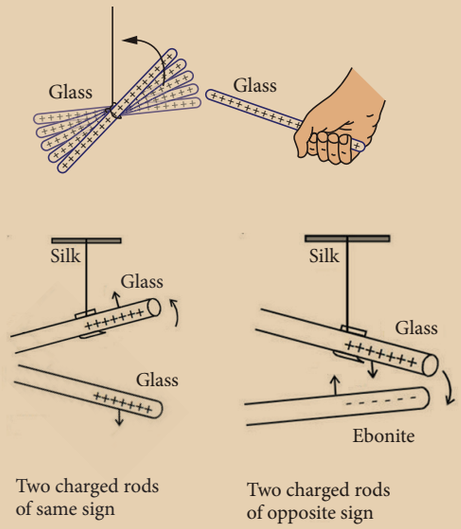


Figure 2.5 Transfer of charges in ebonite rod.

From these we know that when two materials are rubbed together, some electrons may be transferred from one material to the other, leaving them both with a net electric charge.

DO YOU KNOW?

If a negatively charged glass rod is brought near another glass rod, the rods will move apart as they repel each other. If a positively charged glass rod is brought close to a negatively charged ebonite rod, the rods will move toward each other as they attract. The force of attraction or repulsion is greater when the charged objects are closer.



2.3.2 Transfer by Conduction

Activity 2

Take a sheet of paper. Turn it into a hollow cylinder. Tie one end of the cylinder with a silk thread and hang it from a stand. Now take an ebonite rod and charge it by rubbing it with a woollen cloth. Bring this charged ebonite rod near the paper cylinder. The cylinder will be attracted by the rod. If you touch the paper cylinder by the charged rod, you will see the paper cylinder repelling the rod. Can you give the reason?

When the ebonite rod is rubbed with woollen cloth, electrons from the woollen cloth are transferred to the ebonite rod. Now ebonite rod will be negatively charged. When

it is brought near the paper cylinder, negative charges in the rod are attracted by the positive charges in the cylinder. When the cylinder is touched by the rod, some negative charges are transferred to the paper. Hence, the negative charges in the rod are repelled by the negative charges in the cylinder.

Thus, we can say that charges can be transferred to on object by bringing it in contact with a charged body. This method of transferring charges from one body to other body is called transfer by conduction.

DO YOU KNOW?

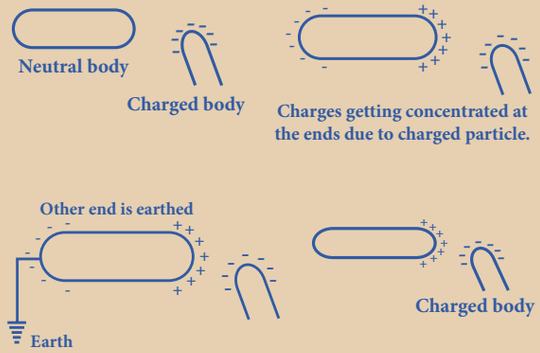
The materials which allow electric charges to pass through them easily are called conductors of electricity. For example, metals like aluminium, copper are good conductors of electricity. Materials which do not allow electric charges to pass through them easily are called insulators. Rubber, wood and plastic are insulators.

2.3.3 Transfer by Induction

We saw that we can charge an uncharged object when we touch it by a charged object. But, it is also possible to obtain charges in a body without any contact with other charges. The process of charging an uncharged body by bringing a charged body near to it but without touching it is called induction. The uncharged body acquires an opposite charge at the near end and similar charge at the farther end.

Activity 3

Bring a negatively charged plastic rod near a neutral rod. When the negatively charged plastic rod is brought close to the neutral rod, the free electrons move away due to repulsion and start piling up at the farther end. The near end becomes positively charged due to deficit of electrons. When the neutural rod is grounded, the negative charges flow to the ground. The positive charges at the near end remain held due to attractive forces and the electrons inside the metal is zero. When the rod is removed from the ground, the positive charge continues to be held at the near end. This makes the neutral rod a positively charged rod.



Similarly, when a positively charged rod is brought near an uncharged rod, negatively charged electrons are attracted towards it. As a result there is excess of electrons at nearer end and deficiency of electrons at the farther end. The nearer end of the uncharged rod becomes negatively charged and far end is positively charged.

2.4 Flow of Charges

Suppose you have two metallic spheres; one having more negative charge (excess of electrons) and the other having more positive charge (deficiency of electrons). When you connect them both with the help of a metallic wire, excess electrons from the negatively charged sphere will start flowing towards the positively charged sphere. This flow continues till the number of electrons in both the sphere is equal. Here, the positively charged sphere is said to be at higher potential and the negatively

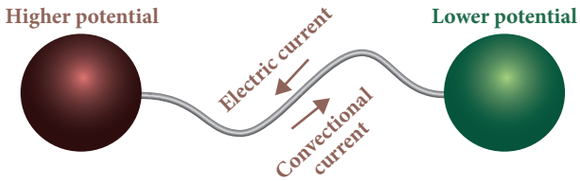


Figure 2.6 Transfer of charges

charged sphere is said to be at lower potential. Hence, electrons flow from lower potential to higher potential. This is known electric current (flow of electrons). The difference between these potentials is known as potential difference, commonly known as voltage.

Before the discovery of electrons it was considered that electric current is due to the flow of positive charges. Flow of positive charge is called conventional current. Conventional current flows from higher potential to lower potential.

2.5 Electroscope

An electroscope is a scientific instrument used to detect the presence of electric charge on a body. In the year 1600, British physician William Gilbert invented the first electroscope. It is the first electrical instrument. There are two types of electroscope: pith-ball electroscope and gold-leaf electroscope. An electroscope is made out of conducting materials, generally metal. It works on the principle that like charges repel each other. In a simple electroscope two metal sheets are hung in contact with each other. They are connected to a metal rod that extends upwards, and ends in a knob at the end.

The first electroscope developed in 1600 by William Gilbert was called versorium. The versorium was simply a metal needle allowed to pivot freely on a pedestal. The metal would be attracted to charged bodies brought near.

If you bring a charged object near the knob, electrons will either move out of it or into it. This will result in charges on the metal leaves inside the electroscope. If a negatively charged object is brought near the top knob of the electroscope, it causes free electrons in the electroscope to move down into the leaves, leaving the top positive. Since both the leaves have negative charge, they repel each other and move apart.

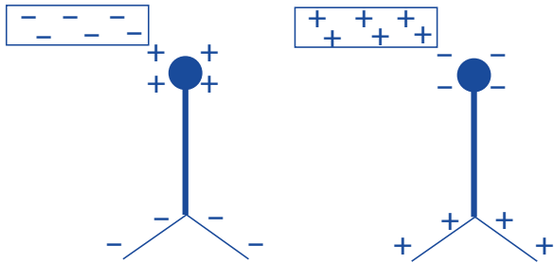


Figure 2.7 Movement of charges in electroscope

If a positive object is brought near the top knob of the electroscope, the free electrons in the electroscope start to move up towards the knob. This means that the bottom has a net positive charge. The leaves will spread apart again.

2.5.1 Gold leaf electroscope

The gold-leaf electroscope was developed in 1787 by a British scientist named Abraham Bennet. Gold and silver are used in electroscope because they are the best conductors of electric current.

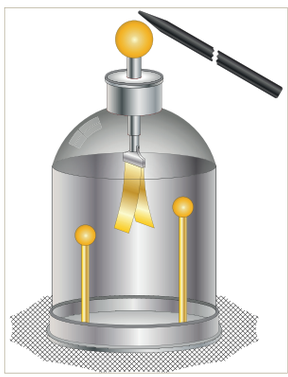


Figure 2.8 Gold leaf electroscope

Structure of Electroscope

It is made up of a glass jar. A vertical brass rod is inserted into the jar through a cork. The top of the brass rod has a horizontal brass rod or a brass disc. Two gold leaves are suspended from the brass rod inside the jar.

Working of Electroscope

When the brass disc of the electroscope is touched by a charged object, electric charge gets transferred to the gold leaf through the rod. This results in the gold leaves moving away from each other. This happens because both the leaves have similar charges.

Charging

Transfer of charge from one object to another is called charging. In case of the gold leaves charge is transferred through the brass rods.

Electrical Discharge

The gold leaves resume their normal position after some time. This happens because they lose their charge. This process is called electrical discharge. The gold leaves would also be discharged when someone touches the brass rod with bare hands. In that case, the charge is transferred to the earth through the human body.

2.6 Lightning and Thunder

Activity 4

Rub your foot on a carpet floor and touch a door knob. What do you feel? Do you feel the shock in your hand? Why does this happen?

Getting a shock from a doorknob after rubbing your foot on a carpet floor, results from discharge. Discharge occurs when electrons on the hand are quickly pulled to the positively charged doorknob. This movement of electrons, which is felt as a shock, causes the body to lose negative charge. Electric discharge takes place in a medium, mostly gases. Lightning is another example of discharge that takes place in clouds.

Lightning is produced by discharge of electricity from cloud to cloud or from cloud to ground. During thunderstorm air is moving upward rapidly. This air which moves rapidly, carries small ice crystals upward. At the same time, small water drops move downward. When they collide, ice crystals become positively charged and move upward and the water drops become negatively charged and move downward. So the upper part of the cloud is positively charged and the lower part of the cloud is negatively charged. When they come into contact, electrons in the water drops are attracted by the positive charges in the ice crystals. Thus, electricity is generated and lightning is seen.

Sometimes the lower part of the cloud which is negatively charged comes into contact with the positive charges accumulated near the mountains, trees and even people on the earth. This discharge produces lot of heat and sparks that results in what we see as lightning. Huge quantities of electricity are discharged in lightning flashes and temperatures of over 30,000°C or more can be reached. This extreme heating causes the air to expand explosively fast and then they contract. This expansion and contraction create a shock wave that turns into a booming sound wave, known as thunder.

DO YOU KNOW?

Lightning's extreme heat will vaporize the water inside a tree, creating steam that may burn out the tree.

Sometimes lightning may be seen before the thunder is heard. This is because the distance between the clouds and the surface is very long and the speed of light is much faster than the speed of sound.

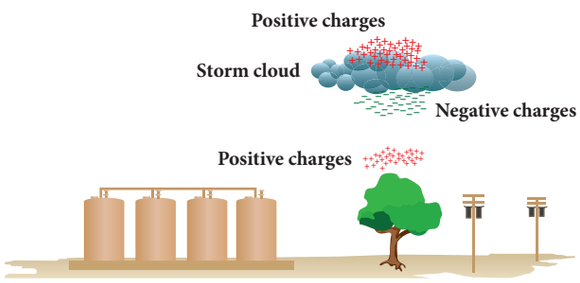


Figure 2.9 Formation of Lightning

During lightning and thunder, we should avoid standing in ground and open spaces. You should make yourself as small as possible by squating. It is however safe to stay inside a car because the car acts as a shield and protects us from the electric field generated by the storm.

2.6.1 Earthing

A safety measure devised to prevent people from getting shocked if the insulation inside electrical devices fails is called Earthing. Electrical earthing can be defined as the process of transferring the discharge of electrical energy directly to the Earth with the help of low-resistance wire.

We get electrical energy from different sources. Battery is one such source. We use it in wall clocks, cell phones etc. For the working of refrigerators, air conditioners, washing machines, televisions, laptops and water heaters we use domestic power supply. Usually an electric appliance such as a heater, an iron box, etc. are fitted with three wires namely live, neutral and earth. The earth wire is connected to the metallic body of the appliance. This is done to avoid accidental shock.

Suppose due to some defect, the insulation of the live wire inside an electric iron is burnt then the live wire may touch the metallic body of the iron. If the earth wire is properly connected to the metallic body, current will pass into the Earth through earth wire and it will protect us from electric shock. The Earth, being a good conductor of electricity, acts as a convenient path for the flow of electric current that leaks out from the insulation.

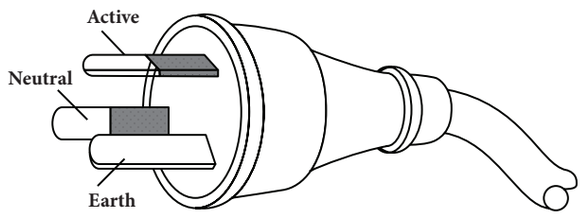


Figure 2.10 Live, Neutral and Earth wire

2.6.2 Lightning Arresters

Lightning arrestor is a device used to protect buildings from the effects of lightning. Lightning conductor consists of a metallic lightning rod that remains in air at the top of the building. Major portion of the metal rod and copper cable are installed in the walls during its construction. The other end of the rod is placed deep into the soil. When lightning falls, it is attracted by the metallic rods at the top of the building. The rod provides easy route for the transfer of electric charge to the ground. In the absence of lightning arrestors, lightning will fall on the building and the building will be damaged.

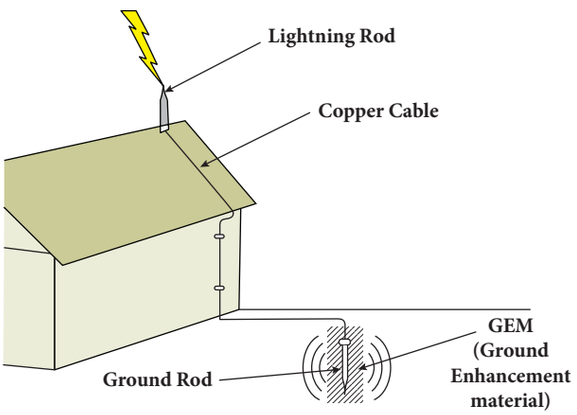


Figure 2.11 Lightning arresters

2.7 Electric Circuits

We saw that when two oppositely charged spheres are connected by a metal wire, electrons flow from the sphere which is at lower potential to the sphere at higher potential. Similarly, if two terminals of a battery which are at different potential are connected by a metallic wire, electrons will flow from negative terminal to positive terminal. The path through which electrons flow from one terminal to another terminal of the source, is called electric circuit.

A simple circuit consists of four elements: a source of electricity (battery), a path or conductor through which electricity flows (wire), a switch to control the circuit and an electrical resistor (lamp) which is any device that requires electricity to operate.

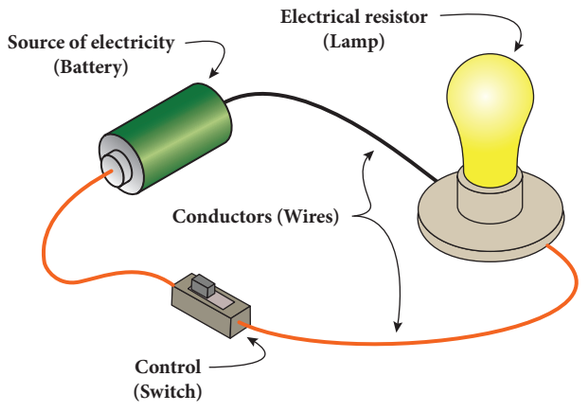


Figure 2.12 Simple electric circuit

The above figure shows a simple circuit containing a battery, two wires, key and an electric bulb. The source can be a battery or the electric outlet in your room. The electrical resistor refers to the device that consumes the energy. Control (key) is the mechanism that is used to start, stop and regulate the electric current. When the key is on, electrons from the battery flow through the circuit from the negative terminal through the wire conductor, then through the bulb and finally back to the positive terminal. The light glows when current is flowing through its filament. There are two basic ways in which we can connect these components. They are: series and parallel.

DO YOU KNOW?

The electric eel is a species of fish which can give electric shocks of upto six hundred fifty watts of electricity. But if the eel repeatedly shocks, its electric organs become completely discharged. Then a person can touch it without being shocked.

2.7.1 Series Circuit

A series circuit is one that has more than one resistor (bulb) but only one path through which the electrons can travel. From one end of the battery the electrons move along one path with no branches through the resistors (bulbs) to the other end of the cell. All the components in a series circuit are connected end to end. So, current through the circuit remains same throughout the circuit. But, the voltage gets divided across the bulbs in the circuit. In the following series circuit two bulbs are used as resistors.

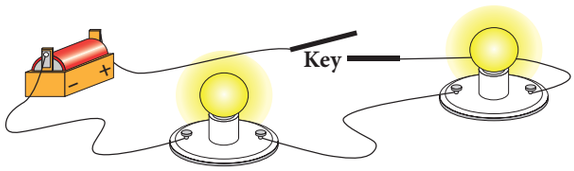


Figure 2.13 Series circuit

In this series circuit, charges (electrons) from the battery have only one path to travel. Here battery, key and two bulbs are connected in series. Charges flow from the battery to each bulb, one at a time, in the order they are wired to the circuit. If one bulb in the circuit is unscrewed, the current flow to another bulb would be interrupted. We put serial lights during festivals. If the lights are in a series circuit, one burned out bulb will keep all the lights off. If the number of bulbs in a circuit with a battery increases, the light will be dimmer because many resistors are acting on the same power from the battery.

We saw that in series circuit same current travels through every resistance and the voltage will be different across each resistance. Let us consider three bulbs connected in series. Let I be the current through the circuit and V_1, V_2, V_3 be the voltage across each bulb. The supply voltage V is the total of the individual voltage drops across the resistances.

$$V = V_1 + V_2 + V_3$$

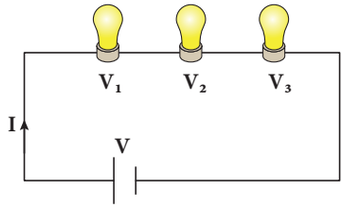


Figure 2.14 Voltage in series circuit

2.7.2 Parallel Circuit

In a parallel circuit, there is more than one resistor (bulb) and they are arranged on many paths. This means charges (electrons) can travel from one end of the cell through many branches to the other end of the cell. Here, voltage across the resistors (bulbs) remains the same but the current flowing through the circuit gets divided across each resistor.

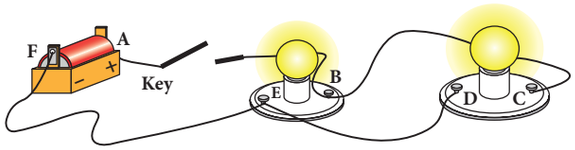


Figure 2.15 Parallel circuit

In the above diagram current can flow in two paths: ABEFA and ABCDEFA. Here, it is clear that electricity from the cell can take either path ABEFA or path ABCDEFA to return to the cell. From the diagram you will notice that even when one resistor (bulb) burns out, the other bulbs will work because the electricity is not flowing through only one path. All the light bulbs in our homes are connected in parallel circuit. If one bulb burns out, the other bulbs in the rooms will still work. The bulbs in a parallel circuit do not dim out as in series circuits. This is because the voltage across one branch is the same as the voltage across all other branches.

Let us consider three bulbs connected in series. Let V be the voltage across the bulbs and I_1, I_2, I_3 be the current across each bulb. The current I from the battery is the total of the individual current flowing through the resistances.

$$I = I_1 + I_2 + I_3$$

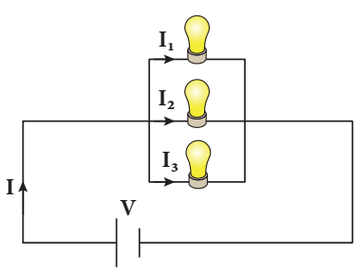


Figure 2.16 Current in parallel circuit

Table 2.1 Difference between series and parallel circuits.

Series circuit	Parallel circuit
Same amount of current flows through all the components.	The current flowing through each component combines to form the current flow.
Voltage is different across different components.	Sum of the voltage through each component will be the voltage drawn from the source.
Components are arranged in a line.	Components are arranged parallel to each other.
If one component breaks down, the whole circuit will burn out.	Other components will function even if one component breaks down.

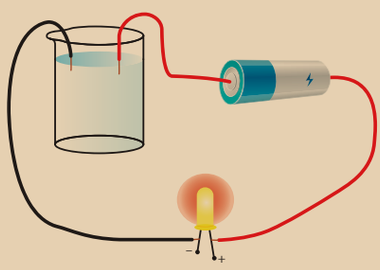
2.8 Effects of Current

When current is flowing through a conductor it produces certain effects. These are known as effects of electric current. These effects result in conversion of electrical energy into different forms of energies such as heat energy, mechanical energy, magnetic energy, chemical energy and so on.

2.8.1 Chemical Effect of Current

Activity 5

Take two pieces of wire, an LED light and a battery, and make a simple electric circuit. Take some water in a glass and put the wires in the water as shown in the figure. Does the LED bulb glow? What do you understand from this?



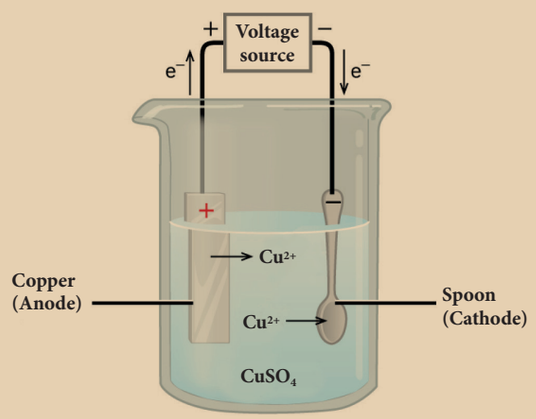
We saw that electricity is conducted by metals. This activity shows that liquids also conduct electricity. When electric current is passed through a conducing solution, some chemical reactions take place in the solution. This chemical reactions produce electrons which conduct electricity. This is called chemical effect of electric current. The decomposition of molecules of a solution into positive and negative ions on passing an electric current through it, is called electrolysis. Electrolysis has a number of applications. It is used in extraction and purification of metals. The most general use of electrolyte is electroplating.

Electroplating

Electroplating is one of the most common applications of chemical effects of electric current. The process of depositing a layer of one metal over the surface of another metal by passing electric current in called electroplating.

Activity 6

Take a glass jar and fill it with copper sulphate solution. Take a copper metal plate and connect it to the positive terminal of battery. Connect an iron spoon to the negative terminal of the battery. Now, dip them in the copper sulphate solution. When electric current is passed through the copper sulphate solution, you will find that a thin layer of copper metal is deposited on the iron spoon and an equivalent amount of copper is lost by the copper plate.

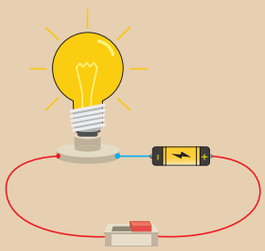


Electro plating is applied in many fields. We use iron in bridges and automobiles to provide strength. However, iron tends to corrode and rust. So, a coating of zinc is deposited on iron to protect it from corrosion and formation of rust. Chromium has a shiny appearance. It does not corrode. It resists scratches. But, chromium is expensive and it may not be economical to make the whole object out of chromium. So, the objects such as car parts, bath taps, kitchen gas burners, bicycle handlebars, wheel rims are made from a cheaper metal and only a coating of chromium is deposited over it.

