GOVERNMENT OF TAMILNADU

STANDARD NINE

TERM II

VOLUME 3

NOT FOR SALE

Untouchability is Inhuman and a Crime

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Note to the teacher…

As we present this revised edition of the Science Textbook, we would like to express our deepest gratitude to the learners and the teaching community for their enthusiastic responses.

In science some concepts could be subject to change from time to time as new theories and principles are constantly being evolved.

We have tried to present facts and concepts of science (both concrete and abstract) in a visually appealing manner without detracting from the content.

Activity based learning is now accepted as the basis of science education.These activities should be regarded as a means for open-ended investigation rather than for verification of principles/content given in the textbook are designed to facilitate low cost activities and experiments using locally available materials. With a view to streamlining the activities, we have now segregated them into three groups:

- I Do - activities to be done by an individual learner.
- We Do - activities to be done by a group of learners.
- We Observe - activities to be demonstrated by the teacher.

The third group of activities have a higher degree of difficulty or require careful handling as it may involve dealing with chemicals, electricity etc.,

The “More to know” snippets in the text represents some unusual and interesting facts or information in which the students need not be examined.

The evaluation section is nothing but another space for learning in a different manner. As the focus is on understanding, rote learning is to be discouraged thoroughly. Application of learnt ideas, problem solving skills and critical thinking is to be encouraged. There could be scope for more than one answer to a question, which should be acknowledged always.

To facilitate further reference, books and websites have been suggested at the end of each lesson. Suggestions and constructive criticism are most welcome. Valuable suggestions will be duly incorporated.

- Authors

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Chapter 1

IMPROVEMENT IN FOOD RESOURCES

- Improvement in Crop Yields
- Nutrient Management
- Uses of Manure and Fertilizers
- Hybridization in Plants and Animals
- Animal Husbandry
- Poultry Farming
- Pisciculture
- Aquaculture
- Apiculture

1. INTRODUCTION

Food is a source of energy for our body. It nourishes and protects us from diseases. Plants and animals provide us with food. It is important that we take care of these resources to ensure constant and adquate supply of food. Our population is growing exponentially and we need to find some ways and means to improve and increase the source of food.

What can we do to make sure that we always have sufficient food? Here are three ideas. Which one would you choose ?

Eat less food

Grow more food

Save and store food

We have limited land and water at our disposal. Keeping this in mind, scientists and agriculturists have been thinking of different ways by which we can grow more food.

Note three differences that you observe between these two pictures.

1. _____
2. _____
3. _____

How would these changes have an impact on the availability of food?

_____

The population on this planet is constantly growing. The world population, according to the United States Census Bureau, was 6 billion in 1999 and has grown alarmingly to 7 billion in 2012. This would put pressure on the supply of food to mankind. The area available for plant cultivation is shrinking but the amount of food required is increasing. We must meet the demand for food by increasing the food produce from agriculture and animal farming.

Thus, we clearly understand the reasons for the scarcity of food.

The problem of food scarcity can be overcome by:

i) increasing the yield of crops.

ii) preventing cultivable lands from being used for other purposes.

iii) optimizing water resources for cultivation.

iv) improving the system of preservation and distribution of food materials.

1.1 IMPROVEMENT IN CROP YIELDS

Majority of the world's population depends on agriculture. We have to think of smart ways to increase food production. Agricultural scientists are working to increase the quality and quantity of food that we produce from plants.

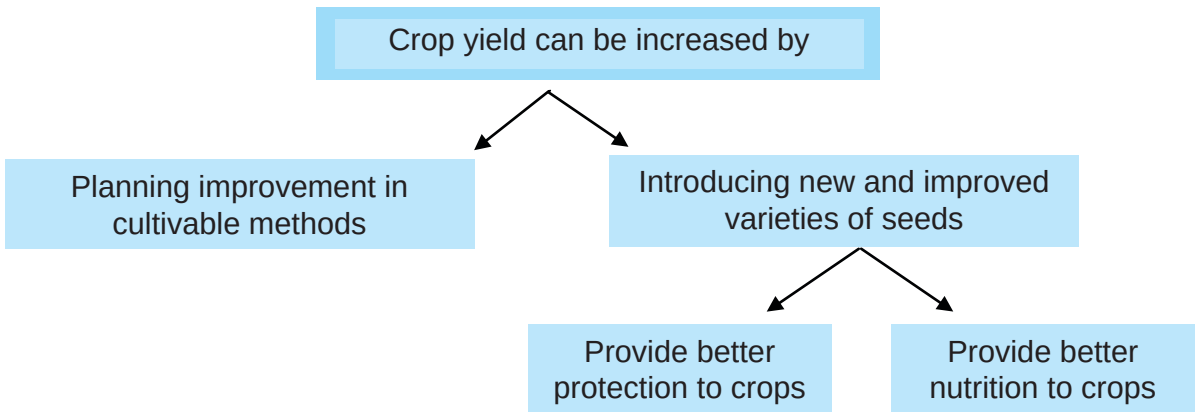
Plants that are cultivated in farms and harvested for food are called crops. There are a large variety of crops. Here are some examples:

Crops grown for cereals: Rice, Wheat, Maize, Millet

Crops grown for pulses : Pea, Greengram, Blackgram

Crops grown for oilseeds: Groundnut, Sunflower, Mustard, Sesame

Crops grown for animal fodder: Oats, Sudan grass, Elephant grass, Alfalfa.



Introduction of new and improved varieties

Improved varieties or strains of crops are produced by selective breeding for various important characteristics such as disease resistance, response to fertilizers, product quality and higher yield.

Common factors for crop improvement

❍ Higher Yield	To increase the productivity of the crop per acre.
❍ Improved Quality	Quality of crop products vary from crop to crop. e.g. baking quality in wheat, protein quality in pulses, oil quality in oil seeds.
❍ Biotic and abiotic resistance	Crop production is decreased due to biotic (diseases, insects and pests) and abiotic factors (heat, cold, salinity and drought). Resistance to these stress factors can improve crop production.
❍ Change in maturity pattern	Shorter maturity period; Uniform maturity makes the harvesting process easy and reduces losses during harvesting.
❍ Wider Adaptability	One variety can be grown under different climatic conditions in different areas. Developing varieties of wider adaptability helps in stabilizing crop production.
❍ Desirable agronomic characters	Tallness and profuse branching are desirable characters for fodder crops. Dwarfness is desired in cereals. Developing varieties of desired agronomic characters give higher productivity.

