GOVERNMENT OF TAMILNADU

STANDARD EIGHT

TERM - I

VOLUME 3

SCIENCE

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Untouchability is Inhuman and a Crime

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3 years

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- Certified Stock Broker & Investment Analysis
- Certified Financial Analyst
- Certified Financial Planner
- Certified Investment Banker

C.A

CPT
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Law Courses
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- BA+LLB
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- BBM+LLB
- BBA+LLB

JOB / Post Graduation

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 term-I science book has 9 units.
- Each unit has simple activities that can be demonstrated by the teacher and also few group activities are given for 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?

QR GUIDE

- Download the QR code scanner from the google play store/
  apple app store into your smartphone
- Open the QR code scanner application
- Once the scanner button in the application is clicked, camera opens and then bring it closer to the QR code in the textbook.
- Once the camera detects the QR code, a URL appears in the screen. Click the URL and go to the content page.

UNIT 1

MEASUREMENT

Learning Objectives

XDED2K

At the end of this lesson, students will be able to:

- Understand SI units, base quantities and base units.
- Explain the system of units and measurements.
- Analyze the different system of units.
- Know about temperature, amount of substance, electric current and luminous intensity.
- Explore the knowledge of accuracy in measurements.
- Difference between the plane angle and solid angle, different clocks.
- Solve the numerical problems.

Introduction

Physics is the study of nature and natural phenomena. Physics is considered as the base of all science subjects. Physics is based on experimental observations. The principles and observations allow us to develop a deeper understanding of nature. Scientific theories are valid, only if they are confirmed through various experiments.

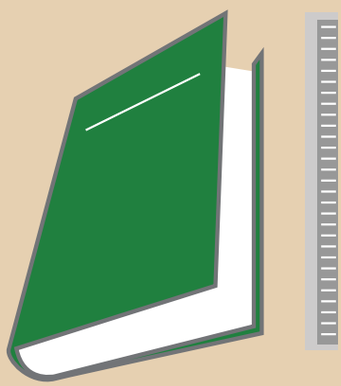
Theories in physics use many physical quantities that have to be measured.

Measurement is the base of all scientific studies and experimentations. It plays a vital role in our daily life. Measurement is the process of finding an unknown physical quantity by using a standard quantity.

We need three things for a perfect measurement. They are (i) an instrument, (ii) a standard quantity and (iii) an acceptable unit.

Activity 1

Students are asked to measure the length and breadth of their science book using a ruler (scale) and compare their measurement with those of their friends.



In this activity, let the length of the book be 15 cm, the length is the physical quantity, ruler is the 'instrument', 15 is the 'magnitude' and 'cm' is the unit. This process is called "Measurement".

Here, all the students will not get the same value. Thus, one can infer that there may be an error while taking the measurement. This lesson helps us to get a better understanding of measurements.

1.1 System of Units

People in various part of the world are using different systems of units for measurement. Some common systems of units are :

1. FPS - System (Foot for length, Pound for mass and Second for time)
2. CGS -System (Centimetre for length, Gram for mass and Second for time)
3. MKS - System (Metre for length, Kilogram for mass and Second for time)

The 'CGS', 'MKS' and SI units are metric systems of units and 'FPS' is not an metric system. It is a British system of units.

1.1.1 International System of Units

In earlier days, scientists performed their experiments and recorded their results in their own system. Due to lack of communication, they couldn't organize other's experimental results. So, the scientists planned to follow a uniform system for taking the measurements.

As you studied in the lower classes, in 1960, in the 11th General Conference on Weights and Measures at Paris in France, the scientists recognized the need of using standard units for physical quantities. That was called as "International System of Units" and is popularly known as SI System (abbreviated from the French name 'Systeme International'). The scientists chose seven physical quantities as 'Base Quantities' and defined a 'Standard Unit' to measure each one. They are known as Base Units or Fundamental Units (Table 1.1)

1.1.2 SI Base Units

Table: 1.1 Base Quantities and Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Temperature	kelvin	K
Electric Current	ampere	A
Amount of Substance	mole	mol
Luminous Intensity	candela	cd

You have already studied about Length, Mass and Time in the lower classes. So, now you are going to study about the other base quantities such as temperature, current, amount of substance and luminous intensity.

In December 1998, the National Aeronautics and Space Administration (NASA), USA launched the Mars Climate Orbiter to collect the data of the Martian climate. Nine months later, on September 23, 1999, the Orbiter disappeared while approaching Mars at an unexpectedly low altitude. An investigation revealed that the orbital calculations were incorrect due to an error in the transfer of information between the spacecraft's team in Colorado and the mission navigation team in California. One team was using the English FPS system of units for calculation, while the other group was using the MKS system of units. This misunderstanding caused a loss of approximately 125 million dollars.

1.2 Temperature

Identify, which of these objects are hot or cold? (Fig 1.1)

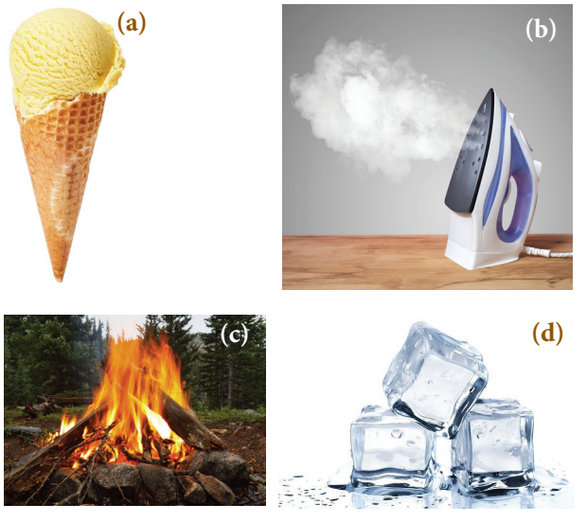


Fig 1.1 - Various Hot and Cold Objects

You can see that some objects are cold, and some are hot. You also know that, some objects are hotter than others while some of them are colder than others.

How do you decide, which is hotter and which is colder? So, you need a reliable quantity to decide the degree of hotness or coldness of an object. That quantity is 'temperature'.

Temperature is a physical quantity that expresses the degree of hotness or coldness of a substance. Heat given to a substance will increase its temperature. Heat removed from a substance will lower its temperature.

1.2.1 Definition

Temperature is a measure of the average kinetic energy of the particles in a system.

The SI unit of Temperature is kelvin. 'Thermometers' are used to measure temperature directly.

Usually, thermometers are calibrated with some standard scales. Celsius, Fahrenheit, Kelvin are the most commonly used scales to measure Temperature.

In these thermometers, melting point of pure ice (0°C) is taken as Lower Fixed Point (LFP) and Boiling point of water (100°C) is taken as Upper Fixed Point (UFP).

Table : 1.2 Various Scales to measure Temperature

Types of Scale	Lower Fixed Point (LFP)	Upper Fixed Point (UFP)	No. of divisions in thermometer
Celsius	0° C	100° C	100
Fahrenheit	32° F	212° F	180
Kelvin	273 K	373 K	100

Activity 2

Measure the room temperature inside the class room and outside the class room by using a thermometer and tabulate it with different time intervals for a week. Do you find any differences in these values? Discuss your observations.

Day	10:00 a.m.		12:00 p.m.		2:00 p.m.		4:00 p.m.	
	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
Day-1								
Day-2								
Day-3								
Day-4								
Day-5								

1.2.2 Conversion of Scales of Temperatures

The general formula for the conversion of scales of temperature is:

$$\frac{C-0}{100} = \frac{F-32}{180} = \frac{K-273}{100}$$

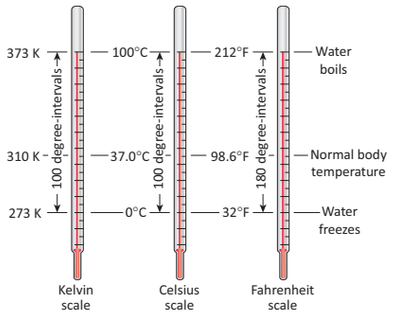


Fig: 1.2 - Various Thermometers

1.2.3 Application of various thermometric scales

1. Physicians use 'clinical thermometers'. It is graduated in 'Fahrenheit Scale'
2. Scientists are using thermometers with kelvin scale.
3. Common temperature measurements are made in celsius scale. (Example: Weather reports are given in celsius scale.)

Info bits

"Normal temperature of the human body is between 98.4° F and 98.6° F"

Infra red thermometer, measures the temperature of an object without any physical contact.

Activity 3

Collect the highest and lowest temperature details of your nearest town or city from the news paper or television for a week and record the values in a tabular column. Does this data remain same throughout the year?

1.3 Electric Current (I)

Flow of electric charges, in a particular direction is known as 'electric current'.

The magnitude of an electric current is the amount of electric charges flowing through a conductor in one second.

$$\text{Total capitalised value of the business} = \frac{\text{Average profit}}{\text{Normal rate of return}} \times 100$$

$$I = \frac{Q}{t}$$

SI unit of Electric Current is 'ampere' and it is denoted as A. Unit of charge is coulomb.

Fig 1.3 - Ammeter

One ampere is defined as one 'coulomb' of charge moving in a conductor in one second. Ammeter is a device used to measure 'electric current'. (Fig 1.3)

More to Know

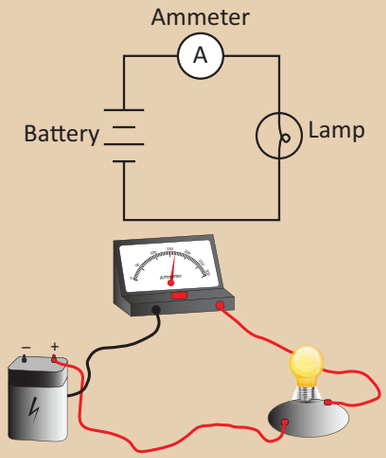
At very low temperature, around 30 K (-243.2° C), some conductors conduct electric current without any loss. These conductors are known as 'SUPER CONDUCTORS'.

The super conductors are used to levitate trains from the track.

Super conductors can be used as memory or storage element in the computers.

Activity 4

Measure the current in an electric circuit.



Components Required:

Battery, Ammeter, Lamp (Bulb)

Procedure:

1. Connect the battery, ammeter and the lamp in series as shown in the figure.
2. Note the ammeter reading
3. It is the current in the circuit

1.4 Amount of substance

Can you count the number of copper coins in the picture? (Fig 1.4)

Can you count the number of copper atoms in a coin? (Fig 1.4)

M6M2GC

It is very difficult to count the number of atoms because the atoms are not visible. There is an indirect method to count the number of atoms or molecules in a substance in multiples of mole. Let us see in detail.

Fig 1.4 - Copper Coins

Amount of substance is a measure of the number of entities (particles) present in a substance. The entity may be an atom, molecule, ion, electron or proton etc.

Generally, the amount of substance is directly proportional to the number of atoms or molecules.

The SI unit of amount of substance is mole and it is denoted as 'mol'.

Mole is defined as the amount of substance, which contains 6.023×10^{23} entities.

More to Know

The number 6.023×10^{23} is also known as Avogadro Number.

1.5 Luminous Intensity

Fig 1.5 (a & b) - Photometer in day to day life

Have you seen these scenes on the television? (Fig 1.5)

What is the umpire doing? Is he taking a 'selfie' ? (Fig 1.5)

No, he is checking the intensity of light, as perceived by the human eye, by using an instrument called 'Photometer'.

1.5.1 Definition

The measure of the power of the emitted light, by a light source in a particular direction, per unit solid angle is called as Luminous Intensity.

The SI unit of luminous intensity is candela and is denoted as 'cd'.

Fig 1.6 - Photometer

The light emitted from a common wax candle is approximately equal to one candela

Luminous intensity is measured by a 'photometer' (Fig 1.6) (Luminous Intensity Meter) which gives the luminous intensity in terms of candela directly.

Info bits

Luminous Flux or luminous power is the measure of the perceived power of light. Its SI unit is 'lumen'.

One lumen is defined as the luminous flux of the light produced by the light source that emits one candela of luminous intensity over a solid angle of one steradian.

1.6 Plane angle

It is the angle between the intersection of two straight lines or intersection of two planes. (Fig 1.7)

The SI unit of Plane Angle is 'radian' and is denoted as 'rad'.

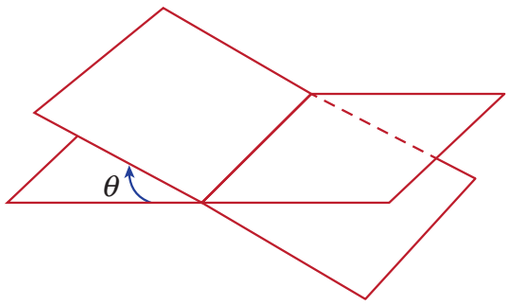


Fig 1.7 - Plane Angle

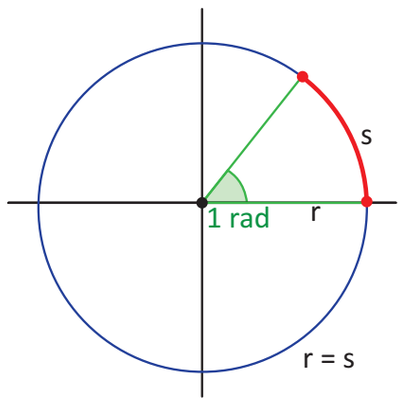


Fig 1.8 - Radian

Radian is the angle subtended at the centre of a circle by an arc whose length is equal to the radius of the circle. (Fig 1.8)

π radian = 180°

1 radian = $\frac{180°}{\pi}$

1.7 Solid Angle

It is the angle formed by three or more planes intersecting at a common point.

It can also be defined as 'angle formed at the vertex of the cone'

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The SI unit of solid angle is 'steradian' and is denoted as 'sr'.

1.7.1 Definition

Steradian is the solid angle at the centre of a sphere subtended by a portion whose surface area is equal to the square of its radius of the sphere. (Fig 1.9)

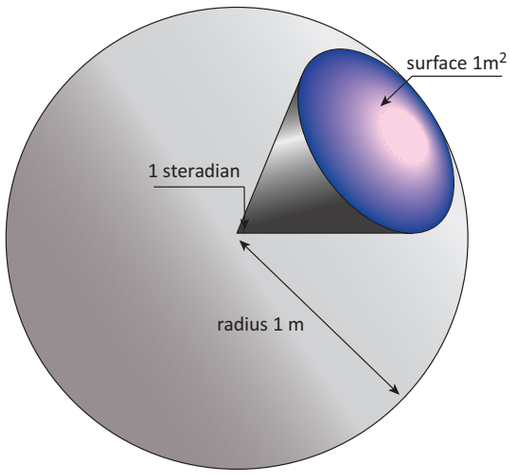


Fig 1.9 - Steradian

DO YOU KNOW?

Until 1995, Plane Angle and Solid Angle were classified under supplementary quantities. In 1995, they were shifted to derived quantities.

Table: 1.3 Difference between Plane Angle and Solid Angle

Plane Angle	Solid Angle
Angle between the intersection of two lines or planes	Angle between the intersection of three or more planes at a common point
It is two dimensional	It is three dimensional
Unit is radian	Unit is steradian

1.8 Clocks

Clocks are used to measure time intervals. So, many clocks were used from the ancient time. Scientists modified the clock's mechanism to obtain accuracy.

Fig 1.10 - Ancient Clock

1.8.1 Types of clocks based on display:

1. Analog clocks; 2. Digital clocks

1. Analog clocks

Fig 1.11 - Analog Clock

It looks like a classic clock. It has three hands to show the time. (Fig 1.11)

Hours Hand: It is short and thick. It shows 'hour'.

Minutes Hand: It is long and thin. It shows 'minute'.

Seconds Hand: It is long and very thin. It shows 'second'. It makes one rotation in one minute and 60 rotations in one hour.

Analog clocks can be driven either mechanically or electronically.

Activity 5

Students must make a model of an Analog clock using a cardboard.

2. Digital clocks

A **digital clock** displays the time directly. It shows the time in numerals or other symbols. It may have a 12 hours or 24 hours display. (Fig 1.12)

Recent clocks are showing Date, Day, Month, Year, Temperature etc.

Digital clocks are often called as Electronic Clocks.

Fig 1.12 - **Digital Clock**

Activity 6

Students must make a model of a digital clock using match sticks on a cardboard, with date and time.

1.8.2 Types of clocks based on working mechanism

1. Quartz Clock:

These clocks are activated by 'electronic oscillations', which are controlled by a 'quartz crystal'. (Fig 1.13)

The frequency of a vibrating crystal is very precise. So, the quartz clock is more accurate than the mechanical clock.

These clocks have an accuracy of one second in every 10^9 seconds.

Fig 1.13 - **Quartz Clock**

More to Know

The principle of a quartz clock is the Piezo - electric property of a crystal. Piezo-electric property means that when a pressure is applied along a particular axis of a crystal, an electric potential difference is developed in a perpendicular axis.

In the reverse piezo-electric effect, a crystal becomes mechanically stressed when a voltage is applied across its opposite faces.

2. Atomic Clock:

These clocks are making use of periodic vibrations occurring within the atom. (Fig 1.14)

These clocks have an accuracy of one second in every 10^{13} seconds.

Atomic clocks are used in Global Positioning System (GPS), Global Navigation Satellite System (GLONASS) and International time distribution services.

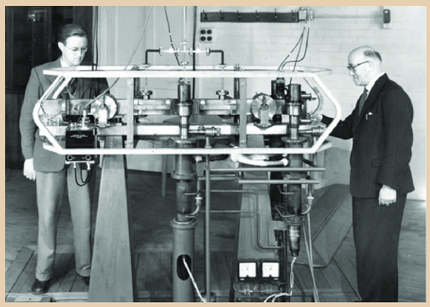
Fig 1.14 - **Atomic Clock**

BYUQV4

More to Know

The first atomic clock was developed in 1949 at the US National Bureau of Standards. But, it was less accurate than the quartz clock.

The first accurate atomic clock (based on Caesium - 133) was built by Lauis Essan and Jack Penny in 1955, at the National Physics Laboratory in the United Kingdom.



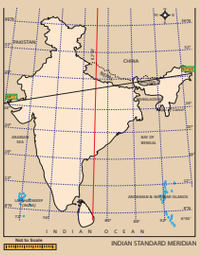
Activity 7

You may know about the 'Sun Dial'. Construct a sundial of your own and read out the values from morning to evening. Compare your values with modern clocks.

DO YOU KNOW?

Greenwich Mean Time (GMT) is the mean solar time at the Royal Observatory, located at Greenwich in London. It is measured at the longitude of zero degree.

The Earth is divided into 24 zones, each of a width of 15 degree longitude. These regions are called as 'Time Zones'. Time difference between two adjacent time zones is 1 hour.



Indian Standard Time (IST):

The location of Mirzapur in Uttar Pradesh is taken as the reference longitude of the Indian Standard Time. It is located at 82.5 degree longitude.

IST = GMT + 5:30 hours

1.9 Accuracy in Measurements

Measurement is the base of all experiments in science and technology. The value of every measurement contains some uncertainty. These uncertainties are called as 'Errors'.

The difference between the real value and the observed value is called an error.

1.9.1 Accuracy

NVGKJZ

Accuracy is the closeness of a measured value to the actual value or true value. (Fig 1.15)

1.9.2 Precision

Precision is the closeness of two or more measurements to each other. (Fig 1.15)

1.10 Approximation

Activity 8

Observe the 'Rasam making' process in your home. Ask your elders and try to answer the following questions:
The rasam is made for how many persons?
How could you increase the taste?
How much of salt has to be added?
Is there any prescribed standard for taking the ingredients?

We are not following any standard values for preparing a dish. We are following an approximation method for choosing ingredients.

While we prepare a dish, the ingredients are taken approximately.

Approximation is the process of finding a number, which is acceptably close to the exact value of the measurement of a physical quantity.

Fig 1.15 - Accuracy and Precision

It is an estimation of a number obtained by rounding off a number to its nearest place value.

When the data are inadequate, physicists are in need of an approximation to find the solution for problems. Approximations are usually based on certain assumptions having a scientific background and they can be modified whenever accuracy is needed.

Activity 8

Calculate the approximate 'heart beat' of a man in a day. (Hint: Take number of heart beats per minute as 75, approximately)

1.11 Rounding off

Calculators are widely used in day to day life to do the calculations. The result given by a calculator has too many digits. Hence, the result containing more digits should be rounded off. The technique of rounding off is used in many areas of physics.

1.12.1 Rules for rounding off

- Decide which is the last digit to keep.
- Leave it the same, if the next digit is less than 5.
- Increase it by one, if the next digit is 5 or greater than 5.

Thinking Corner:

Since, the true value is also an observed value then what is meant by true value? Think and discuss it with your friends?

1.12 Numerical Problems:

1. Convert 80° C into kelvin.

   Solution:

   $K = C + 273$

   $K = 80 + 273$

   $K = 353$ kelvin

2. Convert 300 K into celsius.

   Solution:

   $C = K - 273$

   $C = 300 - 273$

   $C = 27$ celsius.

3. When 2 coulomb of charge, flows through a circuit for 10 seconds, calculate the current?

   Solution:

   Given: Charge Q = 2 C; time t = 10 s

   $I = \frac{Q}{t}$ or $I = \frac{2}{10}$

   $I = 0.2$ A

4. Convert 60° into radian.

   $1° = \frac{\pi}{180}$

   $60° = \frac{\pi}{\cancel{180}_{3}} \times \cancel{60}$

   $= \frac{\pi}{3}$ radian

5. Convert $\frac{\pi}{4}$ into degrees.

   π radian = 180°

   $\frac{\pi}{4}$ radian $= \frac{180}{4} = 45°$

6. Round off the number 1.864 to two decimal places

   Step: 1 Identify the last digit to be kept. 6 is the last digit to be kept.

   Step: 2 The following digit, i.e. 4 is less than 5. So, retain it as 6. The answer is 1.86

7. Round off the number 1.868 to two decimal places

   Step: 1 Identify the last digit to be kept. 6 is the last digit to be kept.

   Step: 2. The following digit, i.e. 8 is greater than 5. So, increase 6 by one. The answer is 1.87

Points to remember

- SI units - International System of units, introduced in the 14th General Conference on Weights and Measure in 1971.
- Base quantities: Length, Mass, Time, Temperature, Electric current, Amount of substance & Luminous Intensity - 7 quantities.
- Temperature: Measure of hotness or coldness of a substance - average kinetic energy of the particles in a system - its unit is 'kelvin'.
- Electric current: Flow of electric charges (electrons) in a unit time - unit: ampere
- Amount of substance: Measure of number of entities (Particles) present in a substance - unit: mole.
- Luminous Intensity: Amount of light emitted by a light source in a particular direction per unit time - unit: candela.
- Plane angle : Angle between the intersection of two lines or planes - unit: radian.
- Solid angle: Angle between the intersection of three or more planes - unit: steradian
- Quartz clock : uses the 'electronic oscillations' controlled by a 'quartz crystal'.
- Atomic clock: uses the 'periodic vibrations occurring within the atom'.
- Accuracy: closeness of a measured value to the actual value.
- Precision: closeness of two or more measurements to each other.
- Approximation: Process of finding the solution by means of 'estimation'.

TEXT BOOK EXERCISES

DNP9YR

Choose the best answer

1. Which one the following system of units is the British System of unit?
   a) CGS b) MKS
   c) FPS d) SI

2. Electric current belongs to _____ quantities
   a) base
   b) supplementary
   c) derived
   d) professional

3. SI unit of temperature is
   a) celsius b) fahrenheit
   c) kelvin d) ampere

4. Amount of substance is
   a) directly proportional to the number of atoms
   b) inversely proportional to the number of atoms
   c) directly proportional to the square of number of atoms
   d) inversely proportional to the square of number of atoms

5. Luminous intensity is the intensity of
   a) Laser light
   b) UV light
   c) visible light
   d) IR light

6. Which one of the following devices is used to measure electric current

a) 

b) 

c) 

d) 

7. SI unit stands for
   a) International system of units
   b) Integrated System of units
   c) International symbol of units
   d) Integrated symbol of units

8. Closeness of two or more measured values is called as
   a) accuracy b) precision
   c) error d) approximation

9. Quantities other than base quantities are called as
   a) supplementary quantities
   b) derived quantities
   c) professional quantities
   d) energy quantities

10. Which of the following statements about approximation is wrong?
    a) Approximation gives accurate value.
    b) Approximation simplifies the calculation.
    c) Approximation is very useful when little information is available.
    d) Approximation gives the nearest value only.

II. Fill in the blanks.

1. The solid angle is measured in _____.
2. _____ recognized the need of 'Standard Units' for physical quantities.
3. The coldness or hotness of a substance is expressed by _____.
4. _____ is used to measure electric current.
5. _____ of substance, contains $6.023 \times 10^{+23}$ atoms or molecules.
6. Luminous Intensity is the amount of visible light, that is emitted in unit area per unit _____.
7. Quartz clock uses _____ oscillations.
8. The uncertainty in measurement is called as _____.
9. _____ is the closeness of the measured value to the original value.
10. The intersection of two straight lines gives us_____.

III. True or False.

1. SI units are metric system of units.
2. Temperature is a measure of total kinetic energy of the particles in a system.
3. In thermometers, freezing point of water is taken as the Upper Fixed Point.
4. One coulomb of charge flowing per minute is called 'ampere'.
5. Amount of substance gives the number of particles present in the substance.
6. Intensity of light from a candle is approximately equal to one 'candela'.
7. Angle formed at the top of a cone is an example of 'Plane Angle'.
8. Quartz clocks are used in GPS Devices.
9. Candela is used to express electric field intensity.
10. The number 4.582 can be rounded off as 4.58 .

IV. Match the following:

Column A			Column B
1.	Temperature	a	Closeness to the Actual Value
2.	Plane Angle	b	Measure of hotness or coldness
3.	Solid Angle	c	Closeness to two or more measurements
4.	Accuracy	d	Angle formed by the intersection of three or more planes
5.	Precision	e	Angle formed by the intersection of two planes

V. Assertion & Reason.

1. Direction: Mark the correct choice as
   a. If both assertion and reason are true and 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. Assertion is true, but reason is false.
   d. Assertion is false, but reason is true.

1. **Assertion:** The SI system of units is the suitable system for measurements.
   Reason: The SI unit of temperature is kelvin.
2. **Assertion:** Electric current, amount of substance, Luminous Intensity are the fundamental physical quantities.
   Reason: They are independent of each other.
3. **Assertion:** The seconds hand of a clock is having least count of one second.
   Reason: Least count is the maximum measurement that can be measured accurately by an instrument.
4. **Assertion:** Avogadro's number is the number of atoms in one mole of substance.
   Reason: Avogadro's number is a constant
5. **Assertion:** Radian is the unit of solid angle.
   Reason: One radian is the angle subtended at the centre of a circle by an arc of length equal to its radius.

VI Answer in a word or two (Very Short Answer):

1. What is the unit of mass in FPS system?
2. How many base quantities are included in SI system?
3. Give the name of the instrument used for the measurement of temperature.
4. What is the 'Lower Fixed Point' of the Fahrenheit scale?
5. What is the SI unit of Luminous Intensity?
6. What is the value of Avogadro's number?
7. What type of oscillations are used in atomic clocks?
8. Mention the types of clocks based on their display.
9. How many times will the 'minute hand' rotate in one hour?
10. How many hours are there in a minute?

VII Answer the questions given below (Short Answer):

1. What is measurement?
2. Name some common systems of measurement.
3. Define- Temperature.
4. Define - ampere.
5. What is electric current?
6. What is luminous Intensity?
7. Define - mole.
8. What are the differences between Plane angle and solid angle?

9. What are errors?

VIII Answer in detail:

1. List out the base quantities with their units.
2. Write a short note on different types of clocks.

IX Higher Order Thinking Question:

1. Your friend was absent yesterday. You are enquiring about his absence. He told, he was affected by a fever of 100°C and went to a hospital for treatment. Is it possible of 100°C fever? If it is wrong, try to make him to understand his mistake.

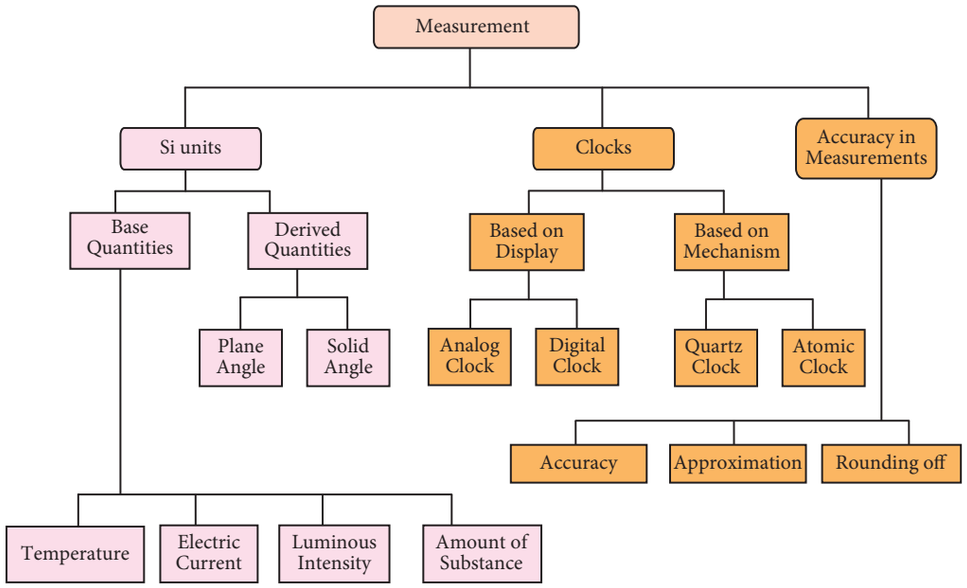
REFERENCE BOOKS

1. Units and measurements – John Richards, S. Chand publishing, Ram nagar, New Delhi.
2. Units of Measurement - Past, Present and Future. International System of Units - Gupta, S. V. eBook ISBN 978-3-642-00738-5 DOI 10.1007/978-3

GLOSSARY

Kinetic energy	energy of moving objects
Calibration	process of configuring an instrument in a particular range
Electronic Oscillation	oscillations produced by an electronic circuit
Quartz Crystal	crystal formed by Silicon and Oxygen (SiO_2)
Potential Difference	the difference in potential between two points in an electric field or electric circuit.

Mind Map



ICT CORNER

Measurement


History of timekeeping devices

From Wikipedia, the free encyclopedia

For thousands of years, devices have been used to measure and keep track of time. The curr measurement dates to approximately 2000 BC from the Sumerians.

The Egyptians divided the day into two 12-hour periods, and used large obelisks to track the water clocks, which were probably first used in the Precinct of Amun-Re, and later outside Eg by the Ancient Greeks, who called them clepsydrae. The Zhou dynasty is believed to have us same time, devices which were introduced from Mesopotamia as early as 2000 BC.

Other ancient timekeeping devices include the candle clock, used in ancient China, ancient Ja timestick, widely used in India and Tibet, as well as some parts of Europe; and the hourglass, clock. The sundial, another early clock, relies on shadows to provide a good estimate of the h cloudy weather or at night and requires recalibration as the seasons change (if the gnomon w

The earliest known clock with a water-powered escapement mechanism, which transferred ro dates back to 3rd century BC in ancient Greece;[6] Chinese engineers later invented clocks inc mechanisms in the 10th century;[7] followed by Iranian engineers inventing water clocks driver

This activity enables the students to learn about the various types of Time keeping devices

Steps

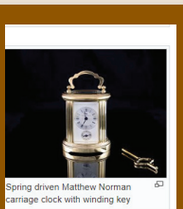
- Open the Browser and type URL link given below (or) Scan the QR Code.
- Click and select the "History of time keeping devices"
- Options will be given. Select any content (Eg) Digital clock
- It gives clear understanding of the "History of time keeping devices"


Uses of digital clocks [edit]

This digital clock has been attached to an oven.

Step1

Step2


Spring driven Matthew Norman carriage clock with winding key

Step3


Simple horizontal sundial

Step4

Web link: scan the QR Code

*Pictures are indicative only

B359_8_SCIENCE_EM

UNIT 2

FORCES AND PRESSURE

Learning Objectives

QKB4NM

After learning this unit, students will be able to:

- Understand the concept of force and its effects.
- Differentiate thrust and pressure.
- Understand pressure and its application.
- Understand the relation between force and pressure.
- Understand the characteristics of atmospheric and liquid pressure.
- State Pascal's law and know its applications.
- Apply Pascal's law in day to day life.
- Know the instrument used to measure atmospheric and liquid pressure.
- Understand the property of surface tension and viscosity.
- Analyze friction in rest and motion.
- Know the ways to increase and decrease the friction.
- Solve numerical problems related to force and pressure.

Introduction

Every day you can observe bodies around you. When you are coming to school, you can notice that some of them are moving, some of them are at rest. What pushes or pulls them? What brings the moving bodies to rest? What is the effect of these pulls or pushes?

All the above questions can be answered by saying just one word, which is "Force".

2.1 FORCE

Observe the following actions in day to day life:

Opening up a pen, opening a door, kicking a football, striking a carrom coin, making of chapattis etc., all these actions need a force. Force is an 'action of push or pull', which makes the bodies to move or brings the moving bodies to rest. It even changes the shape and size of certain bodies.

Activity 1

Make two groups of students. Let them stand along a straight line, one behind the other, on a playground. Start the game of "tug of war" with a rope. Observe the movement of the students.

Who are the winners?

The group of students who pull the rope with a greater force will definitely win. The winners are applying a greater amount of force. Hence, the rope moves in the direction of the greater force.

2.1.1 Definition of force

Force is that which changes or tends to change: i) the state of rest or ii) the state of uniform motion of a body or iii) the direction of a moving body or iv) the shape of a body.

Pushes and pulls are forms of forces. The direction of a force is in the direction in which a push or a pull is applied. Thus, force is a vector quantity, which has magnitude and direction. It is measured with a unit called "newton (N)".

2.1.2 Factors on which a force depends

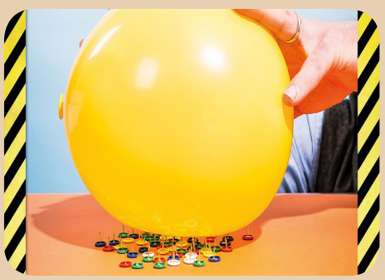
You have studied the effects of force so far. Now, you are going to study the factors on which the effect of a force actually depends.

When you play any game, the greater the force you apply on a body, greater will be its effect on it. Just observe the strokes of the bat by a batsman. If he wants to hit the cricket ball to the boundary, the striking force on the ball must be greater.

Now, the question before you is does it depend on the area of impact?

Activity 2

Fix a matrix of sharp pins on a wooden board in rows and columns. Take a big blown up balloon. Next, place it gently over the pins. Place a small book on the top of the balloon. Will the balloon burst? Will the pins prick the balloon?



Inference: It is a wonderful sight to see that the balloon will not burst. How is this possible?

Reason: If you prick the blown up balloon with a single pin it will burst. But, this did not happen even though many more pins were pricking the balloon.

A single pin produces a large pressure over a small area. But, when a large number of pins prick a body, each pin exerts very little pressure on the balloon, as the applied force gets distributed over a larger surface of the body. So, the balloon will not burst.

We conclude that the effect of a force depends on the magnitude of the force and the area over which it acts.

2.1.3 Thrust

It is a force acting perpendicularly on any given surface area of a body. It is measured by the unit newton.

2.1.4 Pressure

The effect of force can be measured using a physical quantity called pressure. It can be defined as the amount of force or thrust acting perpendicularly on a surface of area one square meter of a body. Unit of pressure is pascal (Pa) or N m^{-2}.

Pressure = $\frac{\text{Thrust (or) Force}}{\text{Area}}$, $P = \frac{F}{A}$. The SI unit of pressure is pascal (named after the French scientist Blaise Pascal). 1 pascal = 1 N m^{-2}

Pressure exerted by a force depends on the magnitude of the force and the area of contact.

SOLVED PROBLEM: 2.1

Calculate the pressure exerted by the foot of an elephant using the following data. Average weight of an elephant is 4000 N. Surface area of the sole of its foot is 0.1m^2 .