2.8.2 Heating Effect of Current

Activity 7

Take a battery, a bulb, a switch and few connecting wires. Make an electric circuit as shown in the figure. Keep the switch in the 'OFF' position. Does the bulb glow? Now move the electric switch to the 'ON' position and let the bulb glow for a minute or so. Touch the bulb now. Do you feel the heat?



When electric current passes through a conductor, there is a considerable 'friction' between the moving electrons and the molecules of the conductor. During this process, electrical energy is transformed to heat energy. This is known as heating effect of electric current. The heat produced depends on the amount of resistance offered by the wire.

Copper wire offers very little resistance and does not get heated up quickly. On the other hand, thin wires of tungsten or nichrome which are used in bulbs offer high resistance and gets heated up quickly. This is

the reason why tungsten wire is used in the filaments of the bulbs and nichrome wire is used as a heating element in household heating appliances. Heating effect of electric current can be seen in many devices. Some of them are given below.

Fuse

Fuse is a strip of alloy wire which is made up of lead and tin with a very low melting point. This can be connected to the circuit. The fuse is usually designed to take specific amount of current. When current passing through the wire exceeds the maximum limit, it gets heated up. Due to low melting point it melts quickly disconnecting the circuit. This prevents damage to the appliances.

Figure 2.17 Fuse wire

Electric cookers

Electric cookers turn red hot when electric current is passed through the coil. The heat energy produced is absorbed by the cooking pot through conduction.

Electric kettles

The heating element is placed at the bottom of the kettle which contains water. The heat is then absorbed by the liquid and distributed throughout the liquid by convection.

Electric irons

When current flows through the heating element, the heat energy developed is conducted to the heavy metal base, raising its temperature. This energy is then used to press clothes.

Points to Remember

- Opposite charges attract each other and like charges repel each other.
- Charges can be transferred from one region to another region by any of the following ways: Transfer by friction, Transfer by conduction and Transfer by induction.
- Friction between objects results in transfer of electrons between them.
- When a charged body touches another body, charges can be transferred from one body to another.
- Induction is a process of charging an uncharged body by bringing a charged body near to it but not touching it.
- Electroscope is an instrument used to detect and measure electric charges.
- Earthing is the process of connecting the exposed metal parts of an electrical circuit to the ground.
- Lightning arrester is a device used to protect buildings from the effects of lightning.
- A simple circuit consists of four elements: a source of electricity (battery), a path or conductor through which electricity flows (wire), a switch to control the circuit and an electrical resistor (lamp) which is any device that requires electricity to operate.
- The decomposition of molecules of a solution into positive and negative ions on passing an electric current through it is called electrolysis.
- A fuse is a strip of alloy wire which is made of lead and tin with a very low melting point.

A-Z GLOSSARY

Battery	A device that stores and produces electricity from chemical cells.
Circuit	The path that electricity follows.
Electric charge	Basic property of matter carried by some elementary particles. Electric charge can be positive or negative.

Electric current	Flow of electric charges through a material.
Electron	A tiny particle which rotates around the nucleus of an atom. It has a negative charge of electricity.
Electroscope	A scientific instrument used to detect the presence of electric charges on a metal body.
Friction	The resistance that one surface or object encounters when moving over another.
Fuse	A strip of wire that melts and breaks an electric circuit if the current exceeds a safe level.
Volt	Unit of electrical force or electric pressure.
Voltage	An electromotive force that causes electrons to flow.

E7I4T7

TEXT BOOK EXERCISES

I. Choose the best answer.

1. When an ebonite rod is rubbed with fur, the charge acquired by the fur is
   (a) negative (b) positive
   (c) partly positive and partly negative
   (d) None of these

2. The electrification of two different bodies on rubbing is because of the transfer of
   a) neutrons b) protons
   c) electrons d) protons and neutrons

3. Which of the following a simple circuit must have?
   a) Energy Source, Battery, Load
   b) Energy Source, Wire, Load
   c) Energy Source, Wire, Switch
   d) Battery, Wire, Switch

4. An electroscope has been charged by induction with the help of charged glassrod. The charge on the electroscope is
   a) negative b) positive
   c) both positive and negative
   d) None of the above

5. Fuse is
   a) a switch
   b) a wire with low resistance
   c) a wire with high resistance
   d) a protective device for breaking an electric circuit

II. Fill in the blanks.

1. _____takes place by rubbing objects together.
2. The body which has lost electrons becomes _____
3. _____ is a device that protects building from lightning strike.
4. _____ has a thin metallic filament that melts and breaks the connection when the circuit is overheated.
5. Three bulbs are connected end to end from the battery. This connection is called _____

III. State True or False. If false, correct the statement.

1. The charge acquired by an ebonite rod rubbed with a piece of flannel is negative.

2. A charged body induces an opposite charge on an uncharged body when they are brought near.
3. Electroscope is a device used to charge a body by induction.
4. Water can conduct electricity.
5. In parallel circuit, current remains the same in all components.

IV. Match the following.

Two similar charges	acquires a positive charge
Two dissimilar charges	prevents a circuit from overheating
When glass rod is rubbed with silk	repel each other
When ebonite rod is rubbed with fur	attract each other
Fuse	acquires a negative charge

V. Give reason for the following.

1. When a glass rod is rubbed with silk cloth both get charged.
2. When a comb is rubbed with dry hair it attracts small bits of paper.
3. When you touch the metal disc of an electroscope with a charged glass rod the metal leaves get diverged.
4. In an electroscope the connecting rod and the leaves are all metals.
5. One should not use an umbrella while crossing an open field during thunderstorm.

VI. Choose the correct answer from the following directions.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true and reason is not the correct explanation of assertion.

c) If the assertion is true but reason is false.

d) If the assertion is false but reason is true.

1. **Assertion:** People struck by lightning receive a severe electrical shock.
   Reason: Lightning carries very high voltage.
2. **Assertion:** It is safer to stand under a tall tree during lightning.
   Reason: It will make you the target for lightning.

VII. Answer briefly.

1. How charges are produced by friction?
2. What is earthing?
3. What is electric circuit?
4. What is electroplating?
5. Give some uses of electroplating.

VIII. Answer in detail.

1. Explain three ways of charge transfer.
2. What is electroscope? Explain how it works?
3. Explain series and parallel circuit.
4. How lightning takes place?
5. What is electroplating? Explain how it is done.

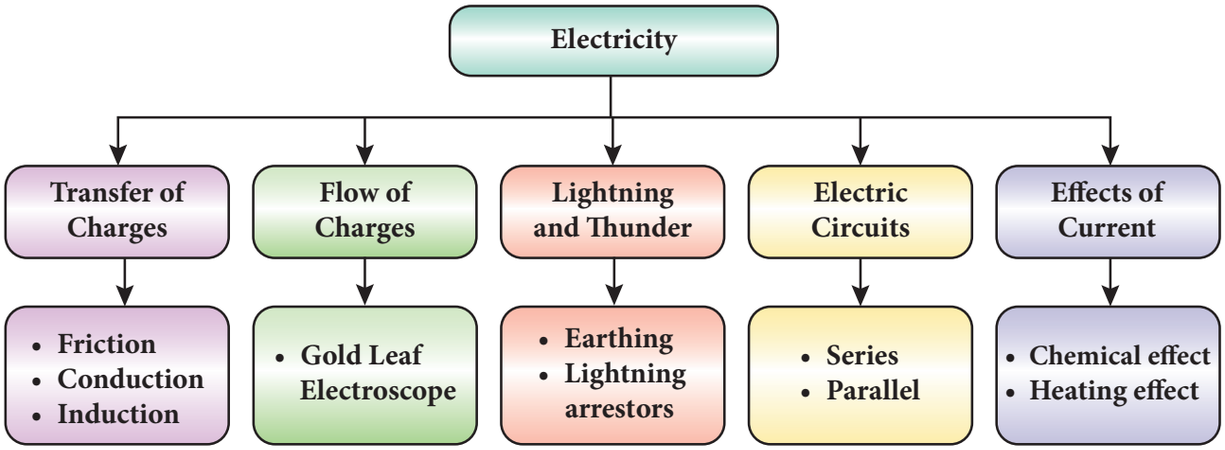
REFERENCE BOOKS

1. Concept of physics - HC Verma
2. A Text-Book on Static Electricity - Hobart Mason
3. Fun With Static Electricity - Joy Cowley
4. Frank New Certificate Physics. McMillan Publishers.

INTERNET RESOURCES

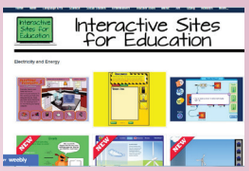
1. http://sciencenetlinks.com/lessons/static-electricity-2/
2. https://www.stem.org.uk/resources/community/collection/13389/static-electricity
3. https://www.physicsclassroom.com/class/estatics

Concept Map



ICT CORNER

Electricity



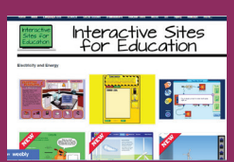
Through this activity you will learn the usage of electricity through Interactive games.

Step 1 Open the Browser and type the URL given below

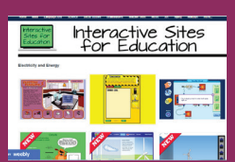
Step 2 You will see lot of games which is related to Electricity

Step 3 Click the Electricity circuits activity (First activity), you will see the sub topics, like Electricity in home, Introduction to circuits etc...

Step 4 Select the sub topic and play the game. Likewise play all the games.



Step1



Step2

Step3

Step4

Browse in the link:

http://interactivesites.weebly.com/electricity-and-energy.html

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*Pictures are indicative only

UNIT 3

AIR

Learning Objectives

A4P1Y8

After completing this lesson students will be able to:

- know about the occurence and composition of oxygen, nitrogen and carbon dioxide in the atmosphere.
- understand the properties and uses of oxygen, nitrogen and carbon dioxide.
- understand nitrogen fixation.
- identify the causes of Green house effect, Global warming and Acid rain.
- suggest remedial measures for the prevention and control of these effects.

Introduction

Air is a mixture of gases that surrounds our planet earth. It is essential for the survival of all the living things. Air contains 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide and small amount of other gases. We breath in oxygen and breath out carbon dioxide. Plants in turn use carbon dioxde for photosynthesis and release oxygen into the atmosphere. Since men have been cutting down trees for their needs, the amount of carbon dioxide in the atmosphere is increasing. This is responsible for the raising of atmospheric temperature. Industries and vehicles release gases like carbon monoxide and sulpher dioxide into the atmosphere. This has resulted in effects like global warming and acid rain which affect us in many ways. In total, the quality of air is gone in the modern days. In this lesson we are going to study about the effects like green house effect, global warming and acid rain. We will also study about occurrence and properties of the gases oxygen, nitrogen and carbon dioxide.

3.1 Oxygen

All living things in the world need oxygen. We cannot imagine the world without oxygen. Swedish chemist C.W. Scheele first discovered oxygen in 1772. He called the gas **fire air** or **vital life** because it was found to support the process of burning. It was independently discovered by the British scientist Joseph Priestley in 1774. Lavoisier named oxygen. The name oxygen comes from the Greek word 'oxygenes' which means 'acid producer'. It is called so because early chemists thought that oxygen is necessary for all acids.

3.1.1 Occurrence of Oxygen

Oxygen is the most abundant element on the earth by mass and the third most abundant element after Hydrogen and Helium in the universe. It occurs both in free state and combined state. It is present in free state as dioxygen molecule (O_2) in the atmosphere. Most of this has been produced by the process photosynthesis in which the chlorophyll present in the leaves of plants uses solar energy to produce glucose.

Table 3.1 Percentage of Oxygen

Oxygen in free state		Oxygen in combined state	
Source	**Percentage**	**Source**	**Percentage**
Atmospheric air	21 %	Plants and animals	60 – 70 %
Water	88 – 90 %	Minerals in the form of silicates, carbonates and oxides	45 – 50 %

$$6CO_2 + 6H_2O + \text{Energy from the Sun} \longrightarrow C_6H_{12}O_6 + 6O_2$$

In combined state it is present in the earth's crust as silicates and metal oxides. It is also found in the water on the surface of the earth. Tri oxygen molecule (O_3) known as ozone is present in the upper layers of the atmosphere.

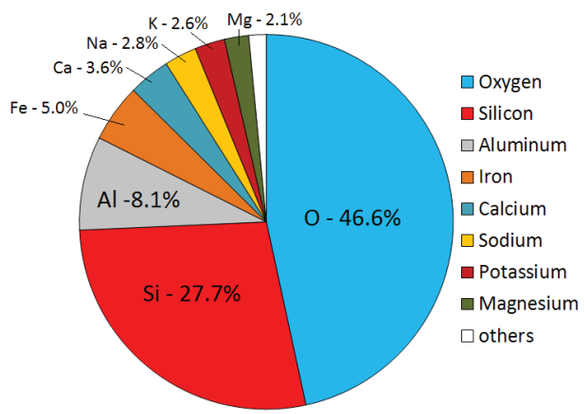

Figure 3.1 Percentage of elements in the Earth's crust

3.1.2 Physical properties of Oxygen

- Oxygen is a colourless, odourless and tasteless gas.
- It is a poor conductor of heat and electricity
- Oxygen dissolves readily in cold water.

DO YOU KNOW?

Oxygen is about two times more soluble in water than nitrogen. If it had the same solubility as nitrogen, then less oxygen would be present in seas, lakes and rivers that will make life much more difficult for living organisms.

- It is denser than air.
- It can be made into liquid (liquified) at high pressure and low temperature.
- It supports combustion.

3.1.3 Chemical properties of Oxygen

1. Combustibility

Oxygen is a non-combustible gas as it does not burn on its own. It supports the combustion of other substances.

DO YOU KNOW?

If oxygen has the capacity to burn itself, striking a match stick will be enough to burn all the oxygen in our planet's atmosphere.

2. Reaction with metals

Oxygen reacts with metals like sodium, potassium, magnesium, aluminium, iron etc., to form their corresponding metal oxides which are generally basic in nature. But the metals differ in their reactivity towards oxygen.

$$\text{Metal} + \text{Oxygen} \longrightarrow \text{Metal oxide}$$

Example

$$4Na + O_2 \longrightarrow 2Na_2O$$

Sodium Oxygen Sodium oxide

Activity 1

Heat a strip of magnesium ribbon in the flame till it catches fire and introduce it into the jar containing oxygen. It burns with a dazzling bright light and white ash of magnesium oxide is formed.

Table 3.2 Reactivity of Oxygen with metals

Metal	Condition	Product formed
K	Room temperature	Potassium Oxide (K_2O)
Mg	Heating slightly	Magnesium Oxide (MgO)
Ca	Heating slightly	Calcium Oxide (CaO)
Fe Cu Ag	High temperature	Iron Oxide (Fe_3O_4) Cupric Oxide (CuO) Silver Oxide (Ag_2O)
Au Pt	Even at high temperature	No action

3. Reaction with non metals

Oxygen reacts with various non-metals like hydrogen, nitrogen, carbon, sulphur, phosphorus etc., to give corresponding non metallic oxides which are generally acidic in nature.

Non-metal + Oxygen ⟶ Non-metallic oxide

Example

$$\underset{\text{Carbon}}{C} + \underset{\text{Oxygen}}{O_2} \longrightarrow \underset{\text{Carbon dioxide}}{CO_2}$$

Table 3.3 Reactivity of Oxygen with non metals

Non metal	Products formed
C	Carbon dioxide (CO_2)
N	Nitric oxide (NO)
S	Sulphur dioxide (SO_2)
P	Phosphorus trioxide (P_2O_3) or Phosphorus pentoxide (P_2O_5)

Activity 2

Heat a small piece of phosphorous and introduce it into the oxygen jar. Phosphorous burns with suffocating smell and gives phosphorous pentaoxide (white fumes).

4. Reaction with Hydrocarbons

Hydrocarbons (compound containing C and H) react with oxygen to form carbon dioxide and water vapour. E.g. Wood, Petrol, Diesel, LPG, etc. When they burn in oxygen, they produce heat and light energy. Hence they serve as fuel.

$$\text{Hydrocarbon} + O_2 \longrightarrow \underset{\text{vapour}}{CO_2 + \text{Water}} + \text{Heat} + \text{Light energy}$$

5. Rusting

The process of conversion of iron into its hydrated form of oxide in the presence of air and moisture (humid atmosphere) is called rusting. Rust is hydrated ferric oxide.

$$4Fe + 3O_2 \longrightarrow 2Fe_2O_3$$
$$Fe_2O_3 + X\,H_2O \longrightarrow \underset{\text{(rust)}}{Fe_2O_3 \cdot X\,H_2O}$$

(X = Number of water molecules which is variable)

3.1.4 Uses of Oxygen

- It is used as oxy-acetylene light for cutting and welding metals.
- It is used to remove carbon impurities from steel.

Figure 3.2 Uses of Oxygen

- Plants and animals use oxygen from the air for respiration.
- It is used to oxidize rocket fuel.
- It is used for artificial respiration by scuba divers, mountaineers, astronauts, patients etc.
- Mixed with powdered charcoal it is used as explosives.
- It is used in the synthesis of methanol and ammonia.

3.2 Nitrogen

Nitrogen is one of the most important elements. Animals and plants need nitrogen for their growth. All living organisms (including us) contain nitrogen. It is an essential element present in proteins and nucleic acids which are the 'building blocks' of all living things. It was first isolated from the air by Swedish chemist Carl Wilhelm Scheele in 1772. The name 'nitrogen' is derived from the Greek words 'nitron' and 'gene' meaning 'I produce nitre'. Nitre is potassium nitrate compound of nitrogen. Antoine Lavoisier suggested the name *azote*, from the Greek word meaning 'no life'.

3.2.1 Occurrence of Nitrogen

Nitrogen is the fourth most abundant element in the human body by mass. It accounts for about three percent of the mass of the human body. It is thought to be the seventh most abundant element in the universe by mass. Titan, the largest moon of Saturn, has an atmosphere made up of 98% Nitrogen. Nitrogen occurs both in free state and combined state. Nitrogen exists in free state in the atmospheric air as dinitrogen (N_2). It is present in volcanic gases and gases evolved by burning of coal. Nitrogen is present in combined state in the form of minerals like nitre (KNO_3) and chile salt petre ($NaNO_3$). It is present in organic matters such as protein, enzymes, nucleic acid etc.

3.2.2 Physical properties of Nitrogen

- It is a colourless, tasteless and odourless gas.
- It is slightly lighter than air.
- It is slightly soluble in water.
- Nitrogen becomes a liquid at low temperature and looks like water.
- When it freezes, it becomes a white solid.
- It is neutral to litmus like oxygen.

3.2.3 Chemical properties of Nitrogen

1. Chemical reactivity

Nitrogen is inactive at ordinary conditions. It combines with many elements at high temperature and pressure or in the presence of catalyst.

2. Combustibility

Nitrogen is neither combustible nor a supporter of combustion. So nitrogen in the air moderates the rate of combustion.

3. Reaction with metals

Nitrogen reacts with metals like lithium, calcium, magnesium etc., at high temperature to form their corresponding metal nitrides.

$$\text{Metal} + \text{Nitrogen} \xrightarrow{\Delta} \text{Metal nitride}$$

Example

$$3Ca + N_2 \xrightarrow{\Delta} Ca_3N_2$$

Calcium Nitrogen Calcium nitride

4. Reaction with non metals

Nitrogen reacts with non-metals like hydrogen, oxygen etc., at high temperature to form their corresponding nitrogen compounds.

$$\text{Non-metal} + \text{Nitrogen} \xrightarrow{\Delta} \text{Nitrogen compound}$$

Example

$$3H_2 + N_2 \xrightarrow{\Delta} 2NH_3$$

Hydrogen Nitrogen Ammonia

3.2.4 Uses of Nitrogen

- Liquid nitrogen is used as a refrigerant.
- It provides an inert atmosphere for conducting certain chemical reactions.
- It is used to prepare ammonia (by Haber's process) which is then converted into fertilizers and nitric acid.
- It is used for inflating tyres of vehicles.
- It is used for filling the space above mercury in high temperature thermometer to reduce the evaporation of mercury.
- Many explosives such as TNT (Trinitrotoluene), nitroglycerin, and gun powder contain nitrogen.
- It is used for the preservation of fresh foods, manufacturing of stainless steel, reducing fire hazards, and as part of the gas in incandescent light bulbs.

DO YOU KNOW?

Now a days nitrogen is used as a substitute for compressed air in tyres. Have you noticed it? Why do people prefer nitrogen instead of compressed air in tyres?

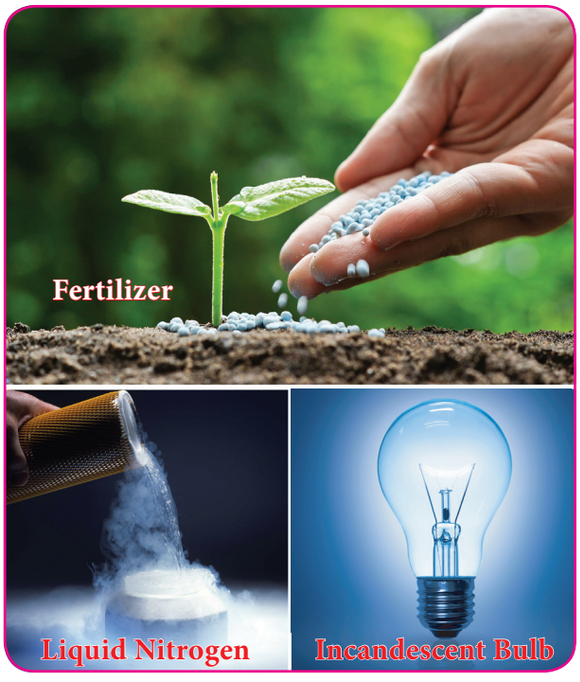

Figure 3.3 Uses of Nitrogen

3.2.5 Nitrogen fixation

Nitrogen gets circulated in the air, soil and living things as the element itself or in the form of its compounds. Just as there is a circulation of carbon in nature so also there is a circulation of nitrogen. It is essential for the proper growth of all plants. The plants cannot make use of the elemental nitrogen from the air as such. The plants require soluble compounds of nitrogen. Thus, plants depend on other processes to supply them with nitrates. Any process that converts nitrogen in the air into a useful nitrogen compound is called nitrogen fixation. Fixation of nitrogen is carried out both naturally and by man.

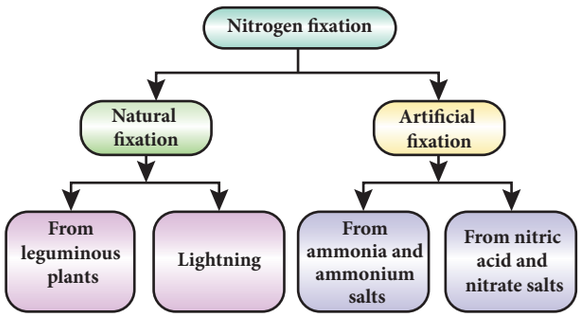

Figure 3.4 Nitrogen fixation in plants

3.3 Carbon dioxide

Carbon dioxide is a chemical compound in which one carbon and two oxygen atoms are bonded together. It is a gas at room temperature. It is represented by the formula CO_2. It is found in the earth's atmosphere and it sends back the solar energy which is reflected by the surface of the earth, to make it possible for living organisms to survive. When carbon dioxide accumulates more in the atmosphere it produces harmful effects.