Selecting good varieties of crops, planning improvement in crop production and ensuring crop protection will result in increased crop yield.

Some improved varieties of crops and fruits


Fodder crop


Paddy


Wheat


Baby corn


Maize


Sunflower


Mango


Grapes

1.2 NUTRIENT MANAGEMENT

Plants take in carbon, hydrogen and oxygen from air or water, and absorb many other nutrients from the soil. Scientists have identified sixteen elements that are important for the growth and reproduction of plants.

Nitrogen is needed for plants to prepare proteins, nucleic acids, chlorophyll and other important organic molecules. Deficiency of nitorgen causes chlorosis in plants. Phosphorus is needed for the process of converting light energy from the sun into chemical energy. Similarly, different elements are needed for important activities in the life cycle of a plant.

MACRO-NUTRIENTS

Elements which are essential in large quantities for the growth of plants are called Macro-nutrients. They are carbon, hydrogen, oxygen, nitrogen, phosphorous, sulphur, potassium, calcium, magnesium and iron.

MICRO-NUTRIENTS

Elements that are needed for the growth of plants in very small quantities are called Micro-nutrients. They are manganese, copper, molybdenum, zinc, boron and chlorine.

Just as in humans, plants too are affected by nutrition deficiencies. It can affect the process of growth and reproduction resulting in low yield or no yield.

1.3 USES OF MANURE AND FERTILIZERS

During farming and harvesting of crops, a large amount of nutrients are extracted by plants from the soil. This deficiency is compensated with the addition of chemicals in the form of fertilizers and manure.

Manure is an organic substance prepared by the decomposition of plant and animal waste.

Based on the kind of biological material used, manure can be classified as follows:

i) Compost & Vermi Compost:

Vermicompost is manure prepared by using earthworms to speed up the process of decomposition of plant and animal waste.

Vermi Compost

ii) Green Manure : Green manure is prepared by using leguminous plants like sunhemp and soyabean. These are grown for a specific period of time and then ploughed back into the soil. Green plants add nutrients and organic matters like nitrogen and phosphorous to the soil.

Green Manure - Sunhemp

ACTIVITY 1.1 **WE DO**

Take two potted plants of 'Keerai'. Name them A and B. Add cow dung or urea to potted plant A and sprinkle water. Sprinkle water alone on potted plant B. Keep them in sunlight and observe their growth for 15-20 days.

Which one grows faster? Why?

ACTIVITY 1.2 **WE DO**

Collect animal waste like cow dung, plant waste, domestic waste and sewage waste. Allow them to decompose in a pit in your garden for a few days. What do you get?

USES OF MANURE

- Manure enhances the water holding capacity of the soil.
- It increases the number of friendly microbes.
- It improves the soil texture.

FERTILIZERS

Fertilizers are chemicals like nitrogen, phosphorous and potassium that are commercially produced in factories and used as plant nutrients.

When there is a specific nutrient missing in a plant, it is recommended to use a fertilizer. Small or micro doses of fertilizers can result in dramatic improvements in the health of a plant.

Types of Fertilizers	Examples
Nitrogenous Fertilizers	Urea, Ammonium Sulphate, Ammonium Nitrate
Phosphatic Fertilizers	Single Super Phosphate, Triple Super Phosphate
Potassic Fertilizers	Potassium Nitrate, Pottassium Chloride
Complex Fertilizers	Nitrophosphate, Ammonium Phosphate, Diammonium Phosphate (DAP)

Usage of fertilizers has its own disadvantages. Fertilizers account for additional expenses for farmers. Moreover, these chemicals being water-soluble can get washed away and contaminate the natural water-supply. Farmers also have to take meticulous care with the dosage, as excess chemicals can destroy soil fertility. Excess fertilizers that are washed away into the ponds, lakes, canals and rivers can also result in the growth of unwanted plants like Water Hyacinth and Algae. These plants grow in excess amounts. They deprive the water-body of oxygen and stop the flow of water. As a result, fishes and other living organisms do not get sufficient sunlight and oxygen and they die.

The excessive richness of nutrients in water that causes dense growth of algae on the surface and causes death of other organisms living in the water is called *eutrophication.*

ACTIVITY 1.3 **I DO**

Visit a paddy field nearby where fertilizer has been applied and observe the population of earthworms. Compare this with the number of earthworms in a garden where fertilizer has not been applied. What difference do you notice? How does it occur ?

Differences between Manure and Fertilizers

Manure	Fertilizers
1. Manure is a natural substance obtained from the decomposition of cattle dung, human waste and plant waste.	1. Fertilizer is a mineral or chemical compound containing nutrients like sulphur, phosphorous and nitrogen.
2. Manure contains organic substances.	2. Fertilizers are inorganic compounds.
3. Manure can be prepared in fields.	3. Fertilizers are manufactured in factories.
4. Manure contains all nutrients but in small quantities.	4. Fertilizers contain more quantities of one specific nutrient or more.
5. Manure adds plenty of humus to soil and improves the texture of the soil.	5. Fertilizers do not contribute to the addition of humus to the soil.
6. Manure is not easily absorbed because it is less soluble in nature.	6. Fertilizers are soluble in water and it is easily absorbed.
7. Manure is less soluble; it is not easily washed away from the soil and hence its effect is long lasting.	7. Fertilizers are easily washed away by water and hence their effect is of shorter duration and require repeated application.

Farmers must efficiently balance the use of fertilizers and manure.

Some agriculturists practice organic farming. This method makes use of manure like recycled farm waste to nourish the crops. This avoids the use of insecticides and fertilizers.

MORE TO KNOW

Fertilizers which are produced from living organisms are called Bio-fertilizers. The main source of bio-fertilizers are bacteria, cyanobacteria and fungi. Bio-fertilizers are renewable and non-polluting sources of plant nutrients. They also improve the soil nutrients. Rhizobium and Cyanobacteria such as Anabaena and Nostoc are some common bio-fertilizers.