Solution:

Average weight of the elephant = 4000 N

Weight of one leg = force exerted by one leg = 4000/4 = 1000 N

Area of the sole of one foot = 0.1 m^2.

Pressure = $\frac{\text{Force}}{\text{Area}} = \frac{1000}{0.1}$

$$= 10000 \ \frac{N}{m^2} = 10^4 \ N \ m^{-2}$$

Pressure exerted by one leg of the elephant is 10,000 newton on one square metre.

Increasing pressure:

The effect of pressure can be increased by increasing the thrust or by decreasing the area of the surface of the body experiencing the thrust.

Examples:

The axe, nail, knife, injection needle, bullet etc., all these are having sharp fine edges so as to exert a larger pressure on a smaller area of the body; in order to get the maximum effect from them.

It is very difficult to walk on sand. But, camels can walk easily on it because they have large padded feet, which increase the area of contact with the sandy ground. This reduces the pressure and enables them to walk easily on the sand.

Examples:

1. More number of wheels are provided for a heavy goods-carrier for decreasing the pressure; thereby increasing the area of contact on the road.
2. Broader straps are provided on a back-pack for giving a lower pressure on the shoulders by providing a larger area of contact with the shoulder.
3. It is difficult to drive an automobile, which has flattened tyres.

Figure 2.1 Broader straps

2.2 PRESSURE EXERTED BY AIR - ATMOSPHERIC PRESSURE

You all know very well that air fills the space all around us. This envelope of air is called as atmosphere. It extends up to many kilometres above the surface of the Earth. All objects on the surface of the Earth experience the thrust or force due to this atmosphere.

The amount of force or weight of the atmospheric air that acts downward on unit surface area of the surface of the Earth is known as **atmospheric pressure**. It can be measured using the device called **barometer**. The barometer was invented by "Torricelli".

Atmospheric pressure decreases with altitude from the surface of the Earth.

Atmospheric pressure can be measured by the height of the mercury column in a barometer. The height of the mercury column denotes the atmospheric pressure at that place at a given time in 'millimetre of mercury'. Even if you tilt the tube at various angles, you will see that the level of mercury will not vary. At sea level, the height of the mercury column is around 76 cm or 760 mm. The pressure exerted by this mercury column is considered as the pressure of magnitude 'one atmosphere' (1 atm).

More to know

Cooking in a place located at a higher altitude is difficult. Why?

At a higher altitude, due to the lack of atmospheric pressure the boiling point of a substance reduces. So, the water boils even at 80° C. At this temperature, the thermal energy that is produced is not sufficient enough for baking or cooking. So, cooking is difficult at higher altitude.

1 atmospheric pressure = 1 atm = pressure exerted by the mercury column of height 76 cm in the barometer = 1.01×10^5 N m^{-2}.

In the SI system 1 atm = 1,00,000 pascal (approximately).

SI unit of atmospheric pressure is Nm^{-2} or pascal.

To realise the effect of atmospheric pressure:

Activity 3

Take a conical flask. Take a well boiled egg, after removing its shell. Place the egg on the mouth of the flask. It will not enter the flask. Next, take a piece of paper. Burn it and drop it inside the flask. Wait for a few seconds; let it burnt fully. Now, keep the egg on the mouth of the flask. Wait for a few minutes. What did you observe?

Inference: The egg placed at the mouth of the flask gets compressed and it falls into the flask, due to the atmospheric pressure.

Reason: When the paper is burning in the flask, the oxygen present in the air inside the conical flask is used up for its combustion. This reduces the pressure of the air in the flask. The air in the atmosphere tends to occupy the low pressure region in the flask. So, it rushes through the mouth of the flask, thus pushing the egg into the flask. Eventually, the egg falls down to the bottom of the flask.

2.3 FORCES IN LIQUIDS

2.3.1 Buoyant force of a liquid

An upward force is exerted by water on a floating or a partly submerged body. This upward force is called **buoyant force**. The phenomenon is known as "buoyancy". This force is not only exerted by liquids, but also by gases. Liquids and gases together are called fluids.

This upward force decides whether an object will sink or float. If the weight of the object is less than the upward force, then the object will float. If not, it will sink.

A body floats if the buoyant force > its weight; A body sinks if its weight > buoyant force.

2.3.2 Pressure exerted by liquids

Liquids do not have a definite shape. The force acting on unit area of the surface, on which the liquid is placed, is called the static pressure of the liquid. Liquids exert a pressure not only on the base of their container/vessel, but also on its side walls. The pressure exerted by a liquid depends upon the depth of the point of observation considered in it.

An instrument used to measure the difference in the liquid pressure is called a "manometer". You can measure the pressure of fluids enclosed in a definite container using the manometer.

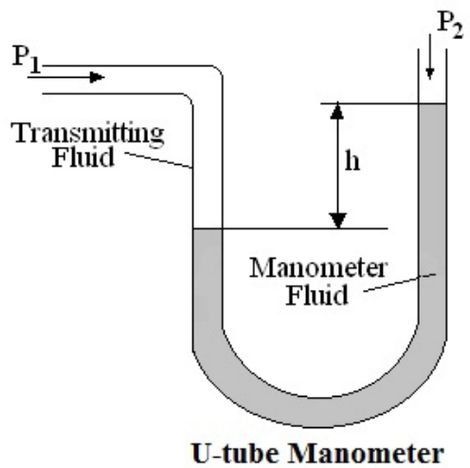


Figure 2.2 Manometer

a) Pressure exerted by a liquid on the base of a container depends upon the height of the liquid column:

Activity 4

Take a glass tube that is open at both ends. Fix a rubber balloon at the lower end of the tube. Put some water into the tube and observe the balloon. Now, pour some more water into the balloon and again observe the balloon.

Inference: The balloon starts bulging outwards. The bulge increases with an increase in the height of the water column.

Reason: The pressure exerted by a liquid at the bottom of a container depends on the height of the liquid column in it.

You have already studied that the atmospheric pressure is measured in terms of the height of the mercury column in a barometer.

b) Liquids exert the same pressure in all directions at a given depth:

c) Liquid pressure varies with the depth:

Activity 5

Take a plastic bottle. Punch three holes on its sides at the same height from its base. Now, pour some water into it and let it flow through the holes. Observe the flow of the water.

Inference: The water comes out from all the holes with the same force and falls on the ground/table, at the same distance from the bottle.

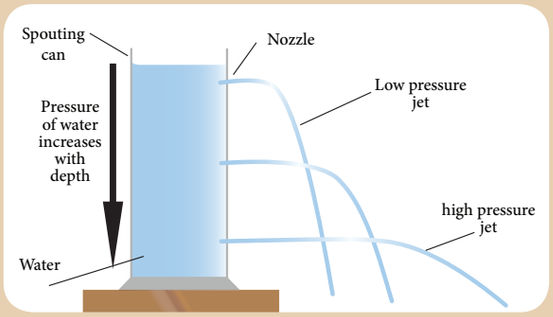
Reason: This activity confirms that liquids exert the same pressure in all directions, at a given depth in their container.

Activity 6

Take a plastic bottle. Punch three holes on its side in the same direction, but at different heights. Now pour some water into it and let it flow through the holes. Observe the flow of water.

Inference: The water comes out from all the holes with a different force and falls on the table at points that are at variable distances from the bottle. Water from the lowest hole comes out with the greatest force and falls at a point that is at the maximum distance from the bottle. Water from the topmost hole comes out with the least force and falls at the point that is at the minimum distance from the bottle.

Reason: This activity confirms that the pressure in a liquid varies with the depth of the point of observation in it.



Thinking Corner

Why dams are made stronger and thicker at the bottom than at the top?

Why do scuba divers wear a special suit while they go into deep sea levels?

Home Assignments

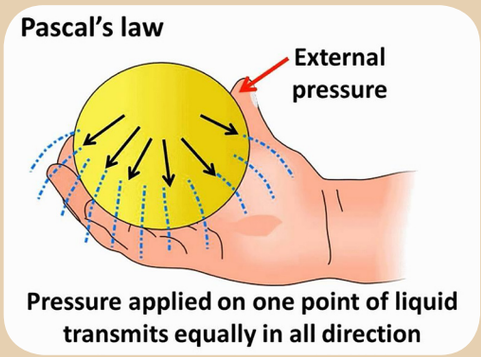
1. Ask your family doctor how blood pressure is to be measured?
2. Read the life history of Blasie Pascal.

Activity 7

Take a rubber ball. Fill it with water. Then, make tiny holes on it with a pin at different points on its surface. Press anywhere on the ball. What do you observe?

Inference: There are identical streams of water flowing in all directions from the holes.

Reason: This is due to the phenomenon that the pressure, which is applied on the liquid, is equally transmitted in all direction. This concept was first given by the French scientist Blasie Pascal.



2.3.3 Pascal's law:

The pressure applied at any point of a liquid at rest, in a closed system, will be distributed equally through all regions of the liquid.

2.3.4 Application of Pascal's law:

Some of the following examples highlight their working according to Pascal's law.

- In an automobile service station, the vehicles are lifted upward using the hydraulic lift, which works as per Pascal's law.
- The automobile brake system works according to Pascal's law.
- The hydraulic press is used to make the compressed bundles of cotton or cloth so as to occupy less space.

Activity 8

Fill two identical syringes with water. Connect them with a plastic tube. Press gently on one end of a piston. What do you observe?

Inference: If one piston is pressed downward, then the other piston will move up slightly, depending on the pressure given on the first piston.

Reason: This activity confirms that the pressure exerted on a liquid at rest is transmitted equally to other portions of the liquid.

2.4 SURFACE TENSION

Thinking Corner

- Why are rain drops spherical in nature?
- A liquid flowing out of a very small opening of a tube or tap comes out in the form of fine drops and not as a continuous stream. Why?
- Trees are greenish. They are greenish at the tip too. How does the water rise upward in a tree or plant against the force of gravity?

All the above questions have an answer, i.e., **"due to surface tension"**.

Surface tension is the property of a liquid. The molecules of a liquid experience a force, which contracts the extent of their surface area as much as possible, so as to have the minimum value. Thus, the amount of force acting per

unit length, on the surface of a liquid is called surface tension. It has the unit N m^{-1} .

Activity 10

Take a paper clip. Take a beaker of water. Take a tissue paper and spread it on the surface of the water. Gently, place the paper clip on the tissue paper. Observe what happens to the paper pin after some time.

Inference: After a few moments the tissue paper will submerge and the paper clip will make a small depression on the surface of the water. It will instantly begin to float on the surface, even though it is denser than water.

Reason: This is due to the water molecules on the surface, which tend to contract themselves like the molecules of an elastic membrane. A force exists on them, which tends to minimize the surface area of water. The paper clip is balanced by the molecules on the water surface that is now behaving like a stretched elastic membrane. So, it does not submerge.

2.4.1 Application of surface tension:

- Water molecules rise up due to surface tension. Xylem tissues are very narrow vessels present in plants. Water molecules are absorbed by the roots and these vessels help the water to rise upward due to "capillarity action" (you will study this topic in the forth-coming classes), which is caused by the surface tension of water.
- For a given volume, the surface area of a sphere is the minimum. This is the reason for the liquid drops to acquire a spherical shape.
- Water strider insect slides on the water surface easily due to the surface tension of water.
- During a heavy storm, sailors pour soap powder or oil into the sea near their ship to decrease the surface tension of sea water. This process reduces the impact of the violent water current against the all of ship.

Figure 2.3 Water strider

2.7 VISCOUS FORCE OR VISCOSITY

Activity 11

Take a small quantity of different kinds of liquid like coconut oil, honey, water and ghee etc., in a cup. Place one drop of each liquid on a separate glass plate. Next, gently raise one end of the glass plate, one by one, so as to allow the liquid to slide down the smooth surface of the plate. Observe the speed of each liquid.

Inference: Each liquid moves with a different speed. Water flows faster than other liquids. Coconut oil flows with a moderate speed. Ghee flows very slowly.

Reason: Between the layers of each liquid, in motion, there is a frictional force parallel to the layers of the liquid. This frictional force opposes the motion of the liquid layers while they are in motion.

Definition:

When a liquid is flowing, there is a frictional force between the successive layers of the liquid. This force which acts in order to oppose the relative motion of the layer is known as viscous force. Such a property of a liquid is called viscosity.

Viscosity force is measured by the unit called poise in CGS and kg m^{-1} s^{-1} or N s m^{-2} in SI.

2.6 FRICTION

Thinking Corner

Ram is a good student. But, sometimes he does not care about the cleanliness of his surroundings. Once, he got bananas from his mother. After eating them he just threw the peels of banana on the path of his house. When his brother crossed the path, unknowingly he kept his leg on them. He fell down with a scream. Ram rushed out and helped him. This incident occurred because of his negligence. He realised his mistake. He took the peels of banana and put them in the dustbin.

He then asked himself how the peels of banana had made his brother slide over the path. Could you help him?

Reason: Ram's brother falls down due to the lack of friction between his feet and the banana peels.

You have studied that forces are classified into two types: contact force and non-contact force. Now, you are going to study one of the contact forces, i.e., **friction**.

It is easy to hold a tumbler due to the friction between the surfaces of your palm and the tumbler. But, when oil is applied to your palm, the contact force between your fingers and the tumbler is reduced. So, the friction is reduced. Hence, it is difficult to hold it with an oily hand.

2.6.1 Origin of friction

Frictional force or friction arises when two or more bodies in contact move or tend to move, relative to each other. It acts always in the opposite direction of the moving body. This force is produced due to the geometrical dissimilarities of the surface of the bodies, which are in relative motion.

2.6.2 Effects of friction:

Friction can produce the following effects:

a) Friction opposes motion.

b) Friction causes wear and tear of the surfaces in contact.

c) Friction produces heat.

2.6.3 Types of friction:

Friction can be classified into two basic types: static friction and kinetic friction.

Static friction: The friction experienced by the bodies, which are at rest is called static friction. (E.g.: all the objects rigidly placed to be at rest on the Earth, a knot in a thread.)

Kinetic friction: Friction existing during the motion of bodies is called kinetic friction.

Further, kinetic friction can be classified into two: sliding friction and rolling friction.

Sliding friction: When a body slides over the surface of another body, the friction acting between the surfaces in contact is called sliding friction.

Rolling friction: When a body rolls over another surface, the friction acting between the surfaces in contact is called rolling friction.

Rolling friction is less than sliding friction. That is why wheels are provided in vehicles, trolleys, suitcases etc.

Activity 12

Push or slide a book on a rough surface. It is difficult to push it. Isn't it? Now, keep some cylindrical pencils underneath the book. Again, push it. It is easy to move the book. Why?

Reason: When you push the book, the pencils roll in the direction of the applied force. They prevent the contact of the book

with the rough surface. Rolling pencils offer the least amount of friction. So, it is easy to displace the book in comparison with sliding it on the table.

This method is often used in moving heavy wood from one place to another.

2.6.4 Factors affecting friction

a) Nature of a surface:

Activity 13

Arrange some notebooks one over the other to form a platform, on a table. Keep a wide scale, as a slide, such that one of its ends rests on the pile of books. Take different kinds of materials like cotton cloth, plastic paper, newspaper, writing pad etc. Place some glass marbles in a bowl placed on the table.

First, keep a rectangular piece of paper near the end of the scale, which is in contact with the table. Now, release a glass marble from the top end of the scale such that it rolls down the scale. Allow the marble to roll over the piece of paper and finally, come to rest.

Measure the distance travelled by the marble over the paper, using the meter scale. Replace the 'rolling surface' by placing the plastic sheet, wooden plank, cotton cloth, etc. In each trial measure the distance travelled by the glass marble. Tabulate the distance covered by the marble over each surface.

S. No.	Rolling surface placed on the table	Distance covered by the glass marble after sliding down (in centimetre)
1	Paper	
2	Glass	
3	Cotton cloth	
4	Wood	

Inference: The marble covers a lesser distance over the cotton cloth in comparison with the distance it covers over the glass plate.

Reason: A rough surface like the cotton cloth, offers more frictional force. So, the marble moves slowly and covers a minimum distance. The smooth surface of glass, offers lesser friction. So, the glass marble travels a greater distance over it.

The above activity reveals the 'effect of the force of friction', which increases as the roughness of the surface increases.

It is easy to walk or ride a vehicle on a road, but it is difficult to do the same on sand due to its greater friction (roughness).

b) Weight of the body:

It is easy to pedal your cycle without any load on its carrier. With a load placed on its carrier, it is difficult to move it because the weight on the carrier increases the friction between the surface of the tyre and the road.

c) Area of contact:

For a given weight, the friction is directly related to the area of contact between the two surfaces. If the area of contact is greater, then, the friction will be greater too.

A road roller has a broad base, so it offers more friction on the road. But, a cycle has the least friction, since the area of contact of the tyre with the surface of the road is less.

2.6.5 Advantages of friction

7AUZKH

Friction is a necessity in most of our day to day activities. It is desirable in most situations of our daily life.

- We can hold any object in our hand due to friction.
- We can walk on the road because of friction. The footwear and the ground help us to walk without slipping.

- Writing easily with a pen on paper is due to friction.
- Automobiles can move safely due to friction between the tyres and the road. Brakes can be applied due to frictional resistance on brake shoes.
- We are able to light a matchstick, sew clothes, tie a knot or fix a nail in the wall because of friction.

Though it is giving a negative effect, in most of our day to day life friction helps us to make our life easy. So, it is called as "necessary evil".

2.6.6 Disadvantages of friction

- Friction wears out the surfaces rubbing with each other, like screws and gears in machines or soles of shoes.
- To overcome the friction an excess amount of effort has to be given to operate a machine. This leads to wastage of energy.
- Friction produces heat, which causes physical damage to the machines.

2.6.7 Increasing and decreasing friction

a) Area of contact:

Friction can be increased by increasing the area of the surfaces in contact. Have you seen the sole of a shoe, which has grooves? It is done to provide the shoes a better grip with the floor, so that you can walk safely. Treaded tyres (tyres with slots and projections) are used to increase the friction.

Brake shoes in a cycle have to be adjusted so that they are as close as possible to the rim of the wheel, in order to increase the friction.

E.g.: Sumo players, Kabbadi players rub their hand with mud, to get a better grip. Football shoes are having soles with many projections, for providing a stronger grip with the ground.

b) Using lubricants:

A substance, which reduces the frictional force, is called a lubricant. E.g.: grease, coconut oil, graphite, castor oil, etc.

The lubricants fill up the gaps in the irregular surfaces between the bodies in contact. This provides a smooth layer thus preventing a direct contact between their rough surfaces.

c) Using ball bearing:

Since, the rolling friction is smaller than sliding friction, sliding is replaced by rolling with the usage of ball bearings. You can see lead shots in the bearing of a cycle hub.

Points to remember

Force

- Force is defined as 'a push' or 'a pull' acting on a body, which tends to change i) its state of rest or of motion or ii) its shape. The SI unit of force is newton.
- Force acts only when two or more objects interact with one other.
- A force can start a motion, stop a motion, change the direction of motion, and can change the shape or size of a body.

Pressure

- The effect of force can be measured using the physical quantity called pressure. It can be defined as the amount of force or thrust acting perpendicularly on one square meter area of a surface. Unit of pressure is pascal (Pa) or Nm^{-2}
- Fluids (liquids, gases and air) also exert pressure.
- All objects on the surface of the Earth experience a constant thrust or force due to the atmosphere.
- The amount of force due to the atmospheric air that acts on unit surface area of the Earth is known as atmospheric pressure.
- Atmospheric pressure can be measured by a device called barometer.
- 1 atmospheric pressure = 1 atm = pressure due to 76 cm of mercury column in a barometer = $1.01 \times 10^5 N\ m^{-2}$

Friction

- Friction is the force that opposes the motion of an object.
- It slows down or prevents the motion of a body. Friction always opposes the motion and it produces heat.
- Friction is caused by irregularities on the surfaces, which are in contact.
- Friction depends on the nature of the surfaces and mass of the bodies in contact.
- Friction is classified into two types: static friction and kinetic friction. Kinetic friction can be further classified as rolling friction and sliding friction.

Surface Tension

- Surface tension is the property of a liquid.
- The water molecules experience a force that contracts the surface of water as much as possible, so as to occupy the minimum surface area. The amount of force acting per unit length on the liquid surface is called surface tension. It has the unit Nm^{-1}.

Viscous Force

- When the liquids are flowing there is a frictional force between the layers of the liquid, which oppose their relative motion. This force is called viscous force and the phenomenon is known as viscosity.
- Viscosity is measured by the unit called poise in CGS and kg m^{-1} s^{-1} and N s m^{-2} in SI.

A-Z GLOSSARY

Force	action of push or pull
Thrust	Force acting perpendicularly on any given surface area
Pressure	force acting on unit area
buoyant force	An upward force exerted by liquid on floating body
Surface tension	The surface molecules of a liquid experience a force which contracts the surface area
Friction	This force is produced due to the geometrical dissimilarities of the surface of the bodies which are in relative motion.

TEXT BOOK EXERCISES

HHMB6Q

I. Choose the correct answer for each of the following:

1. If we apply a force against the direction of motion of a body, then the body will
   a) stop moving
   b) move with an increased speed
   c) move with a decreased speed
   d) move in a different direction

2. Pressure exerted by a liquid is increased by
   a) the density of the liquid
   b) the height of the liquid column
   c) Both (a) & (b)
   d) None of the above

3. Unit of pressure is
   a) pascal b) N m^{-2}
   c) poise d) Both (a) & (b)

4. The value of the atmospheric pressure at sea level is
   a) 76 cm of mercury column
   b) 760 cm of mercury column
   c) 176 cm of mercury column
   d) 7.6 cm of mercury column

5. Pascal's law is used in
   a) hydraulic lift
   b) brake system
   c) pressing heavy bundles
   d) All the above

6. Which of the following liquids has more viscosity?
   a) Grease b) Water
   c) Coconut oil d) Ghee

7. The unit of viscosity is
   a) N m^2 b) poise
   c) kg m s^{-1} d) no unit

II. Fill in the blanks

1. The pressure of a liquid column _____ with the depth of the column.
2. Hydraulic lift works under the principle of _____.
3. The property of _____ of a liquid surface enables the water droplets to move upward in plants.
4. A simple barometer was first constructed by _____.

III. State whether the following statements are true or false:

1. Force acting on a given area is called pressure.
2. A moving body comes to rest due to friction alone.
3. A body will sink if the weight of the body is greater than the buoyant force.
4. One atmosphere is equivalent to 1,00,000 newton force acting on one square metre.
5. Rolling friction is slightly greater than the sliding friction.
6. Friction is the only reason for the loss of energy.
7. Liquid pressure decreases with the decrease of depth.
8. Using barometers, one can measure the height of a building.
9. Surface tension causes the spherical nature of a water drop.
10. Viscosity depends on the pressure of a liquid.

IV. Arrange the following in the increasing order:

1. Rolling friction, static friction, sliding friction
2. Let a marble roll on the following surfaces. Arrange the choice of the material such that a marble moving over it covers a greater distance.
   Cotton cloth, glass plate, paper, card board, silver plate

V. Match the following

Match: I		
Column I		**Column II**
a)	Static friction	viscosity
b)	Kinetic friction	least friction
c)	Rolling friction	objects are in motion
d)	Friction between the liquid layers	objects are sliding
e)	Sliding friction	objects are at rest

Match: II		
Column I		**Column II**
a)	Barometer	reduce friction
b)	Increase friction	atmospheric pressure
c)	Decrease friction	cause of friction
d)	Lubricants	increasing area of contact
e)	Irregular surface	decreasing area of contact

VI. ANALOGY

1. Knot in a thread : _____ friction; ball bearing : _____ friction
2. Downward force : weight ; Upward force offered by liquid : _____

VII. Problems:

1. A stone weighs 500 N. Calculate the pressure exerted by it if it makes a contact with a surface of area 25 cm^2.
2. In a hydraulic lift, the surface area of the input piston is 10 cm^2. The surface area of the output piston is 3000 cm^2. A 100 N force applied to the input piston raises the output piston. Calculate the force required to raise the output piston.

VIII. ASSERTION & REASON

1. Mark the correct choice as:
   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 the 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: Sharp knives are used to cut the vegetables.
   Reason: Sharp edges exert more pressure.
2. Assertion: Broad straps are used in bags.
   Reason: Broad straps last for long life.
3. Assertion: Water strider slides easily on the surface of water.
   Reason: Water strider experiences less buoyant force.

IX (A). Answer the following in one or two sentences (LOT):

1. Give two examples to verify that a force changes the shape of a body.
2. Give two examples to verify that a force tends to change the static condition of a body.
3. Taking out paste from a tooth paste tube is an example to highlight which physical property?
4. What do you feel when you touch a nail immediately after it is hammered into a wooden plank? Why?
5. How does the friction arise between the surfaces of two bodies in relative motion?
6. Name two instruments, which help to measure the pressure of a fluid.
7. Define one atmosphere.
8. Why are heavy bags provided with broad straps?
9. How does surface tension help a plant?
10. Which has greater viscosity, oil or honey? Why?

X. Answer the following questions with a few sentences (MOT):

1. Define friction. Give two examples of the utility of friction in day to day life.
2. Write down three ways of minimising friction.
3. How do sailors protect their ship during a heavy storm?
4. Write down three applications of Pascal's law.
5. Why is a ball bearing used in a cycle hub?

XI. Answer the following questions in detail:

1. "Friction is a necessary evil"- explain.
2. Give the different types of friction and explain each with an example.
3. Describe an experiment to prove that friction depends on the nature of a surface.
4. Explain how friction can be minimised.
5. Describe an experiment to prove that the pressure in a liquid increases with depth.

XII. HOT CORNER

1. Why is it not advisable to take a fountain pen while travelling in an aeroplane?
2. Is there any possibility of making a special device to measure the magnitude of friction directly?
3. Vidhya posts a question: Mercury is costly. So, instead of mercury can we use water as a barometric liquid? Answer to Vidhya and explain, the difficulty of constructing a water barometer.

4. A bubble rises from the bottom of a pond to its surface by increasing its radius by 3 times its value when it was at the bottom. Calculate the depth of the pond. (Hint: Pressure depends on the depth of the pond. Volume is inversely related to pressure.) [Science Olympiad]

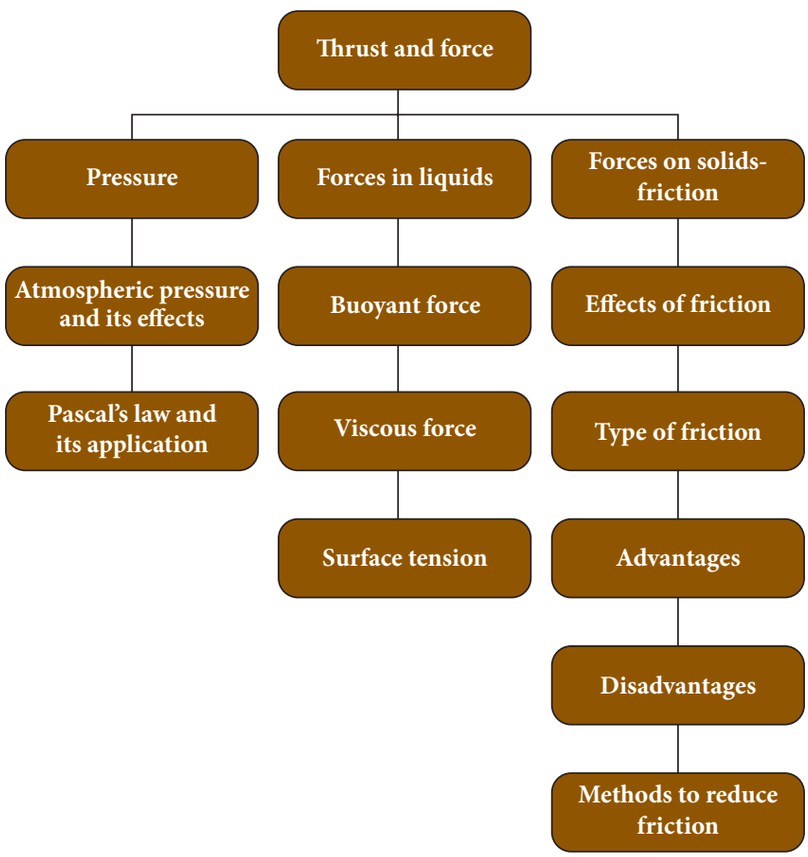
PROJECT WORK:

Observe the devices, gadgets or things around you. List out the types of friction involved in each device? How would you minimise the friction? Record your observations and discuss your results with your classmates.

REFERENCE BOOKS

1. Fundamentals of Physics (English, Hardcover) David Halliday & Jearl Walker.
2. Principles of Physics, International Student Version (English, Paperback) Jearl Walker, David Halliday, Robert Resnick.
3. Concepts of Physics (Volume-1) 1st Edition (English, Paperback) H. C. Verma.
4. Fundamentals of Physics (English, Hardcover) David Halliday

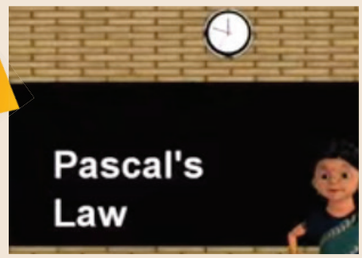
Mind Map



ICT CORNER

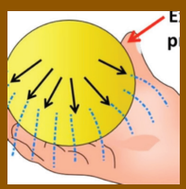
Force & Pressure

This activity helps to learn about the Fluid pressure & Pascal's Law

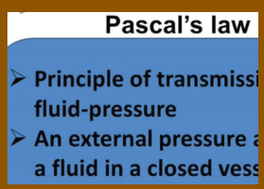


Steps

- Open the Browser and type the URL link given below (or) Scan the QR Code.
- Select the "Fluid Pressure and Pascal's Law" .You can view this page
- You can view this page .Touch the play button
- To get more idea about the Pascal's Law for fluid pressure through Experiment



Step1



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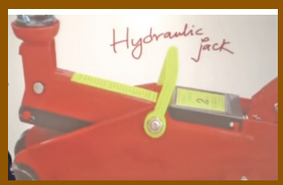

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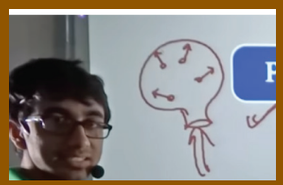

Step4

Web link: scan the QR Code

*Pictures are indicative only

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UNIT 3

LIGHT

Learning Objectives

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At the end of this lesson, students will be able to:

- Acquire knowledge about various types of mirrors.
- Understand image formation in spherical mirrors.
- Know the applications of spherical mirrors.
- Acquire knowledge about laws of reflection.
- Compare regular and irregular reflections.
- Know the working principle of kaleidoscope and periscope.
- Understand refraction and dispersion of light.

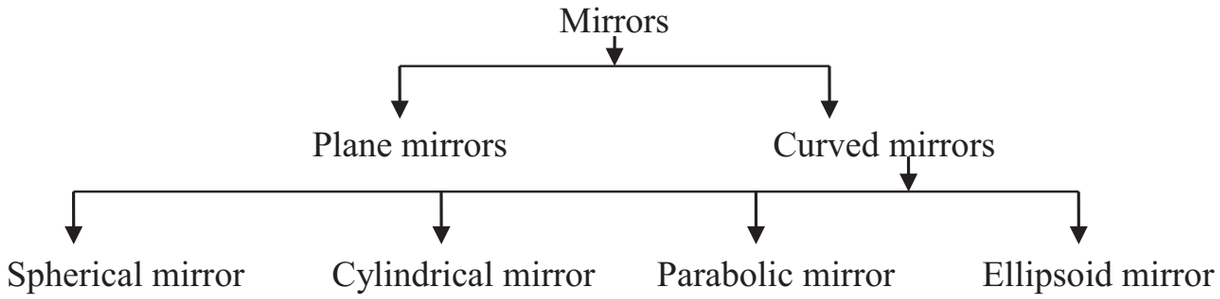
Introduction

Lofty mountains covered with greenish vegetation, magnificent trees reaching up to the clouds, beautiful streams drifting down the valleys, bluish sea water roaring towards the coast and the radiant sky in the morning being filled with golden red color, all give delight to our eyes and peace to our mind. But, can we see them all without light? No, because, we can see things around us only when the light reflected by them reaches our eyes.

Light is a form of energy and it travels in a straight line. You have studied in your lower classes, how it is reflected by the polished surfaces such as plane mirrors. In this lesson, you will study about other types of mirrors like the spherical mirrors and parabolic mirrors and their applications in our daily life. You will also study about the laws of reflection and the laws of refraction and some of the optical instruments, such as periscope and kaleidoscope, which work on these principles.

3.1 Types of Mirrors

We use mirrors in our daily life for various purposes. We use them for decoration. In vehicles, they are used as rear view mirrors. They are also used in scientific apparatus, like telescope. The mirror is an optical device with a polished surface that reflects the light falling on it. A typical mirror is a glass sheet coated with aluminium or silver on one of its sides to produce an image. Mirrors have a plane or curved surface. Curved mirrors have surfaces that are spherical, cylindrical, parabolic and ellipsoid. The shape of a mirror determines the type of image it forms. Plane mirrors form the perfect image of an object. Whereas, curved mirrors produce images that are either enlarged or diminished. You would have studied about plane mirrors in your lower classes. In this section, you will study about spherical and parabolic mirrors.



Method of coating a glass plate with a thin layer of reflecting metals was in practice during the 16th century in Venice, Italy. They used an amalgam of tin and mercury for this purpose. Nowadays, a thin layer of molten aluminium or silver is used for coating glass plates that will then become mirrors.

3.1.1 Spherical mirrors

Spherical mirrors are one form of curved mirrors. If the curved mirror is a part of a sphere, then it is called a 'spherical mirror'. It resembles the shape of a piece cut out from a spherical surface. One side of this mirror is silvered and the reflection of light occurs at the other side.

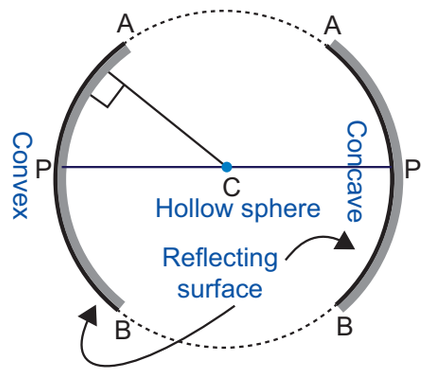


Figure 3.1 Spherical mirror

Concave mirrors

A spherical mirror, in which the reflection of light occurs at its concave surface, is called a concave mirror. *These mirrors magnify the object placed close to them.* The most common example of a concave mirror is the make-up mirror.

Convex mirror

A spherical mirror, in which the reflection of light occurs at its convex surface, is called a convex mirror. *The image formed by these mirrors is smaller than the object.* Most common convex mirrors are rear viewing mirrors used in vehicles.

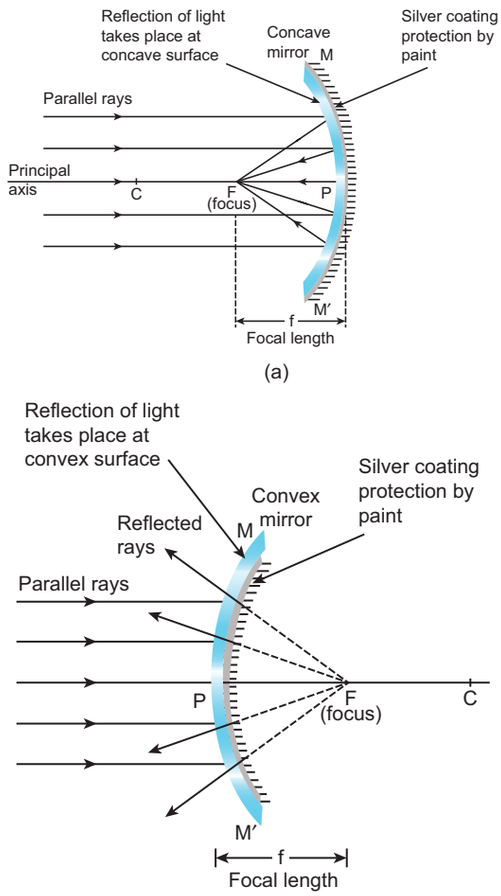


Figure 3.2 Concave and Convex mirrors

DO YOU KNOW?