3.3.1 Occurrence of Carbon dioxide

Carbon dioxide is present in air to the extent of about 0.03% in volume. It is evolved by the plants and animals during respiration and is produced during fermentation reactions. Much of the naturally occurring CO_2 is emitted from the magma through volcanoes. CO_2 may also originate from the bio degradation of oil and gases. Human CO_2 emissions upset the natural balance of the carbon cycle. Man-made CO_2 in the atmosphere has increased global temperatures which is warming the planet. While CO_2 derived from fossil-fuel is a very small component of the global carbon cycle, the extra CO_2 is cumulative because the natural carbon exchange cannot absorb all the additional CO_2.

3.3.2 Physical properties of Carbon dioxide

- Carbon dioxide is a colourless and odourless gas.
- It is heavier than air.
- It does not support combustion.
- It is fairly soluble in water and turns blue litmus slightly red. So it is acidic in nature.
- It can easily be liquified under high pressure and can also be solidified. This solid form of CO_2 is called dry ice which undergoes sublimation.

The process of conversion of solid into vapour without reaching liquid state is called sublimation.

3.3.3 Chemical properties of Carbon dioxide

1. Combustibility

It is non-combustible and not a supporter of combustion.

2. Reaction with metals

Lighter metals like sodium, potassium and calcium, combine with CO_2 to form corresponding carbonates whereas magnesium gives its oxide and carbon.

Example

$$4Na + 3CO_2 \longrightarrow 2Na_2CO_3 + C$$

Sodium — Sodium carbonate

$$2Mg + CO_2 \longrightarrow 2MgO + C$$

Magnesium — Magnesium oxide

3. Reaction with sodium hydroxide (Alkali)

Sodium hydroxide (base) is neutralized by carbon dioxide (acidic) to form sodium carbonate (salt) and water.

Base + Acid $\longrightarrow$ Salt + Water

$$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$$

Sodium carbonate

4. Reaction with Lime water (Calcium hydroxide)

When a limited amount of CO_2 is passed through lime water, it turns milky due to the formation of insoluble calcium carbonate.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

Calcium carbonate

When an excess amount of CO_2 is passed through lime water, it first turns milky and the milkyness disappears due to the formation of soluble calcium hydrogen carbonate, $Ca(HCO_3)_2$.

Venus' atmosphere consists of roughly 96-97% carbon dioxide. Because of the amount of carbon dioxide present, the surface of Venus continually retains heat and as such, the surface temperature of Venus is roughly 462°C, making it the hottest planet in our solar system.

3.3.4 Uses of Carbon dioxide

- CO_2 is used to prepare soft drinks or aerated drinks.
- It is used in fire extinguishers
- It is used in manufacturing sodium carbonate by Solvay process.

- Solid carbon dioxide, called as dry ice is used as a refrigerant. The gas is so cold that moisture in the air condenses on it, creating a dense fog which is used in stage shows and movie effects.
- It is used along with ammonia in the manufacture of fertilizers like urea.
- CO_2 can be used in the preservation of food grains, fruits etc.

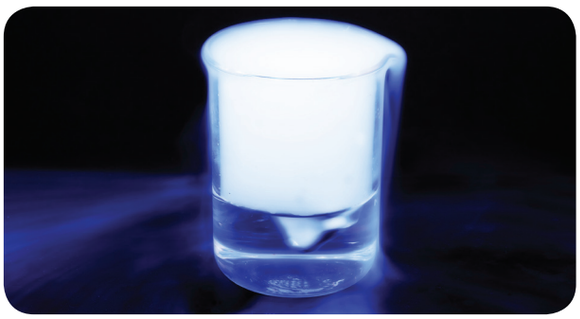

Figure 3.5 Solid carbon dioxide

DO YOU KNOW?

Aerated water is nothing but carbon dioxide dissolved in water under pressure. This is also called 'soda water'.

3.4 Green House Effect and Global Warming

The solar radiation is absorbed by the surface of land and ocean. In turn, they release infra red radiation or heat into the atmosphere. Certain gaseous molecules present in the atmosphere absorb the infra red rays and reradiate the heat in all directions. Hence, these gases maintain the temperature of earth's surface. The gases which absorb these radiations are called **green house gases** and this effect is called **green house effect**.

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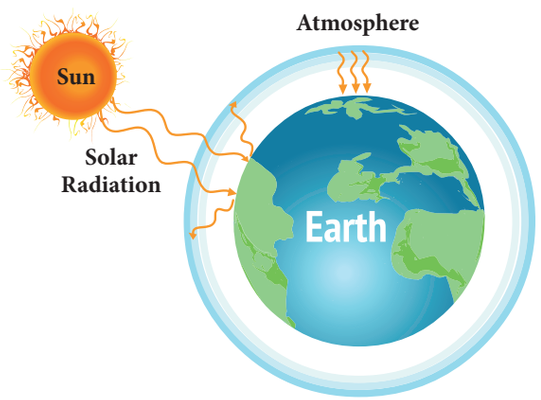


Figure 3.6 Greenhouse effect

The green house gases are CO_2, N_2O, CH_4, CFC (Chlorofluoro carbon) etc. The increase in the levels of these gases results in the gradual increase of temperature of the earth's surface. This increased green house effect is caused due to increase in the air pollutants and it results in the average increase of temperature of the atmosphere. This is called as **Global warming**.

3.4.1 Effects of Global warming

The following are the effects of global warming.

- Melting of ice cap and glaciers.
- Increase in frequency of floods, soil erosion and unseasonal rains.
- Loss of biodiversity due to the extinction of coral reefs and other key species.
- Spreading of waterborne and insectborne diseases.

3.4.2 Preventive measures

In order to save the earth and its resources we need to take certain measures. Some of the measures are given below.

- Reduction in the use of fossil fuels.
- Controlling deforestation.
- Restricting the use of CFCs.
- Planting more trees.
- Reducing, reusing and recycling resources.

3.5 Acid rain

Rain water is actually the purest form of water. However, pollutants such as oxides of nitrogen and sulphur in the air released by factories, burning fossil fuels, eruption of volcanoes etc., dissolve in rain water and form nitric acid and sulphuric acid which adds up to the acidity of rain water. Hence, it results in acid rain.

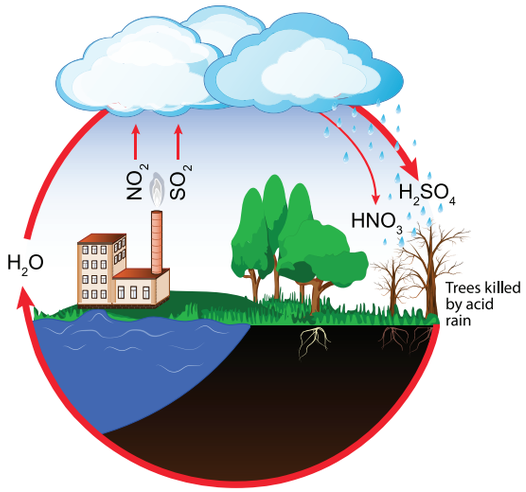


Figure 3.7 Acid rain

DO YOU KNOW?

Acid rain has pH less than 5.6 whereas pH of pure rain water is around 5.6 due to dissolution of atmospheric CO_2 in it.

3.5.1 Effects of Acid rain

Acid rain affects us in many ways. Some of the consequences are given below.

- It irritates eyes and skin of human beings.
- It inhibits germination and growth of seedlings.
- It changes the fertility of the soil, destroys plants and aquatic life.
- It causes corrosion of many buildings, bridges, etc.

3.5.2 Preventive measures

Acid rain and its effects can be controlled by the following ways.

- Minimizing the usage of fossil fuel such as petrol, diesel etc.,
- Using CNG (**C**ompressed **N**atural **G**as).
- Using non-conventional source of energy.
- Proper disposal of the industrial wastes.

Points to Remember

- Oxygen exists in nature as silicates, carbonates, oxides and water. It also exists in free state as part of air in the atmosphere.
- Oxygen is a colourless and odourless gas; it dissolves sparingly in water; it is denser than air.
- Metals like magnesium, iron and sodium burn in oxygen and give basic oxides.
- Bacteria convert atmospheric nitrogen directly into soluble nitrogen compounds.
- Though nitrogen is inactive at ordinary condition, it combines with many elements at high temperature and pressure or in the presence of catalyst.
- Carbon dioxide cannot exist as a liquid at atmospheric pressure. It occurs as carbonates in nature.
- Carbon dioxide is acidic in nature and turns lime water milky. It is used in fire extinguisher.
- Global warming refers to an average increase in the temperature of the atmosphere or simply it is the warming of the earth.
- The green house gases are carbon dioxide, methane, nitrous oxide, chlorofluoro carbons, etc.

A-Z GLOSSARY

Atmosphere	Gaseous jacket that surrounds the earth.
Fixation of nitrogen	Process that converts nitrogen in the air into a nitrogen compounds.
Global warming	An average increase in the temperature of the atmosphere.
Green House Effect	Trapping of radiation from the sun by green house gases in the atmosphere that leads to rise in the earth's atmospheric temperature.
Haber's process	Synthesis of ammonia from nitrogen and hydrogen with the help of catalyst under 500 atm pressure and 550°C temperature.

Oxygenes	A Greek word meaning 'acid producers' from which the name 'Oxygen' is derived.
Soda water	Water produced when carbon dioxide is dissolved in water under pressure.
Sublimation	Process of conversion of solid directly to vapour without reaching liquid state.

TEXT BOOK EXERCISES

Z3N6F8

I. Choose the best answer.

1. Which of the following is true about oxygen?
   a) Completely burning gas
   b) Partially burning gas
   c) Doesn't support burning
   d) Supports burning
2. Aerated water contains
   a) air b) oxygen
   c) carbon dioxide d) nitrogen
3. Solvay process is a method to manufacture
   a) lime water b) aerated water
   c) distilled water d) sodium carbonate
4. Carbon dioxide with water changes
   a) blue litmus to red
   b) red litmus to blue
   c) blue litmus to yellow
   d) doesn't react with litmus
5. Which of the following is known as azote?
   a) Oxygen b) Nitrogen
   c) Sulpher d) Carbon dioxide

II. Fill in the blanks.

1. _____ is called as vital life.
2. Nitrogen is _____ than air.
3. _____ is used as a fertilizer.
4. Dry ice is used as a _____.
5. The process of conversion of iron into hydrated form of oxides is called _____.

III. Match the following.

1. Nitrogen	-	Respiration in living animals
2. Oxygen	-	Fertilizer
3. Carbon dioxide	-	Refrigerator
4. Dry ice	-	Fire extinguisher

IV. Answer briefly.

1. What are the sources of oxygen?.
2. Mention the physical properties of oxygen.
3. List out the uses of nitrogen.
4. Write about the reaction of nitrogen with non metals.
5. What is global warming?
6. What is dry ice? What are its uses?

V. Answer in detail.

1. What happens when carbon dioxide is passed through lime water? Write the equation for this reaction.
2. Name the compounds produced when the following substances burn in oxygen.
   a) Carbon b) Sulphur
   c) Phosphorous d) Magnesium
   e) Iron f) Sodium
3. How does carbon dioxide react with the following?
   a) Potassium b) Lime water
   c) Sodium hydroxide
4. What are the effects of acid rain? How can we prevent them?

VI. Higher Order Thinking Questions.

1. Soda bottle bursts sometimes when it is opened during summer. Why?
2. It is said that sleeping beneath the tree during night is bad for health. What is the reason?
3. Why does the fish die when it is taken out of water?
4. How do astronauts breathe when they go beyond earth's atmosphere?

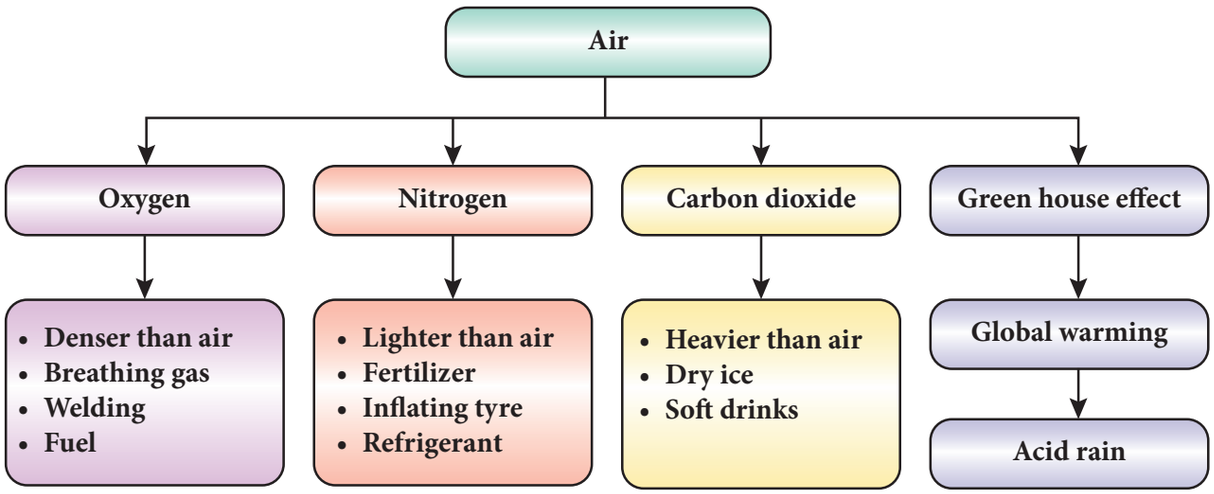
REFERENCE BOOKS

1. Environmental Science - Timothy O Riordan Second edition
2. Basic of atmospheric science - A. chandrasekar
3. Text book of Air pollution and its control - S.C. Bhatia

INTERNET RESOURCES

www.chemicool.com
www.nationgeographic.com
www.environmentalpollutioncenters.org

CONCEPT MAP



ICT CORNER

AIR

Through this activity you will know about carbon emission, climate change, global average temperature etc.

Step 1

- Open the Browser and type the URL given below.
- Click onany one of the items to know about carbon emission, climate change, global average temperature, sea level etc.
- For example, click on the "**Climate Time Machine**" a popup screen will open. In that you can able to see carbon emission global average sea level, temperature, sea ice etc.
- When you click global average sea level, you will find year wise sea level.

B359_8_SCIENCE_EM

Browse in the link: https://climatekids.nasa.gov/menu/play/

UNIT 4

ATOMIC STRUCTURE

Learning Objectives

N9B5H7

After completing this lesson, students will be able to:

- understand the advantages and limitations of Dalton's atomic theory.
- distinguish the fundamental particles and their properties.
- get an idea about Thomson's atom model and its limitations.
- calculate the valency of different elements.
- write the chemical formula and molecular formula of compounds.
- balance the chemical equations.
- state the laws of chemical combinations.

Introduction

Every substance in our surrounding is made up of unique elements. There are 118 elements identified worldwide so far. Out of these elements, 92 elements occur in the nature and the remaining elements are synthesised in the laboratories. Copper, Iron, Gold and Silver are some of the elements found in the nature. Elements like Technetium, Promethium, Neptunium and Plutonium are synthesised in the labaratories. Each element is made up of similar, minute particles called atoms. For example, the element gold is made up of similar atoms which determine its characteristics. The word atom is derived from the Greek word **atomas**. **Tomas** means smallest divisible particle and atomas means smallest indivisible particle. Ancient philosophers like Democritus have spoken about atoms. Even our Tamil poet Avvaiyar has mentioned about atoms in her poem while describing Thirukkural (அணுவைத் துளைத்து ஏழ் கடலைப்புகட்டிக் குறுகத் தரித்த குறள்). But, none of them have scientific base. The first scientific theory about atom was given by John Dalton. Followed by him, J.J.Thomson and Rutherford have given their theory about atom. In this lesson, we will study how atomic theories evolved at different times. We will also study about valency, molecular formula, rules for naming chemical compounds and balancing chemical equations.

4.1 Dalton's Atomic Theory

John Dalton provided a basic theory about the nature of matter. He proposed a model of atom known as Dalton's atomic theory in 1808 based on his experiments. The main postulates of Dalton's atomic theory are:

- All the matters are made up of extremely small particles called atoms (Greek philosopher Democritus used the same name for the smallest indivisible particles).
- Atoms of the same element are identical in all respects (size, shape, mass and properties).

- Atoms of different elements have different sizes and masses and possess different properties.
- Atoms can neither be created nor be destroyed. i.e., atom is indestructible.
- Atoms of different elements may combine with each other in a fixed simple ratio to form molecules or compounds.
- An atom is the smallest particle of matter that takes part in a chemical reaction.

DO YOU KNOW?

John Dalton, son of a poor weaver, began his career as a village school teacher at the age of 12. He became the principal of the school seven years later. In 1793, he moved to Manchester to teach Physics, Chemistry and Mathematics in a college. He proposed his atomic theory in 1803. He carefully recorded each day, the temperature, pressure and amount of rainfall from his youth till the end. He was a meticulous meteorologist.

4.1.1 Advantages of Dalton's Atomic Theory

- Dalton's theory explains most of the properties of gases and liquids.
- This explains the laws of chemical combination and the law of conservation of mass.
- This theory helps to recognize the molecular differences of elements and compounds.

4.1.2 Limitations of Dalton's Atomic Theory

- Atom is no longer considered as the smallest indivisible particle.
- Atoms of the same element have different masses (Isotopes).
- Atoms of the different elements may have same masses (Isobars).
- Substances made up of same kind of atoms may have different properties (Ex. Coal, Graphite and Diamond are made up of carbon atoms but they differ in their properties).

4.2 Fundamental Particles

In 1878, Sir William Crookes, while conducting an experiment using a discharge tube, found certain visible rays travelling between two metal electrodes. These rays are known as Crookes' Rays or Cathode Rays. The discharge tube used in the experiment is now referred as Crookes tube or more popularly as Cathode Ray Tube **(CRT)**.

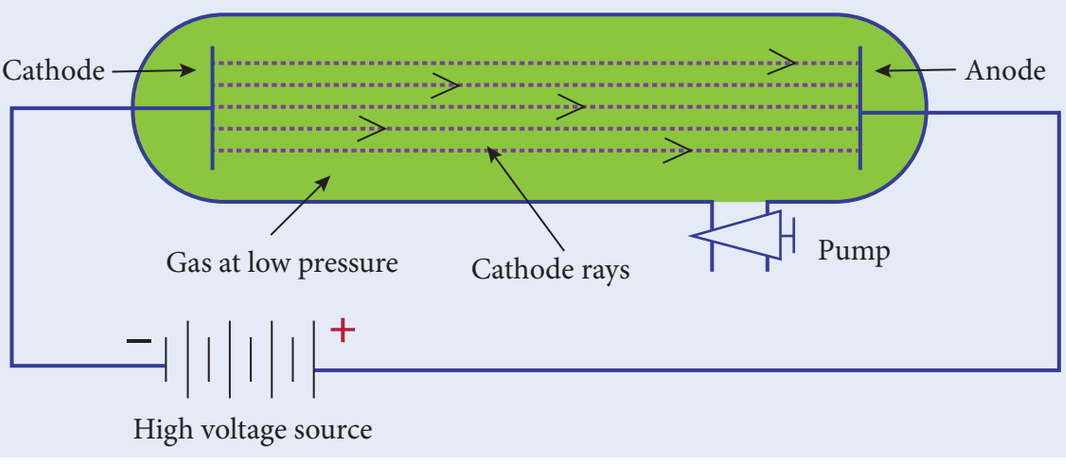


Figure 4.1 Cathode Ray Tube

Cathode Ray Tube is a long glass tube filled with gas and sealed at both the ends. It consists of two metal plates (which act as electrodes) connected with high voltage. The electrode which is connected to the negative terminal of the battery is called the cathode (negative electrode). The electrode connected to the positive terminal is called the anode (positive electrode). There is a side tube which is connected to a pump. The pump is used to lower the pressure inside the discharge tube.

DO YOU KNOW?

Electricity, when passes through air, removes the electrons from the gaseous atoms and produces ions. This is called electrical discharge.

4.2.1 Discovery of Electrons

When a high electric voltage of 10,000 volts or more is applied to the electrode of a discharge tube containing air or any gas at atmospheric pressure, no electricity flows through the air. However, when the high voltage of 10,000 volts is applied to the electrodes of discharge tube containing air or any gas at a very low pressure of about 0.001 mm of mercury, a greenish glow is observed on the walls of the discharge tube behind anode. This observations clearly show some invisible ray coming from the cathode. Hence, these rays are called cathode rays. Later, they were named as **electrons**.

DO YOU KNOW?

The fact that air is a poor conductor of electricity is a blessing in disguise for us. Imagine what would happen if air had been a good conductor of electricity. All of us would have got electrocuted, when a minor spark was produced by accident.

Properties of Cathode rays

- Cathode rays travel in straight line from cathode towards anode.
- Cathode rays are made up of material particles which have mass and kinetic energy.
- Cathode rays are deflected by both electric and magnetic fields. They are negatively charged particles.
- The nature of the cathode rays does not depend on the nature of the gas filled inside the tube or the cathode used.

DO YOU KNOW?

In television tube cathode rays are deflected by magnetic fields. A beam of cathode rays is directed toward a coated screen on the front of the tube, where by varying the magnet field generated by electromagnetic coils, the beam traces a luminescent image.

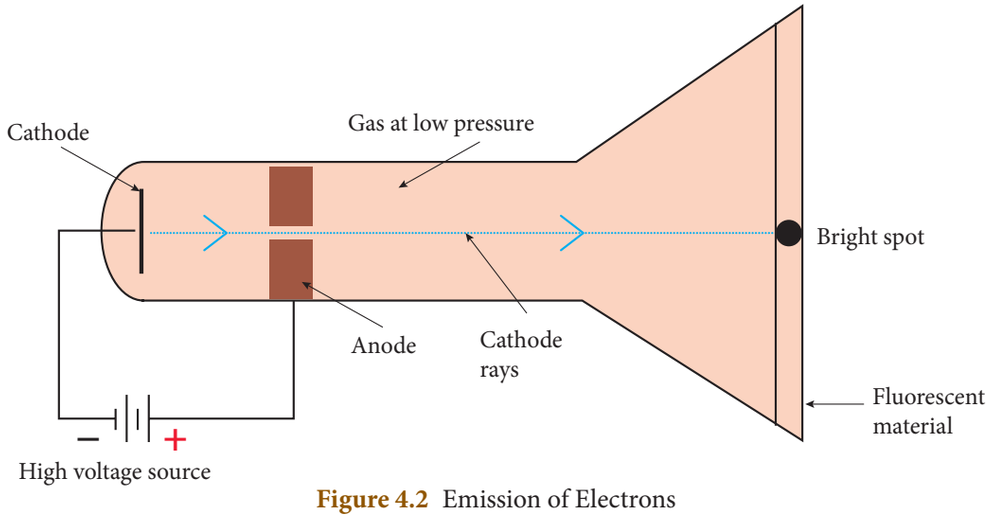


Figure 4.2 Emission of Electrons

4.2.2 Discovery of Protons

The presence of positively charged particles in the atom has been precisely predicted by Goldstein based on the conception that the atom being electrically neutral in nature, should necessarily possess positively charged particles to balance the negatively charged electrons.