1.4 PROTECTION FROM PESTS AND DISEASES

Organisms that attack or destroy crops, food or farm animals are called pests. They damage cultivated crops and plant products in storage. Crop yield is affected due to pests during the process of sowing, harvesting, storing and consumption. This causes a great loss to the national economy.

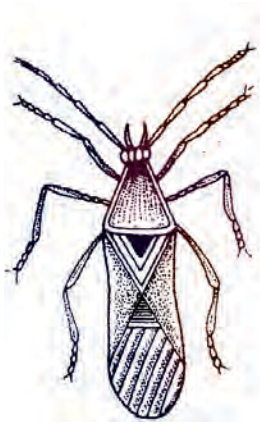
1.4.1 INSECT PESTS

Insects attack plants in all stages of their growth. Based on the mode of attack, insect pests are classified into three types:

i) Chewing Insects: They cut and chew the root, stem and leaves of the plants. e.g. grasshoppers and caterpillars.

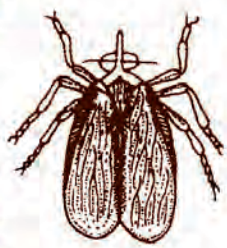
ii) Sucking Insects: They suck the cell sap from different parts of the plants. e.g. leaf hoppers and aphids.

iii) Borer Insects: They make holes and enter different parts and feed on plant tissues. e.g. sugarcane borer.


Gundhi Bug


Sugarcane Top-borer


Sugarcane Stem-borer


Pyrilla
(Sugarcane Leaf Hopper)


Mustard Aphid

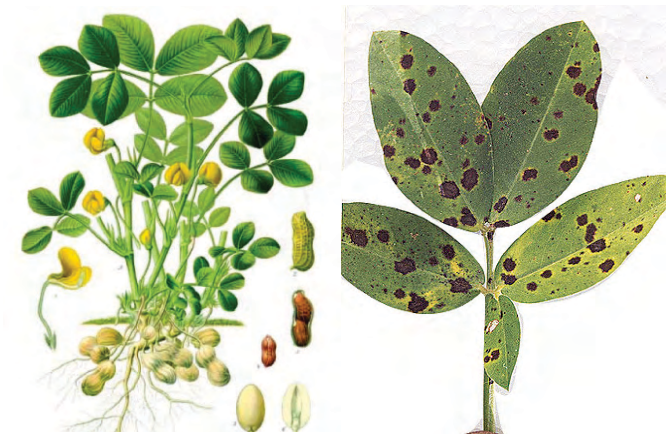

Painted Bug

Some common Indian Insects and Pests of Crop Plants

1.4.2 DISEASES OF CROP PLANTS

A wide variety of plant pathogens such as bacteria, virus and fungi exist in our environment. When conditions become favourable, they spread and infect crop plants causing diseases.

Based on the mode of transmission, plant diseases are classified into four types.


Tikka disease of Groundnut

1.	Seed borne diseases	They spread through seeds. e.g. Leaf spot of rice, Loose smut of wheat.
2.	Soil borne diseases	They spread through the soil. They affect roots and stems in plants. e.g. Tikka disease of groundnut.
3.	Air borne diseases	These diseases are transmitted through air. They attack all aerial parts of plants like leaves, flowers and fruits. e.g. Blast of rice, Rust of wheat .
4.	Water borne diseases	The diseases which are transmitted through water are called water-borne diseases. e.g. Bacterial blight of rice.

A man spraying pesticides

Pesticides are toxic chemicals that destroy pests.

i) **Insecticides:** Chemical substances which are used to kill insects are called insecticides. e.g. DDT (Dichloro diphenyl trichloro ethane), Malathion.

ii) **Fungicides:** Chemicals used to kill fungi are called fungicides. e.g. Bordeaux mixture.

iii) **Weedicides:** Chemical substances which are used to kill weeds are called weedicides. e.g. 2,4-D. (2, 4 - Dichloro phenoxy acetic acid)

iv) **Rodenticides:** Chemicals used to kill rodents like rats, mice and squirrels are called rodenticides, e.g. Zinc Phosphate, Arsenic.

1.4.3 METHODS OF INSECT PEST CONTROL

The infestation of different types of insect pests can be controlled by the following methods:

- Root-cutting insects are controlled by mixing insecticides in soil. e.g. Chloropyriphos.
- Stem and leaf cutting insects and boring insects are controlled by dusting or spraying insecticides. e.g. Malathion, Lindane and Thiodan.
- The sap-sucking insects can be controlled by spraying insecticides. e.g. Dimethoate and Metasystox.

1.4.4 PRECAUTIONS FOR APPLYING PESTICIDES

- Do not touch the pesticide with bare hands; use rubber gloves while handling it.
- Do not blow, suck or apply mouth to any sprinkler, nozzle or other parts of the spraying equipment.
- Do not spray pesticides against the direction of wind in the open field.
- Use only the prescribed dose of pesticides for spraying.

ACTIVITY 1.4 **WE DO**

Visit a crop field nearby. Observe and identify weeds, insect pests and diseases noticed in crops.

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1.4.5 STORAGE OF GRAINS

Most crops are harvested once a year. In order to get a supply of food items regularly throughout the year, they are stored in safe storage.

Cereals or food grains are stored by the farmers, traders and the Food Corporation of India (FCI).

During storage, grains and seeds are subjected to spoilage by various agencies. Factors responsible for such damages are:

i) Biotic factors (insects, rodents like squirrel and rat, birds, fungi, mites and bacteria)

ii) Abiotic factors (moisture and temperature)

These factors cause,

- infestation of insects
- degradation in quality
- loss in weight
- poor germinability
- discolouration of product
- poor marketability.

Therefore, it is essential to protect the produce from any kind of loss during storage.

Preventive and Control Measures are used when the produce is stored for future use. They include strict cleaning of the produce before storage, proper drying of the produce in sunlight and then in shade and fumigation using chemicals that kill pests.

1.5 HYBRIDIZATION IN PLANTS AND ANIMALS

1.5.1 HYBRIDIZATION IN PLANTS

Improved varieties of seeds and plants can be introduced by the process of hybridization.

Hybridization is the method of producing improved varieties by crossing the genes of two or more dissimilar and specially selected parent animals or plants. The parents with desirable qualities are selected and the best characters are brought together in a single variety.