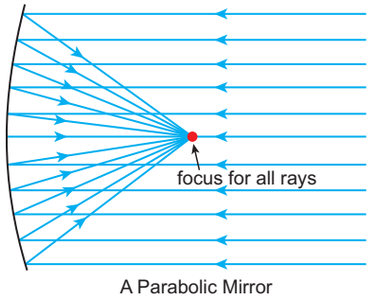
Convex mirrors used in vehicles as rear-view mirrors are labeled with the safety warning: 'Objects in the mirror are closer than they appear' to warn the drivers. This is because inside the mirrors, vehicles will appear to be coming at a long distance.

3.1.2 Parabolic mirrors

A parabolic mirror is one type of curved mirror, which is in the shape of a parabola. It has a concave reflecting surface and this surface directs the entire incident beam of light to converge at its focal point.

In the same way, light rays generated by the source placed at this focal point will fall on this surface and they will be diverged in a direction, which is parallel to the principal axis of the parabolic mirror. Hence, the light rays will be reflected to travel a long distance, without getting diminished.

Parabolic mirrors, also known as parabolic reflectors, are used to collect or project energy such as light, heat, sound and radio waves. They are used in reflecting telescopes, radio telescopes and parabolic microphones. They are also used in solar cookers and solar water heaters.



A Parabolic Mirror

Figure 3.3 Parabolic mirror

DO YOU KNOW?

The principle behind the working of a parabolic mirror has been known since the Greco-Roman times. The first mention of these structures was found in the book, 'On Burning Mirrors', written by the mathematician Diocles. They were also studied in the 10th century, by a physicist called Ibn Sahl. The first parabolic mirrors were constructed by Heinrich Hertz, a German physicist, in the form of reflector antennae in the year 1888.

3.2 TERMS RELATED TO SPHERICAL MIRRORS

In order to understand the image formation in spherical mirrors, you need to know about some of the terms related to them.

Center of Curvature: It is the center of the sphere from which the mirror is made. It is denoted by the letter **C** in the ray diagrams. (A ray diagram represents the formation of an image by the spherical mirror. You will study about them in your next class).

Pole: It is the geometric centre of the spherical mirror. It is denoted by the letter **P**.

Radius of Curvature: It is the distance between the center of the sphere and the vertex. It is shown by the letter **R** in ray diagrams. (*The **vertex** is the point on the mirror's surface where the principal axis meets the mirror.* It is also called as '**pole**'.)

Principal Axis: The line joining the pole of the mirror and its center of curvature is called principal axis.

Focus: When a beam of light is incident on a spherical mirror, the reflected rays converge (concave mirror) at or appear to diverge from (convex mirror) a point on the principal axis. This point is called the 'focus' or 'principal focus'. It is also known as the focal point. It is denoted by the letter **F** in ray diagrams.

Focal length: The distance between the pole and the principal focus is called focal length (f) of a spherical mirror.

There is a relation between the focal length of a spherical mirror and its radius of curvature. The focal length is half of the radius of curvature.

That is, focal length = $\frac{\text{Radius of curvature}}{2}$.

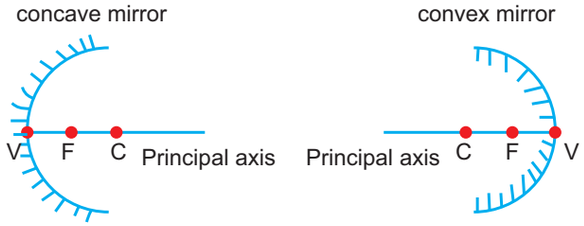


Figure 3.4 Terms related to a spherical mirror

PROBLEM 1

The radius of curvature of a spherical mirror is 20 cm. Find its focal length.

Solution:

Radius of curvature = 20 cm

Focal length (f) = $\frac{\text{Radius of curvature}}{2}$

$= \frac{R}{2} = \frac{20}{2} = 10$ cm

PROBLEM 2

Focal length of a spherical mirror is 7 cm. What is its radius of curvature?

Solution:

Focal length = 7 cm

Radius of curvature (R) = 2 × focal length = 2 × 7 = 14 cm

3.3 IMAGES FORMED BY SPHERICAL MIRRORS

Images formed by spherical mirrors are of two types: i) real image and ii) virtual image. Real images can be formed on a screen, while virtual images cannot be formed on a screen.

Image formed by a convex mirror is always erect, virtual and diminished in size. As a result, images formed by these mirrors cannot be projected on a screen.

The characteristics of an image are determined by the location of the object. As the object gets closer to a concave mirror, the image gets larger, until attaining approximately the size of the object, when it reaches the centre of curvature of the mirror. As the object moves away, the image diminishes in size and gets gradually closer to the focus, until it is reduced to a point at the focus when the object is at an infinite distance from the mirror.

The size and nature of the image formed by a convex mirror is given in Table 3.1.

Concave mirrors form a real image and it can be caught on a screen. Unlike convex mirrors, concave mirrors show different image types. Depending on the position of the object in front of the mirror, the position, size and nature of the image will vary. Table 3.2 provides a summary of images formed by a concave mirror.

Table 3.1 Image formed by a convex mirror

POSITION OF THE OBJECT	POSITION OF THE IMAGE	IMAGE SIZE	NATURE OF THE IMAGE
At infinity	At F	Highly diminished, point sized	Virtual and erect
Between infinity and the pole (P)	Between P and F	Diminished	Virtual and erect

Table 3.2 Image formed by a concave mirror

POSITION OF THE OBJECT	POSITION OF THE IMAGE	IMAGE SIZE	NATURE OF THE IMAGE
At infinity	At F	Highly diminished	Real and inverted
Beyond C	Between C and F	Diminished	Real and inverted
At C	At C	Same size as the object	Real and inverted
Between C and F	Beyond C	Magnified	Real and inverted
At F	At infinity	Highly magnified	Real and inverted
Between F and P	Behind the mirror	Magnified	Virtual and erect

You can observe from the table that a concave mirror always forms a real and inverted image except when the object is placed between the focus and the pole of the mirror. In this position, it forms a virtual and erect image.

Activity 1

Take a curved silver spoon and see the image formed by it. Now, turn it and find the image formed. Do you find any difference? Find out the reason.

3.4 APPLICATIONS OF CURVED MIRRORS

Concave mirrors

1. Concave mirrors are used while applying make-up or shaving, as they provide a magnified image.
2. They are used in torches, search lights and head lights as they direct the light to a long distance.
3. They can collect the light from a larger area and focus it into a small spot. Hence, they are used in solar cookers.
4. They are used as head mirrors by doctors to examine the eye, ear and throat as they provide a shadow-free illumination of the organ.
5. They are also used in reflecting telescopes.

Figure 3.3 Concave mirrors

Convex mirrors

1. Convex mirrors are used in vehicles as rear view mirrors because they give an upright image and provide a

wider field of view as they are curved outwards.

2. They are found in the hallways of various buildings including hospitals, hotels, schools and stores. They are usually mounted on a wall or ceiling where hallways make sharp turns.
3. They are also used on roads where there are sharp curves and turns.

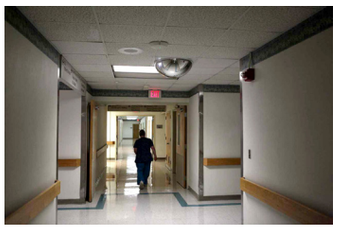


Figure 3.3 Convex mirrors

Activity 2

List out various convex and concave mirrors used in your daily life.

3.5 LAWS OF REFLECTION

Activity 3

Take a plane mirror and try to focus the light coming from the Sun on a wall. Can you see a bright spot on the wall? How does it occur? It is because the light rays falling on the mirror are bounced onto the wall by it. Can you produce the same bright spot with the help of any other object having a rough surface?

Not all the objects can produce the same effect as produced by the plane mirror. A ray of light, falling on a body having a shiny, polished and smooth surface alone is bounced back. This bouncing back of the light rays as they fall on the smooth, shiny and polished surface is called reflection.

Reflection involves two rays: i) incident ray and ii) reflected ray. The incident ray is the light ray in a medium falling on the shiny surface of a reflecting body. After falling on the surface, this ray returns into the same medium. This ray is called the reflected ray. An imaginary line perpendicular to the reflecting surface, at the point of incidence of the light ray, is called the normal.

The relation between the incident ray, the reflected ray and the normal is given as the law of reflection. The laws of reflection are as follows:

- The incident ray, the reflected ray and the normal at the point of incidence, all lie in the same plane.

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- The angle of incidence and the angle of reflection are always equal.

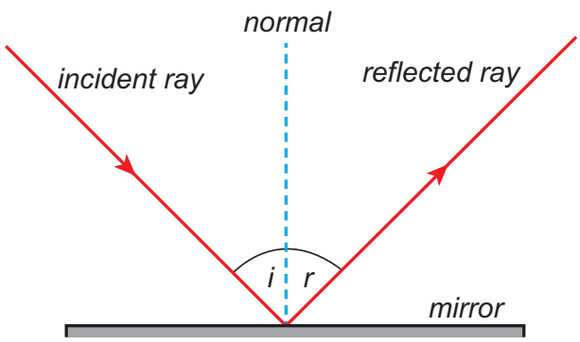


Figure 3.7 Reflection of light

DO YOU KNOW?

Silver metal is the best reflector of light. That's why a thin layer of silver is deposited on the side of materials like plane glass sheets, to make mirrors.

3.6 TYPES OF REFLECTION

You have learnt that not all bodies can reflect light rays. The amount of reflection depends on the nature of the reflecting surface of a body. Based on the nature of the surface, reflection can be classified into two types namely, i) regular reflection and ii) irregular reflection.

3.6.1 Regular reflection

When a beam of light (collection of parallel rays) falls on a smooth surface, it gets reflected. After reflection, the reflected rays will be parallel to each other. Here, the angle of incidence and the angle of reflection of each ray will be equal. Hence, the law of reflection is obeyed in this case and thus a clear image is formed. This reflection is called 'regular reflection' or 'specular reflection'. Example: Reflection of light by a plane mirror and reflection of light from the surface of still water.

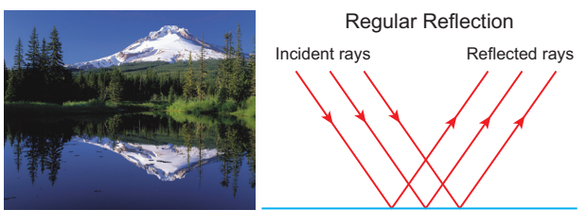


Figure 3.8 Regular reflection

3.6.2 Irregular reflection

In the case of a body having a rough or irregular surface, each region of the surface is inclined at different angles. When light falls on such a surface, the light rays are reflected at different angles. In this case, the angle of incidence and the angle of reflection of each ray are not equal. Hence, the law of reflection is not obeyed in this case and thus the image is not clear. Such a reflection is called 'irregular reflection' or 'diffused reflection'. Example: Reflection of light from a wall.

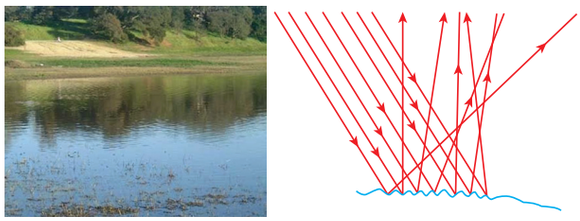
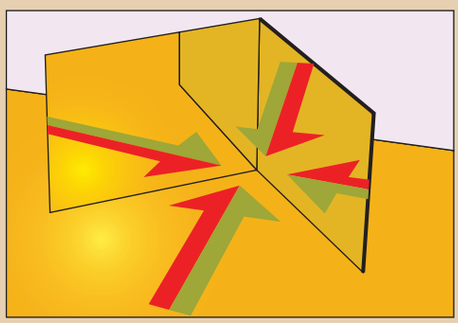


Figure 3.8 Irregular reflection

3.7 MULTIPLE REFLECTIONS

Activity 4

Take two plane mirrors and keep them perpendicular to each other. Place an object between them. You can see the images of the object. How many images do you see in the mirrors? You can see three images. How is it possible to have three images with two mirrors?



In the activity given above, you observed that for a body kept in between two plane mirrors, which were inclined to each other, you could see many images. This is because, the 'image' formed by one mirror acts as an 'object' for the other mirror. The image formed by the first mirror acts as an object for the second mirror and the image formed by the second mirror acts as an object for the first mirror. Thus, we have three images of a single body. This is known as multiple reflection. This type of reflections can be seen in show rooms and saloons.

The number of images formed, depends on the angle of inclination of the mirrors. If

the angle between the two mirrors is a factor of 360°, then the total number of reflections is finite. If θ (Theta) is the angle of inclination of the plane mirrors, the number of images formed = $\frac{360°}{\theta} - 1$. As you decrease this angle, the number of images formed increases. When they are parallel to each other, the number of images formed becomes infinite.

PROBLEM 3

If two plane mirrors are inclined to each other at an angle of 90°, find the number of images formed.

Solution:

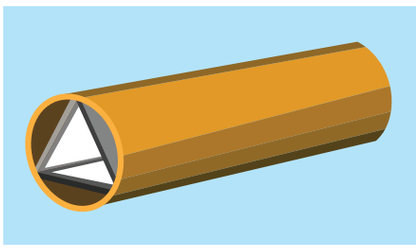
Angle of inclination = 90°

Number of images formed =

$$\frac{360°}{\theta} - 1 = \frac{360°}{90°} - 1 = 4 - 1 = 3$$

3.7.1 Kaleidoscope

It is a device, which functions on the principle of multiple reflection of light, to produce numerous patterns of images. It has two or more mirrors inclined with each other. It can be designed from inexpensive materials and the colourful image patterns formed by this will be pleasing to you. This instrument is used as a toy for children.



Kaleidoscope

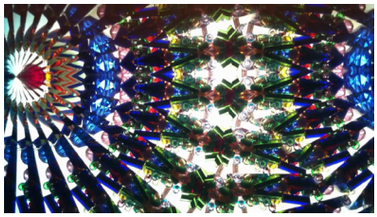


Figure 3.10 Image formed in a Kaleidoscope

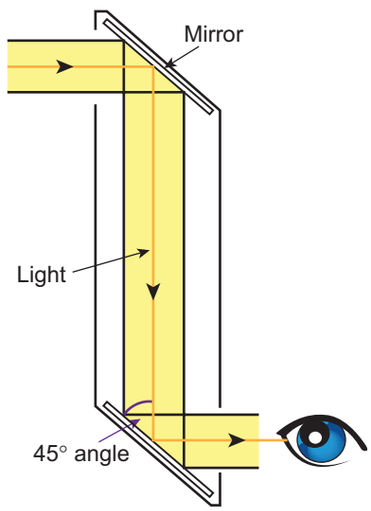
Activity 5

Take three equal sized plane mirror strips and arrange them in such a way that they form an equilateral triangle. Cover the sides of the mirrors with a chart paper. With the help of a chart paper cover the bottom of the mirrors also. Put some coloured things such as pieces of bangles and beads inside it. Now, cover the top portion with the chart paper and make a hole in it to see. You can see the beautiful patterns.

CAUTION: Be careful while handling the glass pieces. Do this under the supervision of your teacher.

3.7.2 Periscope

It is an instrument used for viewing bodies or ships, which are over and around another body or a submarine. It is based on the principle of the law of reflection of light. It consists of a long outer case and inside this case mirrors or prisms are kept at each end, inclined at an angle of 45°. Light coming from the distant body, falls on the mirror at the top end of the periscope and gets reflected vertically downward. This light is reflected again by the second mirror kept at the bottom, so as to travel horizontally and reach the eye of the observer. In some complex periscopes, optic



fibre is used instead of mirrors for obtaining a higher resolution. The distance between the mirrors also varies depending on the purpose of using the periscope.

Uses

- It is used in warfare and navigation of the submarine.
- In military it is used for pointing and firing guns from a 'bunker'.
- Photographs of important places can be taken through periscopes without trespassing restricted military regions.
- Fibre optic periscopes are used by doctors as endoscopes to view internal organs of the body.

Figure 3.11 Periscope used in Submarine

3.8 REFRACTION OF LIGHT

We know that when a light ray falls on a polished surface placed in air, it is reflected into the air itself. When it falls on a transparent material, it is not reflected completely, but a part of it is reflected and a part of it is absorbed and most of the light passes through it. Through air, light travels with a speed of 3×10^8 m s^{-1}, but it cannot travel with the same speed in water or glass, because, optically denser medium such as water and glass offer some resistance to the light rays.

So, light rays travelling from a rarer medium like air into a denser medium like glass or water are deviated from their straight line path. This bending of light about the normal, at the point of incidence; as it passes from one transparent medium to another is called refraction of light.

When a light ray travels from the rarer medium into the denser medium, it bends towards the normal and when it travels from the denser medium into the rarer medium, it bends away from the normal. You can observe this phenomenon with the help of the activity given below.

Activity 6

Take a glass beaker, fill it with water and place a pencil in it. Now, look at the pencil through the beaker. Does it appear straight? No. It will appear to be bent at the surface of the water. Why?

In this activity, the light rays actually travel from the water (a denser medium) into the air (a rarer medium). As you saw earlier, when a light ray travels from a denser medium to a rarer medium, it is deviated from its straight line path. So, the pencil appears to be bent when you see it through the glass of water.

3.8.1 Refractive Index

Refraction of light in a medium depends on the speed of light in that medium. When the speed of light in a medium is more, the bending is less and when the speed of light is less, the bending is more.

8ZPIP5

The amount of refraction of light in a medium is denoted by a term known as refractive index of the medium, which is the ratio of the speed of light in the air to the speed of light in that particular medium. It is also known as the absolute refractive index and it is denoted by the Greek letter 'μ' (pronounced as 'mew').

$$\mu = \frac{\text{Speed of light in air (c)}}{\text{Speed of light in the medium (v)}}$$

Refractive index is a ratio of two similar quantities (speed) and so, it has no unit. Since, the speed of light in any medium is less than its speed in air, refractive index of any transparent medium is always greater than 1.

Refractive indices of some common substances are given in Table 3.3.

Table 3.3 Refractive Index of substances

SUBSTANCES	REFRACTIVE INDEX
Air	1.0
Water	1.33
Ether	1.36
Kerosene	1.41
Ordinary Glass	1.5
Quartz	1.56
Diamond	2.41

In general, the refractive index of one medium with respect to another medium is given by the ratio of their absolute refractive indices.

$$_1\mu_2 = \frac{\text{Absolute refractive index of the second medium}}{\text{Absolute refractive index of the first medium}}$$

$$_1\mu_2 = \frac{\frac{c}{v_2}}{\frac{c}{v_1}} \quad \text{or} \quad _1\mu_2 = \frac{v_1}{v_2}$$

Thus, the refractive index of one medium with respect to another medium is also given by the ratio of the speed of light in first medium to its speed in the second medium.

PROBLEM 4

Speed of light in air is 3×10^8 m s^{-1} and the speed of light in a medium is 2×10^8 ms^{-1}. Find the refractive index of the medium with respect to air.

Solution:

$$\text{Refractive index } (\mu) = \frac{\text{Speed of light in air (c)}}{\text{Speed of light in the medium (v)}}$$

$$\mu = \frac{3 \times 10^8}{2 \times 10^8} = 1.5$$

PROBLEM 5

Refractive index of water is 4/3 and the refractive index of glass is 3/2. Find the refractive index of glass with respect to the refractive index of water.

Solution:

$$_w\mu_g = \frac{\text{Refractive index of glass}}{\text{Refractive index of water}} = \frac{\frac{3}{2}}{\frac{4}{3}} = \frac{9}{8} = 1.125$$

3.8.2 Snell's Law of Refraction

Refraction of light rays, as they travel from one medium to another medium, obeys two laws, which are known as Snell's laws of refraction. They are:

I) The incident ray, the refracted ray and the normal at the point of intersection, all lie in the same plane.

II) The ratio of the sine of the angle of incidence (i) to the sine of the angle of refraction (r) is equal to the refractive index of the medium, which is a constant.

$$\frac{\sin i}{\sin r} = \mu$$

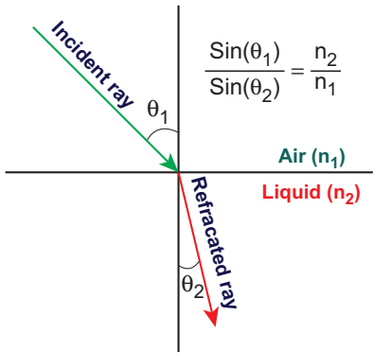


Figure 3.12 Snell's Law

3.9 DISPERSION

Activity 7

Place a prism on a table and keep a white screen near it. Now, with the help of a torch, allow white light to pass through the prism. What do you see? You can observe that white light splits into seven colored light rays namely, violet, indigo, blue, green, yellow, orange and red (VIBGYOR) on the screen. Now, place another prism in its inverted position, between the first prism and the screen. Now, what do you observe on the screen? You can observe that white light is coming out of the second prism.

In the above activity, you can see that the first prism splits the white light into seven coloured light rays and the second prism recombines them into white light, again. Thus, ***it is clear that white light consists of seven colours.*** You can also recall the Newton's disc experiment, which you studied in VII standard.

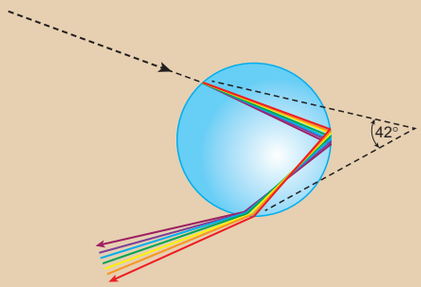
Splitting of white light into its seven constituent colours (wavelength), on passing through a transparent medium is known as dispersion of light.

Why does dispersion occur? It is because, light of different colours present in white light have different wavelength and they travel at different speeds in a medium. You know that refraction of a light ray in a medium depends on its speed. As each coloured light has a different speed, the constituent coloured lights are refracted at different extents, inside the prism. ***Moreover, refraction of a light ray is inversely proportional to its wavelength.***

Thus, the red coloured light, which has a large wavelength, is deviated less while the violet coloured light, which has a short wavelength, is deviated more.

DO YOU KNOW?

The formation of rainbow is an example of dispersion of white light. This can be seen on the opposite side of the Sun. After a rainfall, large number of droplets still remain suspended in the air. When white light passes through them, it is split into seven colours. Dispersion of white light from a large number of droplets eventually forms a rainbow.



Points to remember

- Mirror is an optical device with a polished surface that reflects the light falling on it.
- Curved mirrors have surfaces that are spherical, cylindrical, parabolic and ellipsoid.
- If the curved mirror is a part of a sphere, then it is called a 'spherical mirror'.
- A spherical mirror, in which the reflection of light occurs at its concave surface, is called a concave mirror.
- A spherical mirror, in which the reflection of light occurs at its convex surface, is called a convex mirror.
- Parabolic mirrors, also known as parabolic reflectors, are used to collect or project energy such as light, heat, sound and radio waves.

- The focal length of a spherical mirror is half of its radius of curvature.
- Real images can be formed on a screen, while virtual images cannot be formed on a screen.
- Concave mirrors form a real image and it can be caught on a screen.
- Concave mirrors are used as make-up mirrors.
- Convex mirrors are used in vehicles as rear view mirrors.
- The laws of reflection are: The incident ray, the reflected ray and the normal at the point of incidence, all lie in the same plane.The angle of incidence and the angle of reflection are always equal.
- Based on the nature of the surface, reflection can be classified in to two types namely, i) regular reflection and ii) irregular reflection.
- The number of images formed by a mirror depends on the angle of inclination of the mirrors.
- Snell's laws of refraction are: The incident ray, the refracted ray and the normal at the point of intersection, all lie in the same plane; The ratio of the sine of the angle of incidence (i) to the sine of the angle of refraction (r) is equal to the refractive index of the medium, which is a constant.

A-Z GLOSSARY

Mirror	Glass sheet coated with aluminium or silver on one of its sides to produce an image.
Center of Curvature	The center of the sphere from which the mirror is made.
Radius of Curvature	Distance between the center of the sphere and the vertex.
Pole	Point on the mirror's surface where the principal axis meets the mirror.
Principal Axis	Line joining the pole of the mirror and its center of curvature.
Focus	Point where the reflected rays converge at or appear to diverge from a point on the principal axis.
Focal length	Distance between the pole and the principal focus.
Reflection	Bouncing back of the light rays as they fall on the smooth, shiny and polished surface.
Specular reflection	Reflection that obeys the laws of reflection and produces a clear image.
Diffused reflection	Reflection that does not obey the laws of reflection and does not produce a clear image.
Kaleidoscope	Device, which produces numerous and wonderful image patterns.
Periscope	Instrument used for viewing objects, which are over and around another body.
Refraction of light	Bending of light about the normal, at the point of incidence; as it passes from one transparent medium to another.
Refractive index	Ratio of the speed of light in the air to the speed of light in that particular medium.
Dispersion of light	Splitting of white light into its seven constituent colours (wavelength).

TEXT BOOK EXERCISES

ML5WHN

I. Choose the best answer.

1. Mirrors having a curved reflecting surface are called as
   a) plane mirrors b) spherical mirrors
   c) simple mirrors d) None of the above
2. The spherical mirror with a reflecting surface curved inward is called
   a) convex mirror b) concave mirror
   c) curved mirror d) None of the above
3. The centre of a sphere of which the reflecting surface of a spherical mirror is a part is called
   a) pole
   b) centre of curvature
   c) cradius of curvature
   d) aperture
4. The spherical mirror used as a rear view mirror in the vehicle is
   a) concave mirror b) convex mirror
   c) plane mirror d) None of the above
5. The imaginary line passing through the centre of curvature and pole of a spherical mirror is called
   a) centre of curvature b) pole
   c) principal axis d) radius curvature
6. The distance from the pole to the focus is called
   a) Pole length b) focal length
   c) principal axis d) None of the above
7. Focal length is equal to half of the
   a) centre of curvature b) axis
   c) radius of curvature d) None of the above
8. If the focal length of a spherical mirror is 10 cm, what is the value of its radius of curvature?
   a) 10 cm b) 5 cm
   c) 20 cm d) 15 cm
9. If the image and object distance is same, then the object is placed at
   a) infinity b) at F
   c) between f and P d) at C
10. The refractive index of water is
    a) 1.0 b) 1.33
    c) 1.44 d) 1.52

II. Fill in the blanks.

1. The spherical mirror used in a beauty parlour as make-up mirror is _____.
2. Geometric centre of the spherical mirror is _____.
3. Nature of the images formed by a convex mirror is _____.
4. The mirror used by the ophthalmologist to examine the eye is _____.
5. It the angle of incidence is 45°, then the angle of reflection is _____.
6. Two mirrors are parallel to each other, then the number of images formed is _____.

III. Match the following.

A)

1. Convex mirror	-	a. Radio telescopes
2. Parobolic mirror	-	b. wall
3. Regular reflection	-	c. rear – view mirror
4. Irregular reflection	-	d. Plane mirror

B)

1. Snell's law	-	a. Kaleidoscopce
2. Dispersion of light	-	b. sin i/sin r =μ
3. Refractive index	-	c. Rainbow
4. Multiple reflection	-	d. c/v = μ

IV. Answer in brief.

1. What is called a spherical mirror?
2. Define focal length?
3. The radius of curvature of a spherical mirror is 25 cm. Find its focal length.
4. Give two applications of a concave and convex mirror.
5. State the laws of reflection.
6. If two plane mirrors are inclined to each other at an angle of 45°, find the number of images formed.
7. Define the refractive index of a medium.
8. State the Snell's law of refraction

V. Answer in detail.

1. Explain the images formed by a concave mirror?
2. What is reflection? Write short notes on regular and irregular reflection?
3. Explain the working of a periscope.
4. What is dispersion? Explain in detail.
5. Speed of light in air is 3×10^8 m s^{-1} and the refractive index of a medium is 1.5. Find the speed of light in the medium.

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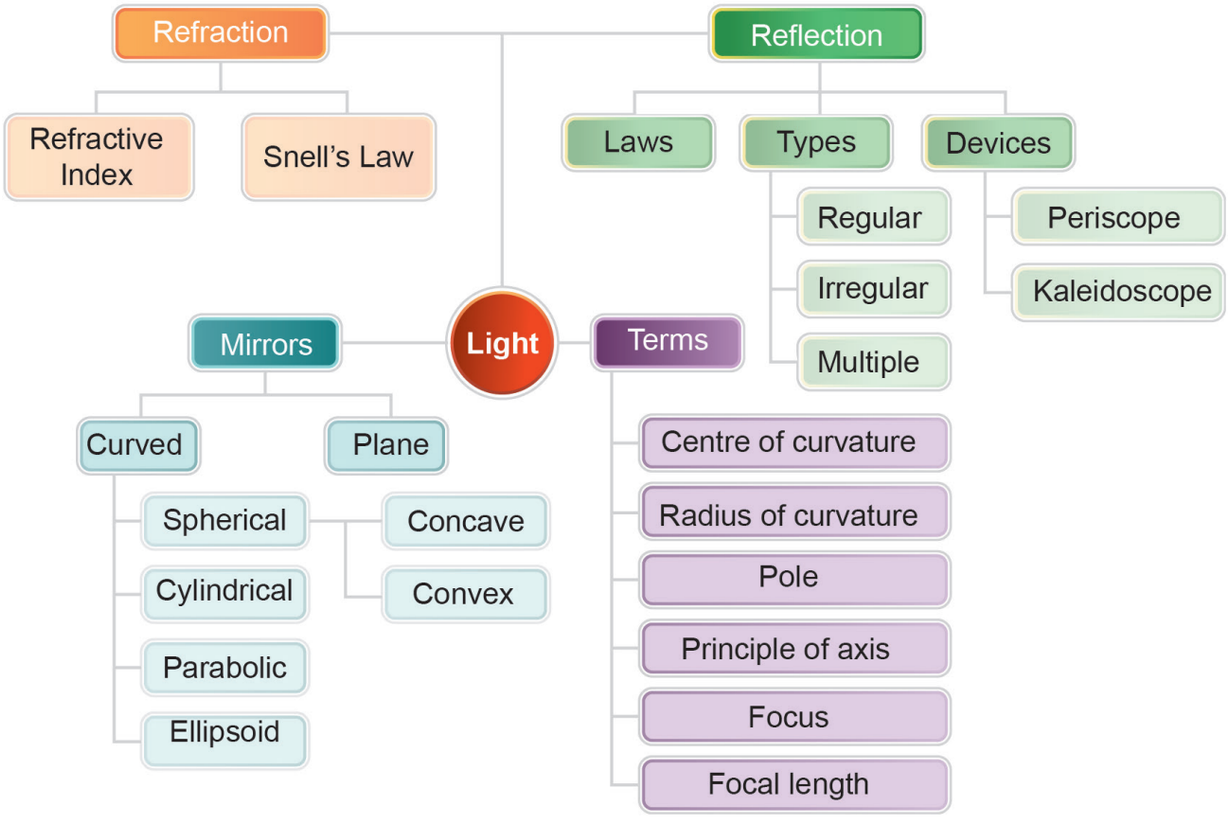
MIND MAP



UNIT

4

MATTER

Learning Objectives

KWBDE1

After completing this lesson you will be able to

- Know about the types of matter.
- Know the symbols of various elements.
- Classify elements into metals,non-metals and metalloids
- Compare the properties of metals and non metals.
- Acquire knowledge about compounds of solids, liquids and gases state.
- Know about the uses of compounds in daily life.

INTRODUCTION

a)

b)

c)

Figure 4.1 a) Ice, b)water, c) Steam

In the universe all manifestations, phenomena and evolution of life are caused by matter and energy. The various objects which exist around us are made of some kind of matter. We perceive some of these objects through our senses like sight, touch, hearing, taste and smelling. A glass tumbler can be seen, agarbatti burning can be recognized by its smell whereas wind blowing can be felt. All kinds of matter possess mass and occupy space, of course some are heavy and others are light. Thus, matter can be defined as anything, which occupies space or volume and mass and can be perceived by our senses.

As we know already matter exists in

Solids: Substances like wood, stone, sand, iron etc.

Liquids: Substances like water, milk, fruit juice, etc

Gases: Substances like oxygen, nitrogen, carbon dioxide, steam, etc.,

How the matter is composed?

Matter in any physical state is composed of smaller particles such as atom, molecules or

ions. Molecules are also made up of atoms of same or different kinds. Hence, atoms are the building blocks of matter.

1. **Atom:** An atom is the smallest particle of an element, which exhibits all the properties of that element. It may or may not exist independently but takes part in every chemical reaction. We have learned about the basics of atoms in Class VII, atomic structure chapter.
2. **Molecules**: Atoms of the same element or different elements combine to form a molecule. A molecule is the smallest particle of a pure substance (element or compound), which can exist independently and retain the physical and chemical properties of the substance.
3. **Ions :** Atoms or group of atoms having a charge (positive or negative) are called ions.

4.1 Why symbols?

A symbol is an image, object, etc., that stands for some meaning. For instance, a dove is a symbol of peace. Similarly, we denote mathematical operations by symbols. For example (+) denotes addition; (–) denotes subtraction, etc. In the same way in chemistry each element is denoted by a symbol. Writing out the name of an element every time would become too troublesome. So, the name of an element is represented by shortened form called as symbol.

4.1.1 Symbol of elements

Let us learn the brief history of symbols of elements.

Greek symbols

The symbols in form of the geometrical shapes were those used by the ancient Greeks to represent the four basic elements around us such as earth, air, fire and water.

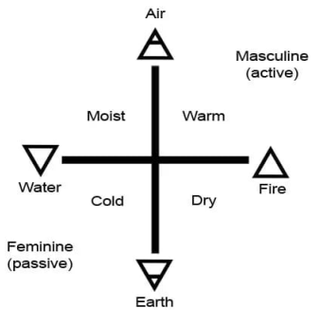


Figure 4.2 Greek symbols

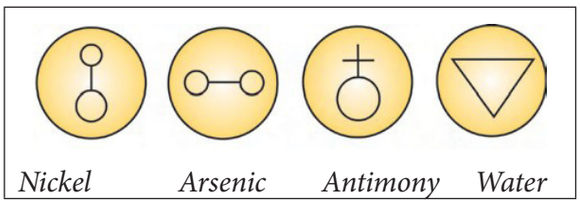
Alchemist symbol

In the days of alchemists, the different materials that they used were represented by the above-mentioned symbols while they try to change less valuable metal into gold. The process was called **alchemy** and the men who did this work were known as **alchemists**.

Dalton symbols

In 1808, John Dalton, English scientist tried to name the various elements based on these pictorial symbols. These symbols are difficult to draw and hence they are not used. It is only of historical importance.

Pictorial symbols



Daltons 1808AD(CE) symbols and formulae.

Hydrogen	Soda	Ammonia
Nitrogen	Pot Ash	Olefiant
Carbon	Oxygen	Carbonic Oxide
Sulphur	Copper	Carbonic Acid
Phosphorus	Lead	Sulphuric Acid
Alumina	Water	

Figure 4.3 Dalton Symbols

Berzelius symbols

In 1813, Jon Jakob Berzelius devised a system using letters of alphabet rather than signs.,. The modified version of Berzelius system follows under the heading 'System for Determining Symbols of the Elements'

Present System for Determining Symbols of the Elements

1. The symbols of the most common elements, mainly non-metals, use the first letter of their English name.

Element	Symbol	Element	Symbol
Boron	B	Oxygen	O
Carbon	C	Phosphorus	P
Fluorine	F	Sulphur	S
Hydrogen	H	Vanadium	V
Iodine	I	Uranium	U
Nitrogen	N	Yttrium	Y

2. If the name of the element has the same initial letter as another element, then symbol uses the first and second letters of their Element name. First letter in upper case and the second letter is in lower case.

Element	Symbol	Element	Symbol
Aluminium	Al	Gallium	Ga
Barium	Ba	Helium	He
Beryllium	Be	Lithium	Li
Bismuth	Bi	Neon	Ne
Bromine	Br	Silicon	Si
Cobalt	Co	Argon	Ar

3. If the first two letters of the names of elements are the same, then the symbol consists of first letter and second or third letter of English name that they do not have in common.