Goldstein repeated the cathode ray experiment by using a perforated cathode. On applying a high voltage under low pressure, he observed a faint red glow on the wall behind the cathode. Since these rays originated from the anode, they were called anode rays or canal rays or positive rays. Anode rays were found as a stream of positively charged particles.

DO YOU KNOW?

When invisible radiation falls on materials like zinc sulphide, they emit a visible light (or glow). These materials are called fluorescent materials.

Properties of Anode rays

- Anode rays travel in straight lines.
- Anode rays are made up of material particles.
- Anode rays are deflected by electric and magnetic fields. Since, they are deflected towards the negatively charged plate, they consist of positively charged particles.
- The properties of anode rays depend upon the nature of the gas taken inside in the discharge tube.
- The mass of the particle is the same as the atomic mass of the gas taken inside the discharge tube.

DO YOU KNOW?

When hydrogen gas was taken in a discharge tube, the positively charged particles obtained from the hydrogen gas were called protons. Each of these protons are produced when one electron is removed from one hydrogen atom. Thus, a proton can be defined as an hydrogen ion (H^+).

$$H \rightarrow H^+ + e$$

4.2.3 Discovery of Neutrons

At the time of J.J.Thomson, only two fundamental particles (proton and electron) were known. In the year 1932, James Chadwick discovered another fundamental particle, called neutron. But, the proper position of these particles in an atom was not clear till Rutherford described the structure of atom. You will study about Rutherford's atom model in your higher classes.

Properties of Neutrons

- Neutron is a neutral particle, that is, it carries no charge.
- It has mass equal to that of a proton, that is 1.6×10^{-24} grams.

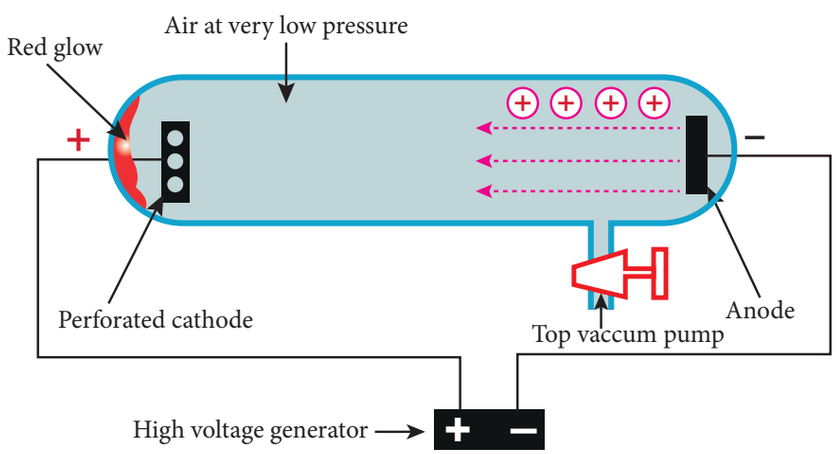


Figure 4.3 Emission of Protons

Table 4.1 Properties of Fundamental particles.

Particle	Mass	Relative charge
Electron (e)	9.1×10^{-28} grams	–1
Proton (p)	1.6×10^{-24} grams	+1
Neutron (n)	1.6×10^{-24} grams	0

Activity 1

Collect more information about the properties of fundamental particles and prepare a chart.

4.3 Thomson's Atom Model

J.J. Thomson, an English scientist, proposed the famous atom model in the year 1904, just after the discovery of electrons.

Thomson proposed that the shape of an atom resembles a sphere having a radius of the order of 10^{-10} m. The positively charged particles are uniformly distributed with electrons arranged in such a manner that the atom is electrically neutral. Thomson's atom model was also called as the plum pudding model or the watermelon model. The embedded electrons resembled the seed of watermelon while the watermelon's red mass represented the positive charge distribution. The plum pudding atomic theory assumed that the mass of an atom is uniformly distributed all over the atom.

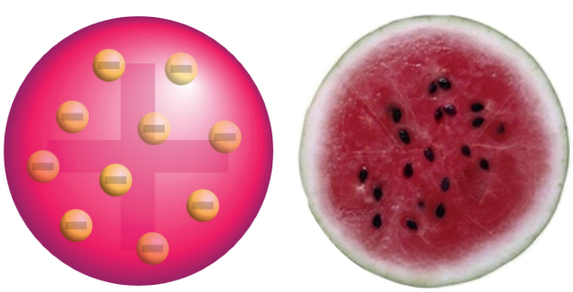


Figure 4.4 Thomson's Atom model

4.3.1 Limitations of Thomson's Atom model

Thomson's atom model could successfully explain the electrical neutrality of atom. However, it failed to explain the following.

1. Thomson's model failed to explain how the positively charged sphere is shielded from the negatively charged electrons without getting neutralised.
2. This theory explains only about the protons and electrons and failed to explain the presence of neutral particle neutron.

4.4 Valency

In order to understand valency of elements clearly, we need to learn a little about Rutherford's atom model here. According to Rutherford, an atom consists of subatomic particles namely, proton, electron and neutrons. Protons and neutrons are found at the centre of an atom, called nucleus. Electrons are revolving around the nucleus in a circular path, called orbits or shells. An atom has a number of orbits and each orbit has electrons. The electrons revolving in the outermost orbit are called valence electrons.

The arrangement of electrons in the orbits is known as electronic configuration. Atoms of all the elements will tend to have a stable electronic configuration, that is, they will tend to have either two electrons (known as duplet)

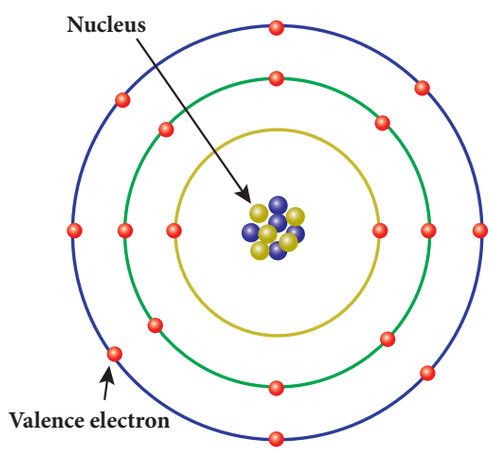


Figure 4.5 Arrangement of electrons in atom

or eight electrons (known as octet) in their outermost orbit. For example, helium has two electrons in the outermost orbit and so it is chemically inert. Similarly, neon is chemically inert because, it has eight electrons in the outermost orbit.

The valence electrons in an atom readily participate in a chemical reaction and so the chemical properties of an element are determined by these electrons. When molecules are formed, atoms combine together in a fixed proportion because each atom has different combining capacity. This combining capacity of an atom is called valency. Valency is defined as the number of electrons lost, gained or shared by an atom in a chemical combination so that it becomes chemically inert.

4.4.1 Types of Valency

As we saw earlier, an atom will either gain or lose electrons in order to attain the stable electronic configuration. In order to understand valency in a better way, it can be explained in two ways depending on whether an atom gains or losses electrons.

Atoms of all metals will have 1 to 3 electrons in their outermost orbit. By loosing these electrons they will have stable electronic configuration. So, they lose them to other atoms in a chemical reaction and become positively charged. Such atoms which donate electrons are said to have positive valency. For example, sodium atom (Atomic number: 11) has one electron in its outermost orbit and in order to have stability it loses one electron and becomes positively charged. Thus, sodium has positive valency.

All non-metals will have 4 to 7 electrons in the outermost orbit of their atoms. In order to attain stable electronic configuration, they need few electrons. They accept these electrons from other atoms in a chemical reaction and become negatively charged. These atoms which accept electrons are said to have negative valency. For example, chlorine atom (Atomic number: 17) has seven electrons in its outermost orbit. By gaining one electron it attains stable electronic configuration. Thus, chlorine has negative valency.

4.4.2 Valency with respect to atoms

Valency of an element is also determined with respect to other atoms. Generally, valency of an atom is determined with respect to hydrogen, oxygen and chlorine.

a. Valency with respect to Hydrogen

Since hydrogen atom loses one elctron in its outermost orbit, its valency is taken as one and it is selected as the standard. Valencies of the other elements are expressed in terms of hydrogen. Thus, valency of an element can also be defined as the number of hydrogen atoms which combine with one atom of it. In hydrogen chloride molecule, one hydrogen atom combines with one chlorine atom. Thus, the valency of chlorine is one. Similarly, in water molecule, two hydrogen atoms combine with one oxygen atom. So, valency of oxygen is two.

Since some of the elements do not combine with hydrogen, the valency of the element is also defined in terms of other elements like chlorine or oxygen. This is because almost all the elements combine with chlorine and oxygen.

Table 4.2 Valency of atoms

Molecule	Element	Valency
Hydrogen chloride (HCl)	Chlorine	1
Water (H_2O)	Oxygen	2
Ammonia (NH_3)	Nitrogen	3
Methane (CH_4)	Carbon	4

b. Valency with respect to Chlorine

Since valency of chlorine is one, the number of chlorine atoms with which one

atom of an element can combine is called valency. In sodium chloride (NaCl) molecule, one chlorine atom combines with one sodium atom. So, the valency of sodium is one. But, in magnesium chloride ($MgCl_2$) valency of magnesium is two because it combines with two chlorine atoms.

c. Valency with respect to oxygen

In another way, valency can be defined as double the number of oxygen atoms with which one atom of an element can combine because valency of oxygen is two. For example, in magnesium oxide (MgO) valency of magnesium is two.

4.4.3 Variable Valency

Atoms of some elements combine with atoms of other elements and form more than one product. Thus, they are said to have different combining capacity. These atoms have more than one valency. Some cations exhibit more than one valency. For example, copper combines with oxygen and forms two products namely cuprous oxide (Cu_2O) and cupric oxide (CuO). In Cu_2O, valency of copper is one and in CuO valency of copper is two. For lower valency a suffix –ous is attached at the end of the name of the metal. For higher valency a suffix –ic is attached at the end of the name of the metal. Sometimes Roman numeral such as I, II, III, IV etc. indicated in parenthesis followed by the name of the metal can also be used.

Table 4.3 Metals with variable valencies

Element	Cation	Names
Copper	Cu^{+}	Cuprous (or) Copper (I)
	Cu^{2+}	Cupric (or) Copper (II)
Iron	Fe^{2+}	Ferrous (or) Iron (II)
	Fe^{3+}	Ferric (or) Iron (III)
Mercury	Hg^{+}	Mercurous (or) Mercury (I)
	Hg^{2+}	Mercuric (or) Mercury (II)
Tin	Sn^{2+}	Stannous (or) Tin (II)
	Sn^{4+}	Stannic (or) Tin (IV)

4.5 Ions

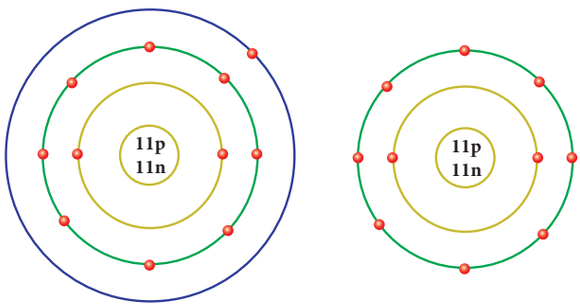
In an atom, the number of protons is equal to the number of electrons and so the atom is electrically neutral. But, during chemical reactions unstable atoms try to attain stable electronic configuration (duplet or octet) either by gaining or losing one or more electrons. When an atom gains an electron it has more number of electrons and thus it carries negative charge. At the same time when an atom loses an electron it has more number of protons and thus it carries positive charge. These atoms which carry positive or negative charges are called ions. The number of electrons gained or lost by an atom is shown as a superscript to the right of its symbol. When an atom loses an electron, '+' sign is shown in the superscript and '–' sign is shown if an electron is gained by an atom. Some times, two or more atoms of different elements collectively lose or gain electrons to acquire positive or negative charge. Thus we can say, an atom or a group of atoms when they either lose or gain electrons, get converted into ions or radicals

4.5.1 Types of Ions

Ions are classified into two types. They are: cations and anions.

Cations

If an atom loses one or more electrons during a chemical reaction, it will have more number of positive charge on it. These are called cations (or) positive radicals. Sodium atom loses one electron to attain stability and it becomes cation. Sodium ion is represented as Na^{+}.



Sodium atom (Na) Sodium ion (Na^{+})

Figure 4.6 Electronic configuration of Sodium

Anions

If an atom gains one or more electrons during a chemical reaction, it will have more number of negative charge on it. These are called anions or negative radicals. Chlorine atom attains stable electronic configuration by gaining an electron. Thus, it becomes anion. Chlorine ion is represented as Cl^-.

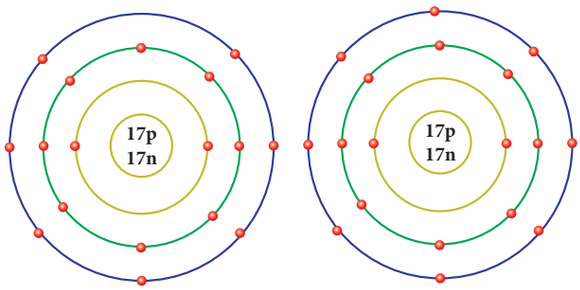


Figure 4.7 Electronic configuration of Chlorine

4.5.2 Different valent ions

During a chemical reaction, an atom may gain or lose more than one electron. An ion or radical is classified as monovalent, divalent, trivalent or tetravalent when the number of charges over it is 1,2,3 or 4 respectively. Based on the charges carried by the ions, they will have different valencies.

Valency of Anions (negative radicals) and Cations (positive radicals)

The valency of an anion or cation is a number which expresses the number of hydrogen atoms or any other monovalent atoms (Na,K,Cl….) which combine with them to give an appropriate compound. For example, two hydrogen atoms combine with one sulphate ions (SO_4^{2-}) to form sulphuric acid (H_2SO_4). So, the valency of SO_4^{2-} is 2. One chlorine atom (Cl) combines with one ammonium ion (NH_4^+) to form NH_4Cl. So, the valency of NH_4^+ is 1. Valencies of some anions and cations and their corresponding compounds are given below.

Table 4.4 Valencies of some anions.

Compound	Name of the anion	Formula of anion	Valency of anion
HCl	Chloride	Cl^-	1
H_2SO_4	Sulphate	SO_4^{2-}	2
HNO_3	Nitrate	NO_3^-	1
H_2CO_3	Carbonate	CO_3^{2-}	2
H_3PO_4	Phosphate	PO_4^{3-}	3
H_2O	Oxide	O^{2-}	2
H_2S	Sulphide	S^{2-}	2
NaOH	hydroxide	OH^-	1

Table 4.5 Valencies of some cations.

Compound	Name of cation	Formula of cation	Valency of cation
NaCl	Sodium	Na^+	1
KCl	Potassium	K^+	1
NH_4Cl	Ammonium	NH_4^+	1
$Mg Cl_2$	Magesium	Mg^{2+}	2
$CaCl_2$	Calcium	Ca^{2+}	2
$Al Cl_3$	Aluminium	Al^{3+}	3

Activity 2

Classify the following ions into monovalent, divalent and trivalent.

Ni^{2+}, Fe^{3+}, Cu^{2+}, Ba^{2+}, Cs^+, Zn^{2+}, Cd^{2+}, Hg^{2+} Pb^{2+}, Mn^{2+}, Fe^{2+}, Co^{2+}, Sr^{2+}, Cr^{3+}, Li^+, Ca^{2+}, Al^{3+}

4.6 Chemical formula or Molecular formula

Chemical formula is the shorthand notation of a molecule of a substance (compound). It shows the actual number of atoms of each element present in a molecule of a substance. Certain steps are followed to write down the chemical formula of a substance. They are given below.

Step1: Write down the symbols of elements/ ions side by side so that the positive

radical is on the left and the negative radical is on the right hand side.

Step2: Write the valencies of the two radicals above their symbols to the right in superscript (Signs '+' and '-' of the ions are omitted).

Step3: Reduce the valencies to simplest ratio if needed. Otherwise interchange the valencies of the elements/ions. Write these numbers as subscripts. However, '1' appearing on the superscript of the symbol is omitted.

Thus, we arrive the chemical formula of the compound.

Let us derive the chemical formula for calcium chloride.

Step 1: Write the symbols of calcium and chlorine side by side.

Ca Cl

Step 2: Write the valencies of calcium and chlorine above their symbols to the right.

Ca^{2} Cl^{1}

Step 3: Interchange the valencies of elements.

Ca Cl^{2}

Thus the chemical formula for calcium chloride is **$CaCl_2$**

Activity 3

Write the chemical formula of the compounds.

Compound	Symbols with valencies	Simplest ratio if any	Chemical formula
Magnesium chlorinde			
Sodium hydroxide			
Calcium oxide			
Aluminium sulphate			
Calcium phosphate			

4.7 Naming chemical compounds

A chemical compound is a substance formed out of more than one element joined together by chemical bond. Such compounds have properties that are unique from that of the elements that formed them. While naming these compounds specific ways are followed. They are given below.

1. In naming a compound containing a metal and a non-metal, the name of the metal is written first and the name of the non-metal is written next after adding the suffix-ide to its name.

   Examples:

   NaCl - Sodium chloride

   Ag Br - Silver bromide

2. In naming a compound containing a metal, a non-metal and oxygen, name of the metal is written first and name of the non-metal with oxygen is written next after adding the suffix- ate (for more atoms of oxygen) or –ite (for less atoms of oxygen) to its name.

   Examples:

   Na_2 SO_4 - Sodium sulphate

   Na NO_2 - Sodium nitrite

3. In naming a compound containing two non-metals only, the prefix mono, di, tri, tetra, penta etc. is written before the name of non- metals.

   Examples:

   SO_2 - Sulphur dioxide

   N_2O_5 - Dinitrogen pentoxide

Activity 4

Write the names of the chemical compounds.

Chemical Compound	Name
SO_3	
Na_2 SO_3	
PCl_5	
$CaCl_2$	
Na NO_3	
BaO	

4.8 Chemical Equation

A chemical equation is a short hand representation of a chemical reaction with the help of chemical symbols and formulae. Every chemical equation has two components: reactants and products. Reactants are the substances that take part in a chemical reaction and the products are the substances that are formed in a chemical reaction.

4.8.1 Steps in writing the skeleton equation

Before writing the balanced equation of a chemical reaction, skeletal equation is written. The following are the steps involved in writing the skeletal equation.

1. Write the symbols and formulae of each of the reactants on the left hand side (LHS) and join them by plus (+) sign.
2. Follow them by an arrow (→) which is interpreted as gives or forms.
3. Write on the right hand side (RHS) of arrow the symbols and formulae for each of the products.
4. The equation thus written is called as skeleton equation (unbalanced equation).
5. If the product is a gas it should be represented by upward arrow (↑) and if it is a precipitate it should be represented by downward arrow(↓).

Example: $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2\uparrow$

4.8.2 Balancing chemical equation

According to law of conservation of mass, the total mass of all the atoms forming the reactants should be equal to that of all the atoms forming the products. This law will hold good only when the number of atoms of all types of elements on both sides is equal. A balanced chemical equation is one in which the total number of atoms of any element on the reactant side is equal to the total number of atoms of that element on the product side.

There are many methods of balancing a chemical equation. Trial and error method (direct inspection), fractional method and odd number-even number method are some of them. While balancing a chemical equation following points are to be borne in mind.

1. Initially the number of times an element occurs on both sides of the skeleton equation should be counted.
2. An element which occurs least number of times in reactant and product side must be balanced first. Then, elements occuring two times, elements occuring three times and so on in an increasing order must be balanced.
3. When two or more elements occur same number of times, the metallic element is balanced first in preference to non-metallic element. If more than one metal or non-metal is present then a metal or non-metal with higher atomic mass (refer periodic table to find the atomic mass) is balanced first.
4. The number of molecules of reactants and products are written as coefficient.
5. The formula should not be changed to make the elements equal.
6. Fractional method of balancing must be employed only for molecule of an element (O_2,H_2,O_3,P_4,…) not for compound (H_2O, NH_3,…)

Now let us balance the equation for the reaction of hydrogen and oxygen which gives water. Write the word equation and balance it.

Step1: Write the word equation.

Hydrogen + Oxygen → Water

Step2: Write the skeleton equation.

$H_2 + O_2 \rightarrow H_2O$

Step3: Select the element which is to be balanced first based on the number of times an element occurs on both sides of the skeleton equation.

Element	H	O
Number of times particular element occurs on both sides	2	2

Step4: In the above case, both elements occur one time each. Here, preference must be given to oxygen because it has higher atomic mass (refer periodic table).

Step5: To balance oxygen, put 2 before H_2O on the right hand side (RHS).

$$H_2 + O_2 \rightarrow 2H_2O$$

Step6: To balance hydrogen, put 2 near hydrogen (H_2) on the left hand side (LHS).

$$2H_2 + O_2 \rightarrow 2H_2O$$

(H = 4 0 = 2) (H = 4 0 = 2)

Now, on both sides number of hydrogen atoms is four and oxygen atoms is two. Thus, the chemical equation is balanced.

4.8.3 Information conveyed by a balanced chemical equation

A balanced chemical equation gives us both qualitative and quantitative information. It gives us qualitative informations such as the names, symbols and formulae of the reactant molecules taking part in the reaction and those of the product molecules formed in the reaction. We also can get quantitative information like the number of molecules/ atoms of the reactants and products that are taking part in the reaction. However, a chemical equation does not convey the following.

i. Physical state of the reactants and the products.
ii. Heat changes (heat liberated or heat absorbed) accompanying the chemical reaction.
iii. Conditions such as temperature, pressure, catalyst etc., under which the reaction takes place.
iv. Concentration (dilute or concentrated) of the reactants and products.
v. Speed of the reaction.

4.9 Laws of chemical combinations

By studying quantitative measurements of many reactions, it was observed that the reactions taking place between various substances are governed by certain laws. They are called as the 'Laws of chemical combinations'. They are given below.

1. Law of conservation of mass
2. Law of constant proportion
3. Law of multiple proportions
4. Gay Lussac's law of gaseous volumes

In this lesson, we will study about the first two laws. You will study about Law of multiple proportions and Gay Lussac's Law of gaseous volumes in standard IX.