Hybridization can be:

i) Intervarietal (cross between two different varieties)

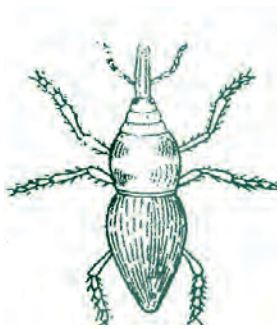
ii) Interspecific (cross between two species of the same genus)

iii) Intergeneric (cross between different genera)

Of the above three types, intervarietal hybridization is widely adopted in plant breeding.

In maize, hybrids are grown because they produce good yield. Modern varieties of maize, wheat and rice that we consume are all products of hybridization.

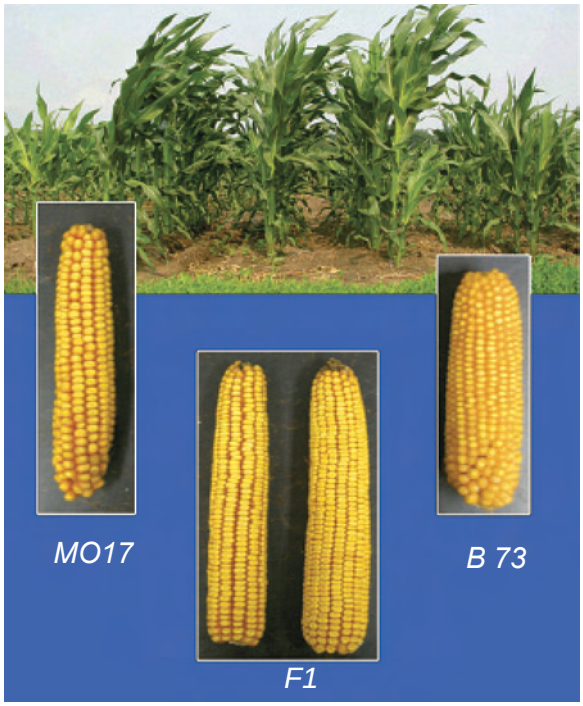
Pulse beetle



Rice weevil

Khapra beetle

Some insect pests of stored grains



Hybrid variety of maize

1.5.2 HYBRIDISATION IN ANIMALS

Hybridisation is a method of breeding, where the offspring is formed by the union of two genetically dissimilar parents. It involves the application of the principles of genetics and physiology of reproduction.

Hybridization has long been used for commercial production of cattle, sheep and poultry. Black Rock chicken is a hybrid of Rhode Island Red and Barred Plymouth Rock chicken. These are examples of two normal breeds that are combined to form an extraordinary breed. Scientists however, proceed with much caution in their efforts to identify better breeds and hybrids.

Some of the characteristics that farmers look for when selecting parent crops or farm animals for hybridization are:

1. Resistance to diseases
2. Tolerance to climatic conditions
3. General appearance
4. Size and configuration
5. Productivity
6. Good health
7. Proper age of reproduction

The different methods of animal hybridisation are as follows :

Inbreeding

Breeding between closely related individuals within the same breed is known as inbreeding.

The importance of inbreeding are:

1. It is used as a tool primarily to build desirable genotype and to promote pure breeds with desirable characteristics.
2. To identify undesirable recessive genes. This enables the breeder to separate them from the stock.
3. Inbreeding promotes uniformity.
4. Inbreeding associated with selection can produce improved stocks.

Inbreeding in cattle

Selection

It is a process of selecting productive individuals for further breeding. Modern approach of selection is based on records of performance.

Outbreeding

It involves breeding of animals that are not closely related.

a) Outcrossing: It involves breeding from the crossing of animals of the same breed (without a common ancestor).

b) Cross breeding: In this method, superior males of one breed are mated with

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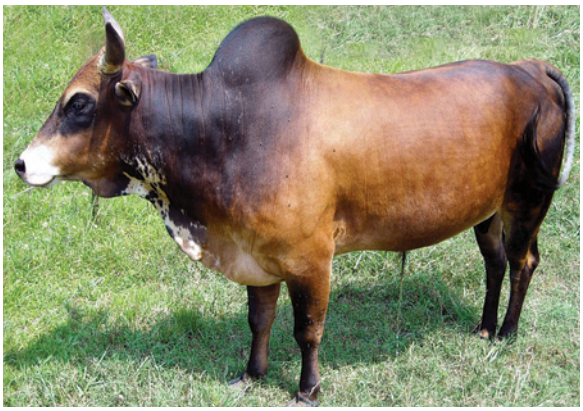
superior females of another breed. It involves the fusion of two different breeds in order to combine the desirable qualities of both.



Zebu

c) Interspecific Hybridisation: In this method, male and female animals of two different species are mated. In some cases, the progeny may combine desirable features of both the parents. For example, mule is produced from a cross between female horse (mare) and male donkey. Mules are sturdier and harder than their parental species and are well suited for hard work in different terrains like mountainous regions. There are two methods of interspecific hybridisation.

i) Natural Method: In this method crossing of indigenous and exotic breeds takes place in order to improve the yield significantly.

ii) Artificial insemination: It is a method used in hybridization in which stored semen of a desired male animal is introduced into the genital tract of a selected female animal using suitable instruments in order to obtain a better breed of the animal.

Advantages of artificial insemination

1. Ensures progeny with desirable qualities.
2. It is an economical method wherein semen from one animal is used to impregnate many females.
3. It provides high yielding animals with increased production of milk, eggs and meat.
4. Frozen semen can be stored for a long period and it can be transported even to remote areas.

1.6. ANIMAL HUSBANDRY

The branch of agriculture which deals with the feeding, sheltering, nurturing and breeding of domestic animals such as cattle, pigs, horses and fowls is called animal husbandry.

The various elements of animal husbandry are :

1. Proper feeding of animals.
2. Provision of clean drinking water for animals.
3. Proper shelter for animals.
4. Prevention and cure of animal diseases.
5. Proper breeding of animals.

Different animals are bred for different purposes.

Some examples are:

Dairy animals: Those that are used as source of milk, e.g. Cow, Sheep.