Element	Symbol	Element	Symbol
Argon	Ar	Calcium	Ca
Arsenic	As	Cadmium	Cd
Chlorine	Cl	Magnesium	Mg
Chromium	Cr	Manganese	Mn
Bromine	Br	Silicon	Si
Cobalt	Co		

4. Some symbols are used on the basis of their old names or Latin name of an element. There are eleven elements.

Name of element	Latin Name	Symbol
Sodium	Natrium	Na
Potassium	Kalium	K
Iron	Ferrum	Fe
Copper	Cupurum	Cu
Silver	Argentum	Ag
Gold	Aurum	Au
Mercury	Hydrargyrum	Hg
Lead	Plumbum	Pb
Tin	Stannum	Sn
Antimony	Stibium	Sb
Tungsten	Wolfram	W

5. Some elements are named using name of country/scientist/colour/mythological character/planet.

Name	Symbol	Name Derived from
Americium	Am	**Am**erica (country)
Europium	Eu	**Eu**rope (country)
Nobelium	No	Alfred **No**bel (scientist)
Iodine	I	Violet (colour, Greek)
Mercury	Hg	God Mercury (mythologic character)
Plutonium	Pu	Pluto (planet)
Neptunium	Np	Neptune (Planet)
Uranium	U	Uranus (planet)

Do you know how to write a symbol for a given element?

While writing a symbol for an element, we should adhere to the following method.

1. If the element has a single English letter as a symbol, it should be written in capital letter.
2. For elements having two letter symbols, the first letter should be in capital followed by small letter

What is the significance of the symbol of an element?

Symbol of an element signifies

- Name of the element
- One atom of the element For example,

- The symbol O stands for the element of Oxygen
- One atom of oxygen

Activity 1

Teacher: Dear students, let us play a memory game. This is an interesting game, which helps you to remember the symbols and their names. Make cards as instructed and then form a small group with your class mates to play.

INSTRUCTIONS:
Prepare 15 cards with the name of elements written on them and 15 cards with their corresponding symbols. Here is a list of names of elements (you have the freedom to choose the name of the elements)

Hydrogen	Calcium	Arsenic
Sodium	Mercury	Oxygen
Argon	Chlorine	Gold
Magnesium	Copper	Helium
Chromium	Iron	Manganese

How to play?

1. Shuffle the 30 cards and place the cards face down on the table.
2. Start the game. Each player will get a chance of taking 2 cards at a time to see. If a player does not get the correct pair, then he/she should keep the cards at the original position. If the name and symbol of the cards match correctly, then he/she can show to all the players and can keep the correct pair of cards with him/her. If correct pairs are shown, players will get another chance until the player makes wrong match. Game will continue till all the cards are taken up. The winner is the one having maximum number of cards.

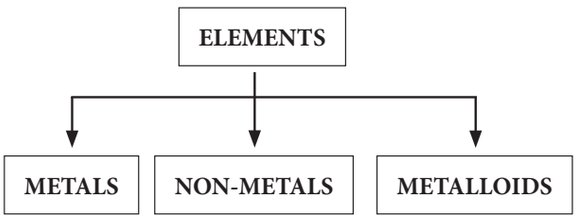
4.2 METALS AND NON-METALS

The progress of man towards civilization is linked with the discovery of several metals and non-metals. Even today, the index of prosperity of a country depends upon the amount of metals and non-metals it produces and uses. The wealth of a country is measured by the amount of gold in its reserve.

These days, metals and non-metals are used for making tools, machines, cars, utensils, etc. Some of the common metals used are iron, copper, silver, gold, lead, zinc, aluminium, magnesium, nickel, chromium and mercury etc. Similarly, the common non-metals used are nitrogen, oxygen, hydrogen, carbon, sulphur, phosphorus and chlorine etc.

An element can be identified as metal or non-metal by comparing its properties with the general properties of metals and non- metals. In doing so, we find that some elements neither fit with the metals or with non-metals. Such elements are called semi-metals or metalloids.

Elements are classified into metals, non-metals, and metalloids based on their properties



4.2.1 METALS

Iron,copper,gold,silver, etc. that we use in our daily life are metals. Can you add some more examples that you come across in day to day activities.

Figure 4.4 Copper

Physical properties of metals

1. **Physical state**: Metals are solid under normal conditions of temperature and pressure. Mercury is liquid at room temperature. Elements cesium (Cs), rubidium (Rb), Francium (Fr) and Gallium (Ga) become liquid at or just above room temperature.
2. **Hardness**: Most metals are hard. The exception here is sodium and potassium, which is soft enough to be cut by a knife. Osmium is so hard that it can scratch glass.
3. **Lustre**: All metals are shiny. The typical shine of metals is called metallic lustre. All metals have a typical metallic lustre. An exception is calcium.

Figure 4.5 Shine Appearance

4. **Density**: Metals generally have high density. Sodium and potassium have exceptionally low density.
5. **Melting point and boiling point:** Metals in general have high melting point and boiling point. Sodium,potassium,mercury and gallium are exceptions.
6. **Tensile strength**: Metals have the capacity to withstand strain without breaking. This property is called tensile strength. It is the property that owes the use of iron for the construction of railway tracks. Zinc, arsenic and antimony are exceptions.
7. **Malleability:** Metals can be hammered into very thin sheets. This tendency of metals is called malleability. Aluminum makes use of this property to transform into silvery foils.

Activity 2

Take a hammer and beat the samples, which are given below. Observe the changes in samples. Record your observations in the table

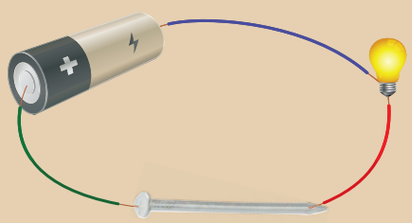
Name of sample	Observing the change in sample
Coal piece	Breaks/ converts into powder
Iron nail	
Copper wire	
Sulphur	

8. **Ductility:** Metals can be drawn into thin wires. This property of metals is called ductility. Example: copper wires.
9. **Conductivity:** Metals are good conductors of heat and electricity. Silver and copper are very good conductors of electricity. However, bismuth and tungsten are poor conductors.

Activity 3

Recall how to make an electric circuit to test whether electricity can pass through an object or not .

Object to be used: iron nail and pencil lead (graphite)



10. **Sonorous**: On being hit, metals produce a typical sound. Hence, they are said to be sonorous. This property is being made used in making temple bells.

4.2.2 NON-METALS

Elements that generally do not shine, neither too hard nor too soft, are non-metals. All gases are non-metals. Some non-metals are Sulphur, Carbon, Oxygen etc..


sulphur


carbon

Figure 4.6 Non-metals

PHYSICAL PROPERTIES OF NON-METALS

1. **Physical state:** Non-metals occur as solids, liquids or gases at normal temperature; for example sulphur, phosphorus occurs in solid state while bromine occurs in liquid state. Gases like oxygen, nitrogen, etc., occur in the gaseous state.
2. **Hardness:** Non-metals are generally not hard except diamond.(a form of carbon)
3. **LUSTRE:** Non-metals have a dull appearance; Graphite and iodine are exceptions as they are shiny and lustrous.

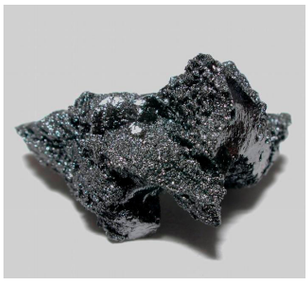


Figure 4.7 Dull appearance

4. **Density:** Non-Metals are generally soft and have low densities. The exception here is diamond (a form of carbon) which is the hardest naturally occurring substance
5. **Melting point and boiling point:** Non-metals have low melting point and boiling point. However, carbon, silicon and boron are exceptions.
6. **Tensile strength:** Non-metals do not have tensile strength. However, carbon fibre (a form of carbon) is as tensile as steel.
7. **Malleability:** Non-metals are non-malleable. If hammered, they form a powdery mass. Actually non-metals in solid state are brittle in nature.
8. **Ductility:** Non-metals are not ductile. Carbon fibre is highly ductile.
9. **Conductivity:** Non-Metals are generally bad conductor of electricity. Graphite (a form of carbon) is exception.
10. **Sonorous**: Non-Metals do not produce sound(non-sonorous) when hit.

Activity 4

To demonstrate that metals produce a sound when struck.

Strike a metal utensil with a metal spoon. Note the kind of sound emitted. Now, strike a piece of wood charcoal with the same spoon. Do you find a difference in the kind of sound produced?

Most metals produce ringing sound when struck i.e. they are sonorous. Non-metals are non sonorous.

A Compartive Study of Metals and Non-Metals

Property	Metal	Non Metal
Physical state at room Temperature	Usually Solid (Occasionaly liquid)	Solid, liquid or gas
Malleablity	Good	Poor-usually soft or brittle
Ductility	Good	Poor-usually soft or brittle
Melting point	Usually high	Usually low
Boiling point	Usually high	Usually low
Density	Usually high	Usually low
Conductivity (Thermal and electrical)	Good	Very poor

4.2.3 Uses of Metals and Non-Metals

Metal

1. Iron is used for making bridges,engine parts, iron-sheet and bars.

2. Copper is used for making electrical wires, coins and statue.

Figure 4.8 Coins contain nickel

3. Silver and gold are used for making jewels,in decorative purposes and photography.

Figure 4.9 Gold is very decorative

4. Mercury is used in thermometers and barometers because of its high density and uniform expansion at different temperature.
5. Aluminium is used in electrical wires, cables and in aerospace industries.

Figure 4.10 Planes are made of an alloy which contains magnesium and aluminium

6. Lead is used in automobile batteries, X-ray machines.

Non-Metals

1. Diamond (a form of carbon) is used for making jewels, cutting and grinding equipments. Graphite is used in making pencil lead.

Figure 4.11 Diamond

2. Sulphur is used in the manufacturing of gun powder and vulcanization of rubber.

Figure 4.12 Sulphur

3. Phosphorus is used in matches, rat poison etc.
4. Nitrogen is used for manufacturing ammonia.
5. Chlorine is used as a bleaching agent and in sterilizing water.
6. Hydrogen is used as a rocket fuel and hydrogen flame is used for cutting and welding purposes, as well as a reducing agent

4.2.4 Metalloids

The elements which exhibit the properties of metals as well as non-metals are called metalloids. Examples: boron, silicon, arsenic, germanium, antimony, tellurium and polonium.

Physical properties of metalloids

Metalloids are all solid at room temperature.

1. They can form alloys with other metals
2. Some metalloids, such as silicon and germanium, can act as electrical conductors under the specific conditions, thus they are called semiconductors.
3. Silicon for example appears lustrous, but is not malleable nor ductile (it is brittle - a characteristic of some non metals). It is a much poorer conductor of heat and electricity than the metals
4. The physical properties of metalloids tend to be metallic, but their chemical properties tend to be non-metallic.

Uses of metalloids

1. Silicon is used in electronic devices .
2. Boron is used in fireworks and as a fuel for ignition in rocket.

4.3 Compound

A compound is a pure substance which is formed due to the chemical combination of two or more elements in a fixed ratio by mass. The properties of a compound are different from those of its constituents.

Water, carbon di oxide, sodium chloride etc. are few examples of compounds. A molecule of water is composed of an oxygen atom and two hydrogen atoms in the ratio 1:2 by volume or 8:1 by mass.

4.3.1 Classsification compound

Based on the origin of chemical constituents, compounds are classified as inorganic compounds and organic compounds.

a) Inorganic compounds

Compounds obtained from non living sources such as rock, minerals etc., are called inorganic compounds. Example: chalk, baking powder etc.,

b) Organic compounds

Compounds obtained from living sources such as plants, animals etc., are called organic compound. Example: Protein, carbohydrates, etc.,

Both inorganic and organic compounds exists in all three states of matter ie., solids, liquids and gases.

Let us learn some important compounds in solids, liquids and gaseous state.

4.3.2 Compounds in solid

Some important compounds that exist in solid state are tabulated as follows

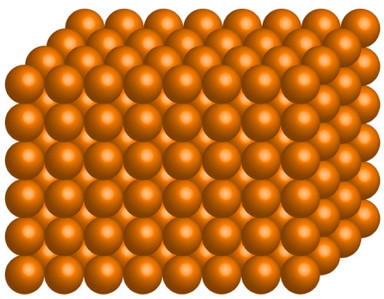
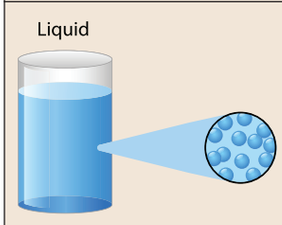


Figure 4.13 Solid

Compound	Consititutent Elements
Silica (sand)	Silicon, Oxygen
Potassium hydroxide (caustic potash)	Potassium, Hydrogen, Oxygen
Sodium hydroxide (Caustic soda)	Sodium, Oxygen, Hydrogen
Copper sulphate	Copper, Sulphur, Oxygen
Zinc carbonate (calamine)	Zinc, carbon, oxygen

4.3.3 Compounds in liquid

Some important compounds that exist in liquid state are tabulated as follows

Compound	Consititutent Elements
Water	Hydrogen, Oxygen
Hydro chloric Acid	Hydrogen, Chlorine
Nitric Acid	Hydrogen, Nitrogen, Oxygen
Sulphuric Acid	Hydrogen, Sulphur, Oxygen
Acetic acid (Vinegar)	Carbon, Hydrogen, Oxygen
	

4.3.4 Compounds in gas

Some important compounds that exist in gaseous state are tabulated as follows

Compound	Consitituent Elements
Carbon dioxide, carbon monoxide	Carbon, Oxygen
Sulphur dioxide	Sulphur, Oxygen
Methane	Carbon, Hydrogen
Nitrogen dioxide	Nitrogen, Oxygen
Ammonia	Nitrogen, Hydrogen

XSX83W

4.3.5 Uses of Compounds

Let us tabulate some compounds and their constituents that we use in our daily life.

Common Name	Chemical Name	Constituents	Uses
Water	Hydrogen Oxide	Hydrogen and oxygen	For drinking and as solvent
Table salt	Sodium chloride	Sodium and chlorine	Essential component of our daily diet, preservative for meat and fish.
Sugar	Sucrose	Carbon, hydrogen and oxygen	Preparation of sweets, toffees and fruit juices.
Baking soda	Sodium bicarbonate	Sodium, hydrogen, carbon and oxygen	Fire extinguisher, preparation of baking powder and preparation of cakes and bread.
Washing soda	Sodium carbonate	Sodium,carbon and oxygen	As cleaning agent in soap and softening of hardwater.
Bleaching powder	Calcium oxy chloride	Calcium, oxygen and chlorine	As bleaching agent, disinfectant and sterilisation of drinking water.
Quick lime	Calcium oxide	Calcium and oxygen	Manufacture of cement and glass.
Slaked lime	Calcium hydroxide	Calcium, oxygen and hydrogen	White washing of walls.
Lime stone	Calcium carbonate	Calcium ,carbon and oxygen	Preparation of chalk pieces.

More to Know

Compound	Consititutent Elements
Copper sulphate	Blue Vitriol
Ferrous sulphate	Green Vitriol
Potassium nitrate	Saltpetre
Sulphuric acid	Oil of Vitriol
Calcium sulphate	Gypsum
Calcium sulphate hemi hydrate	Plaster of paris
Potassium chloride	Muriate of potash

Points to remember

- **Matter:** Anything which occupies space and has mass is called matter.
- **Compound:** The molecule of a substance that contains two or more atoms of different elements combined together in a definite ratio,is said to be a molecule of a compound.
- **Solid:** Material which has a definite shape and definite volume at room temperature with any number of free surfaces is called solid.
- **Liquid:** Material which has a definite volume, but no definite shape and has one free surface, is called liquid.

- **Gases:** Material which has neither definite shape nor definite volume, is easily compressible and has no free surface is called gas.
- **Metals:** Metals are elements that are hard and shiny in appearance.Some metals used in our daily life are iron,copper,gold,silver, etc. Metals conduct heat and electricity.
- **Non metal:** Elements that generally do not shine, neither too hard nor too soft are non-metals. All gases are non-metals.Some non-metals are sulphur,carbon,oxygenetc..
- **Metalloids:** Elements which have some properties of metal and some of non-metals are called metalloids. Some examples are arsenic, germanium etc…
- **Sonority:** On being hit, metals produce a typical sound. They are said to be sonorous. This property is being made used in making temple bells.
- **Symbol:** The easiest way to represent the element and to write the chemical formulas easily.

A-Z GLOSSARY

Disinfectant	Chemical substance which kills or prevents the disease causing microorganism.
Semiconductor	Substance which acts as bad conductor at low temperature and act as good conductor at high temperature.
Reducing agent	Substance which undergo oxidation reaction.
Carbohydrate	Compound contains carbon, hydrogen and oxygen are called carbohydrate.
Bleaching agent	Substance which is used to remove the colour.
Preservative	Substance which prevent from food spoiling organism.

TEXT BOOK EXERCISE

APJ2SS

I. Choose the best answer.

1. Matter is composed of

a) atoms b) molecules

c) ions d) all of the above

2. The liquid metal used in thermometers is

a) Copper b) Mercury

c) Silver d) Gold

3. The Pictorial symbol for water given by the alchemists was

a)  b) 

c)  d) 

4. Which one of the element name not derived from planet?

a) Plutonium b) Neptunium

c) Uranium d) Mercury

5. Symbol of Mercury is

a) Ag b) Hg

c) Au d) Pb

6) A form of non-metal which has high ductility is

a) nitrogen b) oxygen

c) chlorine d) carbon

7. Which one of metal possess low tensile strength?

a) Silver b) Copper

c) Zinc d) Aluminium

8. The property which allows metals to be hammered into their sheets is _____

a) ductility b) malleability

c) conductivity d) tensile strength

9. The non-metal which conduct current is

a) carbon b) oxygen

c) aluminium d) sulphur

10. Pencil lead contains

a) graphite b) diamond

c) aluminium d) sulphur

II. Fill in the blanks.

1. The element which possess character of both metals and non metals are called……

2 . The symbol of Tungsten……..

3. Melting point of most metal is _____ than non-metal.

4. Water contains …….. and ……. element.

5 …….. is the used in semiconductor industry.

III. True or False , if false correct the statement

1. Metals are generally good conductors of electricity, but not good conductors of heat.

2. Gallium metal is in solid state at or just above room temperature.

3. Compounds can be made up of one atom.

4. Coal can be drawn into wires.

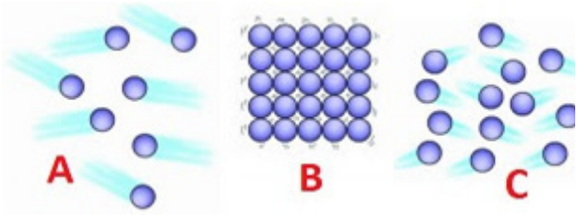
5. Zinc is highly ductile in nature.

IV. Match the substance given in column A with their use given in Column B.

A	B
1. Iron	For making wires
2. Copper	Sewing needle
3. Tungsten	As a fuel for ignition in rocket.
4. Boron	Making the filament of a bulb

2. Match the following:

1. Atom	A. building block of matter
2. Element	B. atoms of different kinds
3. Compound	C. atoms of the same kind



4. Molecule ---- D. smallest unit of a substance

A)1 - A, 2 - C, 3 - B, 4 - D

B) 1 - C, 2 - A, 3 - B, 4 - D

C) 1 - D, 2 - C, 3 - B, 4 - A

D)1 - B, 2 - C, 3 - A, 4 - D

3. Identify the state of matter based on the arrangement of the molecules.

A) A - gas, B - solid, C – liquid

B) A - Liquid, B - solid, C – Gas

C) A - gas, B - solid, C - liquid

D) A - Liquid, B - Gas, C - Solid

V. Very Short Answer Questions

1 .What is ductility?

2. Write the constituent elements and their symbols for the following compounds

a) Carbon monoxide

b) Washing soda

3. Write the symbols for these elements

a) Oxygen b) Gold

c) calcium d) cadmium e) Iron

4. Name two soft metals that can be cut with a knife.

5. Which non-metal is essential for our life and all living beings inhale it during breathing?

6 .Why are bells made of metals?

7. What does a chemical symbol represent?

8. Give two examples for metalloids.

9. Mention any three compounds that exist in liquid state.

10. Write three properties of metalloids.

VI. Short Answer Questions

1. Can you store pickle in an aluminium utensil? Explain.

2. Tabulate four points of difference between metals and non-metals.

3. Define tensile strength.

4. Why are utensils made up of aluminium and brass?

5. Define a Alchemy.

6. Name the elements for following symbols.

a) Na b) W c) Ba d) Al e) U

7. Name six common non-metals and write their symbols.

8. Mention any four compounds and their uses.

9. Mention the metals that are used in jewellery.

10. Mention the uses for the following compounds.

a) Baking soda b) Bleaching powder c) quick lime

VII. Reason out

1.Give reasons for the following.

(a) Aluminum foils are used to wrap food items.

(b) Immersion rods for heating liquids are made up of metallic substances.

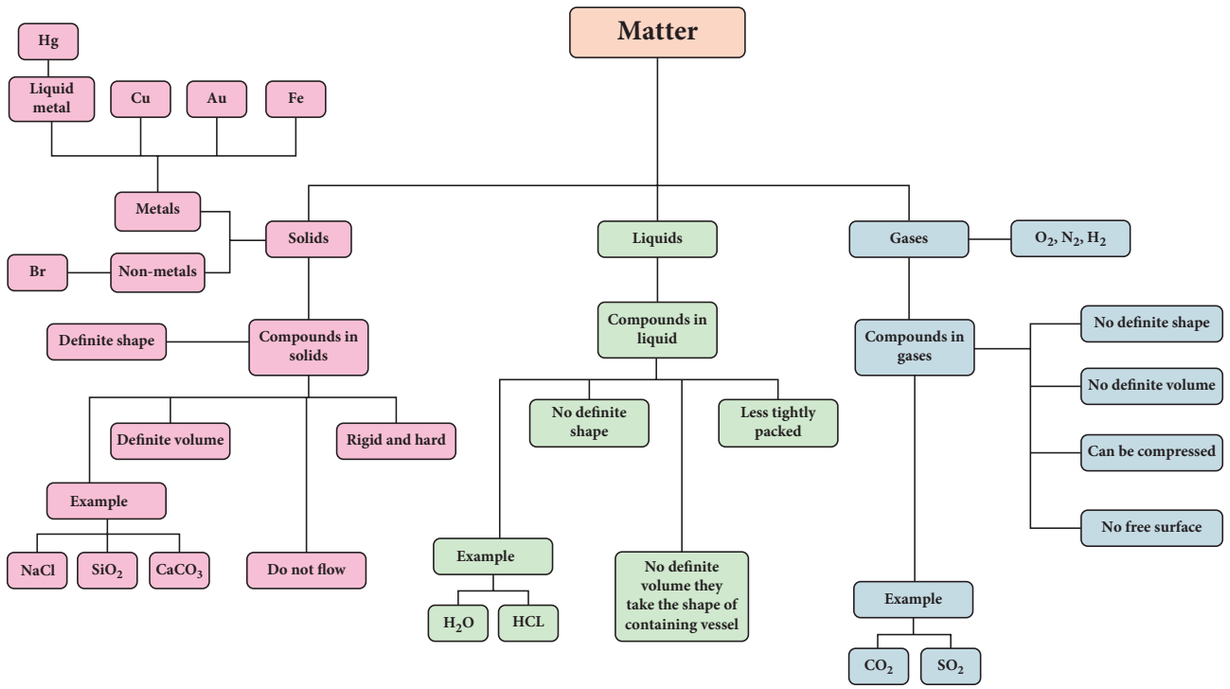
(c) A doctor prescribed a tablet to a patient suffering from iron deficiency. The tablet does not look like iron.

(d) Sodium and potassium are stored in kerosene.

e) Mercury is used in thermometers.

2. Why wires cannot be drawn from materials such as stone or wood?

Mind Map

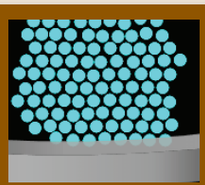


ICT CORNER MATTER

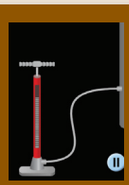
This activity enables the students helps to know about the States of Matter

Steps

- Open the Browser and type the URL link given below (or) Scan the QR Code.
- Select the title "States of Matter: Basics"
- States of Matter: Basics display on the screen. Follow this Experiment
- Click the next and to know about this states of matter



Step1



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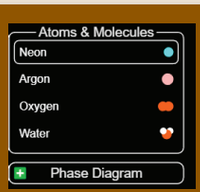

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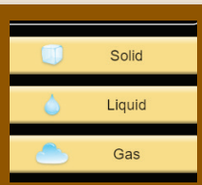

Step4

Cells alive

URL: scan the QR Code

*Pictures are indicative only

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UNIT

5

CHANGES AROUND US

Learning Objectives

4BPSEI

At the end of this lesson, students will be able to:

- Define chemical reaction
- Differentiate chemical changes from physical changes
- Learn how chemical reactions take place by physical contact, solution of reactants, electricity, heat, light and catalyst.
- Experiment chemical reactions based on contact, solutions, heat, light, electricity and catalyst
- Learn about the importance and effects of chemical reactions
- Identify chemical reactions in day to day life
- Observe the changes during a chemical reaction
- Infer what happens during a chemical reaction

INTRODUCTION

Adithya, a standard VIII student once visited Qutub Minar, Delhi and wondered about the 1500 years old rust resistant iron-pillar. He was thinking about why the iron pillar has not rusted for more than 1500 years. One day he noticed milk turned into curd and he wondered how it is happening.

As you studied earlier in standard VII changes like folding a paper, drying wet clothes, bending of iron rod are some examples for physical changes. On the other hand, changes like burning of paper, digestion of food, turning of milk into curd and decaying of vegetables are some of the examples for chemical changes.

Now, shall we do an activity?

Dear students, can you define a chemical change? Yes, you can. A chemical change is a permanent, irreversible change and produces a new substance.

Activity 1

Identify the following changes as Physical or Chemical.

1. Melting of ice, 2. Ripening of fruits, 3.Rusting of iron, 4. Spoilage of food, 5. Burning of wood, 6. Bursting crackers, 7. Burning of camphor, 8. Browning of apples, 9. Running of steam engine, 10. Combustion of petrol and diesel, 11. recycling of plastics

Complete: A chemical change is --------- 1----------, -------- 2 ---------- and produces 3 --------

1. Temporary/permanent
2. Reversible/Irreversible
3. New substance / no new substance

Chemical changes are otherwise called as chemical reactions, because one or more substances(Reactants)undergo a reaction to form one or more new substances(Products).

Reactant(s) ⟶ Product(s)

In a society people live in different conditions not under same conditions. Likewise, all chemical reaction will not occur at all conditions. For every chemical reaction to take place, certain specific condition is required.

Do you know what are the conditions required for a chemical reaction to take place?

Chemical reactions can be done through;

1. Physical contact 2. Solution of reactants 3. Electricity 4. Heat 5. Light 6. catalyst

Let us discuss the conditions that are necessary to carryout a chemical reaction with one or two examples.

5.1 CHEMICAL REACTIONS BASED ON PHYSICAL CONTACT

Dear children, could you remember some of the day to day activities like burning of matchstick on rubbing, iron materials turning into reddish brown. Why and how these changes happen?

EIH3ZR

Students, these changes are due to chemical reactions by contact in physical state. Combination of reactants in their naturally occurring states (solids, liquids, gases) is referred as phycial contact.

1) When dry wood comes into contact with fire, it burns with the help of oxygen to form carbon dioxide, which is given out as smoke.
2) When a matchstick is rubbed on the sides of a matchbox, a chemical reaction takes place to form heat, light and smoke.
3) When quick lime (calcium oxide) comes in contact with water, it forms slaked lime (calcium hydroxide).

Fig:5.1 Burning a match stick

From above reactions, we can conclude that certain chemical reactions take place only when the reactants are brought in contact with each other in their physical states.

Activity 2

Take two test tubes and couple of rust free iron nails. In one test tube pour some water and put an iron nail. Keep the test tube opened for few days. Take another test tube and pour some water as well. But this time pour some coconut oil above the water level to completely immerse the nail inside. Now, place the second iron nail. Leave the set up for a few days. Observe the changes and record them. Which iron nail gets rusted and Why?

5.2 CHEMICAL REACTIONS BASED ON SOLUTION OF REACTANTS

Do you like coffee? How coffee is prepared? As your mother does, when milk is mixed with coffee decoction the colour of milk and decoction changes due to chemical reaction. Your mother adds enough sugar to make it tasty.

MORE TO KNOW

The head of a matchstick contains potassium chlorate and antimony tri sulphide. The sides of the matchbox contain red phosphorous.

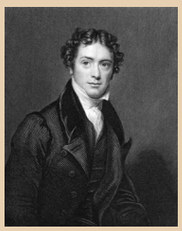
Like this when we mix two substances(Reactants)in solution form, the chemical reaction takes place to form new substances(Products). For example take small amount of solid silver nitrate and sodium chloride in a test tube. Do you observe any change? No, the reactants in solid state have no recations. Now you dissolve the same reactants in water in separate test tubes. Mix both the solutions. What do you observe? Silver nitrate solution reacts with sodium chloride solution to form a white precipitate of silver chloride and sodium nitrate solution. Fom the above reaction, we infer that some chemical reactions proceed only in solution form not in solid form.

5.3 CHEMICAL REACTION BASED ON ELECTRICITY

Can we live without electricity? Absolutely not. Electricity is very essential for our living. We use electricity for cooking, lighting, grinding, watching TV, charging mobiles, laptops, computers, water heaters etc. Do you know electricity can be used to carry out chemical reactions? Yes, by using electricity many chemical reactions are done which are industrially very important. As you know, water is made of hydrogen and oxygen molecules. When electricity is passed through water containing small amounts of sulphuric acid, hydrogen and oxygen gases are liberated. Similarly, a concentrated solution of sodium chloride called BRINE is electrolysed to produce chlorine and hydrogen gases along with sodium hydroxide. This is a very important reaction to produce chlorine industrially.

From the above two reactions, we infer that some chemical reactions proceed only by the passage of electricity. Hence, such reactions are called as **electrochemical reaction** or **electrolysis**.

DO YOU KNOW?



The term electrolysis was introduced by Michael Faraday in the 19th century. Electrolysis is a combination of electron + lysis. Electron is related to electricity and lysis means decomposition.

5.4 CHEMICAL REACTIONS BASED ON HEAT

As you know food is very important for our survival and also many other living beings. Have you closely watched your mother cooks food for you? She boils rice, cooks vegetables, and prepares kuzhambu and rasam etc by heating them over stove. When enough heating is given some chemical reactions take place to convert the raw food (uncooked) items into cooked ones.

You can perform this reaction in your laboratory. Take small amount of lead nitrate in a dry test tube and heat it gently over a flame. Observe the changes closely. You will hear cracking sound and an evolution of reddish brown coloured gas (nitrogen dioxide). In industries limestone rocks are heated to get quicklime (calcium oxide). Hence, some of the chemical reactions can be achieved by the supply of heat only. These reactions are called **thermo chemical reactions** or **thermolysis**.

DO YOU KNOW?

Limestone is the raw material for quicklime, slaked lime, cement and mortar

MORE TO KNOW

Chemical reactions accompanying evolution of heat are called exothermic reactions whereas reactions involving absorbtion of heat are called endothermic reactions.

5.5 CHEMICAL REACTIONS BASED ON LIGHT

What will happen if there is no sunlight? All the human activities will be affected and there will be no food for us to survive. Isn't it?

Sunlight is important not only for us but also for plants as welll. As you know photosynthesis is a process in which light energy from the sun is used by the plants to prepare starch from carbondioxide and water. The sunlight in uses the chemical reactions beween carondioxide and water, which finally ends up in the production of starch (photo means light and synthesis means production). These chemical reactions in used by light are called as photochemical reactions.

DO YOU KNOW?

Photolysis In Atmosphere: The ultraviolet rays from the sun break Ozone (O_3) molecules in the stratosphere into oxygen and atomic oxygen. This atomic oxygen again combines with molecular oxygen to form Ozone.

MORE TO KNOW

Photochemistry is the branch of chemistry that deals with chemical reactions involving light.

5.6 CHEMICAL REACTION BASED ON CATALYST:

Do you like cakes and buns? Yes, you do. Have you ever questioned about why idly batter prepared by your mother turns into sour taste after few hours? The answer for your question is fermentation. It is a chemical reaction in which a substance is decomposed with the help of yeast or bacteria to give simpler products.In the case of yeasts, the enzymes released by the yeast makes the reaction faster. Like this, in industries some chemical substances are used to alter the speed of a chemical reaction. These substances are called catalysts. For example, metallic iron is used as a catalyst in the manufacture of ammonia using Haber process. This ammonia is the basic material for the production of urea, an important fertilizer in agriculture. In Vanaspati ghee (dalda) preparation finely divided nickel is used as a catalyst.

Thus, speed of the certain reactions is influenced by the catalysts and such reactions are called **catalytic reactions**.

Fig 5.2 Applying urea on paddy crops

DO YOU KNOW?

Enzymes and yeasts are called biocatalysts.

MORE TO KNOW

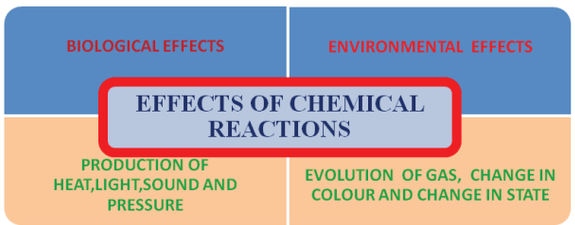
Alcoholic beverages like beer, wine etc are produced by fermentation process in industries .The beer making industries are called BREWERIES.

Activity 3

Buy some fresh yeast from a grocery shop nearby. Prepare a paste of wheat flour with water in a vessel. Add some yeast and leave the vessel closed for few hours under sunlight. Observe the changes closely. What do you infer?

5.7 EFFECTS OF CHEMICAL REACTIONS

We know that every chemical reaction requires a specific condition to occur. When chemical reactions take place there will be production of heat, light,sound,pressure etc. Let us discuss these effects elaborately.



5.7.1 Biological Effects

a) Spoilage of food and vegetables: Food spoilage may be defined as any change that causes food unfit for human consumption. The chemical reactions catalyzed by the enzymes result in the degradation of food quality such as development of bad tastes and odor, deterioration and loss of nutrients.

e.g. 1. Rotten eggs develop a bad smell due to formation of hydrogen sulphide gas

e.g. 2. Decaying of vegetables and fruits due to microbes

b) Rancidity of fishes and meat:

Fishes and meat containing high levels of polyunsaturated fatty acids that undergo oxidation causes bad odour when exposed to air or light. This process is called Rancidity.

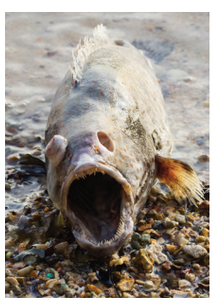


Fig 5.3 Rancid fish on the shore

c) Apples and fruits turn brown when cut:

Apples and some fruits turn brown due to chemical reaction with oxygen in air. This chemical reaction is called browning. The cells of apples, fruits and other vegetables contain an enzyme called polyphenol oxidase or tyrosinase that when in contact with oxygen catalyses a biochemical reaction of plants' phenolic compounds to brown pigments known as melanins.

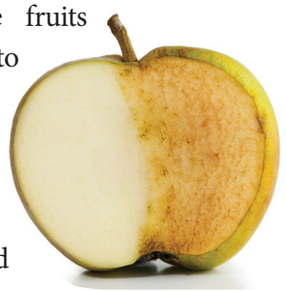


Fig 5.4 Browning of apple

RF3XPM

5.7.2 Environmental Effects

a) Environment is the place around you that comprises both living and non living things. Our environment provides air to breathe, water to drink and the land to produce food. Due to human activities like industries, increasing number of automobiles etc our environment is badly affected now-a-days. So, there is an unwanted change in physical, chemical and biological properties of the environment .This is termed as pollution. The substances which cause these changes are called pollutants. Generally there are three types of pollutions viz air, water and land pollution. Due to increasing human activities lot of chemical substances are produced artificially which harm all the living and non living things.

Fig 5.5 Smoke from industries

We can tabulate the types of chemical substances and their effects.