4.9.1 Law of conservation of mass

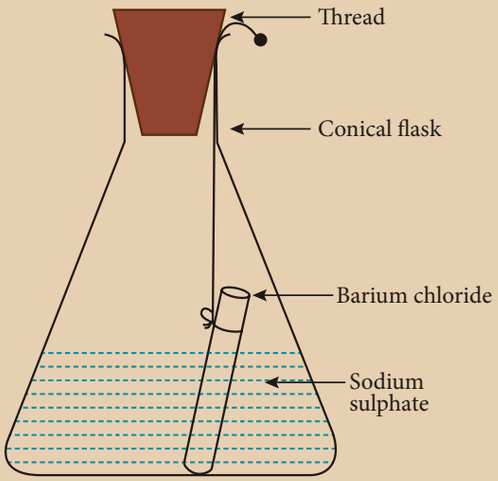
The law of conservation of mass which relates the mass of the reactants and products during the chemical change was stated by a French chemist **Lavoisier** in 1774. It states that **during any chemical change, the total mass of the products is equal to the total mass of the reactants**. In other words the law of conservation of mass means that mass can neither be created nor be destroyed during any chemical reaction. This law is also known as **Law of indestructibility of mass**.

Activity 5

Take some ice cubes in an air tight container and note the weight of the container with ice cubes. Wait for a while for the ice cubes to become water. It is a physical change ie., ice cubes melt and they are converted into liquid. Now weigh the container and compare the weight before and after the melting of ice cubes. It remains the same. Hence it is proved that during a physical change, the total mass of matter remains the same.

Activity 6

Prepare 5% of barium chloride (5g of $BaCl_2$ in 100 ml of water) and sodium sulphate solutions separately. Take some solution of sodium sulphate in a conical flask and some solution of barium chloride in a test tube. Hang the test tube in the conical flask. Weigh the flask with its contents. Now mix the two solutions by tilting and swirling the flask. Weigh the flask after the chemical reaction is occurred. Record your observation. It can be seen that the weight of the flask and the contents remains the same before and after the chemical change. Hence, it is proved that during a chemical change, the total mass of matter remains the same.



Consider the formation of ammonia (Haber's process) from the reaction between nitrogen and hydrogen

$$N_2 + 3H_2 \rightarrow 2NH_3$$

28g 6g 34g

During Haber's process the total mass of the reactant and the product are exactly same throughout the reaction.

Now, it is clear that mass is neither created not destroyed during physical or chemical change. Thus, law of conservation of mass is proved.

4.8.2 Law of constant proportions

Law of constant proportions was proposed by the scientist **Joseph Proust** in 1779. He states that **in a pure chemical compound the elements are always present in definite proportions by mass**. He observed all the compounds with two or more elements and noticed that each of such compounds had the same elements in same proportions, irrespective of where the compound came from or who prepared it. For example, water obtained from different sources like rain, well, sea, and river will always consist of the same two elements hydrogen and oxygen, in the ratio 1:8 by mass. Similarly, the mode of preparation of compounds may be different but their composition will never change. It will be in a fixed ratio. Hence, this law is also known as 'Law of definite proportions'.

Points to Remember

- An atom consists of elementary particles like proton, electron and neutron.
- The discharge tube used in the experiment is now referred as Crookes tube or Cathode Ray Tube **(CRT)**. It is a long glass tube filled with gas and sealed at both the ends.
- Different atoms have different combining capacities. The combining capacity of an atom is known as its **valency**.
- Chemical formula is the shorthand notation of a molecule of a substance (compound). It shows the actual number of atoms of each element in a molecule of a substance.
- In naming a compound containing a metal and a non-metal, the name of the metal is written first and the name of the non-metal is obtained by adding the suffix-ide to its name.
- Balancing chemical equation is necessary, so that law of conservation of mass may be obeyed.
- The law of conservation of mass states that during any chemical change, the total mass of the products is equal to the total mass of the reactants.

GLOSSARY

Anode	The positively charged electrode or an electron acceptor.
Cathode	The negatively charged electrode or an electron donor.
Chemical formula	It is a representation of a substance using symbols for its constituent elements.
Discharge tube	A tube containing charged electrodes and filled with a gas in which ionisation is induced by an electric field.
Ion	An atom or molecule with a net electric charge due to the loss or gain of one or more electrons.
Molecular formula	It is a formula giving the number of atoms of each of the elements present in one molecule of a specific compound.
Precipitate	An insoluble solid that emerges from a liquid solution.
Product	A substance that is formed as the result of a chemical reaction.
Reactant	A substance that takes part in and undergoes change during a reaction.
Valency	The combining power of an element, especially as measured by the number of hydrogen atoms it can displace or combine with.

J1D1C7

TEXT BOOK EXERCISES

1. Choose the best answer.

1. The same proportion of carbon and oxygen in the carbon dioxide obtained from different sources proves the law of _____
   a) reciprocal proportion
   b) definite proportion
   c) multiple proportion
   d) conservation of mass
2. Cathode rays are made up of
   a) neutral particles
   b) positively charged particles
   c) negatively charged particles
   d) None of the above
3. In water, hydrogen and oxygen are combined in the ratio of _____by mass.
   a) 1:8 b) 8:1 c) 2:3 d) 1:3
4. Which of the following statements made by Dalton has not undergone any change?
   a) Atoms cannot be broken.
   b) Atoms combine in small, whole numbers to form compounds.
   c) Elements are made up of atoms.
   d) All atoms of an elements are alike
5. In all atoms of an element
   a) the atomic and the mass number are same.
   b) the mass number is same and the atomic number is different.
   c) the atomic number is same and the mass number is different
   d) both atomic and mass numbers may vary.

II. Fill in the blanks.

1. _____ is the smallest particle of an element.

2. An element is composed of _____ atoms.
3. An atom is made up of _____, _____ and _____.
4. A negatively charged ion is called _____, while positively charged ion is called _____
5. _____ is a negatively charged particle (Electron/Proton).
6. Proton is deflected towards the _____ charged plate (positively, negatively).

III. Match the following.

1.	Law of conservation of mass	-	Sir William Crookes
2.	Law of constant proportion	-	James Chadwick
3.	Cathode rays	-	Joseph Proust
4.	Anode rays	-	Lavoisier
5.	Neutrons	-	Goldstein

IV. Answer briefly.

1. State the law of conservation of mass.
2. State the law of constant proportions.
3. Write the properties of anode rays.
4. Define valency of an element with respect to hydrogen.
5. Define the term ions or radicals.
6. What is a chemical equation?
7. Write the names of the following compounds.

   a) CO b) N_2O c) NO_2 d) PCl_5

V. Answer the following.

1. Find the valency of the element which is underlined in the following formula.

   a) $\underline{Na}Cl$ b) $\underline{C}O_2$ c) $\underline{Al}(PO_4)$

   d) $\underline{Ba}(NO_3)_2$ e) $\underline{Ca}Cl_2$

2. Write the chemical formula for the following compounds

   a) Aluminium sulphate b) Silver nitrate

   c) Magnesium oxide d) Barium chloride
3. Write the skeleton equation for the following word equation and then balance them.

a) Carbon + Oxygen → Carbon dioxide

b) Phosphorus + Chlorine → Phosphorus pentachloride.

c) Sulphur + Oxygen → Sulphur dioxide

d) Magnesium + hydrogen chloride → Magnesium chloride + Hydrogen

4. Balance the following chemical equation.

   a) $Na + O_2 \rightarrow Na_2O$

   b) $Ca + N_2 \rightarrow Ca_3N_2$

   c) $N_2 + H_2 \rightarrow NH_3$

   d) $CaCO_3 + HCl \rightarrow CaCl_2 + CO_2 + H_2O$

   e) $Pb(NO_3)_2 \rightarrow PbO + NO_2 + O_2$

VI. Higher Order Thinking Questions.

1. Why does a light paddle wheel placed in the path of cathode rays begin to rotate, when cathode rays fall on it?
2. How can we prove that the electrons carry negative charge?
3. Ruthresh, Hari, Kanishka and Thahera collected different samples of water from a well, a pond, a river and underground water. All these samples were sent to a testing laboratory. The test result showed the ratio of hydrogen to oxygen as 1:8.

   a) What conclusion would you draw from the above experiment?

   b) Which law of chemical combination does it obey?

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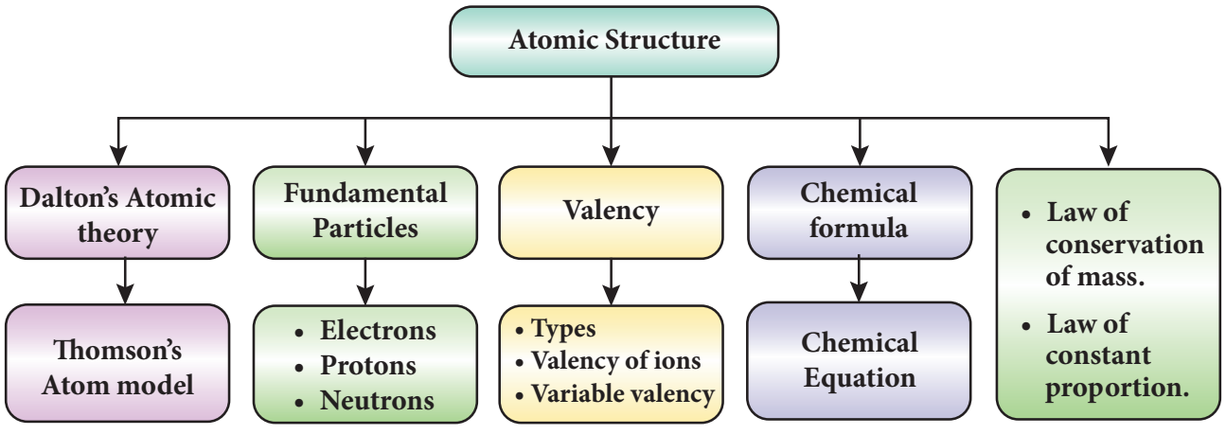
INTERNET RESOURCES

1. https://www.chem4kids.com
2. https://courses.lumenlearning.com/boundless-chemistry/chapter/the-structure-of-the-atom/
3. https://www.khanacademy.org/science/biology/chemistry--of-life/elements-and-atoms/e/atomic-structure

Concept Map



ICT CORNER — ATOMIC STRUCTURE

Through this activity you will learn the atomic structure through Interactive games

Step 1

- Open the Browser and type the URL given below.
- You can see Protons Neutrons and Electrons Atom games.
- Click the first game, you will see the periodic table. Start the quiz and answer it.
- Likewise explore the next game and play it.

B359_8_SCIENCE_EM

URL: https://www.wartgames.com/themes/science/atomicstructure.html

UNIT 5

MOVEMENTS

Learning Objectives

I6K7B7

After completing this lesson, students will be able to:

- know about the movements of different animals.
- differentiate between movement and locomotion.
- recall the types of movements.
- know about human body and its movements.
- summarise the significance and types of joints.
- identify the components of the skeleton.
- understand muscle movements and its types.

Introduction

There are so many movements that happen in our bodies. Sit absolutely still and observe the movements taking place in your body. You must be blinking your eyes from time to time. There will be movements in your body as you breathe. Different parts of your body move while you remain at the same place. There are different ways how animals move from place to place. For example, a cow uses its legs to walk, a snake uses its whole body to slither or crawl, a bird uses its wings to fly, a fish uses its fins to swim and human uses legs to walk. Walking, crawling, flying and swimming - these are only few ways in which animals move from one place to another. Let us learn in detail how these movements take place.

5.1 Movement and Locomotion

Although both movement and locomotion sound similar in their meaning, there are few interesting differences between the two terms. Movement is generally defined "*as the act of changing the place or position by one or more parts of the body*". Movement helps to perform necessary functions such as pumping of blood to different parts of the body in an organism. Movement can be both **voluntary** and **involuntary**. For example, walking is a voluntary movement, while breathing is an involuntary movement.

The movement of an organism from one place to another is known as locomotion. Locomotion helps an organism to find food, avoid harsh weather conditions, escape from their predator etc. Walking, running and swimming are few examples for different types of locomotion. In this process, there is the action of appendages such as limbs, wings, flagella and cilia. In most of the aquatic animals such as fish, whales, and shark, the locomotion results from a series of wave-like muscle contractions. Table 5.1 gives the differences between locomotion and movement.

Table 5.1 Locomotion and Movement.

Locomotion	Movement
Locomotion is the movement of an organism from one place to another.	Movement is the act of changing the place or position by one or more parts of the body.
It is always voluntary.	It can either be voluntary or involuntary.
Locomotion takes place at the organism level.	A movement takes place at the biological level.
Locomotion doesn't necessarily require energy.	Movement requires energy.

5.2 Movement in different Animals

Movement is one of the significant features of living beings. This is the basic mechanism used in majority of the vertebrates including human. Animals exhibit a wide range of movements. In this part let us study about movements in different animals.

5.2.1 Earthworm

The body of earthworm is made up of many rings joined end to end. It has muscles which help to extend and shorten the body. Under its body it has large number of bristles called setae which are connected with muscles. These bristles help to get grip on the ground. During movement, the earthworm first extends the front part of the body, keeping

Activity 1

Observe an earthworm moving on soil in the garden. Gently lift it and place it on a piece of blotting or filter paper. Observe its movement now. In which of the above two surfaces do you find that the earthworm is able to move easily?

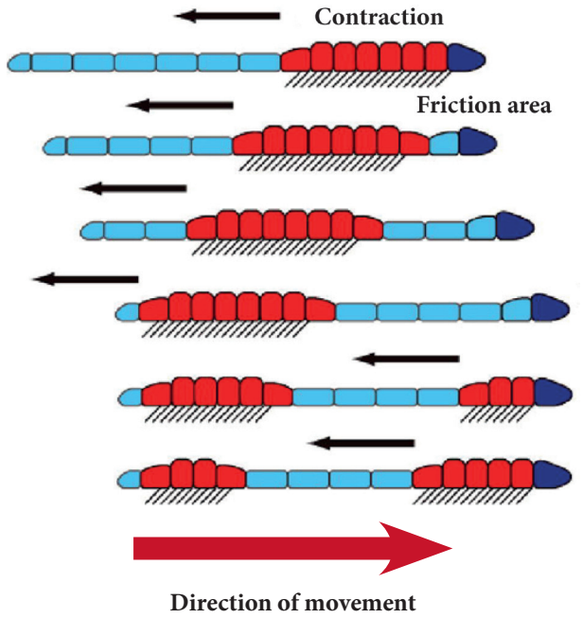


Figure 5.1 Movements in Earthworm

the rear portion fixed to the ground. Then it fixes the front end and releases the rear end. It then shortens the body and pulls the rear end forward. This makes it move forward by small distances. Repeating such muscle contraction and relaxation the earthworm can move through soil. A slimy substance secreted by its body helps this movement.

5.2.2 Cockroach

A cockroach has three pairs of jointed legs, which help it to walk, run and climb. It also has two pairs of wings for flying. Large and strong muscles help in the movement of legs. The body is covered by chitin, a light protective material. Chitin is shed regularly so that the body can grow.

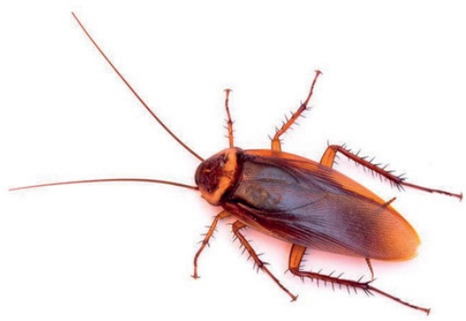


Figure 5.2 Cockroach

Activity 2

Observe a cockroach and identify its legs and wings. Try to know more about other parts of cockroach with the help of your teacher.

5.2.3 Birds

Birds can walk on the ground and fly as well. Some birds can also swim in the water. A bird has streamlined body. Its bones are light and strong. They are hollow and have air spaces between them. The hind limbs of birds are modified as claws, which help them to walk and to perch. The breast bones are modified to hold massive flight muscles which help in moving wings up and down. Birds have special flight muscles and the forelimbs are modified as wings.The wings and tail have long feathers, which help in flying. Birds show two types of flight: **gliding** and **flapping.**

Gliding: During gliding the bird has its wings and tail spread out. In this movement the bird uses air currents for going up and down.

Flapping: This is an active flight. The bird beats the air by flapping its wings. They use flight feathers for this purpose.

Figure 5.3 Movement in birds

Activity 3

Observe a hen and crow. How do they move? Write about the similarity and dissimilarity in your note book.

5.2.4 Snake

The body of snake consists of a large number of vertebrae. The adjoining vertebrae, ribs and skin are inter-connected with slender body muscles. When the snake moves, it makes many loops on its sides. The forward push of the loops against the surface makes the snake move forward. Movement of snake is called ***slithering movement***. Many snakes can swim in water also.

Figure 5.4 Movement in Snakes

Since snakes do not have legs, they use their muscles and their scales to move.

5.2.5 Fish

Fish swims with the help of fins. They have two paired fins and an unpaired fin. The body of a fish is streamlined to reduce friction while moving in water. They have strong muscles, which help in swimming. When a fish swims its front part curves to one side and the tail part stays in the opposite direction. In the next move, the front part curves to the opposite side and the tail part also changes its position to another side. The caudal or tail fin helps in changing direction.

Fish have streamlined body structure which helps them to move smoothly with the flow of water. Muscles and fins on the body and the tail help to keep the balance.

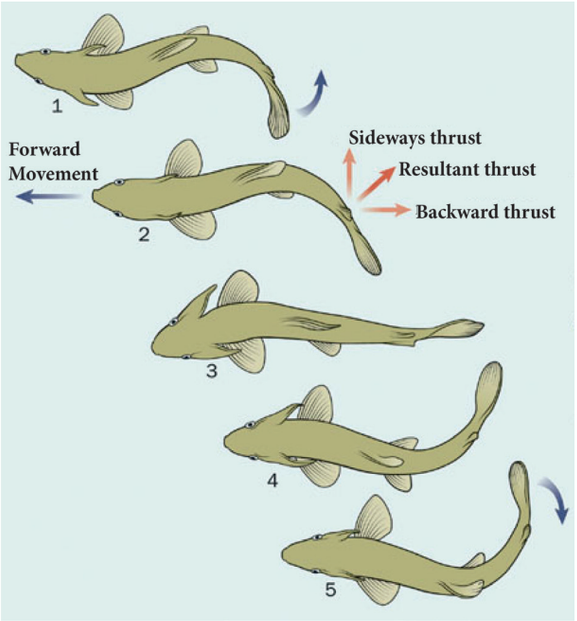


Figure 5.5 Movement in Fish (Swimming)

Activity 4

Make a paper boat; put it in water and push it with narrow end pointing forward. Now hold the boat sideway and push it into water from the broad side. What did you observe? In which process was it easy to move the boat? Have you noticed that the shape of a boat is somewhat like a fish?

5.2.6 Movements in Human body

Humans can move some parts of their body in different directions; however some body parts can be moved only in one direction. Our body is made up of a frame work of bones called **skeleton** which helps in the movement of the body. Some of the movements in body parts of human are:

(a) Movement of eyelids.
(b) Movement of the heart muscles.
(c) Movement of teeth and jaw.
(d) Movement of arms and legs.
(e) Movements of head.
(f) Movements of neck.

Movement of some organs happens because of the combined action of bones and muscles. In such cases, movement is possible along a point where two or more bones meet.

- A Cheetah can run 76 kilometrer per hour.
- A Hippopotamus can run faster than a man.
- Cockroach is the fastest animal on 6 legs covering a metre per second.
- The fastest mammal, the Dolphin can swim up to 35 miles per hours.

5.3 Types of Movements

When we talk about locomotion and movement, there are three types of movements.

5.3.1 Amoeboid movement

It is brought about by pseudopodia which are appendages which move with movement of protoplasm within a cell.

5.3.2 Ciliary movement

This movement is brought about by appendages called as cilia which are the hair-like extensions of the epithelium. Both these kinds of movements are seen with cells of the lymphatic system.

5.3.3 Muscular movement

It is a more complex movement which is brought about by the musculoskeletal system. This type of movement is seen in the higher vertebrates.

To understand more about the movements brought about by the musculoskeletal system, we need to understand the joints, skeleton and types of muscles.

5.4 Joints

The point at which two separate bones meet is called a joint. Depending on the type of movement they allow, joints can be of three types: fixed, slightly moveable and moveable joints.

5.4.1 Fixed or Immoveable joints

In this type of joint no movement is possible between the two bones. The structures between the bones of the skull box are examples of immoveable joints.

5.4.2 Slightly moveable joints

Here, only very little (partial) movement occurs between the two bones. The joint between a rib and the breast bone or between the vertebrae is the example for slightly movable joint.

Joints are the place where two bones meet or connect. Ligaments are short bands of tough fibrous connective tissues that function to connect one bone to another, forming the joint.Tendons are made of elastic tissues and they also play a key role in the functioning of joints.

5.4.3 Freely movable joints

In this type, varying degree of movements is possible between the two bones forming the joint. There are six major types of movable joints. They are given below in Table 5.2.

Table 5.2 Types of movable joints.

Joint	Examples	Description	Mobility
Ball and Socket	Shoulder Hip	A ball shaped head of one bone articulates with a cup like socket of an adjacent bone.	Movement can occur in three planes. This joint allows the greatest range of movement.
Hinge	Elbow Knee Ankle	A cylindrical protrusion of one bone articulates with a trough-shaped depression of an adjacent bone.	Movement is restricted to one plane. This joint allows bending and straightening only.
Pivot	Spine (Atlas / Axis joint at the top)	A rounded or pointed structure of one bone articulates with a ring-shaped structure of Radius Ulna- an adjacent bone.	Movement is restricted to one plane. This joint allows rotation about its longitudinal axis only.
Condyloid	Wrist	Similar to a ball and socket joint but with much flatter articulating surfaces forming a much shallower joint.	Movement can occur in two planes. This joint allows the second greatest range of movement.
Gliding	Spine (between the bony processes of the vertebrae)	Articulating surfaces are almost flat and of a similar size.	Gliding allows movement in three planes, but it is severely limited.
Saddle	Thumb, shoulder and inner ear.	One part is concave (turned inward) at one end and looks like a **saddle.** The other end is convex (turned outward), and looks like a rider in a **saddle.**	Flexion-extension and abduction-adduction movements are seen

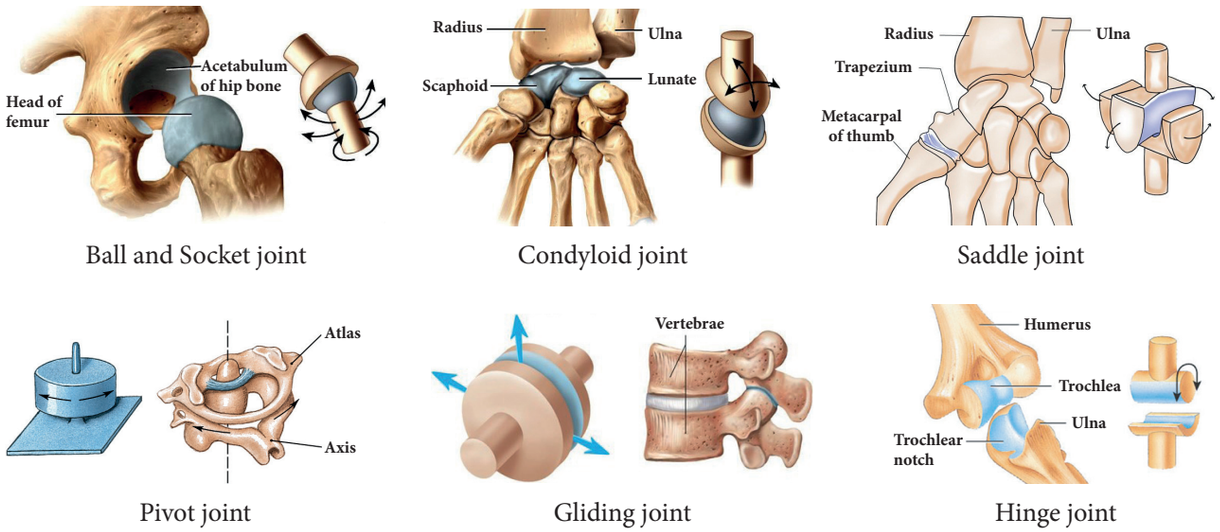


Figure 5.6 Types of joints in human

5.4.4 Synovial joints

A synovial joint is a joint which makes connection between two bones consisting of a cartilage lined cavity filled with fluid, which is known as a *diarthrosis* joint. These are the most flexible type of joint between bones, because the bones are not physically connected and can move more freely in relation to each other. Synovial joints have four main distinguishing features. They are shown in Table 5.3.