Farm animals	Purpose
Cow	Meat and Milk
Buffalo	Meat and Milk
Duck	Egg and Meat
Chicken	Egg and Meat
Sheep	Wool, Meat and Milk
Silkworm	Silk
Bees	Honey and Wax

Meat producing animals: Animals that are reared for their meat, e.g. Cow, Pig.

Poultry animals: Birds that are source of egg and meat, e.g. Chicken, Turkey.

ACTIVITY 1.5 **WE DO**

Visit an animal husbandry clinic to know about the common diseases of cattle.

MORE TO KNOW

Animal Product	Fat %	Protein %	Sugar %	Minerals %	Water %
Milk	3.60	4.00	4.50	0.70	87.20
Egg	12.00	13.00	Trace	1.00	74.00
Meat	3.60	21.10	Trace	1.10	74.20
Fish	2.50	19.00	Trace	1.30	77.20

Cattle: Cows, bulls and oxen are together called cattle. They are raised for milk, meat or labour (draught / draft animals).

Shahiwal, Red Sindhi, Gir and Deoni are examples of Indian cattle breed that are used for their milk.

Holstein Freisian is an exotic breed from Holland and Friesland in the Netherlands. It is distinctive with large black and white colour markings. These cattle have been in use as dairy animals for more than 2,000 years. They are known as a breed that gives very high yield of milk. Murrah and Jersey are examples of cattle that are selected for milk-yielding purposes.

Strong animals that are used for pulling heavy loads for transportation or ploughing fields are called draught (draft) animals. Kangayam, Umblacherry, Amritmahal and Hallikar are popular breeds of draught cattle. These animals can walk long distances carrying heavy loads.

Some breeds like Ongole, Khankrej and Tharparkar are used for both milk and work.

Cattle feed or fodder:

Cattle feed or dry fodder is made of roughage and concentrates. Roughage is a coarse and fibrous substance having low nutrient content. A variety of raw material such as sorghum (jowar or Cholam), cumbu (pearl millet or bajra), tamarind seed, rice bran, tapioca residue, ragi (finger millet) husk, sunflower meal, groundnut oilcake, gingelly oilcake, cotton seedcake and neem cake can be used to make concentrate feed. On an average, a milch cow (a breed that is used for milk production) will consume concentrate feed equivalent to 2.5% - 3% of its bodyweight. About two-thirds of this dry feed should be in the form of crude fibres and the rest one-third should be concentrates. They should also feed on forage or grass varieties like Hybrid Napier, Sudan grass, Berseem and millets. These are also called as green fodder.

Holstein Freisian

When there is a demand for more milk production or stronger draught animals, it directly reflects on an improvement on their feed. Silage is a feed that is highly nutritious. When green fodder is not available, cattle can be fed with silage. Silage can be defined as fermented high-moisture stored fodder, which can be fed to cows, sheep and goats. It is made from ordinary green grass, maize, sorghum or other cereals and other weeds using the entire green plant.

The crops are shredded into small pieces and packed inside bags and sealed to allow fermentation. After two weeks the silage is ready to be fed to cattle.

Cattle can suffer from diseases and parasitic infections. Vaccinations are given to protect them against bacterial and viral infections.

1.7. POULTRY FARMING

Poultry farming is defined as rearing and breeding of avian species for the purpose of egg and meat. Chicken occupy 90% of the total poultry.

The term poultry includes chicken, ducks, geese, turkeys, pigeons and guinea fowls. The poultry industry with its production in the form of eggs and meat is of particular importance in providing a balanced diet for the human population. Proper management of poultry includes methods of hatching, rearing, housing, sanitation, prevention of diseases and a sound marketing system.

Poultry farm

MORE TO KNOW

Dr. V. Kurien is considered as the Father of White Revolution. White Revolution refers to a time when there was tremendous increase in milk production with the use of new improved breeds of cattle. Dr. V.Kurien is the founder chairman of National Dairy Development Board (NDDB). This board designed and implemented the world's largest dairy development programme called OPERATION FLOOD.

Silver revolution

The increase in egg production brought about the 'Silver Revolution' in the area of animal husbandry.

NUTRITIONAL VALUE OF MILK

Constituents	Functions
Calcium	Builds and maintains bone mass
Vitamin D	Promotes calcium metabolism
Protein	Builds and repairs muscles.
Potassium	Maintenance of blood pressure.
Vitamin B_2	Cellular metabolism
Vitamin B_4	Functioning of enzymes
Vitamin B_{12}	Maturation of red blood cells.

There are more than hundred breeds of fowls. The fowls are classified on the basis of their utility to man. They are: 1. meat type 2. egg type 3. dual type.

Examples for cross breeds of Poultry are: HH-260, IBL-80, B-77, IIS-82

Advantages of Cross breeds

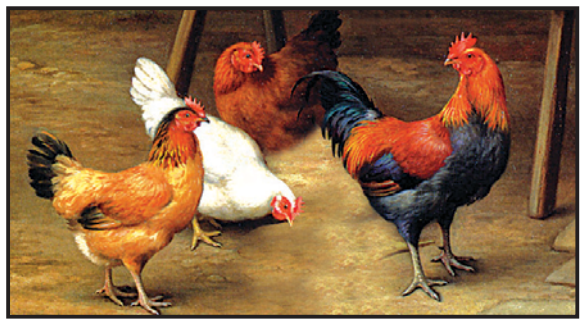
1. Cross breeds lay more number of eggs.
2. The eggs produced are larger in size.
3. They yield more meat.

Nutritional value

Eggs and meat are good sources of protein. Eggs also contain calcium, phosphorus, sodium, vitamins B1, B12 and D.

Housing of Birds

In free-range farming, the poultry are allowed to roam around freely during the day. They are confined in a cage only in the nights. This is a semi-intensive method.



Free range farming

Intensive farming involves growing birds in small cages that are just large enough for them to feed and lay eggs. Animal welfare activists discourage this method as this does not provide sufficient space for the bird to move or spread its wings.

Birds that are reared for meat are also grown in large coops or houses that protect them from predators.

Aseel, Chittagong and Karaknath are examples of Indian varieties of poultry.

Broilers are young chicken that are grown only for their meat.