Sl.no	Type of pollution	Chemical substances responsible for the pollution	Effects
1	Air pollution	Carbon di oxide, Carbon monoxide, oxides of sulphur, oxides of nitrogen, Chlorofluorocarbons, methane etc	Acid rain, Global warming, respiratory problems etc.
2	Water pollution	Waste water containing chemical substances (e.g dyeing industries), detergents, oil spillage etc	Decrease in quality of water, skin diseases etc
3	Land pollution	Fertilizers like urea, various pesticides, herbicides etc.	Spoilage of land, cancer, respiratory diseases etc.

b) What happens to the steel benches and tables during rainy season? They turn into reddish brown. Isn't it?

Do you know why? This is because the iron metal comes into contact with water and oxygen, it undergoes a chemical reaction called RUSTING.

Fig 5.6 Rusted iron barrels and chairs

c) Tarnishing of metal articles: Shiny metal surfaces and other articles lose their shining appearance due to chemical reactions on the surface. For example, silver articles become black on exposure to atmospheric air. Similarly, brass vessels which contain copper as one of constituents develop a greenish layer on exposure to air for a long time. This is due to a chemical reaction between copper and moist air to form basic copper carbonate and copper hydroxide.

Fig 5.7 Damaged iron sheets

5.7.3 Production of heat, light, sound and pressure

a) Production of heat:

Have you ever rubbed your palms in winter season to keep yourself warm? Have you noticed the heat produced when you use cycle pump? Chemical reactions also produce heat energy. Such reactions are called **EXOTHERMIC REACTIONS**. For example when you add water to quicklime (Calcium oxide), lot of heat is released to produce slaked lime (Calcium hydroxide).

Activity 4

Take two clean test tubes. Take sulphuric acid in one test tube and a solution of sodium hydroxide in another tube. Slowly add sodium hydroxide solution to sulphuric acid carefully. Touch the sides of test tube. What do you feel? What do you infer?

Thus we conclude that some chemical reactions produce heat energy.

b) Production of light:

What happens when you ignite a candle? You get light as a result of burning. Some chemical reactions like these produce light. For example when a piece of magnesium ribbon is burnt in a flame, bright light is produced with heat. Even the fireworks during festival times produce different coloured lights which are all

due to chemical reactions. Similarly when we ignite methane gas, it produce heat and light.

So, we can say that light is produced during the chemical reactions .

c) Production of sound:

We produce sound when we speak. When you hit metals like iron, copper etc sound is heard. Some chemical reactions do produce sound when they take place. What happens when you fire cracker during Deepavali? The chemical substances kept in the crackers undergo some chemical reactions to produce sound.

So, sound will be produced in certain chemical reactions.

Activity 5

Take a clean test tube. Add some dilute hydrochloric acid. Drop a piece of magnesium or a piece of zinc metal. What do you see? Now bring a burning matchstick near the mouth of the test tube.

What do you hear? Anything special? What do you infer?

You heard a POP SOUND. Isn't it? When a metal like zinc or magnesium reacts with diluted acids hydrogen gas is produced. Since hydrogen gas is highly flammable it reacts with oxygen in air to produce POP sound.

d) Production of pressure:

What happens when you compress hard a balloon having full of air? Will it burst or not?

Yes, it will burst. This is due to sudden release of air from the balloon as a result of increased pressure on compression. Like this some chemical reactions produce gases which build up the pressure when the reaction takes place in a closed container. If the pressure level goes beyond the limit, we get the explosion. Explosives, fireworks work on this basis. When they are ignited they explode due to pressure generated by gases from the chemical reactions. Thus you hear a huge sound.

So, we conclude that pressure can be generated by certain chemical reactions.

5.7.4 Evolution of Gas, Change in Colour and Change in State

In addition to above effects certain other effects may also take place as a result of chemical reactions.

a) Evolution of gas:

What happens when you open a soda bottle? You can see air bubbles coming out of soda water. Similarly gas evolution may take place as a result of chemical reactions. For example

when dilute hydrochloric acid is added to a solution of sodium carbonate or sodium bicarbonate carbon dioxide gas is evolved.

b) Change in colour:

What happens when you play under hot sun for a long time? Your skin becomes dark. Right?

Like this certain chemical changes produce change in colour. For example when you place a iron nail in a solution of copper sulphate, the blue colour of copper sulphate slowly changes into green due to chemical reaction between iron copper sulphate solution.

c) Change in state:

Take a small ice cube and place it on a plate. What happens after some time? Ice melts into water. Isn't it? Here solid ice cubes change into liquid water. Like this in certain chemical reaction change of state is observed. For example when you burn a piece of camphor, smoke comes out as result of chemical reaction between solid camphor and oxygen. Here, there is a change of state from solid to gas.

Points to remember

- A chemical change is a permanent, irreversible change and produces a new substance.
- In a chemical reaction reactant/reactants give product/products.

- A chemical reaction may take place via physical contact in solid state, solution of reactants, electricity, heat, light and catalyst.
- Rusting is a chemical reaction in which iron objects form hydrated ferric oxide in presence of oxygen and water.
- Electrolysis is a process in which electricity is used to carry out chemical reactions.
- Photolysis is a process in which light is used to carry out chemical reactions.
- Thermolysis is a process in which heat is used to bring about chemical reactions.
- Chemical substance used to alters the speed of the reaction is called catalyst and the process is called catalysis.
- Chemical reactions cause spoilage of food, vegetables and fruits, acid rain, green house effect and damage to materials.
- Global warming is a dangerous condition in which earth's average temperature rises alarmingly due to various human activities.
- Rancidity is a condition in which the food items develop bad odour due to chemical reactions by microbes.

A-Z GLOSSARY

Irreversible	No reverse action
Reactant	Reacting substance in a chemical reaction
Product	Newly formed substance in a chemical reaction
Catalyst	Substance that alters the speed of a chemical reaction
Combustion	Burning with oxygen in air
Rusting	Corrosion of iron objects
Rust	Hydrated iron oxide (ferric oxide)
Precipitate	A new insoluble substance formed in a chemical reaction
Moist Air	Air having water
Decompose	Dissociate/split/broken down
Thermal Decomposition	Dissociation/splitting by heat
Quicklime	Calcium oxide
Ozone	a form of oxygen having three oxygen atoms
Stratosphere	The second layer of atmosphere
Yeast	A kind of single celled fungus
Fertilizer	Artificial manure/ chemically synthesized manure
Spoilage	Deterioration of food items
Rancidity	A chemical change involving food items to produce bad odour
Polyunsaturated Fatty Acids	A long chain carbon based acids present in fats
Oxidation	Addition of oxygen
Splitting Of Fats	Breaking of fats into acid and glycerol
Enzyme	Catalyzing substance in a biological system
Biochemical Reaction	Chemical reaction involving biological substances
Pigments	Colour giving substance/ colourants
Phenomenon	Happening
Acidic	Having acid character
Global Warming	Rise in earth's average temperature
Fossil Fuel	Fuels like coal, petrol obtained from plants and animals once lived and buried beneath the earth
Tarnishing	Losing shine
Lustre	Shine

TEXT BOOK EXERCISE

G8BM4E

I. Multiple choice questions.

1. Burning of paper is a_____ change.
   a) Physical b) chemical
   c) physical & chemical d) neutral
2. The burning of matchstick is an example for chemical reaction based on_____
   a) Contact b) electricity
   c) light d) catalyst
3. _____ metal undergoes rusting.
   a) tin b) sodium
   c) copper d) iron
4. The pigment responsible for browning of apples is_____.
   a) Hydrated iron (II) oxide
   b) melanin
   c) starch
   d) ozone
5. Brine is a concentrated solution of _____.
   a) Sodium sulphate
   b) sodium chloride
   c) calcium chloride
   d) sodium bromide

6) Limestone contains _____ mainly.
   a) Calcium chloride
   b) calcium carbonate
   c) calcium nitrate
   d) calcium sulphate

7. Which of the following factor induces electrtolysis?
   a) Heat b) light
   c) electricity d) catalysis
8. In Haber's process of producing ammonia _____ is used as a catalyst.
   a) Nitrogen b) hydrogen
   c) iron d) nickel
9. Dissolved gases like sulphur dioxide, nitrogen oxides in rain water causes_____
   a) Acid rain b) base rain
   c) heavy rain d) neutral rain
10. _____ is responsible for Global warming.
    a) Carbon di oxide b) methane
    c) chlorofluoro carbons d) all the above

II. Fill in the blanks.

1. Reactants → _____.
2. Photosynthesis is a chemical reaction that takes place in presence of _____.
3. Iron objects undergo rusting when exposed to _____ and _____.
4. _____ is the basic material to manufacture urea.
5. Electrolysis of Brine solution gives _____ gases.
6. _____ is a chemical substance which alters the speed of a chemical reaction.
7. _____ is the enzyme responsible for browning of vegetables, fruits.

III. Write TRUE OR FALSE for the following.

1. A chemical reaction is a temporary reaction.
2. Change in colour may take place during a chemical reaction.

3. Formation of slaked lime from quicklime is a endothermic reaction.
4. CFC is a pollutant.
5. Browning of some vegetables and fruits is due to tannin formation.

IV. Match the following:

A	B
1. Rusting	a) photosynthesis
2. Electrolysis	b) Haber's process
3. Thermolysis	c) Iron
4. food	d) Brine
5. Catalysis	e) Decomposition of limestone
A	**B**
1. Rancidity	a) Decomposition
2. Ozone	b) biocatalyst
3. Tarnishing	c) oxygen
4. Yeast	d) chemical reaction
5. Calcium Oxide	e) fish

V. Give Short Answers For The Following Questions.

1. Define a chemical reaction.
2. Mention the various conditions required for a chemical reaction to occur
3. Define catalysis.
4. What happens when an iron nail is placed in copper sulphate solution?
5. What is pollution?
6. What is Tarnishing? Give an example.
7. What happens to the brine during electrolysis?
8. On heating, calcium carbonate gives calcium oxide and oxygen. Is it exothermic reaction or endothermic reaction?
9. What is the role of a catalyst in a chemical reaction?
10. Why photosynthesis is a chemical reaction?

HOT QUESTIONS

1. Explain the role of yeast in making cakes?
2. Justify the statement. Burning of fossil fuels is responsible for global warming.
3. Discuss acid rain occurs due to emission of smoke from vehicles and industries?
4. Is rusting good for Iron materials? Explain.
5. Do all the fruits and vegetables undergo browning? Explain.
6. Classify the following day to day activities based on chemical reactions by physical contact, solutions of reactants, heat, light, electricity and catalyst.
   a) burning of crackers during festivals
   b) addition of water to quicklime to make it slaked lime
   c) silver ornaments become black on exposure to air for a longtime
   d) copper vessel kept in open air for long time

VI. Answer In Detail

1. Explain how food items are spoilt due to chemical reactions?
2. Explain the three types of pollution.
3. Explain any three conditions that is required for a chemical reaction to take place by citing one example each.

VII. Value Based Questions

1. Kumar is going to build a house. To purchase the iron rods required for construction, he visited an Iron& steel shop nearby. The seller showed him some Iron rods which are fresh and good. He also showed him little older Iron rods which are brownish in appearance. The price of fresh rods are costlier than the older ones, the seller also gave some offer to older ones. Kumar's friend Ramesh advised him not to buy the cheaper rods.

a) Is Ramesh right in his suggestion?

b) Could you explain the reason for his suggestion?

c) What are the values shown by Ramesh?

2. Palanikumar is a Lawyer. He lives in a costly flat. Due to high rent, he wants to shift his residence to a place where he has a chemical industry nearby. There the rent is very cheap and the area is less populated also. Rajasekar, his son studying VIII does not like this and likes to go to some other place.

a) Is Rajasekar right in his attitude?

b) Why did he refuse to go there?

c) What are the values shown by Rajasekar?

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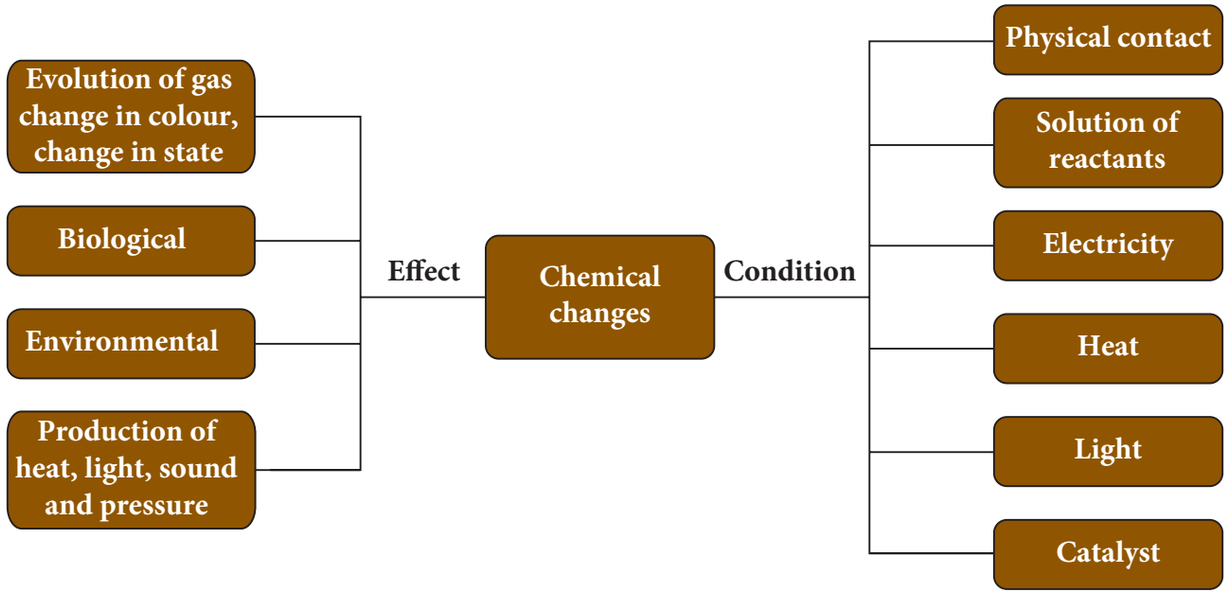
4. NewTrends in ICSE Chemistry by Baljinder Kaur,2017 edition.
5. ICSE conscise chemistry,part1,class IX, Selina.
6. Basic chemistry by Karen C.Timberlake and William Timberlake
7. Pradeep's objective chemistry vol-1 by S.N. Dhawan,S.C.Kheterpal,J.R. Mehta
8. Science book for Tenth class chemistry Part-2 by Lakhmir Singh.

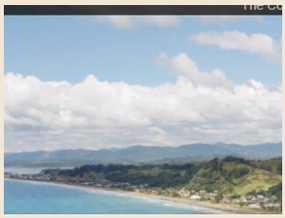
Mind Map



ICT CORNER

Changes Around Us

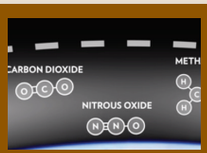
This activity enables the students to understand about the Causes and affects of climate change



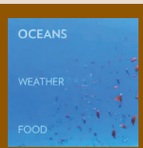
Steps

- Open the Browser and type the URL link given below (or) Scan the QR Code.
- Select the topic "Causes & affects of climate change"
- Click the title "Causes & affects of climate change"
- To know the various affects of climatic changes

Step1



Step2



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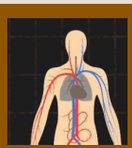

Step4

Web link: scan the QR Code

*Pictures are indicative only

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UNIT

6

MICROORGANISMS

Learning Objectives

T4XGTA

After completing this chapter, the students will be able to:

- Understand the different types of microorganisms.
- Differentiate the various microorganisms based on their shape and occurrence.
- Know the role of microbes in various fields such as medicine, agriculture industry and daily life.
- Know the effects of harmful microorganisms.
- Understand the role of microbes in food process.
- Understand the relationship between man and microbes
- Know the effect of prions and virions on human health.

Introduction

Microorganisms are too small in size that they cannot be seen through naked eye. These organisms can be seen only with the help of a microscope, therefore they are also known as microbes. The science that deals with the study of microorganisms is known as **microbiology**.

Microorganisms occur everywhere. They are found in air, water (ponds, lakes, rivers and oceans), soil and even inside our bodies. Some of them can even survive in severely adverse conditions, such as hot springs, deserts, snow and deep oceans. They remain inactive under unfavourable conditions and become active during favourable conditions.

Microorganisms can be studied under five categories. They are:

- Virus
- Fungi
- Protozoa
- Bacteria
- Algae

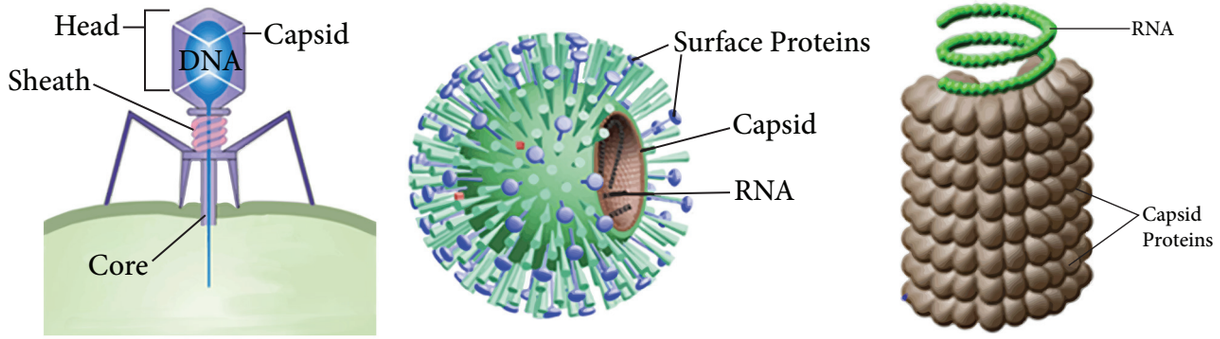
6.1 VIRUS

A virus is a tiny, particle made up of genetic material and protein. They are intermediate between living and non living things. Virus means 'poison' in Latin. Viruses are intracellular obligatory parasites. The study of virus is called **'virology'**. Viruses are 10,000 times smaller than bacteria. Viruses have different shapes. They can be rod shaped, spherical or of other shapes.

6.1.1 Virus structure

A virus contains a core DNA or RNA. Surrounding that core is a protein coat. In some viruses, the protein coat is covered by an envelope made of proteins, lipids, and carbohydrates. The envelope has spikes that help the virus particles attach to the host cells.

Virus shows both living and non living characters:



a) Bacteriophage (Complex) b) Influenza (Spherical) c) Tobacco mosaic virus (Helical)

Fig 6.1 Different shapes of virus

6.1.2 Living characters

- They respond to heat, chemicals and radiations.
- They reproduce inside the host cells and produce copies of themselves.
- They show irritability.

61JBI6

6.1.3 Non-Living characters:

- They are inactive when present freely in the environment.
- They can be crystallized and stored for a very long time, like other non-living things.
- The metabolic machinery, cytoplasm is absent.

Viruses cause many diseases to plants, animals and human beings.

6.2 BACTERIA

Bacteria are single-celled prokaryotes (cells without nuclei). They are considered to be the first living organisms on earth. Bacteria are grouped under the kingdom Monera. The study of Bacteria is called Bacteriology. The size of bacteria range from 1µm to 5µm (micrometer). Bacteria are of two types based on respiration

- Aerobic bacteria (requires oxygen).
- Anaerobic bacteria (Does not requires oxygen).

6.2.1 Cell structure:

A bacterium has an outer covering known as the cell wall. Nuclear material is represented by a nucleoid without nuclear membrane. An extra chromosomal DNA called plasmid is present in the cytoplasm. Protein synthesis is carried out by 70S ribosomes. Other cell organelles (mitochondria, Golgi body endoplasmic reticulum etc.,) are absent. Flagella aids in locomotion.

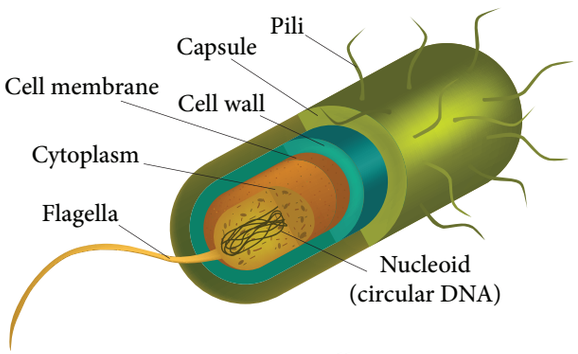


Fig 6.2 Bacteria cell structure

Bacteria are described according to the shape of their cells. They are:

- Bacilli - Rod shaped bacteria. Eg. *Bacillus anthracis*
- Spirilla - Spiral shaped bacteria. Eg. *Helicobacter pylori*
- Cocci - Spherical or ball shaped bacteria. They can stick together in pairs (diplococcus); form a chain (streptococcus) eg. *Streptococcus*

pneumoniae or occur in bunches (staphylococcus).

- Vibrio - comma shaped bacteria. Eg. *Vibrio cholera*.

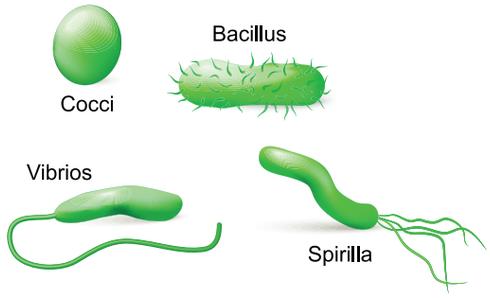


Fig 6.3 3 Shapes of Bacteria

Bacteria are also classified according to the number and arrangement of flagella, which are as follows:

- Monotrichous - Single flagella at one end. Eg. *Vibrio cholera*
- Lophotrichous - Tuft of flagella at one end. Eg. *Pseudomonas*.
- Amphitrichous - Tuft of flagella at both ends. Eg. *Rhodospirillum rubrum*.
- Peritrichous - Flagella all around. Eg. *E.coli*.
- Atrichous - Without any flagella. Eg. *Corynebacterium diptherae*.

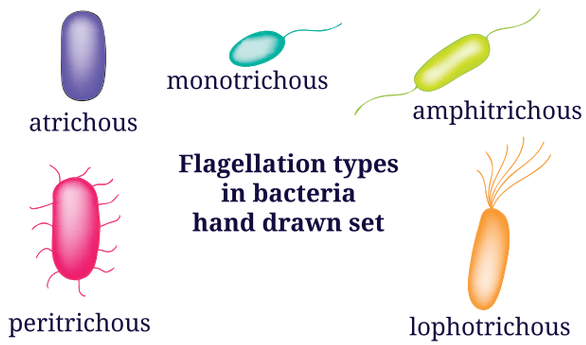


Fig 6.4 Different types of Bacteria based on the arrangement of flagella.

Bacteria get their food in many ways. Photosynthetic bacteria make their own food. (Eg. Cyanobacteria). Bacteria that live in harsh environment use chemicals (Ammonia, hydrogen sulphide) to produce their food instead of utilizing energy from the sun. This process is called chemosynthesis. Some bacteria exhibit symbiotic relationship (eg. E.coli lives in the intestine of man). Bacteria reproduces by fission (binary and multiple fission).

Activity 1

Take one or two drops of butter milk on a slide and spread it. Heat the slide slightly on a lamp (3 – 4 seconds). Add a few drops of crystal violet, leave it for 30 to 60 seconds and wash the slide gently with water. Observe the slide under the compound microscope.

6.3 FUNGI

Fungi are group of eukaryotic organisms that lack chlorophyll. They grow in dark environments. They may be either unicellular (eg. Yeast) or multicellular (eg. Penicillium). They are found in all kinds of habitats. They are included under kingdom Fungi. The study of fungi is called mycology. Some fungi are macroscopic (eg. Mushroom). There are around 70,000 species of fungi, living in the world.

6.3.1 Cell structure:

Unicellular fungi (eg. Yeast)

Yeasts are found freely in the atmosphere. Yeast grows in all kinds of media containing sugar. The cell is ovoid in shape, containing cell

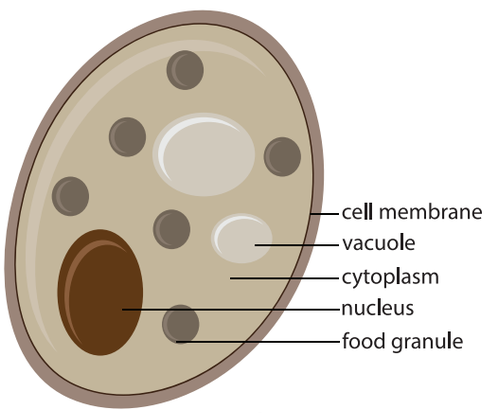


Fig 6.5 Structure of Yeast

wall and a nucleus. The cytoplasm is granular, and has vacuoles, organelles, glycogen an oil globules. Yeast aids in fermentation with the help of the enzyme zymase. Yeast respires anaerobically. Yeast reproduces by budding.

Multicellular fungi (eg. Mushroom)

Mushrooms are found growing on wet soil in shaded places during the rainy season, such as at the roots of the trees. The umbrella shaped structure that grows above the soil is known as the fruiting body. There are small slit like structures under the umbrella which are known as gills. The gills contain spores.

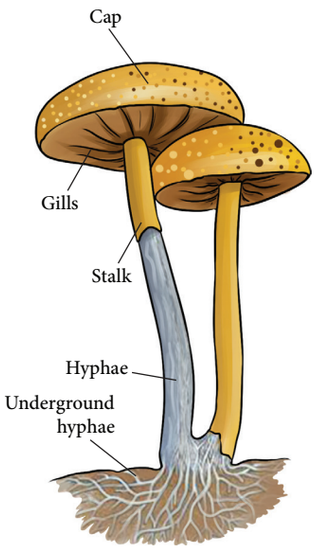


Fig 6.6 Multicellular Fungi – a mushroom

The mycelium is located underneath the fruiting body, in the top layer of the soil. Mycelium in turn is made up of thread-like structures called hyphae. Walls of the hyphae are made up of chitin and cellulose. Hyphae help in transport of nutrients for the growth of mushroom. Reproduction is by the method of fragmentation and spore formation.

Fungi are either saprophytes (i.e., derives nutrition from the remains of dead and decomposing plants and animals) eg. *Rhizopus*, *Penicillium*, *Agaricus*, or parasites (ie. derives nutrition from the living cells of the host) eg. *Puccina*, *Albugo*, *Ustilago*, or symbionts (ie., fungus in the roots of vascular plant) eg. *Mycorrhiza*.

Activity 2

Take some rotten part of vegetable or black spoiled part of bread or coconut with the help of a needle on a slide. Put a drop of glycerine, place a cover slip on it and observe it under the microscope.

6.4 ALGAE

Algae are very simple plant like eukaryotic organisms. Algae are found in moist habitats. Algae are rich in chlorophyll and can be seen as thin film on the surface of lakes and ponds, therefore they are known as 'grass of water'. They are autotrophic and manufacture their own food with the help of chloroplast. Chloroplast contain chlorophyll (green) pigments for photosynthesis. The study of algae is called algology (phycology).

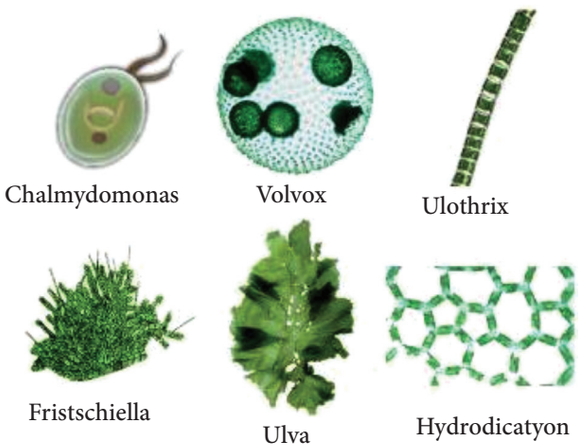


Fig 6.7 Different types of Algae

Their size varies from 1 micron to 50 meter. Algae may be unicellular, microscopic (eg. *Chlamydomonas*) or multicellular and macroscopic (eg. *Sargassum*). Unicellular algae exhibits variety of shapes (i.e., spherical, rod, spindle), where as multicellular algae are in the form of filaments and branches.

6.4.1 Cell structure (Eg. *Chlamydomonas*)

Chlamydomonas is a simple, unicellular, motile fresh water algae. They are oval, spherical or pyriform in shape. The pyriform (pear shape) is a common one found in ponds, ditches and water tanks. They have a narrow anterior end and a broad posterior end.

The cell is surrounded by a thin and firm cell wall made of cellulose. The cytoplasm

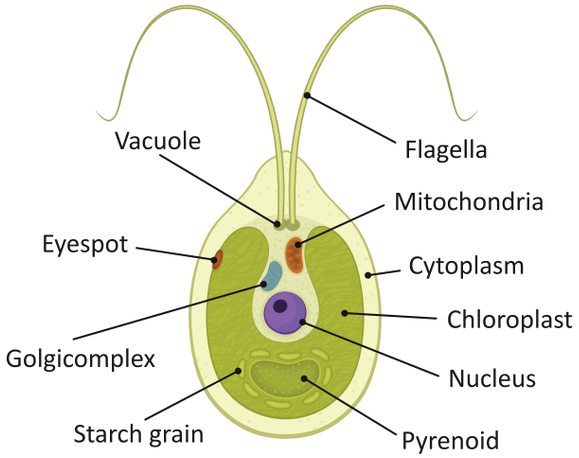


Fig 6.8 Structure of Chlamydomonas

is seen in between the cell membrane and the chloroplast. The cell contains large dark nucleus lying inside the cavity of the cup shaped chloroplast. The anterior part of the cell bears two flagella which helps in locomotion. Two contractile vacuoles are seen at the base of each flagellum. The anterior side of the chloroplast contains a tiny red coloured eyespot. *Chlamydomonas* exhibits sexual and asexual modes of reproduction.

Some algae have other photosynthetic pigments like fucoxanthin (brown), xanthophylls (yellow), phycoerythrin (red), phycocyanin (blue).

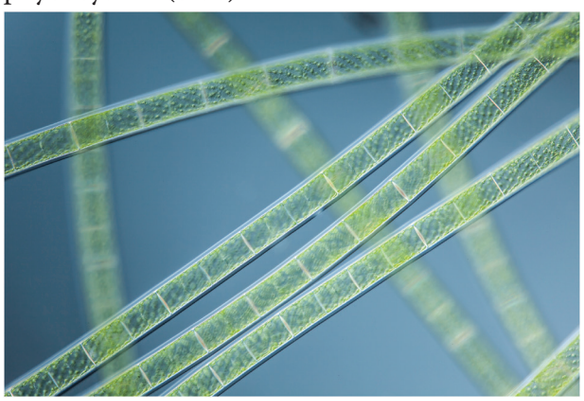


Fig. 6.9 *Spirogyra*

Activity 3

Collect pond water in a small bottle. Take one or two drops of collected greenish pond water on a slide. Cover it with a cover slip and observe through microscope.

6.5 PROTOZOA

A protozoan (in Greek protos = first and zoon = animal) is a single-celled eukaryote. They are included under the kingdom **Protista**. The study of protozoa is called **Protozoology**. They are found in ponds, ocean, in moist soil, and in the cells and tissues of plants and animals causing diseases. They range from 2-200 microns. Protozoans have specialized organelles. These organelles are used for movement, feeding, and other functions. The types of protozoans are as follows:

- Ciliates - presence of cilia for locomotion (eg. *Paramecium*)
- Flagellates - presence of flagella for locomotion (eg. *Euglena*)
- Pseudopods - presence of pseudopodia for locomotion (eg. *Amoeba*)
- Sporozoans - parasites(eg. *Plasmodium*)

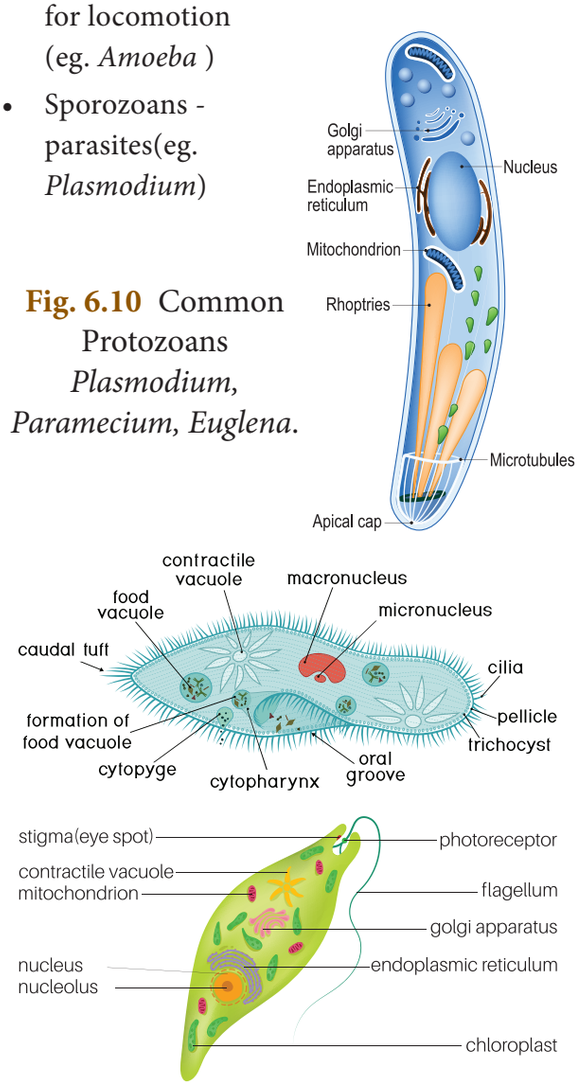


Fig. 6.10 Common Protozoans *Plasmodium, Paramecium, Euglena.*

Activity 4

Take one or two drops of hay (in tamil: vaikol) decoction on a slide and observe it under the microscope.

6.5.1 Cell structure (Eg. *Amoeba*)

Amoeba is a unicellular microscopic organism. It is found in ponds. *Amoeba* is irregular in shape. It has cell membrane, cytoplasm and nucleus. It is a protozoan that move by means of pseudopodia (in Latin, "false feet.") Pseudopodia are the extended part of cell membrane. It helps to catch its prey (algae). The body 'flows' around the food particle and engulfs it forming food vacuoles. Contractile vacuoles are seen in the cytoplasm that help in excretion. *Amoeba* reproduces by means of fission and sporulation.

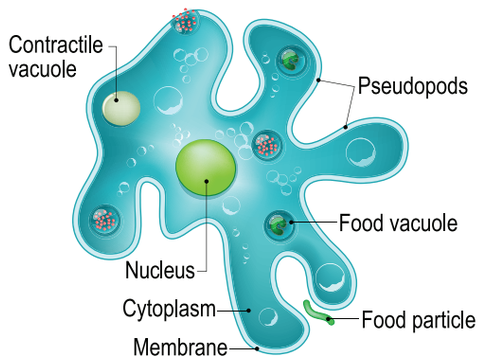


Fig.6.11 *Amoeba*

6.6 USES OF MICROORGANISMS IN MEDICINE, AGRICULTURE, INDUSTRY AND DAILY LIFE

6.6.1 Medicine

We obtain antibiotics and vaccines from microbes.

1. Antibiotics

The word 'Anti' means 'against'. Antibiotic is a substance produced by living organisms which is toxic for other organisms. Sir Alexander Fleming was the first person to discover the antibiotic Penicillin in the year 1928. The antibiotic Penicillin was obtained from the fungi *Penicillium chrysogenum*. It is used to treat diseases such as tetanus, diphtheria. Antibiotic Streptomycin is obtained from *Streptomyces* bacteria to cure various bacterial infections eg. Plague.

Fig 6.13 *Penicillium chrysogenum*

More to know

Scientists discovered a new antibiotic pseudouridimycin. The new antibiotic is produced by a microbe found in a soil sample collected in Italy. The new antibiotic kills drug-sensitive and drug-resistant bacteria in a test tube and cures bacterial infections in mice.

2. Vaccines

Vaccines are prepared from dead or weakened microbes. Edward Jenner was the first person to discover small pox vaccine. He coined the term vaccination. When the vaccine is injected to the body of a patient, the body

produces antibodies to fight against the germs. These antibodies remain inside the body and protects from future invasion of the germs. Therefore vaccination is otherwise called as immunization.

Eg. MMR vaccine for Measles, Mumps, Rubella. BCG (Bacille Calmette Guerin) vaccine for Tuberculosis.