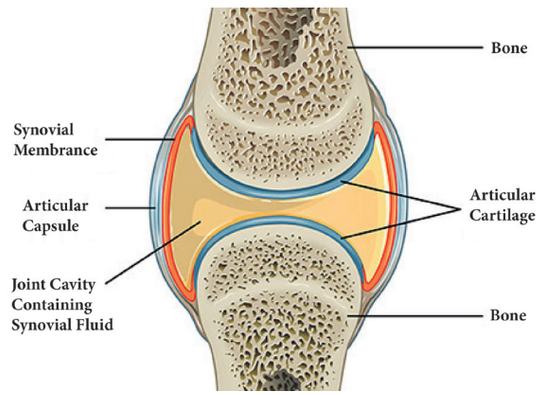


Figure 5.7 Synovial joint in human.

Inflammation of joints is a condition that usually results either due to friction of articulating cartilage or due to lack of synovial fluid in the joint. During this condition, the person feels acute pain in joints particularly while moving joints. This disease is referred to as arthritis. Arthritis is however also caused due to the deposition of uric acid crystals in the joints.

Table 5.3 Feature of synovial joint

Feature	Structure	Function
Ligament	A band of strong fibrous tissue.	To connect bone to bone.
Synovial fluid	A slippery fluid with the consistency of egg-whites that is contained within the joint cavity.	To reduce friction between the articular cartilage in the joint.
Articular cartilage	Glassy-smooth cartilage that is spongy and covers the ends of the bones in the joint.	To absorb shock and to prevent friction between the ends of the bones in the joint.
Joint Capsule	A tough fibrous tissue that has two layers, with the fibrous capsule lying outside the synovial membrane.	The fibrous capsule helps to strengthen the joint, while the synovial membrane lines the joint and secretes synovial fluid.

5.5 Skeleton System

The skeleton system provides the hard structure or framework to the human body which supports and protects the body. It is composed of connective tissues like bones, cartilage, tendons and ligaments. If the skeleton is without joints, no movement would take place and the significance of human body will be no more than a stone. On the basis of presence in the body, skeleton is of two types.

Exoskeleton

It is the skeleton that is found on the exterior layer of the body and it basically originates from embryonic ectoderm or mesoderm. Like scales in the fishes, outer hard layer of the tortoise and feathers of the birds it is dead and it protects and preserves the inner organs.

Endoskeleton

It is the skeleton that is found inside the human body and it originates from the mesoderm. These are found in almost all vertebrates and form the main body structure.

5.5.1 Functions of skeleton

The skeletal system serves five important functions in the human body.

1. It provides structure and shape to the body.
2. It supports and surrounds the internal organs of the body.
3. Calcium and phosphorus, the two minerals that the body needs for important regulatory functions, are stored inside the bones.
4. Red blood cells are produced in the bone marrow.
5. The bones of the skeletal system act as levers for muscular action. Muscular movement would not be possible without **tendons** (fibrous cords of tissue that attach muscle to bone) and **ligaments** (fibrous cords of tissue that attach bone to bone).

DO YOU KNOW?

- The femur or thighbone is the longest and strongest bone of the human skeleton.
- The stapes in the middle ear is the smallest and lightest bone of the human skeleton.

5.5.2 Constituents of skeleton

Human skeleton consists of bone, cartilages and ligaments. Bones comprise the hard framework of the body. Cartilages are the supporting and connecting structures. For example, the cartilage supports the projecting external ears and the tip of the nose. Ligaments bind the bones together. There are different types of bones in human skeletal system. They are:

Long bones: Found in arms and legs.

Short bones: Found in wrist ankle, vertebral column.

Flat bones: Found in skull, ribs, shoulder and hips.

Irregular bones: Found in spine and vertebral column, mandible, palatine, inferior nasal concha, and hyoid.

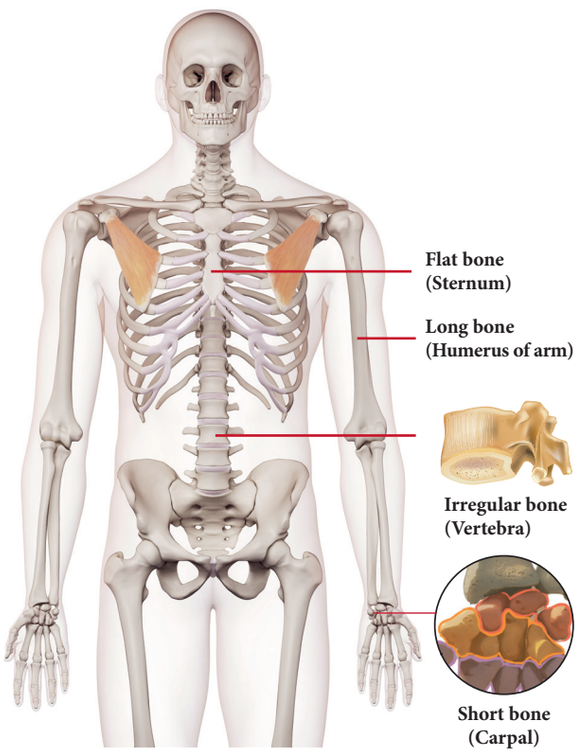


Figure 5.8 Types of bones in human

5.5.3 Parts of skeleton

The skeletal system is composed of bones and the related structures that aid body movement. It is divided into two major parts: the axial skeleton and the appendicular skeleton.

Q4W4N3

I. Axial skeleton

The **axial skeleton** consists of the bones along the *axis*, or central line of the human body. The axial skeleton consists of the skull, facial bones, sternum, ribs, and vertebral column.

a. Skull

Skull is a hard structure made up of small bones. It is formed by 22 bones out of which 8 bones are fixed together to form the cranium and 14 bones fuse to form the face. The only bone which has movable joint is the lower jaw. This movable joint is supported by muscles and ligaments. Skull placed on the top of the backbone can be moved up, down and sidewards.

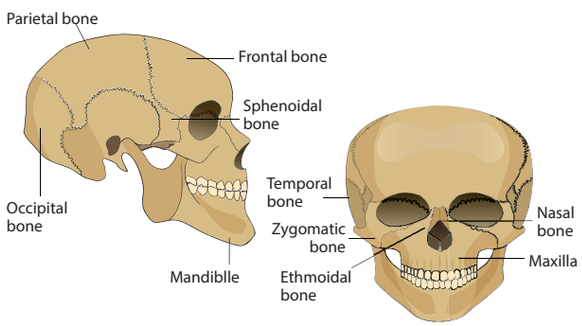


Figure 5.9 Skull bone in human

b. Vertebral column

Vertebral column running at the back of the body is also called as spine or the backbone. It is in the trunk region to offer support to the upper part of the body. Vertebral column is made up of individual bones called as vertebrae. Total vertebral column consists of 7 cervical vertebrae, 12 lumbar vertebrae, 5 fused sacral and 3 fused coccygeal vertebrae. Vertebral column runs from the base of the skull to the hip bone forming a tube. Spinal cord passes through this hollow tube. Vertebrae are joined by gliding points which allow the body to be bent back, front or side wards.

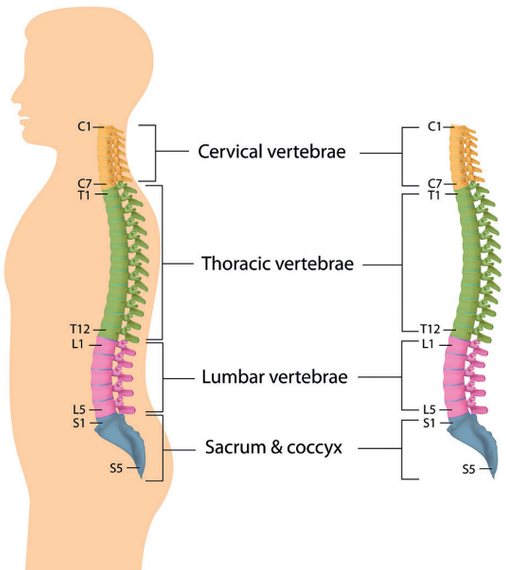
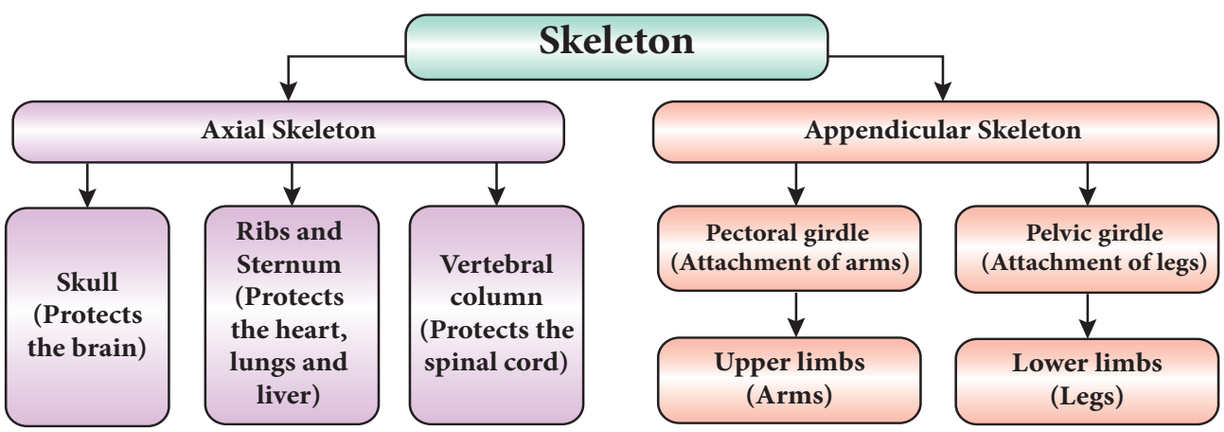


Figure 5.10 Vertebral column in human.



The functions of vertebral column are given below.

- It protects the spinal cord.
- It supports the head.
- It serves as an attachment for the ribs.
- It provides support and place of attachment for the pectoral and pelvic girdle.
- It provides movement for the human skeleton.
- It helps in walking and standing erect with correct posture.

c. Sternum or Rib cage

Rib cage occupies the chest region. It is a cone-shaped structure made up of 12 pairs of ribs. Ribs are attached to vertebrae at the back which curve around to form a cage. 10 pairs of ribs are attached to the breast bone at the front. 2 pairs of lower ribs are free at front. These are called as free-floating ribs. Rib cage is set up in such a way that it can contract and expand during the process of breathing. Rib cage protects the underlying lungs, heart and some part of liver.

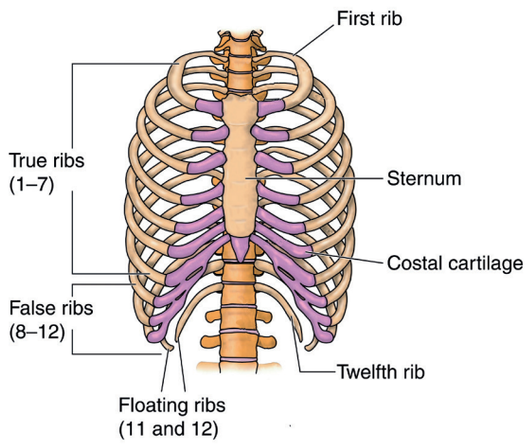


Figure 5.11 Rib cage in human.

Humans and giraffes have the same number of bones in the necks, but the vertebrae in a giraffe's neck are much, much larger.

II. Appendicular skeleton

The **appendicular skeleton** contains the bones in the *appendages* of the body, as well as the structures that connect the appendages to the axial skeleton. Specifically, the appendicular skeleton comprises the shoulder girdle; the arm, wrist, and hand bones; the pelvic girdle; and the leg, ankle, and foot bones.

a. Shoulder bone or Pectoral bone

Shoulder bone is formed by collar bone at the front and the shoulder blade at the back. The collar bone is supported by breast bone at one end and the shoulder blade at the other end. The shoulder bone encloses a socket like cavity into which fixes the ball of the upper arm. This forms a ball and socket joint. This girdle is also called as pectoral girdle.

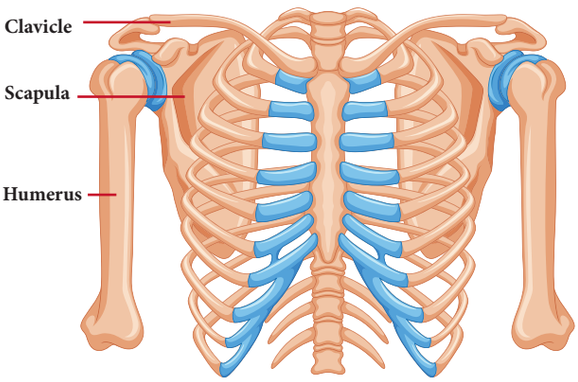


Figure 5.12 Pectoral girdles

b. Pelvic bone

Pelvic bone is also called as pelvic girdle. It is made up of strong bones to balance entire weight of the body. Pelvic girdle is formed by five fused vertebrae at the back and form a

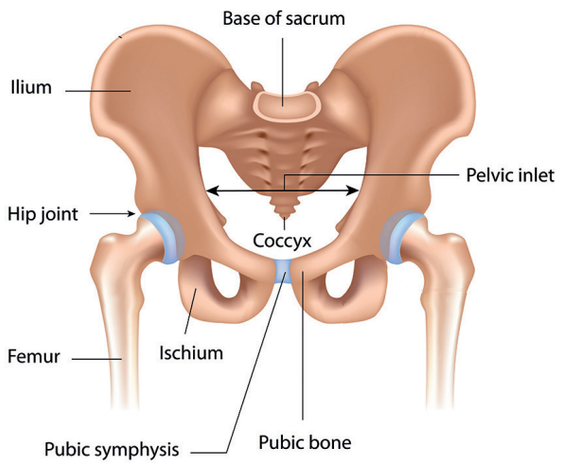


Figure 5.13 Pelvic bones

cavity in the centre while reaching the front part. The thigh bones are attached to either side of the girdle with a ball and socket joint.

c. Arm bone

Arm bone is the upper limb made up of humerus, radius, ulna, carpals, metacarpals and phalanges. All these bones are joined by hinge joints which allow the limb to move only in one direction. Humerus makes up the upper arm. Fore-arm is made up of radius and ulna. Wrist is made up of carpals. Palm is made up of metacarpals. Fingers are made up of phalanges.

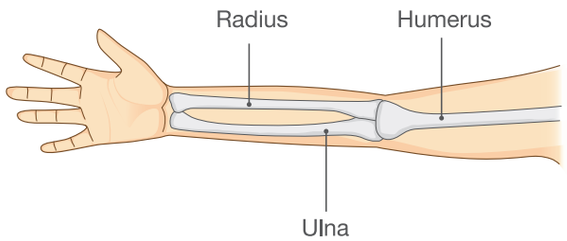


Figure 5.14 Arm bone

d. Leg bone

Leg bone is the lower limb made up of femur, tibia, fibula, tarsals, metatarsals and phalanges. All these bones are joined by hinge joints which allow the limb to move only in one direction. Knee is covered by a cap like structure called as patella or a knee cap. Femur makes up the thigh bone. Leg is made up of tibia and fibula. Ankle is made up of tarsals. Foot is made up of metatarsals. Toes are made up of phalanges.

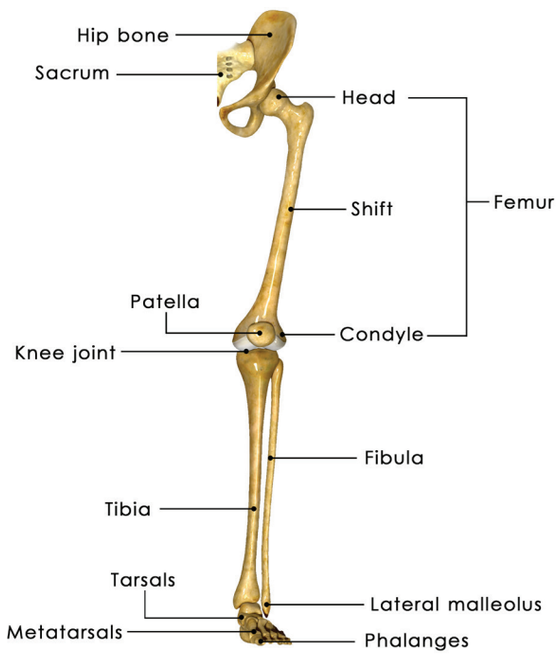


Figure 5.15 Arm bone

5.6 Muscles

The muscles in the body provide the means of all movements. They cover the skeletal framework and also give shape to the body. Muscles help to maintain body posture while sitting, standing or walking. Most muscles are long bundles of contractile tissue. Each muscle usually has two ends - **a fixed end** where the muscle originates and **a movable end** which pulls some other part. This **moveable end** is drawn out to form a tough structure the **tendon** which is attached to the bone. When stimulated by a nerve the muscle contracts to become shorter and thicker and thus it pulls the bone at the moveable end. Muscles can only contact and relax, they cannot lengthen.

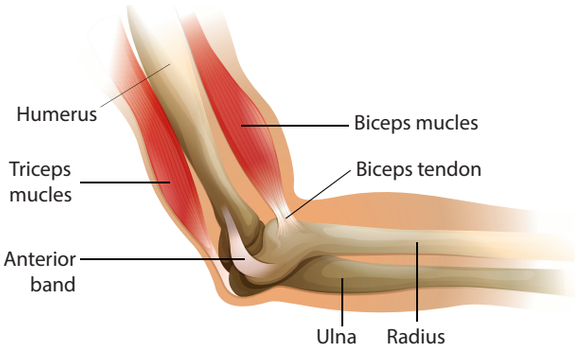


Figure 5.16 Tendon and muscle attachment to the bone in human.

DO YOU KNOW?

- There are muscles in the root of your hair that give you goose bumps.
- It takes 17 muscles to smile and 42 muscles to frown.
- The hardest working muscle is in eye.

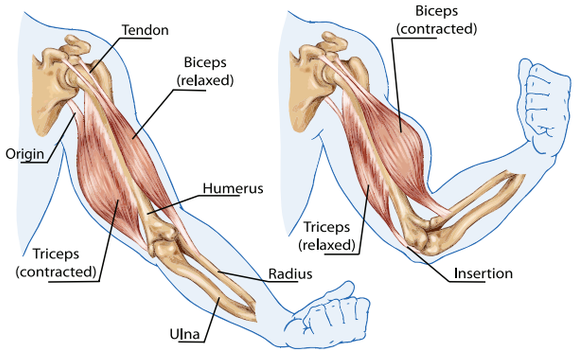


Figure 5.17 Antagonistic pairs of muscle in human (Biceps and Triceps).

Muscles often work in pairs which work against each other. These are called *antagonistic* pairs. The muscles in the upper arm control the bending and straightening of the arm. The two muscles, the biceps and triceps are working against each other. When the biceps contracts the lower arm is raised and the arm bends. In this position the triceps muscle is relaxed. To straighten the arm the reverse happens. The triceps contracts straightening the arm, while the biceps relaxes. Antagonistic muscles can be found all over the body. In the iris of the eye there are two sets of muscle. There are radial muscles which radiate from the pupil like spokes of a bicycle and there are circular muscles. The radial muscles make the pupil of the eye wider, while the circular muscles make the pupil smaller.

Activity 5

Measure the size of your biceps and also ask your friends to do. Take turns lifting a bottle with water as many times as you can. Record the number of lifts each student was able to do. Compare each pair's results with the rest of the class and determine whether those with larger bisceps were able to do more lifts.

5.6.1 Types of Muscles

Muscles found in higher vertebrates are of three types:

- Striated or skeletal muscles or voluntary muscles.
- Unstriated or smooth muscles or involuntary muscles
- Cardiac muscles

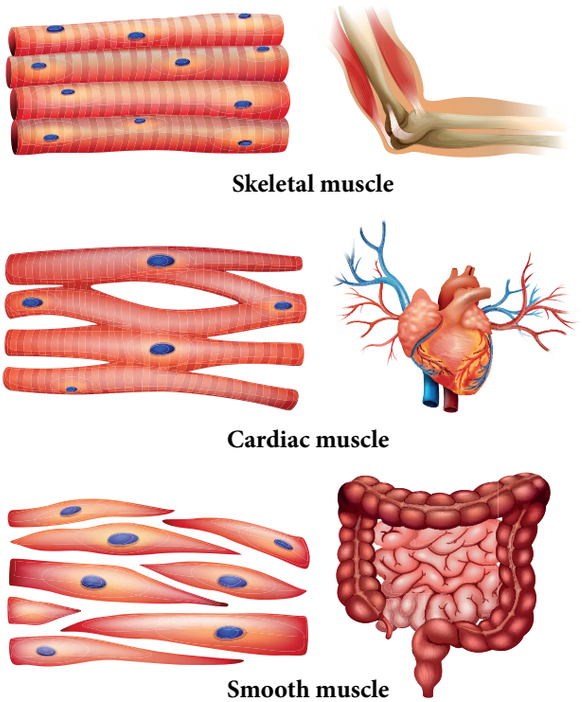


Figure 5.18 Different types of muscle present in the human body.

Table 5.4 Types of muscles

Muscle	Location	Characteristics
Striated / Skeletal / Voluntary muscle	Attached to bones. Found in arms, legs, neck.	Multinucleate, Unbranched, Voluntary.
Non striated / Smooth / Involuntary muscle	Attached to soft parts of the body like blood vessels, iris, bronchi and the skin.	Single, central nucleus Involuntary
Cardiac muscle	Heart	Branched, 1 -3 central nuclei Involuntary

5.6.2 Coordination of Muscles

Most actions in our body like standing, walking, running, playing tennis etc., require combined action of several muscles. To a great extent the muscles have to be coordinated for a particular kind of movement.