Poultry feed

Poultry diets are composed of a mixture of cereal grains, soya bean meal, fish meal, bone meal, wheat bran, groundnut cake, barley, oats, maize, animal by-product meals etc. Trace minerals such as zinc, iron, copper iodine, manganese and selenium must be included in the poultry feed.

MORE TO KNOW

White leghorn is the most high egg yielding breed in the world.

India ranks fifth in the world poultry production.

MORE TO KNOW

Vegetarian eggs: *Fertile eggs rot more rapidly than infertile eggs. Hence the production of infertile eggs is desired. Hens are capable of laying eggs without the presence of cock and the eggs obtained are infertile. Such eggs are called vegetarian eggs.*

Indian breeds:
Chittagong, Aseel, Karaknath and Busra are four breeds of indigenous fowls in India.

Asiatic Breeds:
Brahma and Langshan are asiatic breeds.

Exotic breeds:
Plymouth rock, Leghorn, Rhode island, Black Minorca are examples of exotic breeds.

SCIENCE

ACTIVITY 1.6 **WE DO**

Visit a nearby poultry farm to observe rearing, feeding and breeding of birds.

Poultry disease and control

Poultry are often affected by diseases and attacked by predators like cats, dogs and foxes. Some of the common diseases found in Indian fowls are tick fever (Spirochaetosis), tuberculosis, fowl cholera, fowl pox and flu.

Disease control

Poultry diseases can be controlled by vaccination, isolation of affected birds, improving the sanitary conditions, removing dampness through exposure to sunlight. Feeding poultry with a well-balanced diet will prevent them from developing deficiency diseases.

Poultry industry in Tamilnadu

The Tamilnadu Government is giving great importance to poultry industry. Namakkal, Palladam and Chennai are well-known for poultry industries. Every student studying in schools of Tamilnadu is served with an egg, as a part of nutritious meal on all working days.

1.8. PISCICULTURE

The process of rearing and breeding of fishes in rivers, streams, ponds, irrigation canals and paddy fields is known as pisciculture.

Pisciculture plays an important role in Indian economy. It provides employment and income to millions of fishermen and farmers, particularly in the coastal areas.

Factors to be considered for pisciculture:

1. Topography or location of pond.
2. Water resources and quality of water.
3. Quality of soil (Nutrients).
4. Temperature of water.

Types of pisciculture

a. Extensive pisciculture: growing fish on natural feed.

b. Intensive pisciculture: Growing fish on artificial feed to maximize production.

c. Monoculture: Growing a single type of fish in a water body.

d. Polyculture: Growing one type of fish or more types of fishes with different feeding habits together in a waterbody.

e. Integrated pisciculture: Growing fish along with agricultural crops or other animals.

Common carp

Types of fishing ponds

Fish culture requires different types of ponds for the various stages of the growth of fish. The types of ponds are as follows:

1. Breeding ponds: Sexually mature males and females are collected and left in these ponds for breeding.
2. Hatchery ponds: The seeds collected from breeding ponds are delivered here in order to hatch young fishes called fish fries.
3. Nursery pond: 3 to 5 day old fish fries are retained here for about 20 days and fed well.
4. Rearing ponds: These are deeper ponds where fish fries from the nursery ponds are transferred and maintained for about three months. The fish fries grow to a size of about 125 mm in length and are now called fish fingerlings.

5. Stocking ponds: These are larger ponds and the fingerlings are fed with artificial feed. Organic and inorganic fertilizers are used to increase their size. Antibiotics are used to prevent infectious diseases. When the fishes attain the required growth, they are harvested.

1.9. AQUACULTURE

Aquaculture is a business that involves the production and marketing of aquatic organisms, both plants and animals, under controlled conditions. Aquaculture includes culture of prawn, lobsters, fish, pearl oysters, mussels and crabs.

Nutritional value of fishery products

Fishes are rich in animal protein, vitamins and minerals. The vitamin A content of fish liver helps for good vision. Vitamins such as B_6, B_{12}, D, Biotin, Niacin and minerals such as phosphorus, potassium and iron promote normal growth of the human body. Fish meal for cattle and poultry is prepared from the non-edible parts of fishes.

1.10. APICULTURE

The scientific method of rearing honeybees for honey and wax is called 'Apiculture' or 'Bee keeping'. Honey bees are social insects. They live in colonies. They exhibit teamwork and division of labour. They feed on the pollen and nectar of flowers. The honey bees collect nectar from various flowers. The nectar is swallowed by the bees. In the stomach, the nectar is converted into honey by enzymatic action and stored in the honeycombs. There are three types of bees in a colony.

a. Queen: It is the only fertile female in the hive. The work of the queen bee is to lay eggs.

b. Drones: These are fertile male bees and its function is to mate with the queen bee and fertilize eggs.

c. Workers: These are sterile females. They take care of the queen bee and the young bees, collect nectar, build honeycombs and protect the beehive.

MORE TO KNOW

Facts about Indian Fisheries (both capture and culture)

1. *Total fish production – 2rd position in the world.*
2. *Marine fish production – 7th position in the world.*
3. *Aquaculture production – 2nd position in the world.*
4. *Fish industry contribution - Rs.53,000 crores as foreign exchange annually.*

Honey bee varieties

a. Indigenous varieties

i. Apis indica (Common Indian honey bee)

ii. Apis dorsata (Rock bee)

iii. Apis florea (Little bee)

b. Exotic varieties

i. Apis mellifera (Italian bee)

ii. Apis adamsoni (South African bee)

Economic importance of honey bees

Honey bees are used in the production of honey and bee wax.

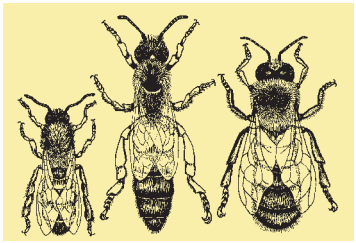
Uses of honey

1. Honey is an energy-rich food. For example, 1 Kg of honey contains 3,200 calories of energy.
2. Honey contains sugar, minerals, vitamins, enzymes and pollen.
3. Honey is an antiseptic and contains formic acid as the preservative.
4. Honey is a blood purifier, a cure against cough, cold, sore throat, ulcers of tongue, stomach and intestine.