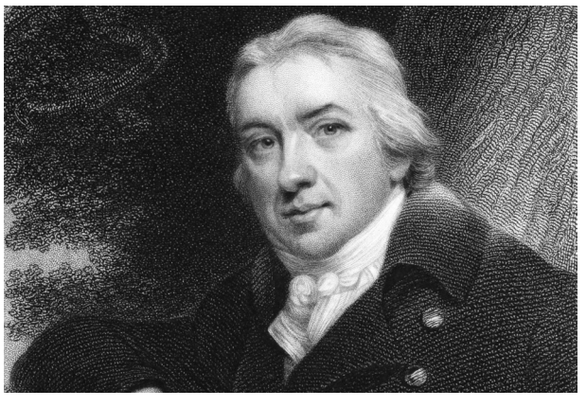


Fig. 6.14 Edward Jenner

6.6.2 Agriculture

1. Natural Fertilizer

Microorganisms are called as decomposers because they act upon degradable wastes. During the process, nitrates and other inorganic nutrients are released into the soil, making the soil fertile. This compost is called as natural fertilizer.

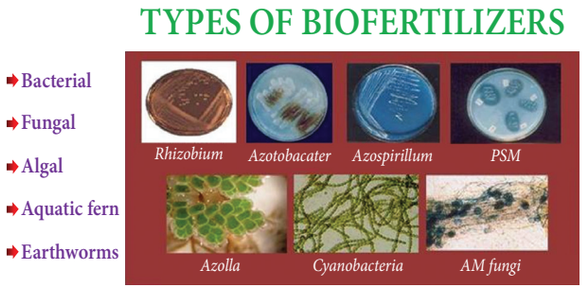


Fig. 6.15 Types of Biofertilizers

2. Nitrogen Fixation:

Rhizobium bacteria living in the root nodules of leguminous plants enrich the soil

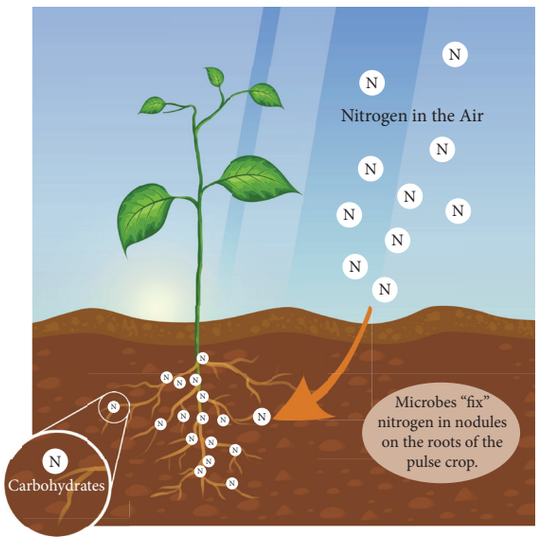


Fig. 6.16 Plant Fixing Nitrogen

by fixing the atmospheric nitrogen as nitrates which are essential for the growth of plants. Some free living bacteria in soil, cyanobacteria Nostoc can also fix nitrogen biologically.

3. Biocontrol Agents:

Microbes are used to protect the crops from pests. For example,

- *Bacillus thuringiensis* (Bt cotton) helps to control insects.
- *Trichoderma* (Fungi) helps to protect roots and control plant pathogens.
- *Baculoviruses* (Virus) attack insects and other arthropods.

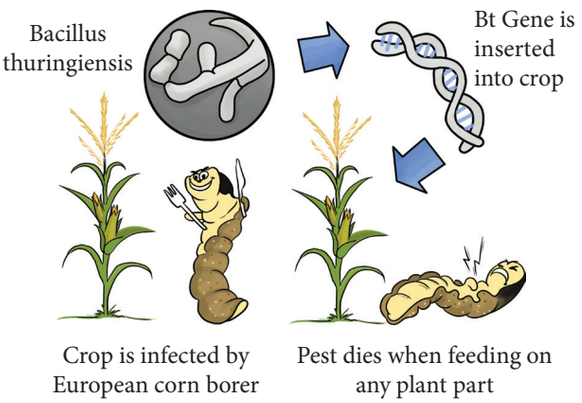


Fig. 6.17 The activity of Biocontrol agents on the insects

6.6.3 INDUSTRY

1. Sewage Treatment

Aerobic microbes are allowed to grow in the primary effluent during the secondary stage of waste water treatment. These microbes consume the major part of the organic matter in the effluent eg. Nitrobacter sps. In the anaerobic treatment of sewage Methanobacterium is used.

2. Production of Biogas

Human and animal faecal matter and plant wastes are broken down by anaerobic bacteria to produce methane (biogas) along with carbon dioxide and hydrogen. These bacteria are called as methanogens.

3. Production of Alcohol and Wine

Alcoholic drinks are prepared by fermentation process using yeast. Sugars in grapes are fermented by using yeast. Beer is produced by the fermentation of sugars in rice and barley.

4. Microbes in Retting and Tanning Process

A. Retting

Flax plants are tied in bundles and kept in water. Bacteria loosen the supporting fibres of the stem by acting on the stem tissues. This process is known as retting. Linen thread is made from these fibres eg. *Pseudomonas aeruginosa*.

B. Tanning

In Tanning industry bacteria act upon the skin of animals and makes it soft and therefore it becomes pliable.

6.6.4 In Daily Life

1. Making of Bread

Yeast is used in bakeries to make bread and cakes. They are added to the dough to produce carbon dioxide which makes the dough rise. Bread and cakes are soft due to carbon dioxide gas. *Chlorella* (green algae) is rich in proteins and vitamins is added to the dough which enrich the bread with nutrients.

2. Preparation of Curd and Cottage Cheese

Lactose in the milk gets turned into Lactic acid by the action of *Lactobacillus* (bacteria). Therefore the milk becomes thick (curd). It gives the sour taste. When curd is processed cottage cheese (panneer) is obtained.

3. In Human Intestine

- *Lactobacillus acidophilus* that lives in the human intestine helps in digestion of food and fight against harmful disease causing organisms.
- *E.coli* bacteria in human intestine help in synthesizing vitamin K and vitamin B complex.

More to Know

Lactobacillus acidophilus are acid-loving bacteria. These are found in buttermilk, yogurt, sour cream, and frozen desserts. They convert sugar and carbohydrates into lactic acid, and hence are called "lactic acid bacteria."

6.7 HARMFUL MICROORGANISMS

A few microorganisms are harmful to humans, animals and plants. They cause diseases and hence they are called as pathogens. Pathogens enter into the body through cuts and wounds in the skin, mouth or nose and cause diseases. Viruses causing 'flu' are spread through air. When the patient sneezes droplets containing viruses spread in air and it gets entered to another person when he breathes. Let us study about some of the diseases caused by the microorganisms in humans, animals and plants.

6.7.1 Diseases Caused By Microorganisms In Humans

Sl. No.	Human Diseases	Causative microorganisms	Mode of transmission	Symptoms	Preventive measures/ Treatment
1.	Tuberculosis	*Mycobacterium tuberculosis* (Bacteria)	Through air and sputum of infected person	Persistent cough, blood mucus, loss of weight, breathlessness	BCG Vaccine
2.	Cholera	*Vibrio cholera* (Bacteria)	By flies and by contaminated food and water	Watery diarrhoea, vomiting, rapid dehydration.	Anticholera vaccine, maintaining personal hygiene.
3.	Common cold	*Influenza* (virus)	Through air	Running nose, sneezing	Isolation of patient
4.	Rabies	*Rhabdo viridae* (virus)	Animal bite	Fever, hallucination, paralysis inability to swallow	Anti-rabies vaccine.
5.	Amoebic dysentery	*Entamoeba histolytica* (Protozoa)	Food water and flies	Severe diarrhea and blood in stool	Proper sanitation to be followed and metronidazole antibiotic to be administered
6.	Malaria	*Plasmodium* (Protozoa)	Female Anopheles mosquito	Nausea, vomiting High fever	Antimalarial drugs like quinine, chloroquine to be taken and also usage of mosquito repellents and nets.

6.7.2 Diseases Caused By Microorganisms In Animals

Animal Diseases	Causative microorganisms	Mode of transmission	Symptoms	Preventive measures/Treatment
Anthrax (cattle) also affects humans	*Bacillus anthracis* (Bacteria)	Through contaminated soil and food	Difficulty in breathing, unconsciousness, loss of appetite	Anthrax Vaccine
Foot and mouth disease	*Aphthovirus* (virus)	Through air and animal vectors	Fever, blisters in mouth, weight loss, decreased milk production	FMD vaccine

6.7.3 Diseases Caused By Microorganisms In Plants

Plant Diseases	Causative micro organisms	Mode of transmission	Symptoms	Preventive measures/ Treatment	
Citrus canker	*Xanthomonas axonopodis* (Bacteria)	Air, water	Lesions on leaves, stems and fruit	Copper based bactericides can be used	
Potato blight disease	*Phytophthora infestans* (Fungi)	Air	Brown lesions on the surface of tubers	Fungicides are used	

MORE TO KNOW

African sleeping sickness, which is spread by the bite of the tsetse fly, is caused by the flagellate protozoan *Trypanosoma*.

6.8 MICROBES IN FOOD PROCESS

For food processing, commonly used microorganisms are yeast, bacteria, and moulds. Fermentation process which is carried out by microorganisms results in the production of organic acids, alcohol and esters. They help to preserve food and generate distinctive new food products.

1. Food Preservation:

Two techniques are followed in food preservation. They are;

- Traditional techniques
- Modern techniques

A) Traditional techniques:

***Fermentation:** Fermentation is the microbial conversion of starch and sugars into alcohol. It makes foods more nutritious and palatable.

* **Pickling:** Pickling is a method of preserving food in an edible antimicrobial liquid. It is of two types:

a) Chemical pickling: Food is placed in an edible liquid that kills bacteria and other microorganisms. Eg. Vinegar, alcohol, vegetable oil. (pickling agents)

B) Fermentation pickling: Bacteria in the liquid produce organic acid as preservation agent that produces lactic acid due to the presence of *Lactobacillus*.

***Boiling:** Boiling liquid food items kill all the microbes. Eg. Milk and Water.

***Sugaring:** Sugar is used to preserve fruits in an antimicrobial syrup with fruit such as apples, pears, peaches, plums or in a crystallized form, therefore the product is stored in dry condition.

B) Modern techniques:

***Pasteurization:** It is a process for preservation of liquid food. This method was invented by Louis Pasteur in 1862. Milk is heated up to 70°c to kill the bacteria and it is cooled to 10°c to prevent the growth of remaining bacteria. Then milk is stored in sterilized bottles in cold places.

2. Food Production:

***Probiotics:** Probiotics are live food supplements used in yoghurt and other fermented milk products. Eg. *Lactobacillus acidophilus* and *Bifidobacterium bifidum*. These bacteria improve the microbial spectrum in the gut and thus contribute to the following effects:

- Decrease the risk of colon cancer
- Decrease cholesterol absorption

More to Know

Scientists discovered a particular strain of probiotic *Bifidobacterium bifidum* can help to repair stomach ulcers caused by *Helicobacter pylori*. Another probiotic in this genus, *Bifidobacterium breve*, is useful in the treatment of childhood constipation.

- Prevent diarrheal diseases by increasing the immunity power.

6.9 RELATIONSHIP BETWEEN MAN AND MICROBES- BALANCES, IMBALANCES AND USES

Thousands of bacteria, fungi and other microbes that live in our gut are essential contributors to a good health. They break down toxins, manufacture some vitamins and essential amino acids and form a barrier against invaders. Gut microbes are the bacteria in human gut. It is one of the most important allies in our overall health and well being. Gut ensures that the body is absorbing all the important nutrients, to function at its highest level. Many different aspects of health are attached to it.

6.10 PRIONS

The word prion is derived from "protinaceous infectious particle". Prions have neither DNA or RNA to transmit infection. A prion is a mutted form of a usually harmless protein. Prions cause diseases by affecting brain or neural tissue. Eg. Creutzfeldt-Jackob disease. Another example is Kuru- associated with cannibalism.

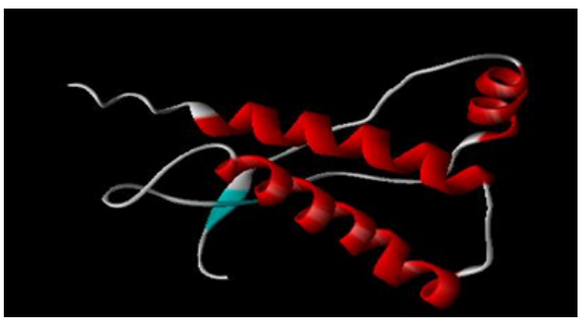


Fig. 6.18 Structure of Prion

6.11 VIRIONS

Virion is an entire virus particle consisting of an outer protein shell called a capsid and an inner core of nucleic acid (RNA or DNA). If the virus is found outside the cell (extracellular) it is known as virion. Virion has the capacity to infect the living tissue.

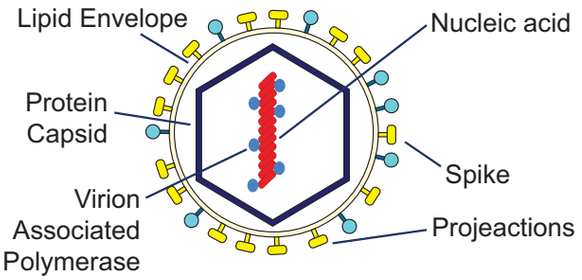


Fig. 6.19 Structure of a Virion

Points to remember

- Micro organism: The organism which can seen only with the help of microscope.
- Virus: Virus show both living and non living characteristics.
- Bacteria: A prokaryotic, single celled organism.
- Fungi: A eukaryotic, non-photosynthetic, spore-forming organism. They range from single celled organisms to very complex multicellular organisms.
- Algae: A single-celled or multicellular eukaryotic, photosynthetic organism.
- Protozoa: A eukaryotic, single celled organism that usually lacks chlorophyll.

TEXT BOOK EXERCISES

WILJ1K

I. Multiple choice questions.

1. Micro organisms are measured in _____.

   a) cm b) mm c) micron d) meter.

2. _____ shows both living and nonliving characteristics.

   a) Protozoa b) virus c) bacteria d) Fungi

3. _____ is a prokaryotic micro organisms.

   a) Virus b) algae c) fungi d) bacteria

4. Based on shape, the bacteria are classified into _____ types.

   a) 2 b) 3 c) 4 d) 5

5. The plant body of algae is called as _____.

   a) stem b) thallus c) leaf d) root

II. Fill in the blanks.

1. _____ is prepared from a mould called Penicillium.
2. _____ are the infectious protein particles.
3. The infact virus particle found outside the host cell is _____.
4. Micro organism can be seen with the help of a _____.
5. Bacteria, which have a flagellum at one end is classified as _____.

III. Match the following:

1.	Nitrogen fixing bacteria	-	Vaccine
2.	Tuberculosis	-	Prion
3.	Kuru	-	Lactobacillus acidophilus
4.	Probiotics	-	Bacteria
5.	Edward Jenner	-	Rhizobium

IV. True or False.

1. Diseases causing micro organisms are called pathogens.
2. Female anopheles mosquito is a carrier of dengue virus.
3. Chicken pox is a communicable disease.
4. Citrus canker is transmitted by insects.
5. Yeast is used in the large scale production of alcohol.

V. Assertion & Reason.

1. Direction: In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the four statements, given below, mark one as the correct answer.

(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 Assertion is true but Reason is false.

(d) If both Assertion and Reason are false.

1. Assertion: Malaria is caused by Protozoa. Reason: The disease is transmitted by mosquito.
2. Assertion: Algae are heterotrophic. Reason: They don't have chlorophyll.

VI. Very short answer type:

1. Write the name of any nitrogen fixing bacteria.
2. Name the bacteria used in the production of vinegar.
3. Write the names of any three protozoans.
4. Who discovered penicillin?
5. Which diseases can be prevented by vaccination?

VII. Short answer type

1. Write the four types of bacteria, based on their shape.
2. What are antibiotics?
3. What are pathogens?
4. How diseases causing micro organisms enter into human beings?
5. Why micro organisms are essential for agriculture?

VIII. Long answer type.

1. Write a short note on bacteria and its structure.
2. How micro organisms are useful in the field of medicine?
3. Write a short note on common human diseases caused by micro organisms.
4. How can we improve the beneficial bacterial count in human beings?
5. Write a short note on Probiotics.

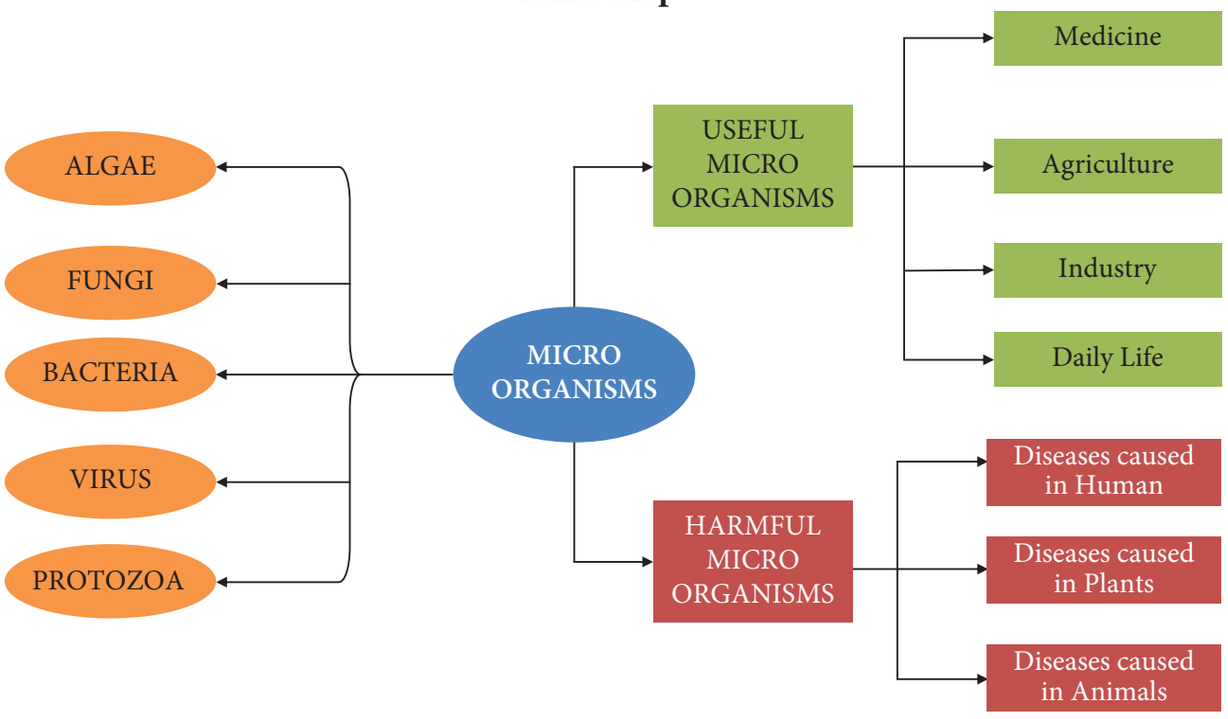
REFERENCE BOOKS

1. Ananthnarayan and Panicker's Textbook of Medical Microbiology Edited by C.K.J.Panicker.
2. Essential Microbiology by Stuart Hogg.
3. Textbook of Microbiology by Surinder Kumar.

A-Z GLOSSARY

Antibiotic	A chemical that kills or inhibits the growth of micro organism and is used to treat infections.
Bacteria	A prokaryotic, single celled organism.
Capsid	The protein coat surrounding a virus.
Fermentation	The conversion of organic compounds such as carbohydrate into simpler substances by microbes, usually under anaerobic conditions (with no oxygen present).
Hyphae	A very fine thread that is the basic structure of fungi.
Micro-organism (microbe)	A small living thing. The group includes bacteria, protozoa, algae, fungi and viruses.
Pathogen	An organism that causes disease.
Vaccine	A special type of medicine that is given to both people and animals to artificially increase immunity to a particular disease and to prevent an infectious disease from developing.

Mind Map



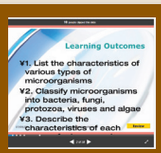
ICT CORNER

MICRO ORGANISMS

This activity enables the students to know about the Classification of Micro organisms

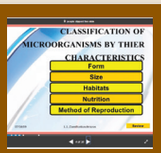
Steps

- Open the Browser and type the given URL (or) Scan the QR Code.
- Options will be given. Select the "Classification of Microorganisms"
- Click and touch the button slides one by one
- To know about the "Classification of Microorganisms"



Step1

Step2



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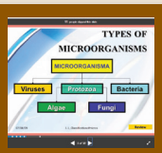

Step4

Web link: scan the QR Code

*Pictures are indicative only

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UNIT 7

PLANT KINGDOM

Learning Objectives

HX6682

At the end of this lesson, students will be able to:

- understand that plants are named with two words (Binomial name).
- study the Bentham and Hooker's classification of seeded plants.
- differentiate the types of algae based on the pigmentation.
- know the salient features of fungi, mode of nutrition, classification and their uses.
- differentiate Bryophytes from Pteridophytes.
- differentiate Monocot from Dicot plants.
- know the importance of medicinal plants and their uses.
- understand the classes of Angiosperms and their characters.

Introduction

The living organisms found on the earth are different in their structures, habit, habitat, mode of nutrition and physiology. The estimated number of species on the earth is 8.7 million. Among them 6.5 million (1 million =10 lacks) species are living on land, 2.2 million species in the ocean. In these 4,00,000 species are flowering plants. The living organisms show lot of similarities and differences so that they can be arranged into many groups systematically. The plant kingdom includes thallophytes, bryophytes, pteridophytes, gymnosperms and angiosperms.

7.1 Taxonomy

Taxonomy is the branch of biology that deals with the study of identification, classification, description and nomenclature of living organisms. The word **taxonomy** is derived from two Greek words (**Taxis**: arrangement and **Nomos**: laws.) The word 'Taxonomy' was first coined by **Augustin-Pyramus de Candolle.**

Classification:

Plants are arranged into different groups and categories on the basis of similarities and differences are called classification.

Types of classification:

There are four types of classification.

1. Artificial system of classification
2. Natural system of classification
3. Phylogenetic system of classification
4. Modern system of classification

7.1.1 Artificial system of classification

This is the earliest system of classification in plants. Plants are classified on the basis of one or few morphological characters. The most famous artificial system of classification is Linnaeus classification which was proposed by **Carolus Linnaeus in Species plantarum**.

7.1.2 Natural system of classification

In this system, plants are classified on the basis of several characters. Bentham and Hooker's classification is an example of Natural System of Classification. This system of classification is based on morphological and reproductive characters of the seeded plants.

This classification is widely used in many Herbaria (herbarium is defined as the collection of pressed, dried plants pasted on a sheet and arranged according to any one of the accepted systems of classification) and botanical gardens all over the world.

Bentham and **Hooker** published their Natural system of Classification in their book named **Genera Plantarum** in 3 volumes.

7.2 OUTLINE OF BENTHAM AND HOOKER'S SYSTEM OF CLASSIFICATION

The division spermatophyta are divided into 3 classes:

- Dicotyledonae
- Gymnospermae
- Monocotyledonae

Class I - Dicotyledonae

- Seed has two cotyledons.
- Leaves have reticulate venation
- Tap root system is present.
- Flowers are tetramerous or pentamerous.

Class II - Gymnospermae (Naked seed plants)

- Plants of this class have no fruit.
- It has three families, they are

1. Cycadaceae
2. Coniferae
3. Gnetaceae

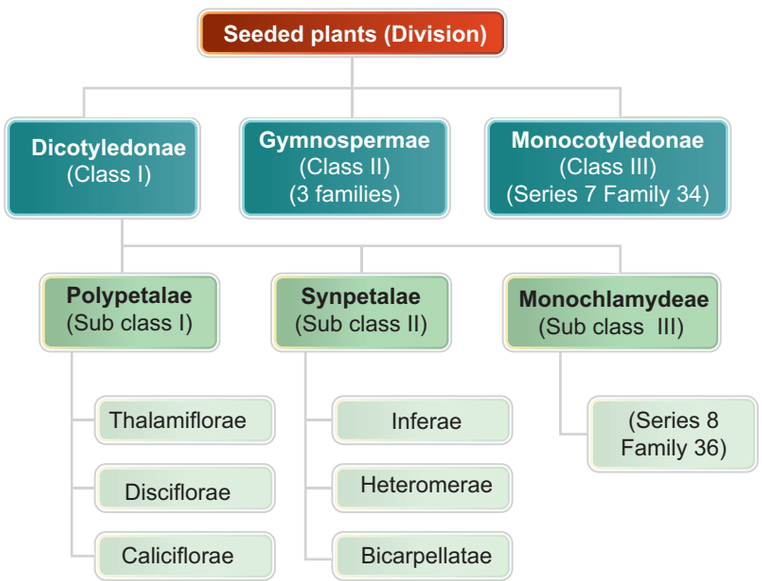
Class III - Monocotyledonae

- Seed has single cotyledon.
- Leaves have parallel venation.
- Fibrous root system is present
- Flowers are Trimerous

7.3 Binomial Nomenclature

The naming of an organisms with two words are known as Binomial Nomenclature. For example, the binomial name of mango is *Mangifera indica*. Here the first word *Mangifera* refers to the genus name and the second word *indica* to the species name.

Outline of Bentham and Hooker's system of Classification



Binomial system had been properly made used by **Linnaeus** in his book, **"Species Plantarum."**

The system of naming the plants on scientific basis is known as **Botanical nomenclature.** Binomial name was first introduced by **Gaspard Bauhin** in the year of 1623.

DO YOU KNOW?

Largest Herbarium of India is in Kolkata, which has more than 10,00,000 (one million) species of herbarium specimens.

7.4 Salient features of Algae

- Algae are chlorophyll bearing simple, primitive plants and are autotrophs.
- Algae belongs to thallophyta, and the plant body of algae are called thallus. i.e. the plant body is not differentiated into root, stem and leaf.
- Most of the algae are living in aquatic region. It may be fresh water or marine water. Very few algae can survive in terrestrial conditions.
- Some algae are very minute and float on the surface of the water. These algae are called Phytoplankton.
- Some of the algae are symbionts (algae living with fungi and they both are mutually benefitted.) e.g. Lichen.
- A few species of them are epiphytes (growing on another plants).

Various forms of Algae:

- Plant body of the algae are unicellular or multicellular
- Unicellular motile (*Chlamydomonas*), non-motile. (*Chlorella*)
- Multicellular unbranched filaments (*Spirogyra*) and branched filaments (*Cladophora*).
- Some algae are giant kelp – Macrocystis.
- Some algae are living as colonial form – *Volvox.*
- Alga like *Chara* resembles largest plant body and it possess well developed sex organs.

Reproduction of Algae:

- Three types of reproduction are seen in algae.
- Vegetative reproduction by fragmentation e.g. *Spirogyra.*
- Asexual reproduction by spore formation e.g. *Chlamydomonos.*
- Sexual reproduction by means of fusion of gametes e.g. *Spirogyra, Chara*

Info bits

The rules and recommendations regarding binomial nomenclature were found in ICBN (International Code of Botanical Nomenclature) now it is known as ICN (International Code of Nomenclature).

Activity 1

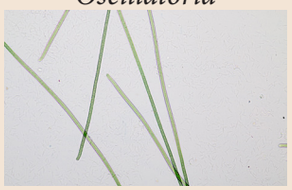
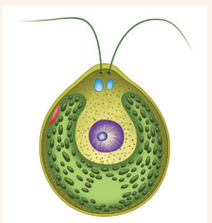
Collect some plants which are growing inside the school area, write their vernacular name, binomial name and classify them into dicotyledons or monocotyledons in the given table 7.1.

Table 7.1

S. No.	Vernacular name of the plant	Binomial name of the plant	Monocotyledons/Dicotyledons
1			
2			
3			
4			
5			

7.4.1 Classification of algae based on pigments (Fritsch – 1935)

Table 7.2

S. No.	Class	Types of Pigments	Reserve food material	Example
1	Bluegreen algae (Cyanophyceae)	Phycocyanin	Cyanophycean Starch	*Oscillatoria* 
2	Green algae (Chlorophyceae)	Chlorophyll	Starch	*Chylamydomonas* 
3	Brown algae (Phaeophyceae)	Fucoxanthin	Laminarian starch and Manitol	*Laminaria* 
4	Red algae (Rhodophyceae)	Phycoerythirin	Floridian Starch	*Polysiphonia* 

The largest herbaria of the world is Museum National d'Historie Naturelle in paris, France

7.4.2 Economic Importance of algae:

1. Food:

Algae are consumed as food by the people in Japan, England and also in India. e.g. *Ulva, Spirulina, Chlorella* etc..

Some algae are used as a food for domestic animals. e.g. *Laminaria, Ascophyllum.*

2. Agriculture

Some of the blue green algae are essential for the fixing of atmospheric nitrogen into the soil, which increases the fertility of the soil. e.g. *Nostoc, Anabaena.*

3. Agar Agar

Agar Agar is extracted from some red algae, namely *Gelidium, Gracillaria*, etc., which is used to prepare growth medium in laboratories.

4. Iodine

Iodine is obtained from brown algae like *Laminaria* (kelp).

5. Algae in space Travel

Chlorella pyrenoidosa is used in spacew travel to get rid of CO_2 and decompose human wastes.

Table 7.3

S. No.	Name of the organisms	Plants	Animals
1			
2			
3			
4			
5			

6. SCP (Single Cell protein)

Some of the single cell algae and blue green algae are used to produce protein. e.g. *Chlorella, Spirulina.*

Activity 2

Collect some pond or lake water and place a drop of water on a slide. With the help of your teacher, observe the slide and write down what you have seen in the microscope. Then write the name of the organism and classify them as plant or animal by using a tick mark in the given Table 7.3.

7.5 Fungi

7.5.1 General characters of fungi

Fungi (singular – fungus) belongs to thallophyta because the plant body is not differentiated into root, stem, and leaves.

The plant body of fungus consists of filament like structures called as **hyphae**. Several hyphae arranged in the form of network called **mycelium**. There are two types of mycelium found in fungi, namely septate mycelium and aseptate mycelium. If the cross wall is seen between the cell, it is called s**eptate mycelium**. If the cross wall is not seen, it is called **aseptate mycelium**. When aseptate mycelium contains many nuclei it is called as **coenocytic mycelium**.

The cells of fungi are multicellular and **eukaryotic** organisation. Some species of fungi like yeast is unicellular and eukaryotic cell. Cell wall of fungi is made up of a chemical substance called **chitin**. The reserve food materials of fungi are glycogen and oil. They have no starch because they have no chlorophyll pigments. So, they are heterotrophs. Heterotrophs are of three types called **parasites, saprophytes** and **symbionts.**

Parasites

Parasites absorbs food from the living organisms with the help of special root called haustoria. e.g. *Cercospora personata*. It affects groundnut plants and causeTikka disease.

Figure.7.1 Tikka disease in groundnut leaves

Saprophytes:

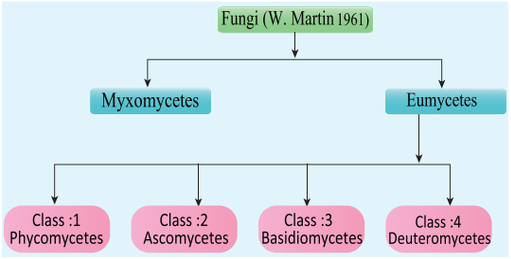
Saprophytes grow up on the dead and decay matters and get food from them. e.g. *Rhizopus.*

Symbionts:

Some species of fungi living with algae and are mutually benefitted. e.g. *Lichen.*

Some fungi live symbiotically with higher plants roots called *Mycorrhizae*

7.5.2 Classification of fungi (W.Martin 1961)



7.5.3 Economic Importance of Fungi:

1. Antibiotic:

Penicillin *(Penicillium notatum),* Neomycin, Gentamycin, Erythromycin are some antibiotics obtained from fungi, which cure variable diseases.

Figure.7.3 *Penicillium notatum*

2. Food:

Mushroom contains rich protein and minerals. The most common edible mushroom is *Agaricus.* (Button mushroom).

Figure.7.4 Agaricus

3. Vitamins:

Fungus like *Ashbya gospii* and *Erymothecium ashbyii* are used to produce vitamin B_2 (riboflavin).

Figure.7.5 Yeast

4. Alcohol:

Fungus like yeast contain enzymes invertase and zymase, which ferment the sugar molasses into alcohol.

Info bits

Fungi placed as third kingdom in RH Wittekar's five kingdom of classification because absence of chlorophyll and starch.

7.5.4 Harmful Effects of Fungi

7QDULT

Table 7.3 Diseases caused by Fungi in Plants

S. No.	Pathogen	Name of the Disease
1	*Fusarium oxisporam*	Wilt disease of cotton
2	*Cercospora personata*	Tikka disease of ground nut
3	*Colletotrichum falcatum*	Red rot of sugar cane
4	*Pyricularia oryzae*	Blast disease of paddy
5	*Albugo candida*	White rust of radish

More to Know

Claviceps purpuriya is the hallucinogenic fungi causes greatest damages to the frustrated youth by giving unreal, extraordinary lightness and hovering sensations

Aspergillus species cause allergy to children while ***Cladosporium*** protects against allergy.

Fig.7.6 Wilt disease of Cotton

Fig.7.7 Red rot of Sugar cane

Fig 7.8 Blast disease of Paddy

Fig.7.9 White rust of Radish

Table 7.5 Diseases caused by Fungi in Human

S. No.	Name of the Fungi	Name of the Disease
1	*Trichophyton sp.*	Ring worm (Circular rash on the skin) 
2	*Microsporum furfur*	Dandruff 
3	*Tinea pedis*	Athletes foot 

7.6 Bryophytes

7.6.1 General Characters of Bryophytes

- Bryophytes are the primitive and simplest group of land plants.
- These are terrestrial and non-vascular cryptogams (they have no vascular tissues like xylem, phloem).

Table 7.6 Differences between algae and fungi

S. No.	ALGAE	FUNGI
1	Algae are autotrophs.	Fungi are heterotrophs.
2	It has pigments.	It has no pigments
3	Reserve food material is starch.	Reserve food materials are glycogen and oil.
4	Some algae are prokaryotic in nature eg: *Cyanobacteria* (*Nostac, Anabenae*)	All are eukaryotic nature. eg: *Agaricus*

Queen of medicine is Penicillin, discovered by Sir Alexander Fleming in 1928.

Activity 3

Collect some fungi from dead and decay matters of coconut, pickle, fruits and bread. Spread the fungi on the slide and observe them through microscope. Classify the fungi and note it down.

Take a piece of bread and pour some water on it and cover it for 4 days. After 4 days place the bread on a slide and observe it through microscope. What will you see? Name the organisms which you have seen in the slide.

- Water is essential to complete their life cycle, so these plants are called **amphibians** of the Plant Kingdom.
- Bryophytes have distinct alternation of generation. gametophytic is dominant and sporophytic generation is small and depends on the gametophytic generation.
- The gametophytic plant can be either thalloid (liverworts) or leafy (mosses).
- The plant remains fixed to the substratum with the help of root like structure called rhizoid.

- Sexual reproduction is oogamous type
- They have well developed sex organs like antheridia and archegonia.
- The male sex organ is antheridium, which produces antherozoid. The female sex organ is archegonium which contains an egg.
- Antherozoid swims and reaches the archegonium, fertilizes the egg and form zygote (2n).
- Zygote is the first cell which develops into sporophytic generation and produce haploid spore (n) by meiosis.
- Spore is the first cell of the gametophytic generation.

7.6.2 Classification of Bryophytes

Bryophyta

Class I: Hepaticae (Liverworts) | Class II: Anthocerotae (Hornworts) | Class III: Musci(Mosses)

Fig.7.10 Riccia

Fig.7.11 Anthoceros

Fig 7.12 Funaria

Class I Hepaticae (e.g. *Riccia*)

- These are lower forms of bryophytes. They are simple in structure than moss.
- Protonemal stage is absent. Sporophyte is very simple and short lived.