Muscles move body parts by contracting and then relaxing. Muscles can pull bones, but they can't push them back to the original position. So they work in pairs of flexors and extensors. The flexor contracts to bend a limb at a joint. Then, when the movement is completed, the flexor relaxes and the extensor contracts to extend or straighten the limb at the same joint. For example, the biceps muscle, in the front of the upper arm, is a flexor, and the triceps, at the back of the upper arm, is an extensor. When you bend your elbow, the biceps contracts. Then the biceps relaxes and the triceps contracts to straighten the elbow.

Points to Remember

- Movement helps to perform necessary functions in an organism. It can be both **voluntary** and **involuntary.**
- Strong muscles and light bones work together to help the birds fly. They fly by flapping their wings.
- Fish swim by forming loops alternately on two sides of the body.
- Snakes slither on the ground by looping sideways. A large number of bones and associated muscles push the body forward.
- The body and legs of cockroaches have hard coverings forming an outer skeleton. The muscles of the breast connected with three pairs of legs and two pairs of wings help the cockroach to walk and fly.
- Earthworms move by alternate extension and contraction of the body using muscles. Tiny bristles on the underside of the body help in gripping the ground.
- Bones and cartilage form the skeleton of the human body. They give the frame and shape to the body and help in movement. It protects the inner organs.
- The skeleton comprises of the skull, the back bone, ribs and the breast bone, shoulder and hipbones, and the bones of hands and legs.
- The bones are moved by alternate contractions and relaxations of two sets of muscles.
- The bone joints are of various kinds depending on the nature of joints and direction of movement they allow.

A-Z GLOSSARY

Antagonist muscle	Muscles that oppose the action of one another.
Appendicular	The arms and legs.
Axial	The trunk and head.
Biceps	Any skeletal muscle having two origins.
Cardiac muscle	Involuntary, striated muscle that constitutes the main tissue of the walls of the heart.
Cartilage	Tough elastic tissue, mostly converted to bone in adults.
Femur	The thigh bone of the human skeleton.
Ligaments	Bands of tough, elastic connective tissue that surround a joint to give support and limit the joint's movement.
Pectoral girdle	The skeletal framework which provides attachment for the forelimbs of or relating to the chest or thorax.
Pelvic girdle	Hips, a foundation for the lower limb.
Skeletal muscle	Voluntary muscles that move bones and produce movement.
Sternum	Long flat bone located in the central part of the chest.
Tendon	Tough band of fibrous connective tissue that usually connects muscle to bone and is capable of withstanding tension.

TEXT BOOK EXERCISES

X5B4E5

I. Choose the best answer.

1. Which of the following parts of our body help us in movement?

   (i) Bones (ii) Skin (iii) Muscles (iv) Organs

   Choose the correct answer from the options below.

   (a) (i) and (iii) (b) (ii) and (iv)

   (c) (i) and (iv) (d) (iii) and (ii)

2. Which one of the following organisms lack muscles and skeleton for movement?

   (a) Dog (b) Snail

   (c) Earthworm (d) Human being

3. _____ joints are immovable.

   (a) Shoulder and arm

   (b) Knee and joint

   (c) Upper jaw and skull

   (d) Lower jaw and upper jaw

4. Why do underwater divers wear fin-like flippers on their feet ?

   (a) To swim easily in water.

   (b) To look like a fish.

   (c) To walk on water surface.

   (d) To walk over the bottom of the sea (sea bed).

5 External ear (pinna)is supported by

   (a) bone (b) cartilage

   (c) tendon (d) capsule

6. Cockroach moves with the help of its

   (a) leg (b) bone

   (c) muscular foot (d) whole body

7. Which one of the following categories of vertebrae are correctly numbered.

   (a) Cervical-7 (b) Thoracic-10

   (c) Lumbar - 4 (d) Sacral - 4

II. Fill in the blanks.

1. Movement of organisms from place to place is called _____.
2. _____ refers to change in position of the part of an organism's body.
3. A structure which provides rigid frame work to the body is called _____
4. Axil skeleton in human consists of _____, _____, _____ and _____.
5. Appendicular skeleton in human consists of _____ and _____.
6. The place where two bones meet is termed as _____.
7. _____ is attached to soft parts of the body like blood vessels, iris, bronchi and the skin
8. _____ muscle makes pupil of eyes wider.

III. State True or False. If false, correct the statement.

1. Skull in humans consists of 22 bones.
2. There are 12 pairs of ribs in human body.
3. Pelvic girdle is a part of axial skeleton.
4. Hinge joint is slightly movable joint.
5. Cardiac muscle is a voluntary muscle.
6. The flexor and extensor muscle of the arm are antagonistic muscles.

IV. Answer very briefly.

1. What is skeleton?
2. What is cranium?
3. Why our backbone is slightly moveable?
4. Differentiate axial and appendicular skeleton.
5. What is ligament?

6. Define Muscle.
7. Differentiate tendons and ligament.

V. Answer briefly.

1. Differentiate between the following.
   a) Movement and Locomotion.
   b) Endoskeleton and Exoskeleton
   c) Pectoral and Pelvic girdle
   d) Ball and socket Joint and Hinge Joint
   e) Voluntary and Involuntary muscle
2. What are antagonistic muscles? Give one example.
3. How is the skeleton of a bird well-suited for flying?
4. What are the functions of skeleton in human body?

VI Answer in detail.

1. Name the different types of joints? Give one example for each type.
2. Write about the human axial skeleton, giving suitable labelled diagram.
3. Discuss various types of movements seen in living organisms.
4. What is a streamlined body? How does it help in the movement of animals that fly or swim in water?
5. Write a short note on different types of muscles.

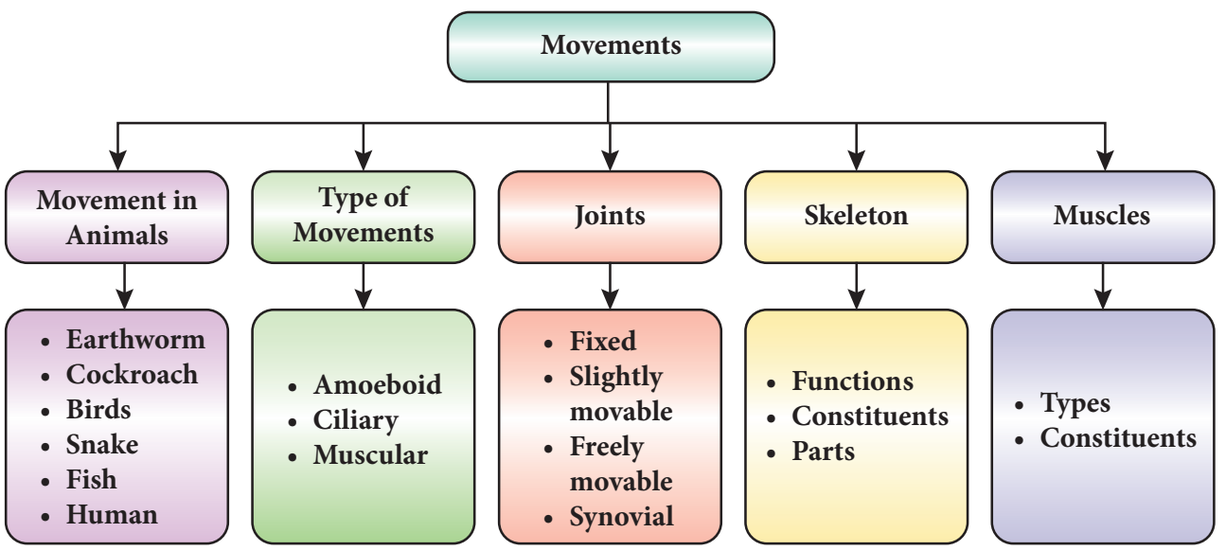
REFERENCE BOOKS

1. Guyton and Hall. J. E, (2006). Textbook of Medical Physiology- Eleventh Edition Elsevier saunders. International Edition.
2. Sembulingam.K and Prema Sembulingam., (2012). Essential of Medical Physiology 6th Edition.
3. R.L. Kotpal (2010). Modern text book of zoology: Inveretbrates. 12th Edition.

INTERNET RESOURCES

1. https://kids.kiddle.co/Muscular_system
2. https://kidshealth.org/en/kids/muscles.html
3. https://www.innerbody.com
4. https://www.visible body.com

Concept Map



UNIT 6

REACHING THE AGE OF ADOLESCENCE

Learning Objectives

T2H1J6

After completing this lesson, students will be able to:

- understand the body changes that take place during adolescence.
- differentiate the secondary sexual characteristics of boys and girls.
- know about the role of hormones in reproduction.
- explain the reproductive phases of life in human.
- understand the nutritional needs of adolescents.

Introduction

Growing up is a natural process that takes place in all living organisms. All living organisms grow up to maturity which is the ability to respond to a particular environment. Maturity along with experiences produces a progressive series of changes in an organism. These series of changes are called development. Different phases of human development are called developmental stages. Human developmental stages include infancy, childhood, adolescence, adulthood, middle age and old age. Among all these stages, adolescence is the most crucial and significant period in an individual's life. It is the period of transition from childhood to adulthood. This period starts at the age of about 10 to 13 and ends at the age of 19 (commonly known as teenage). Almost all of you would have entered this period now. In this lesson you are going to study about the changes that take place in you (which are normal) as you enter the age of adolescence. You will also study about the reproductive phases of human life, reproductive health, nutritional needs of adolescents and personal hygiene during adolescence.

6.1 Adolescence and Puberty

The term adolescence is derived from the Latin word 'adolescere' meaning 'to grow' or 'grow to maturity'. During this period changes occur in height, weight, sex organs, muscle mass as well as in brain structure and function. Biologically it is a physical transition marked by the onset of puberty and termination of physical growth in an individual.

6.1.1 Puberty

Puberty is a period of few years in which rapid physical; physiological and psychological changes occur resulting in sexual maturity. We can predict the sequence of physical changes that will take place but the age of beginning of puberty varies from individual to individual. The average age for the onset of puberty is 10 or 11 for girls and 12 or 13 for boys. But, factors like genetic and biological influences, life events, socio-economic status, nutrition and diet and the amount of body fat also affect the onset and progression of puberty.

Hormones play an important role at the time of puberty. Changes in hormones during this period trigger physical and behavioural changes. Sex hormones secreted at the time of puberty activate the male and female sex glands to produce necessary secretions in the body. The male sex glands, testes release the testosterone and the female sex gland, the ovaries release the estrogen. These result in changes in the primary and secondary sexual characteristics of the male and female.

6.1.2 Body changes at Puberty

Four impotant changes that occur during puberty transform the body of a child into that of an adult. These changes are:

- Changes in body size
- Changes in body proportion
- Development of primary sex characteristics
- Development of secondary sex characteristics

a. Changes in body size

The first major change at the time of puberty is growth which is the increase in body height and weight. It usually begins at the age of 10 to 12 in girls and 12 to 13 in boys. It is almost complete at around 17 to 19 in girls and 19 to 20 in boys. During adolescence both boys and girls add around 23 cm to 26 cm in the height. In addition to height, they also experience significant increase in weight. But increase in weight is influenced by various factors like diet, exercise and life style. The average weight gain during this period is about 17 kg to 19 kg. During this period, increase in fat is seen in girls in contrast to muscle development in boys.

b. Changes in body proportion

Certain body areas which are small proportionately grow big. This can be seen in feet and hands. During childhood, legs grow proportionately more than the trunk. But at the time of puberty trunk also lengthens. Also, trunk broadens at the hip and shoulder thus giving the adult proportion to the body.

Activity 1

Divide the students in your class into different groups (Form separate groups for boys and girls). Measure the height and weight of all the students in each group and find out the average. Record your observations in your notebook.

c. Primary sex characteristics

Reproductive organs of boys and girls become fully functional at the time of puberty.

Figure 6.1 Adolescent growth

In boys, testes grow larger followed by that length and size of the reproductive organ increase. Similarly, female reproductive organ also grows during puberty. Thus, the size of the uterus and the weight of the ovaries increase during this time.

DO YOU KNOW?

Testes and ovaries are called primary sex organs of the male and female respectively.

6.2 Secondary Sex Characteristics

Secondary sex characteristics are the physical features which distinguish male from female. After the progression of puberty, boys and girls become dissimilar in appearance. The secondary sex characters are regulated by the hormones the testosterone or androgen secreted by the testes of the males and estrogen secreted by the ovaries of the females. Androgens cause the growth of the larynx, muscle development, skeletal size and distribution of body and pubic hair, and stimulation of sweat glands. Estrogen and progesterone are the female sex hormones. Estrogen stimulates the development of the breast, the external genitalia, pubic and axillary hairs, and the distribution of body fat.

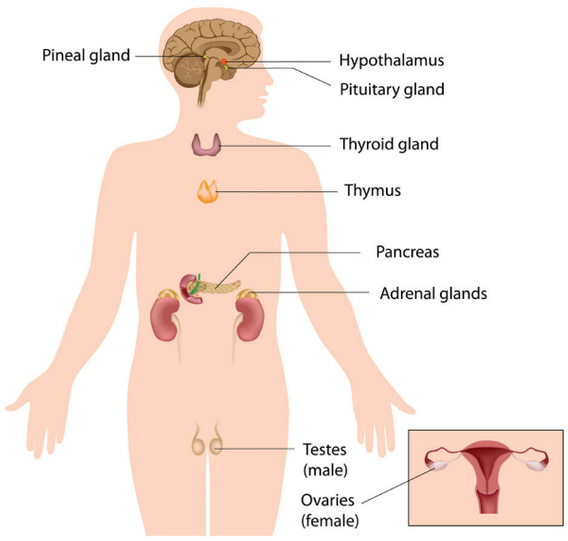


Figure 6.2 The endocrine system

6.2.1 Secondary Sex Characteristics of Boys

The following are the secondary sex characteristics of boys.

a. Hair

Immediately after the development of primary sex characteristics, pubic hair appears followed by axillary and facial hair.

b. Skin

The skin becomes coarse and the pores in the skin enlarge.

c. Glands

The oil producing glands in the skin enlarge and due to this acne may appear on the faces.

DO YOU KNOW?

The secretions of sweat and sebaceous or subcutaneous glands (Oil glands) are very active during adolescence. Many adolescent boys and girls get pimples on face because of increased activity of these glands in the skin. Owing to extra secretions sometimes a distinctive odour is also produced from the bodies.

d. Muscle

The strength of the muscle increases and it gives shape to arms, legs and shoulders.

f. Voice

During this period voice changes occur and the voice becomes husky. Then its pitch drops and the volume increases.

6.2.2 Secondary Sex Characteristics of Girls

Girls show the following secondary sex characteristics at the time of puberty.

a. Hips

Due to the enlargement of the pelvic bone and the development of subcutaneous fat, the hip becomes wider and rounder.

b. Breast

After the enlargement of hips, the breasts begin to develop during this time.

c. Hair

Pubic hair appears followed by axillary and body hair on the limbs.

d. Skin

The skin becomes coarser and the pores enlarge as in the case of boys.

e. Gland

Oil producing glands become active causing acne on the face.

f. Muscles

Increase in muscles takes place which gives shape to shoulders, arms and legs.

g. Voice

Voice becomes shrill and voice breaks are rare among girls.

DO YOU KNOW?

At puberty, the growth of the larynx is larger in boys than that of girls. The growing voice box in boys can be seen as a protruding part of the throat called Adam's apple, so that the voice becomes deep and harsh. This is caused mainly by male hormone (regulatory chemicals) during adolescence. As a result of this, muscles (chords) attached to the cartilage get loosened and thickened. When air passes through these loosened and thickened chords a hoarse sound is produced. In girls larynx is hardly visible from outside because of its small size and the voice becomes high pitched.

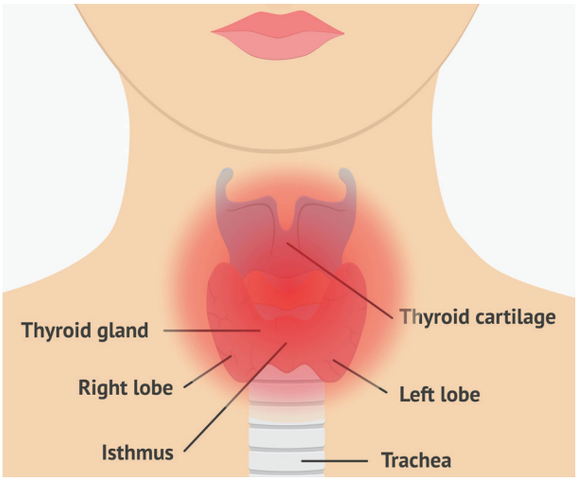


Figure 6.3 Adam's apple

Table 6.1 Secondary sex characteristics in boys and girls.

Girls	Boys
Height and weight increase.	Height and weight increase.
Fatty and subcutaneous tissues develop.	Muscles develop.
Hip broadens.	Shoulder broadens.
Hair grows in arm pits and pubic area.	Hair grows in the arm pits and pubic area, and facial hair also appears.
Voice becomes shrill.	Voice break takes place due to lengthening of vocal cord and enlarging of larynx.
Breast develops.	Size of the penis increases.

Activity 2

Answer the following questions.

- Has your voice changed?
- Are there pimples or acne on your face?
- Do you feel that some changes have taken place in your body?

These changes are normal in your development. Discuss with your teacher or counsellor in your school and clarify your doubts.

6.3 Role of Hormones in Reproduction

The primary hormones that regulate reproduction are the steroids such as androgens, estrogens and progesterone which have masculinizing, feminizing and gestational effects respectively. These hormones are secreted from the gonads which are regulated by the anterior pituitary (adenohypophysis). In male and female, reproductive behavior and reproduction are mainly under the control of LH (Luteinizing Hormone) and FSH (Follicle Stimulating Hormone). LH stimulates the testes to produce androgens, the male sex hormone. Sperms are then actively produced. In man sperm production starts at sexual puberty and may continue throughout his life.

Follicle Stimulating Hormone (FSH)

FSH in the female influences the development of the Graafian follicle and secretion of estrogens. In the male it is necessary for the development of seminiferous tubules, and for spermatogenesis.

Luteinizing Hormone (LH)

In the female, it is the hormone necessary for ovulation, and the secretion of the luteal hormone progesterone, and for the final maturation of the Graafian follicle. In the male it stimulates the interstitial (Leydig) cells of testes and the secretion of testosterone, and is referred to as the Interstitial Cell Stimulating Hormone (ICSH).

Estrogen is not a single hormone but a collection of related steroid hormones.

Prolactin (PRL) or Lactogenic Hormone

The main function of this hormone is milk secretion during lactation.

Oxytocin Hormone

Oxytocin causes expulsion of milk from the breast and it is also involved in the contraction of smooth muscles of uterus during child birth.

6.4 Reproductive phase of life in Human

Reproduction is more important for the continuation of human race. The phase in an individual's life during which there is production of gametes is called reproductive phase. In females, the reproductive phase of life begins at puberty (10 to 12 years of age) and generally lasts till the age of approximately 45 to 50 years, and in males, it is from the age of 13 to life long. The reproductive age may vary from person to person. The following are the reproductive phases in the life of a female.

Menarche

The first menstrual flow begins at puberty and is termed menarche. The ova begin to mature with the onset of puberty. It is the beginning of adolescence, during which mental and emotional maturation occurs and physical growth becomes pronounced.

Ovulation

Ovulation occurs approximately 14 days before the next ovarian cycle commences. Thus in a 28 days cycle ovulation occurs about day 14. One ovum matures and is released by one of the ovaries once in about 28 to 30 days. The release of ovum from the ovary is called ovulation. During this period, the wall of the uterus becomes thick so as to receive the fertilized egg. This results in pregnancy.

Pregnancy

After ovulation the ovum reaches the fallopian tube and fertilization takes place.

The fertilized egg undergoes development and it is implanted in the uterus. The corpus luteum continues to grow and produces large amount of progesterone. This results in pregnancy. Normally, it lasts for 280 days, at the end of which parturition takes place.

Menstruation

If the ovum is not fertilized, the corpus luteum begins to degenerate and the production of hormones progesterone and estrogen ceases. The unfertilized egg and the thickened lining of the uterus along with its blood vessels are shed off. This causes bleeding in woman's reproductive tract which is called menstruation. Menstruation occurs once in about 28 to 30 days. It takes about 3 to 5 days. In some cases, initially menstrual cycle may be irregular. It takes some time to become regular. If it remains irregular for over a year, then it is better to consult a doctor.

Menopause

Menopause marks the end of the reproductive phase of a woman's life. At 45 to 50 years of age, the menstrual cycle stops. Stoppage of menstruation is termed as 'menopause'. During menopause psychological symptoms such as anxiety, irritability, fatigue and loss of concentration may occur. Menopause may be induced by surgical removal of the ovaries, or by pelvic irradiation in a woman of any age.

Now-a-days girls attain puberty at very early age. This is due to food habits. As you eat lot of junk food, the body growth increases and it look like adults.

6.5 Menstrual Cycle

The beginning of the menstrual cycle marks the onset of puberty in human females. The menstrual cycle begins with the casting off of endometrial lining of the uterus and bleeding. The casting of endometrium can be considered as periodic preparation for pregnancy. Menstruation occurs if an ovum released by the ovary of a woman is not fertilized during ovulation. This is described below.

1. When a girl reaches puberty at the age of about 10, the sex hormones released into her blood cause some of the ova (or egg cells) in her ovaries to become mature (or ripe).
2. Usually one mature ovum (or egg) is released from one of the ovaries into the oviduct once in every 28 days. This is called ovulation.
3. Before ovulation (or release of ovum), the inner wall of uterus becomes thick and spongy, and full of tiny blood vessels (or blood capillaries). It prepares itself to receive the fertilized ovum.
4. If the ovum does not get fertilized then the thick and soft inner lining of uterus is no longer needed and hence it breaks. So, the thick and soft inner lining of uterus along with the blood vessels and the dead ovum comes out of the vagina in the form of a bleeding called menstruation.

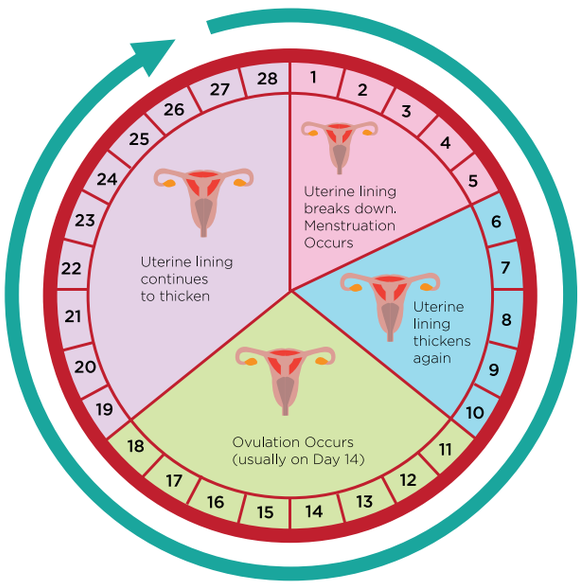


Figure 6.4 Menstrual Cycle

5. Menstruation usually occurs 14 days after ovulation and usually lasts for about 3 to 5 days.
6. After menstruation is over, the inner lining of the uterus starts building up again so that it may become ready to receive the next ovum.
7. If the ovum does not get fertilized even now, then menstruation takes place again. This cycle of menstruation is repeated again and again in women after every 28 days. The menstrual cycle is controlled by hormones.