5. Honey is helpful in building up the haemoglobin content of the blood.
6. Honey is used in the preparation of bread, cakes and biscuits.

Bee wax

It is utilized in the manufacture of cosmetics, lubricants, cold creams, shaving creams, polishes, candles, ointments and in medical preparations.



Worker Queen Drone

MORE TO KNOW

Round dance Waggle dance

HONEY BEE COMMUNICATION (Dance forms)

Round dance indicates that the source of nectar is within 100 mts. Waggle dance signifies a long distance. The dance patterns specify the direction of nectar with respect to the sun. In 1973, KARL VON FRISCH received the Nobel Prize for deciphering this dance language.

MODEL EVALUATION

Section – A

I. Choose the correct answer :

1. *This is an exotic variety of honey bee.*
   a. Apis florea *b. Apis adamsoni* *c. Apis indica* *d. Apis dorsata*
2. *Large ponds in which the fingerlings are fed with artificial feed.*
   a. Breeding ponds *b. Nursing ponds* *c. Hatchery ponds* *d. Stocking ponds*
3. *This insecticide is used to kill root-cutting insects.*
   a. Malathion *b. Metasystox* *c. Lindane* *d. Chloropyriphos*
4. *This crop is grown for oilseeds.*
   a. maize *b. sunflower* *c. rice* *d. wheat*
5. *This is an Indian breed of fowl.*
   a. plymouth *b. rhode island* *c. leghorn* *d. aseel*
6. *Silver Revolution means the _____.*
   a. increase in egg production *b. increase in milk production*
   c. fish and prawn culture *d. rearing of honey bees for honey and wax*

II. Pick the odd one out and give reason by categorizing the rest.

1. *pea, green gram, black gram, millets*
2. *hydrogen, zinc, oxygen, nitrogen*
3. *urea, nitrophosphate, potassium nitrate, farm yard manure*
4. *Sahiwal, Holsteen Freisian, Red sindhi, Gir*

III. Complete the following by choosing the correct options given below:

1. _____ *is the method of growing a single type of fish in a water body.*
2. *Culture of prawns, lobsters, pearl oysters, etc. is called* _____
3. _____ *is the only fertile female in a bee hive.*
4. *Honey helps in building* _____ *of blood.*
5. _____ *is the preservative in honey.*

(Formic acid, Monoculture, Haemoglobin content, Queen bee, Aquaculture)

Section – B

I. Differentiate between the following:

1. *Breeding pond and Stocking pond*
2. *Fungicide and Rodenticide*
3. *Vermi-compost and Urea*
4. *Macronutrient and Micronutrient*
5. *Free range farming and Intensive farming*

II. Define the following:

1. *Eutrophication*
2. *Silage*
3. *Pisciculture*
4. *Apiculture*
5. *Aquaculture*
6. *Hybridization*
7. *Pest*

III. Answer in brief:

1. *What are crops? Give three examples.*
2. *Why is it important to improve food resources?*
3. *Mention two ways by which we can improve food resources through the following:*
   a. crops b. poultry farming c. cattle farming d. pisciculture
4. *Fill in the blanks:*
   a. _____ *is a soil borne disease. (Tikka disease, Blast disease)*
   b. _____ *is an air borne disease. (Blight disease, Rust disease)*
5. *Match the following:*
   a. Insecticide - i. Zinc Phosphate
   b. Fungicide - ii. 2,4-D
   c. Weedicide - iii. Bordeaux mixture
   d. Rodenticide - iv. D.D.T
6. *Identify and correct the mistakes in the given statements:*
   a. Honey is an antiseptic and contains acetic acid as the preservative.
   b. Ongole is an exotic breed of cattle.
7. *a. Deficiency diseases occur in human beings due to lack of nutrients. Does it occur in plants too? Give an example.*

b. If the growth of the plants in your garden is stunted, what will you do to hasten the growth?

8. List out the measures taken to overcome food scarcity.

9. Poultry are often attacked by diseases like tick fever, fowl pox etc. Suggest measures to control such diseases.

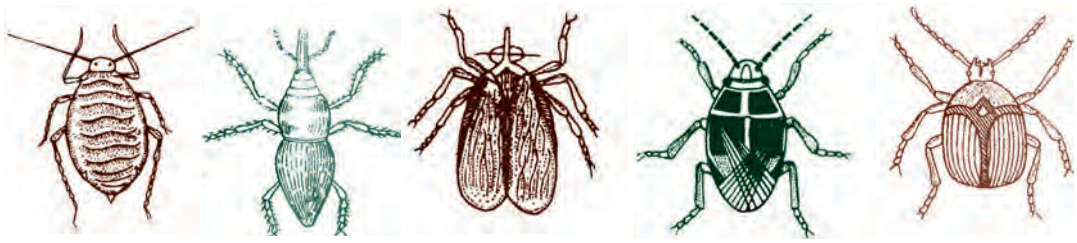
10. Kangayam and Umblacherry breeds are called draught cattle. What do you understand by the term 'draught' ?

11. In a certain poultry farm, the animal welfare activists intervened in the method of farming called intensive farming.

a. What is Intensive Farming?

b. HH – 260, IBL – 80 varieties of birds are better than chittagong and Aseel. Why?

12. Identify the following pests:



a b c d e

13. Expand the following abbreviations:

a. 2,4-D b. DDT c. FCI d. NDDB

14. Match column 'A' with column 'B' and rewrite them.

A		B
a. Seed borne diseases	-	Tikka disease of groundnut
b. Soil borne diseases	-	Leaf spot of rice
c. Air borne diseases	-	Blight of rice
d. Water borne diseases	-	Blast of rice

15. Identify and correct the mistakes in the given statements:

a. Outbreeding is the breeding of two animals of closely related breeds.

b. Inbreeding maintains parental traits.