Class–II Anthocerotae (e.g. *Anthoceros*)

- Gametophyte is undifferentiated thallus, rhizoids are unicellular and unbranched.
- Protonemal stage is absent. Sporophyte is differentiated into foot and capsule only.

Class-III Musci (e.g. *Funaria*)

- These are higher forms in which the gametophytes is differentiated into stem like, leaf like parts.
- Protonemal stage is present.
- Sporophytes is differentiated into foot, seta, and capsule

7.6.3 Economic Importance of Bryophytes:

1. Bryophytes prevent the soil erosion.
2. *Sphagnam* can absorb large amount of water. Hence, it is used by the gardeners in nursery.
3. Peat is a valuable fuel like coal obtained from *Sphagnum*.

Activity 4

Visit a nearby nursery and observe how *Sphagnum* is used in horticulture make a note on it.

More to Know

Sphagnum moss was once used in disposable diapers, because it soaks liquid well.

7.7 Pteridophytes

7.7.1 General Characters of Pteridophyte:

- Pteridophytes are the first true land plants with xylem and phloem. Hence it is called vascular cryptogams.
- Pteridophytes also exhibit alternation of generation. The diploid sporophytic phase

7.7.2 Classification of Pteridophytes:

Table 7.7

Psilopsida (class I)	Lycopsida (class II)	Sphenopsida(class III)	Pteropsida (class IV)
e.g. Psilotum	*e.g. Lycopodium*	*e.g .Equisetum*	*e.g. Nephrolepis*
			

alternates with the haploid gametophytic phase.

- The main plant body is sporophytes, which is the dominant phase, differentiated into true root, stem and leaves.
- Sporophytes reproduce by means of spores. Spores are produced in sporangium.
- The sporangia bearing leaves are called sporophyll.
- Most of the plants produce only one type of spore, it may be either microspore or megaspore (homosporous).
- In some plants two types of spores are produced. They are microspore and megaspore(heterosporous).
- Spores give rise to gametophytic generation called prothallus, which is short lived and independent.
- The gametophytes produce the multicellular sex organs, Antheridium which produces antherozoid (male gamete) and archegonium which contains an egg. (female gamete)
- The antherozoid fertilizes with egg and form diploid zygote. It develops into an embryo which grow differentiate into sporophyte.

7.7.3 Economic Importance of Pteridophytes:

- Ferns are used as ornamental plants.
- The rhizome and petioles of the *Dryopteris* yield the vermifuge drug.
- The sporocarp of *Marsilea* (water fern) is used as food by tribal people.

More to Know

1. *Lycopodium*, is known as club moss.
2. *Equisetum* is known as horse tail.

7.8 Differences between Bryophytes and Pteridophytes

Table 7.8

S. No.	Bryophytes	Pteridophytes
1	Plant body cannot be differentiated into root, stem and leaf.	Plant body can be differentiated into root, stem and leaf.
2	Bryophytes are amphibians.	Pteridophytes are land plants.
3	Vascular tissues are absent.	Vascular tissues are present.
4	The dominant phase of the plant body is gametophyte.	The dominant phase of the plant body is sporophyte.
5	Sporophytic generation depends on the gametophytic generation. e.g. *Riccia*	Gametophytic generation does not depend on sporophytic generation. eg. *Selaginella*

7.9 Gymnosperms

7.9.1 General Characters of Gymnosperms

- Gymnosperm are naked seed plant, i.e. the ovule is not enclosed by ovary.
- Gymnosperms have two phases in its life cycle. (Sporophytic and Gametophytic)
- Plant body is sporophyte dominant which is differentiated into root, stem and leaf.
- They have well developed vascular tissues. (xylem and phloem)
- The water conducting tissue is tracheid. Food conducting tissue is sieve cell.
- They have cone on which sporangia and spores are produced.

7.9.2 Economic Importance of Gymnosperms

- Woods of many conifers are used in the paper industries. e.g. *Pinus, Agathis*
- Conifers are the sources of soft wood for construction, packing and plywood industry e.g. *Cedrus, Agathis*
- Turpentine is an essential oil used for paint preparation extracted from the resin of *Pinus*. It is also used medicinally to get relief from pain and bronchitis etc.,
- Seeds of *Pinus gerardiana* are edible.
- Ephedrine is an alkaloid extracted from *Ephedra*. It cures asthma and respiratory problems.
- *Araucaria bidwillii* is an ornamental plant.

7.10 Angiosperms (Closed seeded plants)

7.10.1 General Characters of Angiosperms

- The term 'Angiosperm 'is derived from two Greek words, i.e. 'Angio' which means box or closed and 'sperma' which means seed.
- Angiosperms are called flowering plants. In this group more than 4,00,000 living species are found.
- They occupy every habitat on earth except extreme environment. (extreme hot and cold conditions).

7.9.3 Classification of Gymnosperms

Cycadales *eg: Cycas sps*	**Ginkgoales** eg: *Ginko biloba*	**Coniferales** eg: *Pinus sps*	**Gnetales** eg: *Gnetum sps*
Palm like small plants (erect and unbranched)	*Ginko biloba* is the only living species in the group.	Evergreen trees with cone like appearance.	Small group of plants.
Leaves are pinnately compound forming a crown.	It is a large tree with fan shaped leaves.	Needle like leaves or scale leaves.	It possesses advanced characters like Angiosperm
Tap root system and Coralloid root. 	They produce unpleasant smell. 	Seeds are winged and produced in female cone. 	Ovules are naked but, developed on flower like shoot. 

- Habit of the plants may be herb, *(Solanaum melongena)* shrub, *(Hibiscus rosasinensis)* and tree – *Mangifera indica (Mango)*
- They have well developed conducting tissues. (Vascular bundles)
- Xylem contains vessel, tracheid, xylem parenchyma and xylem fibre.
- Phloem contains sieve tubes, phloem parenchyma, companion cells and phloem fibres.

7.10.2 Classification of Angiosperms

Angiosperms are divided into two classes, They are:

- Monocotyledons
- Dicotyledons

7.10.3 Characteristic features of monocotyledons

- Seed has only one cotyledon.
- Plants have fibrous root system, leaves with parallel venation.
- Flowers are trimerous and not differentiated in to calyx and corolla.
- Pollination occurs mostly by wind.
- E.g. Grass, Paddy, Banana.

7.10.4 Characteristic features of Dicotyledons

- Seed has two cotyledons.
- Plants have tap root system, leaves with reticulate venation.

Activity 5

Collect some flowering plants from your surroundings and classify them as monocot (or) dicot based on their root system and venation in the given Table 7.11.

- Flowers are tetramerous or pentamerous. Calyx and corolla are well differentiated.
- Pollination occurs mostly by insects.
- E.g. Bean, Mango, Neem

7.11 Uses of Medicinal plants

7.11.1 *Acalypha indica* (Kuppaimeni)

Fig 7.13 *Acalypha indica*

- It belongs to the family Euphorbiaceae.
- The paste obtained from the leaves of this plant is used to cure the burns on the skin.
- The juice of this plant leaves is mixed with lemon juice to cure ringworm

D96EXF

Table 7.11

S. No.	Plants Name	Root sytem	Venation	Dicot/ Monocot
1	Hibiscus	Tap root	Reticulate venation	Dicot
2				
3				
4				
5				

7.11.2 *Aegle marmelos* (Vilvam)

Fig.7.14 *Aegle marmelos*

- It belongs to the family Rutaceae.
- The unripe fruit of this tree is used to treat indigestion.
- It is used to cure chronic, diarrhoea and dysentery.

7.11.3 *Solanum trilobatum* (Thoodhuvalai)

Fig.7.15 *Solanum trilobatum*

- It belongs to the family Solanaceae.
- The leaves and fruits of this plant cure cough and cold.
- It is widely used in the treatment of tuberculosis and bronchial asthma.

7.11.4 *Phyllanthus amarus* (Keezhanelli)

Fig. 7.16 *Phyllanthus amarus*

- It belongs to the family Euphorbiaceae.
- The entire plant is used for the treatment of jaundice.
- It gives additional strength to human liver and used to treat other liver disorders.

7.10.5 *Aloe vera* (Sothu Katrazhai)

Fig.7.17 *Aloe vera*

- It belongs to the family Liliaceae.
- Leaves of this plant is used to cure piles and inflammations on the skin.
- It cures peptic ulcer.

Points to remember

- Scientific method of naming the plants with two words are known as Binomial Nomenclature.
- Algae are chlorophyll bearing, simple primitive plants and are autotrophs.
- Algae like *Chara* has well developed sex organs.
- Parasites have special roots called haustoria.
- Bryophytes are the primitive and simplest group of land plants.
- Pteridophytes are the first true land plants.
- Gymnosperms are the naked seeded plants.
- Angiosperms are the closed seeded plants (ovules are enclosed by the ovary)
- Angiosperms are divided in to two classes, namely monocotyledons and dicotyledons.
- The paste obtained from the leaves of *Acalypha indica cure* the burns on the skin.
- The leaves, flowers and fruits of *Solanum trilobatum* cure the cough and cold.

GLOSSARY

Polypetalae:	free petal.
Gamopetalae:	united petal
Monochlamydeae:	flower with single whorl ,which can not be differentiated in to calyx and corolla.
Vascular tissues:	conducting tissues namely xylem and phloem.
Epiphytes:	Plants growing up on the other plants.
Autotroups:	organisms which prepare their own food.
Heterotrophs:	organisms which depends the other organisms for their nutrition
Isogametes:	gametes are similar.
Haustoria:	special roots present in parasites.
Mycorrhiza:	symbiotic association of fungi with higher plant roots

TEXT BOOK EXERCISES

BJBVTS

I Fill in the blanks:

1. The word 'Taxonomy' is derived from _____
2. Binomial Nomenclature was first introduced by _____
3. The book **"Genera Plantarum"** was written by _____
4. Monocotyledon seeds bear only _____cotyledon.
5. Brown algae belongs to _____class.
6. Agar Agar is obtained from _____ algae.
7. The reserve food material of fungi are _____ and _____
8. The first true land plant is _____
9. Xylem and phloem are absent in_____ plants.
10. Reticulate venation is present in _____ plants.

II.Choose the correct answers:

1. *Solanum trilobatum* is the binomial name of Thoothuvalai. Here the word **'Solanum'** refers to
   a) Species
   b) Genus
   c) Class
   d) Orders
2. _____ is an example for colonial form of algae.
   a) *Oscillatoria* b) *Nostac*
   c) *Volvox* d) *Chlorella*
3. Floridian starch is a reserve food material of _____
   a) Chloroplyceae b) Phaeophyceae
   c) Rhodophyceae d) Cyanophyceae
4. The edible mushroom is _____
   a) *Polyporus* b) *Agaricus*
   c) *Pennicillium* d) *Aspergillus*
5. Soil erosion is prevented by_____ plants.
   a) Algae b) Fungi
   c) Bryophytes d) Pteridophytes
6. The first vascular cryptogams in land plants are _____
   a) Bryophytes b) Pteridophytes
   c) Gymnosperm d) Angiosperm

7. The well-developed sporophytic plant body is seen in

   a) Bryophytes b) Pteridophytes
   c) Gymnosperms d) Angiosperms

8. Binominal Nomenclature was first introduced in the year of _____

   a) 1970 b)1975 c) 1978 d) 1623

9. Penicillin is an antibiotic, which is extracted from_____

   a) Algae b) Fungi
   c) Bryophytes d) Pteridophytes

III True of False

1. In polypetalae, the petals are free.
2. Binomial name should contains more than two words.
3. Artificial system of classification is based on the vegetative characters of the plant.
4. Cell wall of fungi is made up of chitin.
5. Pinus is a closed seeded plant.
6. All bryophytes are hydrophytes.
7. Dicotyledons have well developed characters than the monocotyledons.
8. Mosses are the well developed plant in bryophytes.
9. The dominant phase of the bryophytes is sporophytes.
10. The dominant phase of the pteridophytes is diploid(2n).
11. Seeds of angiosperm are produced inside the ovary.
12. In gymnosperms ovules are developed from the flowers.

IV Match the following

1. Which of the following pairs are in correct?

Laminaria	–	Iodins
Nostoc	–	N_2 fixation
Polysiphonia	–	Green algae
Rhodophyceae	–	Fucoxanthin

i) a, b, c 2) c,d c) a, c, d d) a ,b ,c, d

2. Find out the correct pairs:

Phyllanthus amarus	–	Euphorbiaceae
Solomum trilobatum	–	Solanaceae
Acalypha indica	–	Malvaceae
Aegle marmelos	–	Rutaceac

ii) a,b ii) c,d iii) a,b,c d) a,b,d

3. Which of the following characters are not suitable to angiosperm?

a) Reticulate / parallel venation, closed seeded plants, sieve tubes are present in phloem.

b) Seeds are open, ovary is not present, gametes are produced in cones.

c) Tracheids are the conducting cells, companion cells not are present in phloem.

d) Trimerous or tetramerous, closed seed, seed with seed coat, bears fruit.

1) a,b 2) b,c 3) e,d 4) a,d

4. Which of the following sequences are correct

a) In Bryophytes – Gametophytes - Sex organ – Gamete fusion – Zygote - Spore mother cell – spore – Thallus.

b) In Angiosperm – pollination – fertilization – zygote – new plant.

c) In Gymnosperm – male cone, and female cone – microspore and megaspore – Zygote – new sporophytes plant.

d) In pteridophytes – pollination by wind, fertilization in the presence of water – zygote prothallus, new plant.

1) a, b, c 2) a, b 3) c, d 4) b, d

5. Match column I with coloumn II

Column I	Column II
A. *Penicillium chrysogenum*	1) Blast disease of paddy.
B. *Ginko biloba*	2) Ornamental plants
C . *Araucaria bidwilli*	3) Athlet foot.
D. *Tinea pedis*	4) Penicillin
E. *Pyricularia oryzae*	5) Living fossil

a) A-4, B-5, C-2, D-3, E-1 c) A-3, B-2, C-4, D-5, E-1
b) A-4, B-5, C-1, D-2, E-1 d) A-4, B-2, C-1, D-5, E-3

V Answer the following questions shortly.

1. Define Thallus.
2. What is mean by Binomial Nomenclature? give example.
3. Write any two characters of dicotyledons.
4. Seeds of gymnosperm plants are naked. Why?
5. Write any two economic importance of fungi.

VI Answers the following questions in brief.

1. Write short notes about natural system of classification.
2. Write any three economic importance of algae.
3. Write the differences between algae and fungi.
4. How many classes are there in Bryophytes? What are they?
5. Write any four characters of pteridophytes.

VII Answers the following questions in detail.

1. Draw the outline of Bentham and Hookers system classification.
2. Write any five differences between monocot and dicot plants.
3. Write differences between Gymnosperm and Angiosperm.
4. Write the economic importance of Gymnosperms.
5. Write the names of medicinal plants and explain their uses.

VIII Assertion and Reason

1. Assertion (A): Penicillin is an antibiotic extracted from *Penicillium notatum*.

Reason (R): It can kill (or) inhibits the growth of the other micro organism.

1) Both A and R True, R explains A

2) A only correct, R doesn't explain A

3) A True, R explains A

4. Both A and R False.

2. **Assertion(A):** Artificial system of classification is otherwise called sexual system of classification.

Reason(R): Artificial system of classification is based on the nature of the vegetative characters.

a) Both A and R correct

b) Both A and R incorrect

c)A is correct R is incorrect

d) A is incorrect and R is correct

3. **Assertion(A):** Bryophytes are called Amphibians of the plant kingdom.

Reason(R): Bryophytes are land plants but they need water for the completion of their life cycle.

a) A correct R correct

b) A incorrect R correct

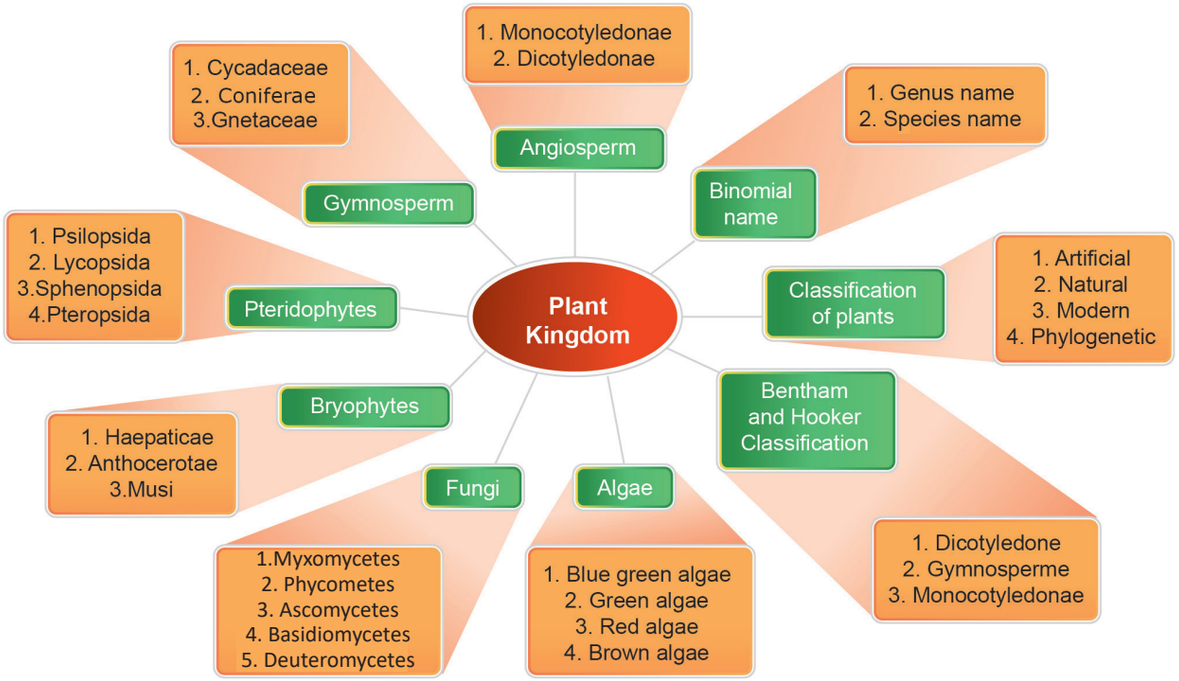
c) A and R correct R explain A

d) A and R incorrect

REFERENCE BOOKS

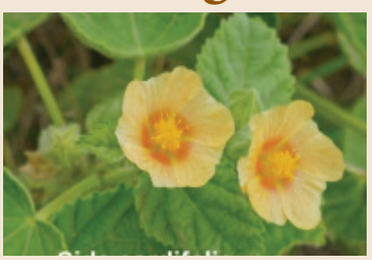
1. Algae by A.V.S.S Sambamurty, published by I.K International publishing house.
2. Bryophyta by Afroz Alam, published by I.K International publishing house.
3. Pteridophyta by O.P.Sharma, published by Mc Graw Hill Educations.
4. Gymnosperms by S.P.Bhatnagar, published by New Age Publishers.
5. Taxonomy of Angiosperms by B.P.Pandey, published by S.Chand
6. Plant Kingdom by Theresa Greenaway, published by Hodder Wayland.

MIND MAP



ICT CORNER

Plant Kingdom

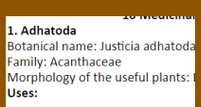


Through this activity the students will learn about Medicinal plants and their uses

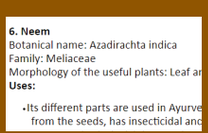
Steps

- Open the Browser and type the URL link (or) Scan the QR Code.
- Click the title "Medicinal plants and their uses
- Select and view the images of Medicinal plants and their uses
- Through this image u can identify the uses of medicinal plants

Step1



Step2



Step3

Step4

Web link : scan the QR Code

*Pictures are indicative only

B359_8_SCIENCE_EM

UNIT

8

ORGANIZATION OF LIFE

Learning Objectives

NFXQIN

At the end of this lesson, students will be able to

- Understand the different levels of organization seen in the animal world
- Learn about each level of organization briefly
- Learn about the structure of eye as an example for organ level of organization
- Learn about the respiratory system as an example for system level of organization
- Understand the various functions of organizational setup with reference to homeostasis, diffusion, osmosis, osmoregulation, cellular respiration and metabolism

Introduction

If you look around your school premises or in your countryside, you will be able to observe numerous varities of animals.There are animals like amoeba which cannot be seen by our naked eye. There are animals like blue whale and elephants which are of huge size. The variations are not only seen size but also in the complexity of their, cells, tissues of the body structure.This is called **organization of life**.

The biological organization are arranged from cellular level to organism level. It goes like tissue, organ, organ system and organisms. Each of this represents a level of organization and hierarchy. This organizations are of two levels, they are lower levels and higher levels of organism.

Irrespective of the level, they exhibit and can perform all the life activities like growth, metabolism, reproduction etc., In this lesson, let us learn different levels of organizations of living organism with suitable example.

8.1 ORGANIZATION OF CELLS AND TISSUES

Cell is the smallest structural and functional unit of living organisms and it is capable of performing specific function. It is also called the building blocks of life. Single-celled organisms like Amoeba are able to carry out all the processes of life, like higher organisms. The body of Amoeba looks like a single cell, while higher animals are made up of billions of cells. Bacteria, yeasts and Amoeba have a single cell body and are called as **unicellular organisms**. Organisms such as human beings, cows and trees are made of a large number of cells and are called **multicellular organisms**. Thus the body has different levels of organisation. **Cells** make up **tissues**, tissues make up **organs**, and organs make up **organ systems**.

Prokaryotes and Eukaryotes

Based on the structural organization, organism can be classified into prokaryotes

and eukaryotes. In some of the organism like bacteria, cyanobacteria and mycoplasma, no true nucleus is seen. These organisms are called prokaryotes. However in the cells of amoeba, animals and plants, a well-defined nucleus, covered by membrane is seen. These organisms are called eukaryotes.

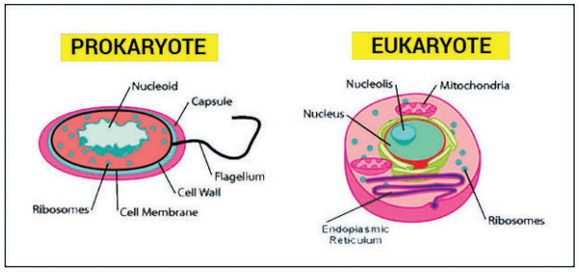


Fig 8.1 Structure of Prokaryote and Eukaryote

Biological levels of organization

The biological organization shows the hierarchy in organization levels from simplest to more complex: atoms, to molecules, cells, tissues, organs, organ systems, organisms, populations, communities, ecosystem and finally biosphere. The pictorial representation of biological organization is given below. Though atoms and molecules make up the cells, they are considered as non living. Where as population, community, ecosystem and biosphere are of ecological importance. Hense we restrict our study from cells to organism.

Activity 1

Boil a hen's egg. Remove the shell. What do you observe? A white material surrounds the yellow part. White material is albumin which solidifies on boiling. The yellow part is yolk. It is a part of the single cell. You can observe this single cell without any magnifying devices.

8.1.1 CELL

Cell is the **structural and functional unit of life**. Cells are often called as"building blocks of life". The study of cells is called **cell biology**. Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids. Cells vary widely in shape and size. There is a central spherical **nucleus** and a variety of cytoplasmic living **cell organelles** like the endoplasmic reticulum, mitochondria. golgibodies, centrioles, ribosomes, lysosomes, etc., present in an animal cell. Each cell organelle performs a specific function.

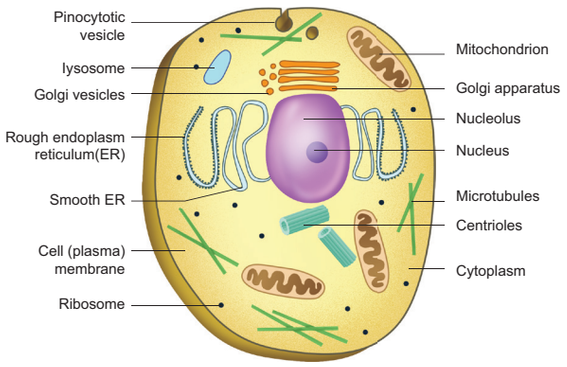


Fig.8.3 Animal cell

Cell ► tissue ► organ ► organ system ► organism

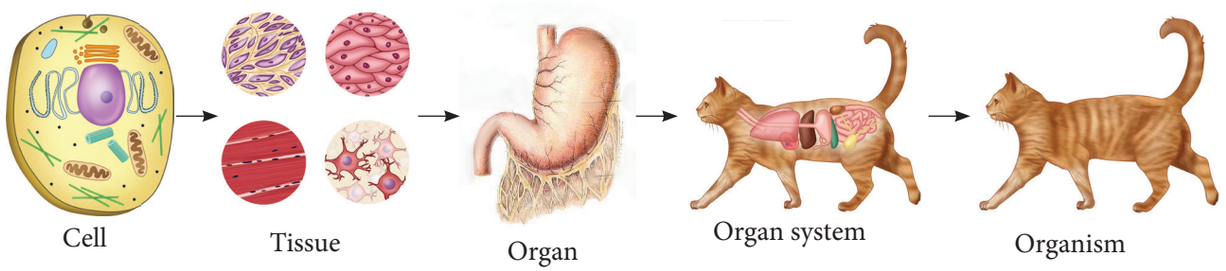


Fig 8.2 Different levels of organization

The size of cells varies in different animals which are measured in units of micron (μm). (**1cm =10 mm: 1 mm = 1000 microns.**) The average cell size varies from 0.5 to 20 μm in diameter. The cells of bacteria are the smallest in size (1-2 μm). In human body, the smallest cell is RBC (7 μm in diameter), the longest one is the nerve cell which reaches a length of about 90 -100 cm and the human egg (ovum) is 100 μm in size . Among multicellular animals, the largest cell is, egg of an ostrich. It measures about 170 mm × 180mm in diameter. It is about 25,000 times bigger than a red blood cell. Mycoplasma with a diameter of 0.0001 mm is the smallest bacterium.

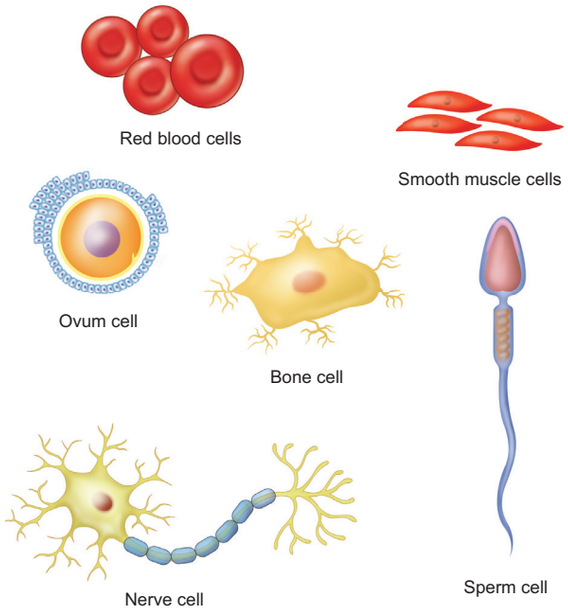
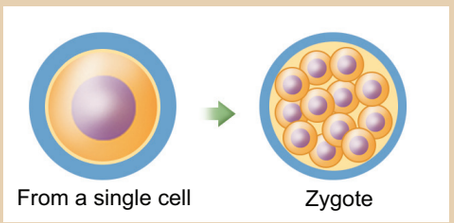


Fig.8.4 Different shapes and sizes of some cells

Stem cell

A stem cell is essentially a 'blank' cell, capable of becoming another more differentiated cell type in the body, such as a skin cell, a muscle cell, or a nerve cell. They are microscopic in size. Stem cells can be used to replace or even heal the damaged tissues in the body. They can serve as a built-in repair system for the human body, replenishing other cells as long as a person is still alive.

Our body is developed from a single cell called zygote. The zygote undergoes continuous mitotic division and forms the foetus consisting multitude of cells of different shape, size and content. Foetal cells gradually attain change in structure and function. This process is known as cell differentiation.



Shape

Cells are of different shapes. Normally they are correlated with their functions. Some cells are oval or round, while certain others are elongated. Some cells are long and pointed at both ends. They exhibit a spindle shape. Cells are sometimes quite long. Some are branched like the nerve cell or a neuron. Some of our WBC cells are Amoeba like with irregular boundaries.

8.1.2 Tissues

Tissues are groups of cells that have a similar structure and act together to perform a specific function. They are of two type's **simple** and **complex tissues**. Simple tissues are made up of cells of same type or kind e.g. glandular tissue and complex tissues are made up of different kind of tissues e.g. tissues of dry skin. Hence, simple tissue is homogeneous and complex tissue is heterogeneous.

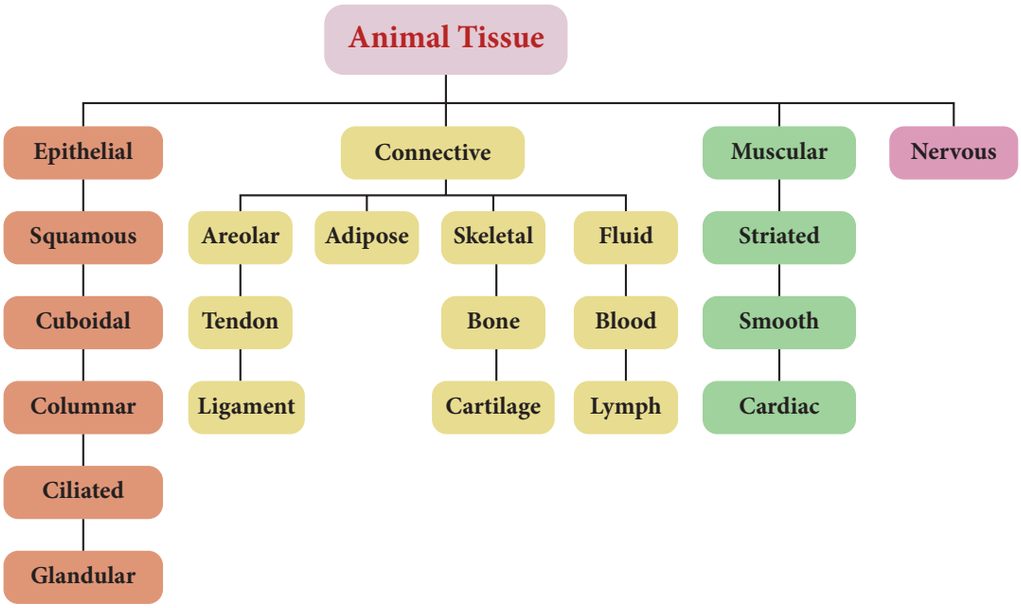


Fig. 8.6. Classification of Animal Tissues

Types of Tissues

Depending on the basis of their structure and function, tissues can be classified into four types – **Epithelial** (covering) tissue for protection, **Muscular** (contractile) tissue for movements and locomotion, **Connective** (supporting) tissue for binding different structures of body and **Nervous** tissue for conduction of nerve impulses. All the complex organisms consist of only four basic types of tissues.

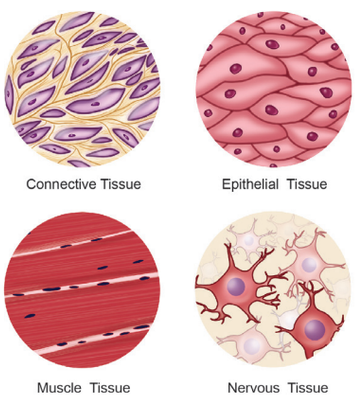


Fig: 8.5 Types of Animal tissues

8.1.3 Organ

Organs are structures made up of two or more types of tissues, organized to carry out a particular function. Example: Brain, heart, lungs, kidney, liver etc., each of which has specific functions. Most organs are made of all four types of tissue. The intestine, for example, is made of epithelial tissue as the inner lining, which helps in enzyme secretion and nutrient absorption. Epithelial tissue is covered by layers of muscle tissue, which help in peristaltic movements to move the food. The intestine is also supplied by blood tissue (connective tissue) which helps in transporting nutrients absorbed by the intestine, and is connected to the brain through the nerve tissue, which conveys instructions from the brain.

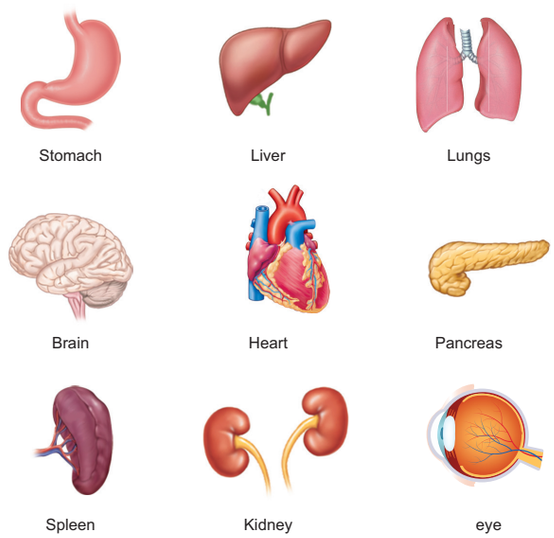


Fig. 8.7 Different types organs present in the human body

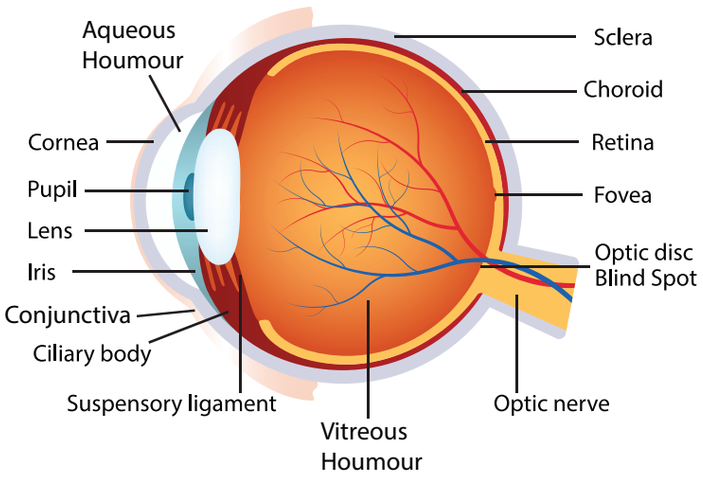


Fig.8.8 Structure of Human Eye

Now let us study in detail about the structure of an eye.

The eyes - Photoreceptor

The eye is one of the important sensory organs in the human body. It is composed of muscular tissue, connective tissue, neural tissue and mainly responsible **for vision, differentiation of color** (the human eye can differentiate approximately 10 – 12 million colors) and **maintaining the biological clock of the human body**. The human eye can be compared to a camera as both functions by gathering, focusing, and transmitting the light through the lens for creating an image of an object.

To understand more in detail about our eye and how our eye functions, we need to look into the structure of the human eye.

Structure and Functions of Human Eye

The human eyes are the most complicated sense organ in the human body, with several parts fixed together form a spherical structure. Every part of the human eye is mainly responsible for a certain action. The structure of a human eye can be broadly classified into the external structure and internal structure.

The External Structure of an Eye

The parts of the eye that are visible externally comprise of the external structure of the eye-

Sclera: It is a tough and thick white sheath that protects the inner parts of the eye. We know it as the **'White of the eye'.**

Conjunctiva: It is a thin transparent membrane that is spread across the sclera. It keeps the eyes moist and clear by secreting small amounts of mucus and tears.

Cornea: It is the transparent layer of membrane that is spread over the pupil and the iris. The main role of the cornea is to refract the light that enters the eyes.

Iris: It is a pigmented layer of tissues that make up the colored portion of the eye. Its primary function is to control the size of the pupil, depending on the amount of light entering it.

Pupil: It is the small opening located at the middle of the Iris. It allows light to come in.

The Internal Structure of an Eye

The internal structure of the eye includes the following parts:

Lens: It is a transparent, biconvex, and an adjustable part of an eye, made up of protein The lens with the help of the cornea refracts light focused on the retina, therefore creating images on it.

Retina: It is the layer present at the back of the eye where all the images are formed. It is the third and inner most coat of the eye which is very sensitive to light because of the presence of

Photoreceptors (rods and cone cells). The retina functions by converting the light rays into impulses and sending the signals to the brain through the optic nerve.

Optic nerve: It is located at the end of the eyes, behind the retina. The optic nerve is mainly responsible for carrying all the nerve impulses from the photoreceptors to the human brain, without which vision would not be possible.