Menstruation stops temporarily when the ovum gets fertilized and the women gets pregnant. This is because, in this case the thick and soft lining of the uterus containing lot of blood vessels is needed for the growth and development of the fertilized ovum to form a baby. Menstruation restarts after the birth of the baby. Menstruation also stops due to nutritional deficiencies, low body weight, stress, eating disorder, excessive weight gain etc.

6.6 Reproductive Health

The physical and mental well-being of an individual is regarded as an individual's health. The World Health Organisation (WHO) has defined the reproductive health as the total well-being of behavioural, emotional, physical and social aspects of adolescence. To keep the body healthy, every human being, at any age, needs to have a diet, exercise and personal hygiene. The following are some of the measures that girls and boys need to take.

Cleanliness

1. Have a bath once or twice a day, paying special attention to underarms, groins and genitals.
2. Change the underwear daily. It should be made of cotton and washed and cleaned everyday.
3. For teenagers, the increased activity of sweat glands sometimes enhances body odour. If cleanliness is not maintained there are chances of having fungal, bacterial and other infections.

Menstrual Hygiene

Girls should take special care of cleanliness during the time of menstrual cycle. Making use of disposable napkins or tampons may reduce chances of infections. First of all, girls should realize that menstruation is as natural as any regular physiological activities like breathing, drinking, eating, urinating and defecation. Girls are advised to use sanitary napkins or tampons rather than cloth. It should be changed frequently depending upon the menstrual flow. If a cloth is being used repeatedly, it should be cleaned with soap and hot water and dried in sunlight for reuse.

Sleep is vital to the well-being of adolescents. It can even help you to come out of the stress you experience during this period. During this period about 8 to 10 hours of sleep each night is necessary. But most teens do not get enough sleep.

Physical Exercise

Walking and playing in fresh air keeps the body fit and healthy. All young boys and girls should take a walk, exercise and play outdoor games. Physical activity leads to the conditions of better health, sound sleep and thereby mental peace. Mental peace promotes happiness in day to day existence.

Activity 3

Collect data on the number of students in your class who exercise regularly and who do not exercise regularly. Do you notice any difference in their fitness and health? Prepare a report on the benefits of regular exercise.

6.7 Nutritional needs of Adolescents

Adolescence is a stage of rapid growth and development. Hence a diet with proper calories and other nutrients is needed for proper growth and physical activity. Balanced diet is very much important during adolescence. Balanced diet includes proteins, carbohydrates, fats and vitamins in requisite proportions. Our Indian meal of roti / rice, dal (pulses), milk, fruits and vegetables forms a balanced food.

The nutritional deficiencies during this period not only retard the physical growth, but also impair the intellectual development and may also delay sexual maturation. A very good amount of proteins and carbohydrates is necessary during this growth period. Apart from that, adolescents need the following dietary components.

Minerals

Since there is an increase in skeletal mass and blood volume during adolescence, the body needs calcium, phosphorus and iron.

Calcium

Calcium intake needs to be increased to prevent osteoporosis in later life. It is present in milk and milk products or other equivalents.

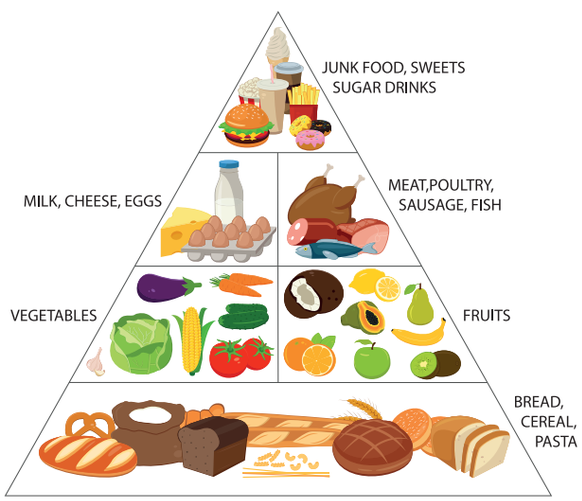


Figure 6.5 Balanced diet

Activity 4

Collect more information on balanced diet and prepare a chart. Display in your class and discuss its importance.

Iodine

It helps to prevent thyroid gland related diseases.

Iron

Iron builds blood and iron-rich foods such as green leafy vegetables, jaggery, meat, dates, fish, chicken, citrus, Indian gooseberry (Nelli) and whole pulses are good for adolescents. Lack of iron in the diet results in anemia. To make up for the loss of iron, adolescents need to have a diet rich in iron. In boys, iron deficiency occurs due to muscle spurt whereas in girls it occurs due to menstruation in addition to the muscular growth.

DO YOU KNOW?

Women should take in more iron in their diet regularly to make up for the loss of blood during menstruation.

6.8 Personal hygiene for Adolescence

During adolescence, growing children need special attention towards diet, exercise and personal hygiene. Personal hygiene is a clear indicator of man's personality. Personal hygiene starts from the hair tip and ends down at the toes. Personal hygiene habits for the adolescence are as follows.

1. Shower or bath daily.
2. Always wash your hands before and after meals.
3. Keep fingernails clean and dipped.
4. Wash your teeth and mouth before and after each meal.

5. Avoid touching your face, nose or mouth while preparing food.
6. Avoid coughing or sneezing around food and close your mouth by using hand kerchief while you cough in public places.
7. If you want to taste the food, use a clean spoon.
8. Change your clothes regularly and wash them cleanly, especially undergarments.
9. Do not defecate in open field. Use clean toilets for defecation.
10. If you are not well, avoid self-medication, consult a doctor.

Activity 5

Answer the following questions.

- Do you exercise regularly?
- Do you keep yourself clean?
- When do you go to bed?
- When do you get up?

Compare your response with that of your friends. Do you think you need to change yourself? Discuss with your teacher.

Points to Remember

- Adolescence is the period of reproductive maturity which lies usually between the ages of 11 to 19 years.
- Voice of boys becomes harsh as chords of voice box get loosened and thickened during adolescence.
- Hormones are the secretions of endocrine glands without ducts which secrete them directly into the bloodstream.
- Testosterone is the male hormone and estrogen is the female hormone that bring about development of several secondary sex characters.
- The uterine wall in female prepares itself to receive the developing fertilized eggs. In case there is no fertilization, the thickened lining of the uterus wall breaks down and goes out of the body along with the blood. This is called menstruation.
- It is important to take balanced diet for the overall growth and development during adolescence.

A-Z GLOSSARY

Adam's Apple	The protruding part of the throat.
Adolescence	The period of transition from childhood to adulthood.
Gland	Group of cells which secrete hormones.
Hormones	The chemical substances secrete in the body.
Menarche	The first menstrual flow at puberty.
Menopause	The stoppage of menstruation.
Menstruation	Bleeding in the reproductive tract of women.
Ovulation	The release of ovum from the ovary.
Primary sex characters	The characters which refer to changes in sex organs.
Puberty	The period at which an organism attains sexual maturity.
Secondary sex characters	The characters which help to distinguish the male from the female.

TEXT BOOK EXERCISES

L3H3Q9

I. Choose the best answer.

1. Adolescence is the period of life between _____ years of age.
   a) 10 to 16 b) 11 to 17
   c) 11 to 19 d) 11 to 20

2. The period at which an organism attains sexual maturity is called _____
   a) puberty b) adolescence
   c) growth d) maturity

3. During puberty, the region below the waist become wider in _____
   a) boys b) girls
   c) Both a and b d) None of these

4. Adam's apple is the growth of the _____
   a) pharynx b) thyroid
   c) larynx d) parathyroid

5. Many adolescent boys and girls get pimples on face, due to the secretions of _____ gland.
   a) sweat
   b) sebaceous
   c) sweat and sebaceous
   d) None of these

6. The sperm is produced by _____
   a) penis b) ovary c) uterus d) testes

7. _____ are the chemical substances, secreted by endocrine glands.
   a) Hormones b) Enzymes
   c) Proteins d) Fatty acids

8. Androgen production is regulated by _____
   a) GH hormone b) LH hormone
   c) TSH hormone d) ACTH hormone

9. During menstruation, the progesterone level is _____
   a) decreased b) increased
   c) ceased d) normal

10. _____ intake needs to be increased to prevent osteoporosis in later life.
    a) Potassium b) Phosphorus
    c) Iron d) Calcium

II. Fill in the blanks.

1. _____ is secreted by the ovaries of female.
2. The hormones secreted by the gonads are controlled by _____
3. Milk secretion during lactation is controlled by _____ hormone.
4. The male and the female gamete fuse together and form _____
5. The first menstrual flow begins at puberty and it is termed as _____
6. _____ usually occurs 14 days after ovulation.
7. _____ includes protein, carbohydrates, fats and vitamins in requisite proportion.
8. _____ helps to prevent thyroid gland related diseases.
9. Iron deficiency leads to _____
10. In women fertilization takes place at _____

III. State True or False. If false, correct the statement.

1. There is a sudden increase in the height of both boys and girls during puberty.

2. The release of ovum from the uterus is called ovulation.
3. During pregnancy, the corpus luteum continues to grow and produces large amount of estrogen and progesterone.
4. Making use of disposable napkins or tampons may increase the chances of infections.
5. Using clean toilets for defecation is a good practice.

IV. Match the following.

1.	Puberty	-	Testosterone
2.	Adam's apple	-	Muscle development
3.	Androgen	-	at 45 to 50 years of age
4.	ICSH	-	Sexual maturity
5.	Menopause	-	Change in voice

V. Answer briefly.

1. What is adolescence?
2. List out the changes which occur during puberty.
3. What is secondary sex characteristics?
4. What is fertilization?
5. Explain Menarche.
6. Explain the process of pregnancy.
7. Explain the importance of cleanliness during the time of menstrual cycle in girls.
8. How is adolescence differ from childhood?

VI. Answer in detail.

1. What are the physical changes that occur in boys and girls during adolescence?
2. Explain the role of hormones in reproduction.
3. Briefly describe the menstrual cycle.
4. Briefly explain the nutritional needs of adolescence.

VII. Higher Order Thinking Questions.

1. What can you suggest to your classmates to keep himself / herself clean and healthy?
2. Adolescence is the energistic stage. What health and good habits you want to develop?

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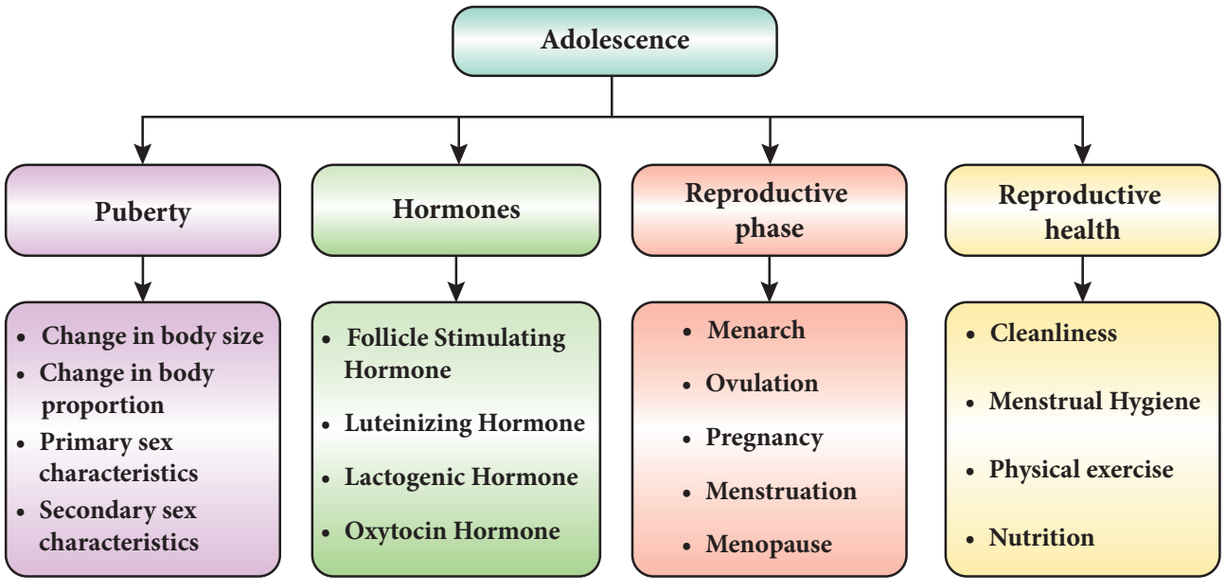
https://www.boldsky.com/health/wellness/2018/world

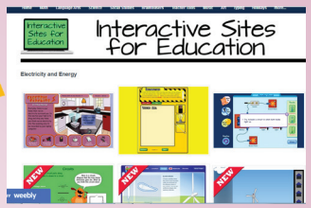
CONCEPT MAP



ICT CORNER

Adolescents

Through this activity you will learn about the age of adolescents.

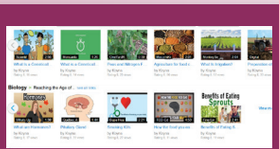


Step 1 Open the Browser and type the URL given below

Step 2 You will see the pop up screen. You will see the video links of hormones, menstrual cycle etc...

Step 3 Click the Hormones video link. You will see the video.

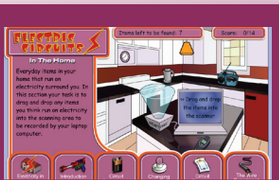
Step 4 Likewise, you can see all the videos by clicking the links



Step1

Step2

Step3



Step4

Browse in the link:

https://www.ticklinks.com/Domain/Open-Links-Library/Course/53/SSC-TN---Class-VIII/Subject/210/Biology/Classic/All/Links/Search

*Pictures are indicatives only.

*If browser requires, allow Flash Player or Java Script to load the page.

B359_8_SCIENCE_EM

UNIT 7

Digital Painting

Learning Objectives

D8A9Y7

After completing this lesson, students will be able to:

- know how to draw a picture through the software Tux Paint.
- explore their creative thinking.
- learn arithmetic calculations through the software Tux Math.

Introduction

Computers have become a part of our daily life in this modern era. Certain programmes in computers help us to learn lessons in a better way and they also increase our creativity. Learning through computers is a fun.

In this chapter, we will learn to use the software Tux Paint and Tux Math.

7.1 Tux Paint

Tux Paint is a free drawing program designed for young children. It has a

simple, easy-to-use interface, fun sound effects, and an encouraging cartoon mascot which help to guide children as they use the program.

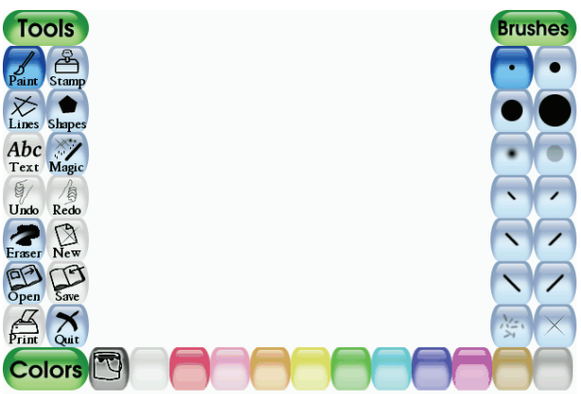
Choose a Tool from the options on the left side of the screen. Then, make choices from the right side of the screen. Directions are provided at the bottom of the screen.

7.1.1 Title Screen

When Tux Paint first loads, a title/credits screen will appear. Once loading is complete, press a key or click on the mouse to continue (Or, after about 30 seconds, the title screen will go away automatically).

7.1.2 Main Screen

The main screen is divided into following sections:



Left Side: Toolbar

This toolbar has the control options to draw and to edit images.

Middle: Drawing Canvas

This is the largest part of the screen dedicated to draw and edit images.

Right Side: Selector

When a tool is selected from the left side tool bar, the right side bar will display the options associated with the specific tool. E.g.- When the line tool is selected, the right side bar shows the various lines available. When the shape tool is selected, different shape options can be seen on the right side.

Lower: Colours

A palette of available colours are shown near the bottom of the screen.

Bottom: Help Area

At the very bottom of the screen, Tux, the Linux Penguin, provides tips and other information while you draw.

7.1.3 Tools Icons

The Paint Brush tool lets you draw freehand, using various brushes (chosen in the Selector on the right) and colors.

The Stamp tool is like a set of rubber stamps or stickers (images).

Use the Left and Right arrows to cycle through the collections.

This tool is used to draw lines.

This tool lets you draw some simple filled, and un-filled shapes.

This tool is used to type texts.

Magic tool is a set of special tools, selecting one of the 'magic' effects from the selector situated in the right side. This tool provides countless number of special visual effects if it is used in various combination with other tools. This tool can be used either by clicking or by dragging the effect directly on to the image to apply it.

This tool appears similar to the Paint Brush, but it is used to erase the picture.

This tool is used to cancel a command given earlier.

This tool is used to reverse the action of Undo.

Clicking the "New" button will start a new drawing.

This tool is used to open the existing file.

This tool is used to save your current picture.

This tool is used to print your current picture.

This tool is used to close Tux Paint window.

7.1.4 Shortcut Keys

Tool Name	Keyboard Shortcut Key
New	Ctrl + N
Open	Ctrl + O
Save	Ctrl + S
Print	Ctrl + P
Quit	Esc
Undo	Ctrl + Z
Redo	Ctrl + Y

7.2 Tux Math

Tux Math is an open source arcade – style video game for learning arithmetic. The main goal is to make learning effective and fun.

7.2.1 Title Screen

Math Command Training Academy: choose this to go to a list of over fifty prepared lessons, starting with simple typing of single digit numbers, and progressing to multiplication and division involving negatives and "missing number" questions (e.g. "-17 × ? = 119"). The player wins if the question list is completed successfully. Successfully completed lessons are indicated with a flashing gold star.

Play Arcade Game: This option can be used to select and play one of the four open-ended "arcade style" games, meaning the game gets faster and faster as long as the player can keep up, with the goal to get the highest score possible.

7.2.2 Options

- Space Cadet - simple addition.
- Scout - addition and subtraction to ten.

- Ranger - addition, subtraction, multiplication and division to ten.
- Ace - all four operations with operands to 20, including negative numbers and "missing number" type questions.

Play Custom Game: This option can be used to play a game based on the config file in the player's home directory.

More Options: These options have "Demo" mode as well as credits and project information.

Points to Remember

- Use the [UP] and [DOWN] arrow keys to select what you wish to do, and then press [ENTER / RETURN / SPACEBAR]. Or, use the mouse to click the menu item.
- Pressing [ESCAPE] will quit the program.

K6L7B3

TEXT BOOK EXERCISES

I. Choose the best answer.

1. Tux paint software is used to _____.
   a) paint b) program
   c) scan d) PDF

2. Which tool bar is used for drawing and editing controls in tux paint software?
   a) Left Side: Toolbar
   b) Right side: Toolbar
   c) Middle: Tool bar
   d) Bottom: Tool bar

3. What is the short cut key for undo option?
   a) Ctrl + Z b) Ctrl + R
   c) Ctrl + Y d) Ctrl + N

4. Tux Math software helps in learning the _____
   a) painting b) arithmetic
   c) programming d) graphics

5. In Tux Math, space cadet option is used for_____.
   a) simple addition b) division
   c) drawing d) multiplication

II. Answer briefly.

1. What is Tux Paint ?
2. What is the use of Text Tool ?
3. What is the shortcut key for Save option?
4. What is Tux Math?
5. What is the use of Ranger ?

GLOSSARY

Acid rain	-	அமிலமழை
Adolescence	-	வளர் இளம் பருவம்
Alimentary cannal	-	உணவுப் பாதை
Anode	-	நேர்மின்வாய்
Artificial respiration	-	செயற்கை சுவாசம்
Bad conductor	-	மின்கடத்தாப் பொருள்
Balanced diet	-	சரிவிகித உணவு
Bone marrow	-	எலும்பு மஜ்ஜை
Cartilages	-	குருத்தெலும்பு
Cathode	-	எதிர்மின்வாய்
Charge	-	மின்துகள்
Chemical equation	-	வேதிச்சமன்பாடு
Chemical formula	-	வேதிவாய்பாடு
Cilia	-	நுண் கேசங்கள்
Colorimeter	-	கலோரிமானி
Condensation	-	ஒடுக்குதல்
Conduction	-	கடத்துதல்
Convection	-	வெப்பச்சலனம்
Cumbustion	-	எரிதல்
Deposition	-	படிதல்
Discharge tube	-	மின்னிறக்கக்குழாய்
Earthing	-	புவித்தொடுப்பு
Electric field	-	மின்புலம்
Electric Potential	-	மின்னழுத்தம்
Electrical discharge	-	மின்னிறக்கம்
Electroplating	-	மின்முலாம் பூசுதல்
Endocrine glands	-	நாளமில்லா சுரப்பிகள்
Endoskeleton	-	உள் எலும்புக்கூடு
Fertilizer	-	உரம்
Friction	-	உராய்வு
Fuel	-	எரிபொருள்
Fuse	-	மின்உருகு இழை
Flagellum	-	கசையிழை
Global warming	-	புவி வெப்பமயமாதல்
Good conductor	-	நற்கடத்தி
Green house effect	-	பசுமை இல்ல விளைவு
Indestructible	-	பிளக்க முடியாத
Induction	-	தூண்டல்
lime water	-	சுண்ணாம்பு நீர்
Magnetic field	-	காந்தப்புலம்
Menopause	-	மாதவிடைவு
Menstruation	-	மாதவிடாய்
Osteoporosis	-	எலும்பு மென்மையாதல்
Ovulation	-	அண்டம் விடுபடுதல்
Pregnancy	-	கர்ப்பமடைதல்
Puberty	-	பருவமடைதல்
Radiation	-	வெப்பக்கதிர்வீச்சு
Refrigerator	-	குளிர்சாதனப்பெட்டி
Resistance	-	மின்தடை
Secondary sex characters	-	இரண்டாம்நிலை பால் பண்புகள்
Segment	-	துண்டு
Skeleton	-	எலும்புக் கூடு
Skull	-	கபாலம்
Specific heat capacity	-	தன் வெப்பஏற்புத்திறன்
Sublimation	-	பதங்கமாதல்
Vacuum flask	-	வெற்றிடக்குடுவை
Variable valency	-	மாறும் இணைதிறன்
Visceral organ	-	உள்ளுறுப்பு

K8P9P9

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