Aqueous Humour: It is a watery fluid that is present in the area between the lens and the cornea. It is responsible for the nourishment of both the lens and the cornea.

Vitreous Humour: it is a semi-solid, transparent, jelly-like substance that covers the interior portion of the eyes. It plays an important role in maintaining the shape of the eye and also causes refraction of light before it reaches the retina.

8.1.4 Organ system

A group of organs form the organ system, and together they perform a particular function. The heart and the blood vessels together make the cardiovascular system. Organs such as nose, pharynx, trachea, lungs and diaphragm work together as the respiratory system. The mouth, esophagus, stomach, duodenum, and the intestines together form the digestive system. Other examples of organ system include the endocrine system, integumentary system, muscular system, reproductive system, skeletal system, urinary system, immune system, etc.

Let us see the respiratory system as an example for organ system elaborately.

The Respiratory System

Our respiratory system consists of organs like trachea, bronchus and lungs which are responsible for exchange of air between the atmosphere and the blood. Together, these organ form what is called the respiratory tract. Let us see the organs of the respiratory tract in detail.

The nose

We inhale air through the nostrils, which lead to the nasal cavity. The inner surface of this cavity is lined with cilia and mucus producing cells, which make it sticky and moist. The cilia and mucus trap dust and germs and prevent them from going deeper into the respiratory tract. The blood vessels in the nose help to warm the inhaled air.

The windpipe

After passing through the nasal cavity, the air enters the pharynx. Then it goes into the trachea or the windpipe which is an elastic tube extending down the length of the neck and partly into the chest cavity. Between the pharynx and the trachea lies a small air passage called the larynx commonly known as the **"voice box"**. The larynx has fold of tissue which vibrate with the passage of air to produce sound.

Bronchi

The trachea divides into two branches called **bronchi (singular: bronchus)**. Each bronchus leads to a lung, where it divides and redivides to finally form air passages called bronchioles.

Lungs

The lungs are organs in the chest cavity that allow our body to take in oxygen from the air. They also help to remove carbondioxide from the body. The lungs lie on either side of the breast bone and fill the inside of the chest cavity. The left lung is slightly smaller than the right lung to allow room for the heart. Within the lungs, each bronchiole leads to a bunch of air sacs called alveoli **(singular: alveolus)**.

The lungs are two spongy elastic bags, on each side of the thoracic cavity. The thoracic cavity is bound dorsally by the vertebral column and ventrally by the sternum, laterally by the ribs and on the lower side by the dome shaped diaphragm.

Alveoli

Alveoli are tiny air sacs in the lungs that take up the oxygen we breathe in and keep your body going. Although they are microscopic, alveoli are the workhorses of your respiratory system.You have about 480 million alveoli, located at the end of bronchial tubes. The total area of the airsacs in the lungs above 2000 square feet or more than one hundred times the body's surface area. Alveoli, is meant for the exchange of oxygen and carbondioxide.

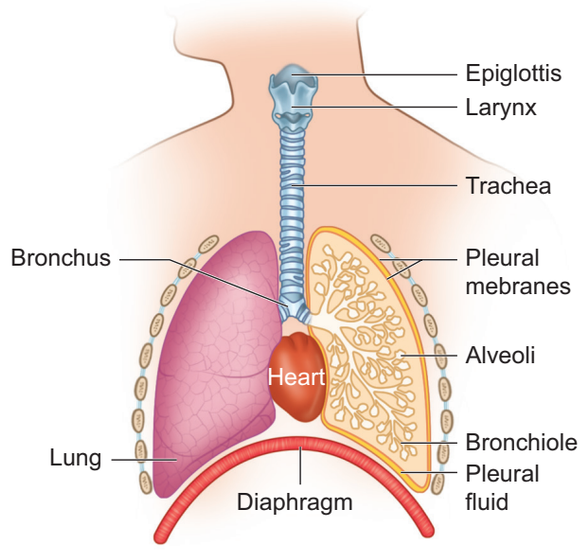


Fig.8.9 Human respiratory system

On an average, an adult human being at rest breathes in and out 15 – 18 times in a minute. During heavy exercise, the breathing rate can increase upto 25 times per minute

Smoking damages lungs. Smoking is also linked to cancer. It must be avoided.

When you sneeze, you should cover your nose so that the foreign particles you expel are not inhaled by others.

Mechanism of Breathing

Inspiration (Inhalation)

The process of taking air into the lungs is called **inspiration** or inhalation. During inspiration, the sternum is pushed up and outward and the diaphragm is pulled down. This increases the volume of the thoracic cavity and the pressure decreases. The air outside the body flows into the lungs. Here exchange of gases takes place between the air and the blood.

Expiration (Exhalation)

The process of expelling air from the lungs is called **expiration or exhalation.** Upon exhalation, the lungs recoil to force the air out of the lungs. The intercostal muscles relax, returning the chest wall to its original position. During exhalation, the diaphragm also relaxes, moving higher into the thoracic cavity. This increases the pressure within the thoracic cavity relative to the environment. Air rushes out of the lungs due to the pressure gradient. This movement of air out of the lungs is a passive event.

Exchange of gases in the Alveoli:

The content of oxygen in the inhaled air in alveoli is more than the blood flowing through the capillaries. So, the oxygen moves into the blood by simple **diffusion**. **Haemoglobin** in the blood combines with **oxygen** to form **oxyhaemoglobin**. The blood carrying oxygen reaches the heart through blood vessels. The heart pumps it to all the tissue in the body. The tissue releases carbon-dioxide which is carried back to alveoli by the blood. Carbon-dioxide diffuses from the blood to the air in the alveoli and is sent out of the body when the air is exhaled.

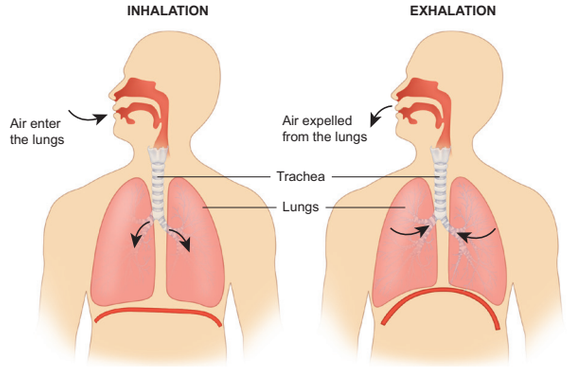


Fig 8.10 Demonstrating (a) inhalation and (b) exhalation

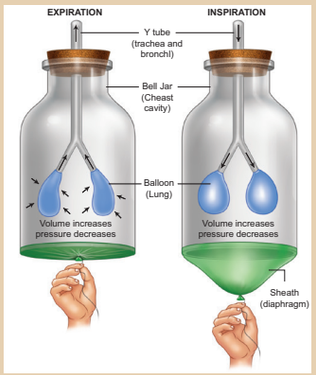
Activity 2

Constructing a model of lungs

Materials required: Y shaped tube, a large balloon, two small balloons, a one litre plastic bottle, cork.

Method of Construction:

1. Cut off the plastic bottle in the middle.
2. Fix two small balloons in the both ends of the Y-tube. Make a hole in the cork and fix the y-tube. Make a small hole in the cork and fix the y-tube through the hole as shown in the picture.
3. Cut a large balloon into two halves and fix one half tightly around the open part of the bottle.



Method of working:

Hold the large balloon in the middle and pull it slowly downwards as shown in the picture, observe the change in the balloons inside the bottle. Now leave the balloon free.

Answer the Question:

1. What do you understand from the demonstration?

Activity 3

What is happening in your body during breathing ?

Stand erect and wave your hands in side wards. Take a deep breath and feel your rib movements. Then run some 100 metres and observe the rib movements?

Compare your result with your friends.

Table 8.1 Differences between inhalation and exhalation

Inhalation	Exhalation
The muscles of the diaphragm contract.	The muscles of the diaphragm relax.
The diaphragm goes downward.	The diaphragm goes upward.
The ribs move upwards and outwards.	The ribs move downwards.
The volume of thoracic (chest) cavity increases.	The volume of thoracic (chest) cavity decreases.
Air enters the lungs through the nose.	Air goes out of the lungs through the nose.

8.2 Homeostasis

Homeostasis is a property of a human biological system where the **self-regulating** process tends to maintain the balance for the survival. The regulation takes place in a defined internal environment. Mammals are capable of maintaining a constant body temperature despite the changes in the external temperature. Behavioural and physiological responses are two important regulating mechanisms that maintain the stability of Homeostasis.

In simple terms, it could be referred as a balance in a system to maintain a stable internal environment for the survival of the animal. If the homeostasis regulates successfully, life continues or if unsuccessful, death or disaster occurs.

All the processes of integration and co-ordination of function are mediated by nervous and hormonal system. The liver, kidneys, and brain (hypothalamus), autonomic nervous system and the endocrine system help to maintain homeostasis.

Maintenance of body fluid concentrations, body temperature are done by various bio-

physical and bio-chemical methods. Human beings are warm blooded in nature i.e, they maintain their body temperature as constant. When the body temperature raises sweat is produced to bring the temperature down. When the body temperature lower heat is produced by the muscular work by shivering. This is an example for homeostasis.

The control of blood glucose level is another example in which insulin hormone is secreted whenever the blood glucose level raises and glucagon hormone is secreted whenever the blood glucose level reduces.

8.3 Diffusion

Diffusion is the movement of particles from an area of **higher concentration to lower concentration**. The overall effect is to equalize concentration throughout the medium.

Examples for diffusion include, perfume filling a whole room and the movement of small molecules across a cell membrane. One of the simplest demonstrations of diffusion is adding a drop of ink to water.

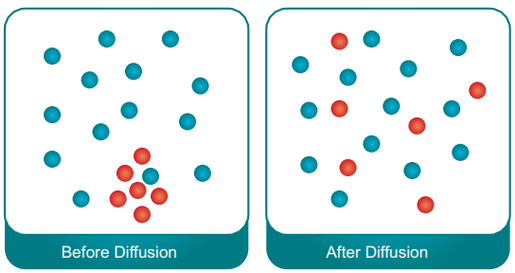


Fig.8.11 Diffusion of gases

What will happen when an incense stick is lit up in a room? How do we feel? The fragrance spreads the entire room. The movement of molecules (ions) from a region of higher concentration to lower concentration.Eg. You can smell incense stick after lighting because the smoke diffuses in the air and makes its way to your nose.

Let us think of the following.

Fig.8.12 Diffusion of smoke through air medium

More to know

1. The mixing of foodstuffs and digestive juices in the gut occurs by diffusion.
2. Exchange of respiratory gases, (oxygen and carbon dioxide) between blood and tissue fluids and between tissue fluid and cells occurs by diffusion.

How does the smell spread in the entire room?

Does the smell spread uniformly in the entire room ?

Can you give any other examples ?

There are other processes in which substances move in water medium. Let us study another such process by the following activity.

Fig.8.13 A tea bag placed in a cup of hot water – diffusion through water medium

8.4 Osmosis

Osmosis is the movement of solvent particles across a semipermeable membrane from a dilute solution into a concentrated solution. The solvent moves to dilute the concentrated solution and equalize the concentration on both sides of the membrane.

The movement of liquids in and out cells is dependent on the concentration of the solution surrounding it. There are 3 types of situations in which this could vary:

1. Isotonic: Here the concentration of external and internal soultion of the organism are the same.

2. Hypotonic: Here the external solution concentration is less compared to the concentration of the inner solution of an organism. In this case water will rush into the organism.

3. Hypertonic: Here the external solution concentration is greater than the concentration of the inner solution of an organism. In this case the water will rush out of the organism.

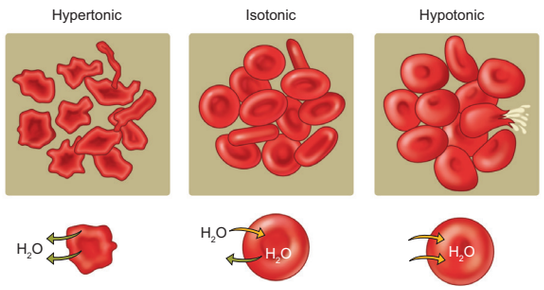


Fig.8.14 Osmosis affects red blood cells in hypertonic, isotonic and hypotonic solutions

8.5 Osmoregulation

The term osmoregulation was coined by **HOBER** in 1902. Osmoregulation is the process by which an organism regulates the water balance in its body and maintains the homeostasis of the body. It includes controlling excess water loss or gain and maintaining the fluid balance and the osmotic concentration, that is, the concentration of electrolytes. It ensures that the fluids in the body do not get too diluted or concentrated

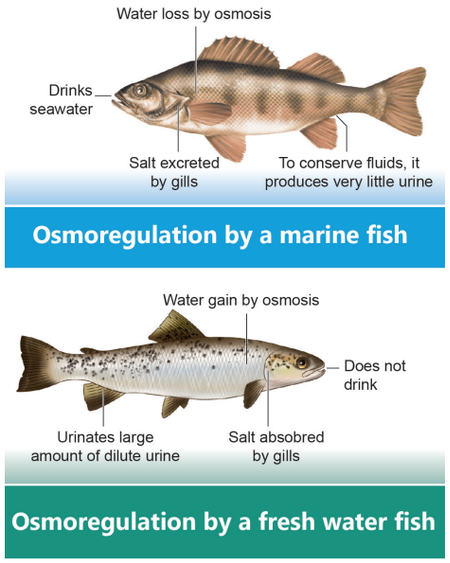


Fig.8.15 Osmoregulation by a freshwater fish

There are two major types of Osmoregulation:

Osmoconformers These organisms try to maintain the osmolality of their body matching with their surroundings. Most of the invertebrates, marine organisms are osmoconformers.

Osmoregulators These organisms maintain their internal osmolality, which can be extremely different from that of the surrounding environment, through physiological processes

8.6 Cellular respiration

Cellular respiration is the process by which organisms break down glucose into a form that the cell can use as energy. This energy is then made available to living cells in the form of **ATP**. Cellular respiration takes place in the cytoplasm and mitochondria of the cells.The Cellular respiration is classified into two types: **aerobic** respiration and **anaerobic** respiration.

Aerobic respiration

In this type of respiration, the food substances are completely oxidized into H_2O and CO_2 with the release of energy. It requires

atmospheric oxygen and all higher organisms respire aerobically. This reaction releases a large amount of energy.

It can be written as the following equation:

Glucose + Oxygen → Carbon dioxide + Water + Energy

Anaerobic respiration:

In this type of respiration, partial oxidation of food takes place and the organisms release energy in the absence of oxygen. This type of respiration occurs in organisms like yeast. Ethyl alcohol and carbon dioxide are the by-products of this process. This reaction releases very little energy because glucose is not completely oxidized.

For example: yeast cells convert glucose into carbon dioxide and ethanol, with the release of energy, without using oxygen.

Glucose → Ethanol + Carbon dioxide + Energy

Table 8.2 Differences between aerobic and anaerobic respiration

AEROBIC	ANAEROBIC
1) Aerobic respiration takes place in the presence of oxygen	1) Anaerobic respiration takes place in the absence of oxygen
2) The end products of aerobic respiration are carbon dioxide and water	2) The end products of anaerobic respiration are CO_2 and ethanol or lactic acid
3) Common in all higher plants and animals	3) Common in certain micro organisms and human muscle cell

8.7 Metabolism

Metabolism is the sum of chemical reactions by which living organisms sustain their life.

Metabolism consists of anabolism (the buildup of substances) and catabolism (the breakdown of substances). The term metabolism is commonly used to refer specifically to the breakdown of food and its transformation into energy, cellular products and waste elimination.

More to know

1. Aerobic respiration releases 19 times more energy than anaerobic respiration from the same amount of glucose
2. In aerobic respiration each glucose molecules produce 36 ATPs.

Yeast makes bread soft, puffy when added to wheat flour in the bakery due to the release of CO_2.

Anabolism

Anabolism or constructive metabolism, is all about building and storing: It supports the growth of new cells, the maintenance of body tissues, and the storage of energy for use in the future. During anabolism, small molecules are changed into larger, more complex molecules of carbohydrate, protein, and fat.

For example,

Glucose → Glycogen and other sugars

Amino acids → Enzymes, hormones, proteins

Fatty acids → Cholesterol and other steroids

Catabolism

Catabolism or destructive metabolism, is the process that produces the energy required for all activity in the cells. In this process, cells break down large molecules (mostly carbohydrates and fats) to release energy. This energy release provides fuel for anabolism, heats the body, and enables the muscles to contract and the body to move. As complex chemical units are broken down into more simple substances, the waste products released in the process of catabolism are removed from the body through the skin, kidneys, lungs, and intestines.The following are examples for catabolism.

Carbohydrates → Glucose

Glucose → CO_2, Water and heat

Protein → Amino acid

The repeated anabolism and catabolism reactions maintain the homeostatic condition in the organism. The metabolic process is the cause for maintaining ionic balance in the body. It is also responsible for movement, growth, development, maintenance and repair of the cells, tissues and the human body.These metabolic reactions occur in different organs of living species.

More to know

Basal metabolism refers to the minimum energy required to maintain the normal activities of the body during complete rest in a warm atmosphere 12 – 18 hours after the intake of food

Points to remember

- Cell is the basic structural and functional unit of living organisms. All living organisms are made up of cells.
- Cells vary in shapes and size .The size of a cell is measured in micrometers. (µm)
- Cells are combined together to form tissues. The tissues are combined together to form organs. Many organs are combined together to form the organ system.
- The sense organ eye is concerned with vision.
- Respiration is the process in which energy is released while food is oxidised. It consists of external respiration and internal respiration (or) cellular respiration.
- There are two types of respiration depending upon the availability of oxygen namely aerobic respiration and anaerobic respiration.
- Selective permeability of plasma membrane enables the cell to maintain homeostasis.
- Diffusion involves movement of molecules from the region of their higher concentration to the region of their lower concentration which can occur without a semi permeable membrane.
- Osmosis involves movement of solvent molecules from the region of their higher concentration to the region of their lower concentration which can take place through a semi permeable membrane.
- Homeostasis is the maintenance of a constant internal environment of the body.
- The sum total of the biochemical reactions metabolism involves in release and utilisation of energy or energy exchange within the organisms.It can be divided into two categories namely anabolism and catabolism.
- The repeated anabolic and catabolic reactions in the metabolic process maintain the homeostatic condition of the body.

A-Z GLOSSARY

Alveoli	Many tiny air sacs of the lungs which allow for rapid gaseous exchange.
Eukaryotic	An organism having cells each with a distinct nucleus within which the genetic material is contained.
Organelles	any of the specialized structures within a cell that perform a specific function.
Micron	It is a small unit of measurement that measures length which is one thousand of a millimeter.
Haemoglobin	Iron containing red pigment of RBCs of vertebrates, gives red colour to blood.
Prokaryotic	Typically unicellular microorganism that lack of a distinct nucleus and membrane bound organelles.
Diaphragm	The muscle that separates the chest(muscle) cavity from the abdomen.
Pleura	Protective covering of the lungs.
Metabolism	The sum of all chemical reactions by which living organisms sustain their life.

TEXT BOOK EXERCISES

32E4C7

I. Choose the best answer.

1. ————————is tough and thick white sheath that protect the inner parts of the eye.
   a) sclera b) conjunctiva
   c) cornea d) iris
2. Maintenance of constant internal environment of the body is known as _____
   a) Homeostasis b) Homeophytes
   c) Homeokinesis d) Homeophilics
3. In the absence of oxygen, glucose is broken down in to _____
   a) Lactic acid b) Citric acid
   c) Acetic acid d) Nitric acid
4. _____cells are specialised cells that can be transformed into any kind of cells.
   a) Nerve b) Stem
   c) Heart d) Bone
5. The process of air passing in and out the lungs is called _____.
   a) Inhalation b) Exhalation
   c) Breathing d) None of these
6. Osmosis is the movement of water molecules from a _____.
   a) Higher concentration to a region of lower concentration.
   b) Lower concentration to a region of higher concentration.
   c) Both of these
   d) None of these
7. The erythrocyte is placed in _____ solution which has lesser concentration of solutes and greater concentration of water than in the cytoplasm.
   a) Hypotonic b) Hypertonic
   c) Neutral d) Acidic

II. Fill in the blanks.

1. _____is the structural and functional unit of living organisms.
2. The largest cell is egg of an _____.
3. _____ is a good example for anaerobic respiration.
4. _____ nerve is located at the end of the eyes behind the retina.
5. The size of the cells are measured in units of _____

III. Write true or False. If false, give the correct answer.

1) In hypotonic condition, concentration of the external and the internal solution of the organism are same .
2) Diffusion is the movement of particles from an area of lower concentration to higher concentration .
3) Human beings are warm blooded in nature.
4) The larynx has fold of tissue which vibrate with the passage of air to produce .
5) Aqueous humour plays an important role in maintaining the shape of the eye.

IV. Match the following.

I Match the following examples for catabolism.
1. Carbohydrates - CO_2, water and heat
2. Glucose - amino acid
3. Protein - glucose

II. Match the following examples for anabolism:
1. Glucose - cholesterol and other steroid
2. Amino acids - glycogen and other sugars
3. Fatty acids - enzymes, hormone, protein

V. Arrange the following words in correct sequence.

Tissues, organ system, organism, cell, organ

VI. Answer in brief.

1. What is cell differentiation?
2. State different types of tissues.
3. Mention the function of 'Alveoli'?
4. Name the processes by which air enters and comes out of our lungs ?
5. Differentiate between Osmoconformers and Osmoregulators?
6. Define Metabolism?

VI. Answer in few words.

1. Define Prokaryotic cell?
2. Define Eukaryotic cell?
3. Tabulate the difference between aerobic and an aerobic respiration.
4. State different types of epithelial cells?
5. Why the human eye is compared with camera?
6. Which organ and organ system help to maintain homeostasis?

VII. Answer in detail.

1. Draw the V.S of human eye and label its parts.
2. Explain Osmosis with an example.
3. Differentiate between inhalation and exhalation.
4. Explain about the types of metabolism with an example.
5. Explain the mechanism of breathing.
6. Read the given paragraph about human eye carefully and correct the mistakes.

   Our eye is cylindrical shaped. The wall of the eyeball is composed of five layers. The outermost layer is cornea. The innermost layer is called sclera. The eyeball consists of elastic nerves and biconcave lens. The pupil attaches lens to iris. Iris has rod and cone shaped cells. Aqueous humour is present between lens and retina. The vitreous humour is present between cornea and lens. The brain changes the light into nerve impulses and sends them to retina.

VIII. HOT Questions.

1. Why do we need instant energy? Does glucose give that energy? Explain.
2. How are they preparing pickles? What are the causes involved in that?

IX. Value Based Questions.

1. Dr. Usha is a pulmonologist (Doctor for respiratory diseases). One day, a school student named Arjun, met her with respiratory problems. After diagnosis, the doctor advised him to go playground daily and play football or basketball. She also advised to do *pranayamam* in the morning.
   a) Why did the doctor advised him to go to the playground?
   b) What is the use of *pranayamam*?
4. Explain why are you not able to breathe normally when you are in closed and crowded places?
5. Shylesh is a school going kid studying standard VIII. He is crazy about playing video games in mobile phones. After couple of months, his eyes turned red and he felt severe pain in his eyes. His science teacher enquired about this and advised his parents to take him to consult an eye doctor.
   i) How does excessive usage of mobile phone affect our eyes?
   ii) What are the values shown by the teacher?

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2. Histology and cell biology by Kierstenburm
3. Elsevier's Dictionary of the Genera of life
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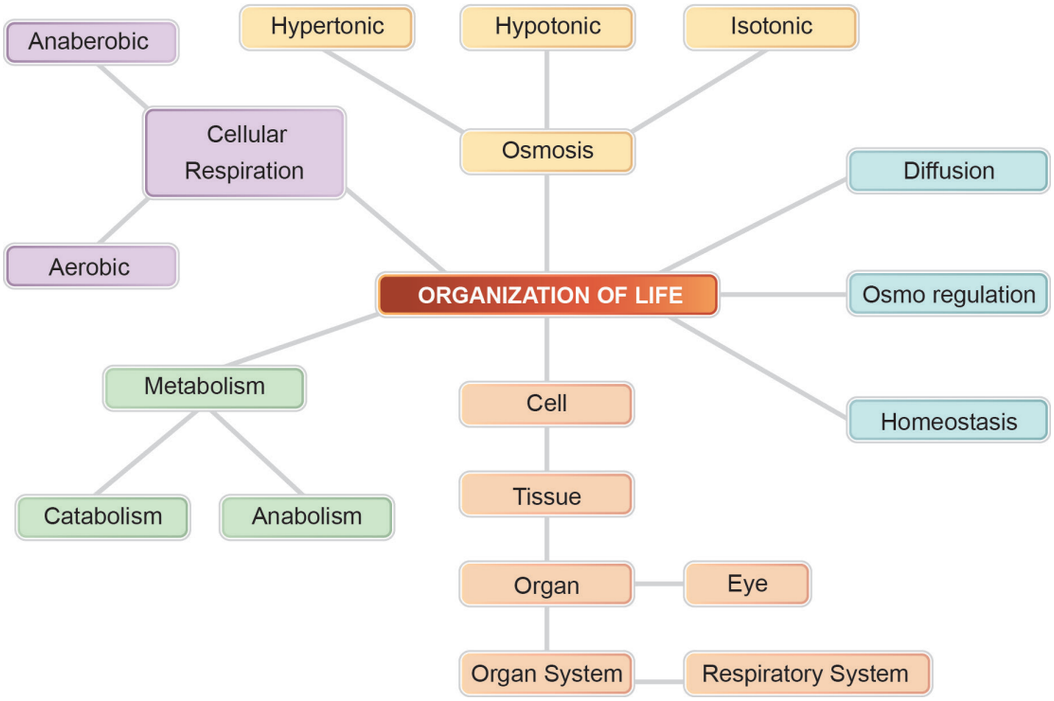
MIND MAPS



UNIT 9

INTRODUCTION TO THE INFORMATION AGE

Learning Objectives

EXZY23

At the end of this lesson students will be able to:

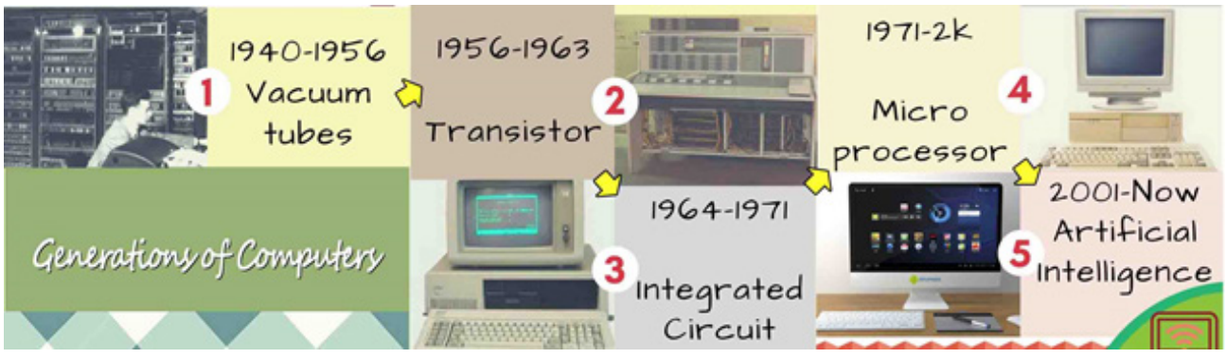
- To know about the computer.
- To know the history of computer.
- To identify Software and Hardware of a computer
- To know the Input unit, CPU and the Output unit.
- To distinguish the features of Hardware and software

Generation of Computers

A Computer is an electronic machine that accepts data, stores and processes data into information. Computer follow instructions, called programs which determine the tasks the computer will perform, the computer is able to work because there are instructions in its memory directing it. In the beginning of 19th century, Charles Babbage, a professor in Mathematics has designed an analogue computer. He is known as the father of computer

Generation of Computers

SN	GENERATION	PERIOD	MAIN COMPONENT USED
1.	First generation	1942-1955	Vacuum tubes
2.	Second generation	1955-1964	Transistors
3.	Third generation	1964-1975	Integrated Circuits(IC)
4.	Fourth generation	1975-1980	Microprocessor
5.	Fifth generation	1980 – till date	Artificial Intelligence



Parts of a Computer

Input Unit

Central Processing Unit (CPU)

Output Unit

Input Unit

The input unit helps to send the data and commands for the processing.

The hardware devices that are used to input data are called input devices.Keyboard, Mouse, Scanner, Barcode reader, Microphone-Mic, Web camera, Light Pen, Joy stick is some of the input devices.

Mouse

Mouse is an essential part of the computer. The standard Mouse has two buttons and a scroll ball in the middle. The mouse is used to move the pointer on a computer screen. Right button is used to select files and to open the folder. Left button is used to carry out corrections in the file. The page on the monitor can be moved up and down using the scroll ball.

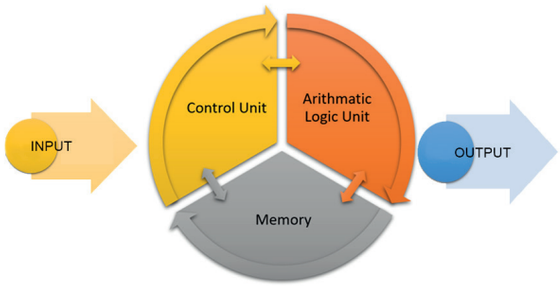
Keyboard

A keyboard is an input device, as is a mouse. A keyboard delivers data in the form of letters, numbers and symbols to the computer .The keys used to type the keys with numbers are called number keys and key with letters are called alphabet keys. Numbers 0,1,2,3,4,5,6,7,8,9 are called number keys and keys with letters A to Z are called Alphabet Keys.

Central Processing Unit (CPU)

CPU is the brain of the Computer. The data is processed in the CPU. The CPU has namely three parts.

1. Memory Unit; 2. Arithmetic Logic -Unit (ALU); 3. Control Unit



Control Unit

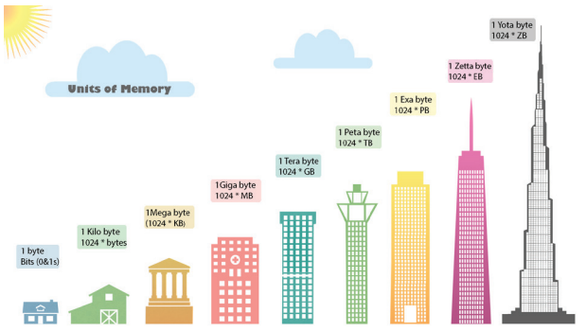
The control unit controls the functions of all the parts of the computer.

Arithmetic Logic Unit

Arithmetic and Logic unit performs all the arithmetic computations like addition, subtraction, multiplication and division.

Memory Unit :

The memory unit in the computer saves all data and information temporarily. We can classify memory unit into two types namely primary and secondary memory. Memory can be expanded externally with the help of Compact Disk (CD), Pendrive, etc.



Output Unit

The output unit converts, the command received by the computer in the form of binary signals into easily understandable characters. Monitor, Printer, Speaker, scanner are some of the output devices.

Classification of Computer

The computers can be classified based on their design, shape, speed, efficiency, working of the memory unit and their applications.

Mainframe Computer
Mini Computer
Micro or Personal Computer
Super Computer


Mainframe


Mini computer


Micro personal computer


Super computer

Personal computer and its types

Personal computer comes under the microcomputer category. Based on the memory and efficiency they can be classified as

1. Desktop; 2. Laptop; 3. Tablet


Desktop


Laptop


Tablet

Hardware

Hardware is the parts of a computer which we can touch and feel. Hardware includes Input and Output devices, Cabinet, Hard Disk, Mother Board, SMPS, CPU, RAM, CD Drive and Graphics Card.

Software

Hardware is lifeless without software in a computer. Softwares are programmed and coded applications to process the input information. The software processes the data by converting the input information into coding or programmed language. Touching and feeling the software is not possible but we can see the functions of the software in the form of output.

Types of Software

The software is divided into two types based on the process. They are

1. System Software (Operating System)
2. Application software

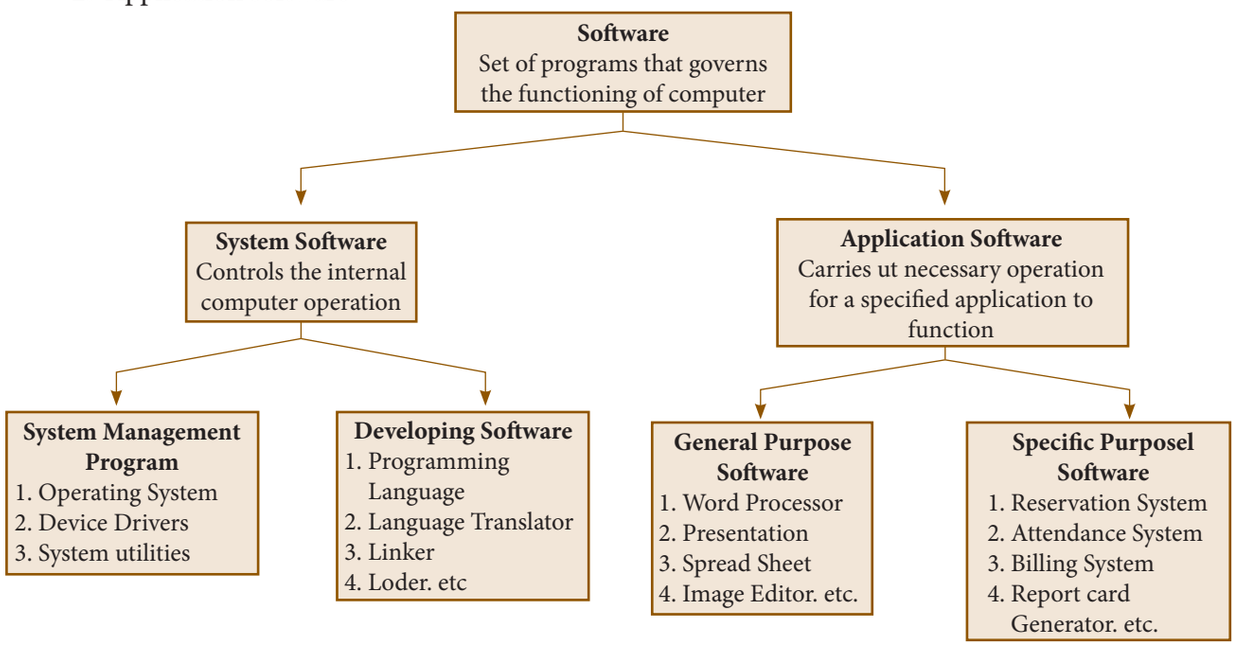
System Software

System Software (Operating system) is software that makes the hardware devices to process the inputted data and to display the result on the output devices like Monitor. Without the operating systems, computer cannot function on its own. Some of the popular operating system are Linux, Windows, Mac, Android etc.

APPLICATION SOFTWARE V/S SYSTEM SOFTWARE

Application Software

Application software is a program or a group of programs designed for the benefit of end user to work on computer. The application programs can be installed in the hard disk for the usage on a particular computer. This type of application program completes one or more than two works of the end user. The following are the examples of application program: Video player, Audio player, Word processing software, Drawing tools, Editing software, etc.



TEXT BOOK EXERCISES

RULSQY

I. Choose the correct answer

1. Who is the father of computer?
   a) Martin Luther King
   b) Graham Bell
   c) Charlie Chaplin
   d) Charles Babbage

2. Which one of the following is an output device?
   a) Mouse b) Keyboard
   c) Speaker d) Pendrive

3. Which one of the following is an input device?
   a) Speaker b) Keyboard
   c) Monitor d) Printer

4. Pen drive is _____device.
   a) Output b) Input
   c) Storage d) Connecting cable

5. Fifth generation computer has _____ Intelligence.
   a) Transistors b) Integrated Circuits
   c) Microprocessor d) Artificial Intelligence

II. Match the following :

Column A	Column B
Keyboard	RAM
Fourth generation Computer	Input device
Hardware	Integrated Circuits
Third generation Computer	Drawing tools
Application Software	Microprocessor

III. Give short answer :

1. What is a Computer?
2. Name the parts of a computer
3. What is Hardware and Software?

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