16. Choose the correct answer :

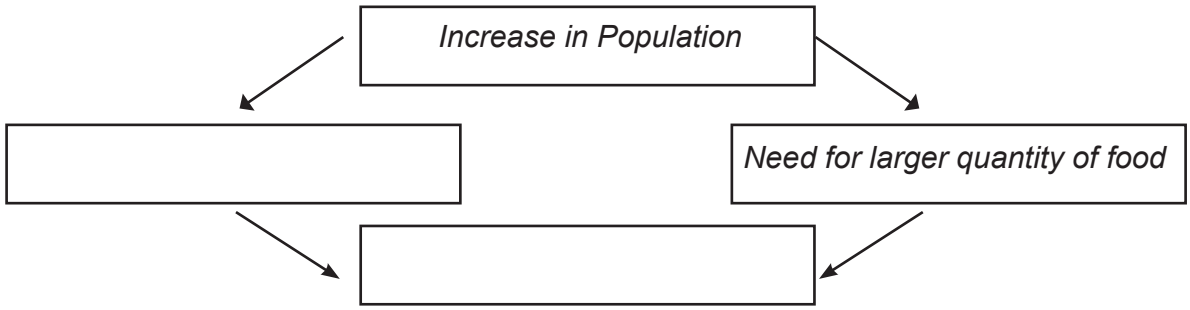
Assertion (A) : Poultry diseases can be controlled by vaccination.

Reason (R): Feeding poultry with a well-balanced diet will prevent deficiency diseases.

a. A is correct but R is wrong b. A is wrong but R is correct.

c. Both A and R are correct d. Both A and R are wrong.

17. Complete the boxes.



18. Complete the blanks based on the kind of biological material used:

a. Vermi compost : _____

b. Green manure : _____

19. Nutrients are essential for the growth of plants. Mention the role of nitrogen and phosphorus in that process.

20. Fertilizers are rich in nutrients and improve crop productivity. What will happen if excessive amount of fertilizers are used?

21. Artificial insemination is more advantageous than natural methods of hybridization. Give reason.

22. Nithya is advised to eat fish regularly. Is it healthy? Justify.

23. Honey bees are 'social insects'. Justify.

Section – C

I. Answer the following:

1. Anbu and Raj have been growing fish fries in their nursery pond for more than two weeks. They have to shift the fish fries to another pond after that. Can you say why?

2. Babu and his friends plan to start a poultry farm. Make a list of all the things they have to do to take care of the fowls.

3. Vimala found many of her potato plants eaten by rats. Suggest one method she can follow to get rid of the rats from the field. Mention two precautions she should take.

4. A group of farmers are planning to increase the yield from crops. Make a list of factors that they should consider for crop improvement.

II. Name the following:

a) Exotic breed of cattle from Holland _____.

b) Two minerals found in milk _____.

c) The Father of white revolution _____.

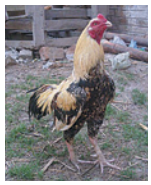
d) Two districts of TN famous for poultry industry _____.

e) The Nobel laurete who deciphered the dance language of honey bees _____.

III. Identify each of the following pictures and write one or two sentences about it:


a


b


c


d


e

IV. Study the given table with sets of 4 terms in Column A.

Pick the odd term out and enter the same in Column B. Identify the common features of the remaining three items and note down in Column C.

MODEL	A	B	C
1.	Aseel, Chittagong and Karaknath, Leghorn.	Leghorn	Indian breeds of Poultry
2.	Inbreeding, Crossbreeding,Interspecific hybridization, Artificial insemination.		
3.	Monoculture, Polyculture, Integrated Fish Culture,Intensive Fish Culture		
4.	Apis indica, Apis dorsata, Apis florea, Apis mellifera		

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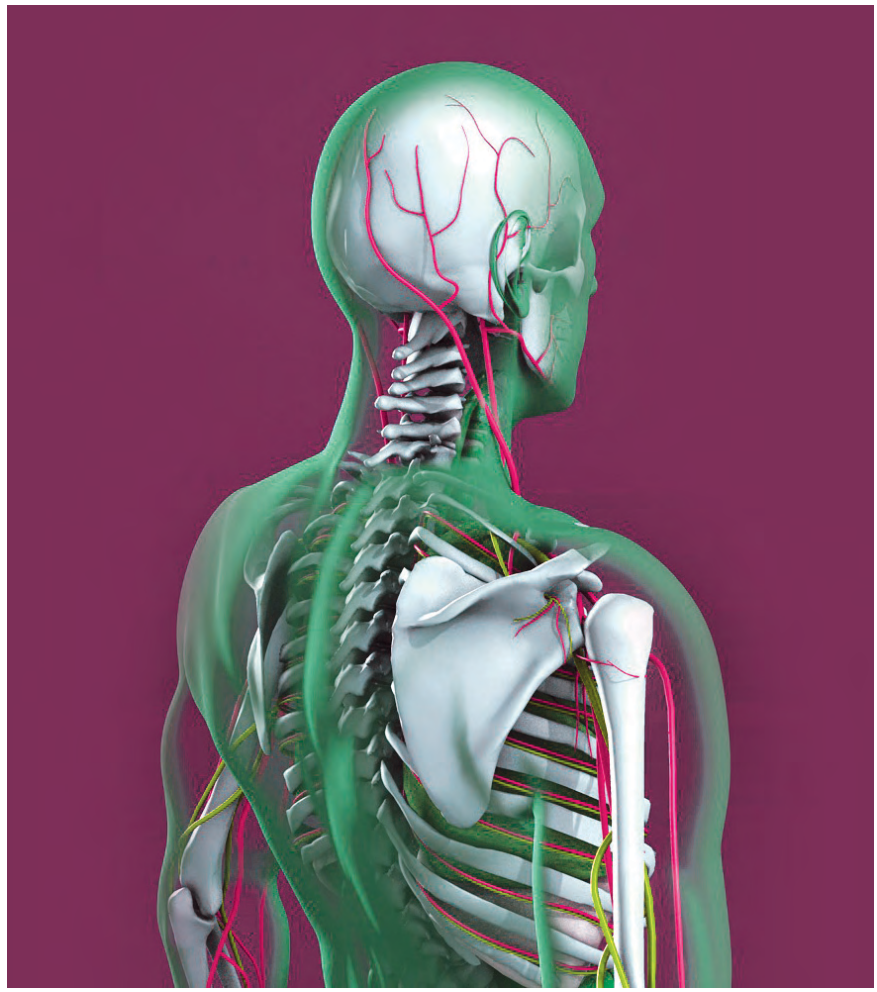
Chapter 2



HUMAN BODY ORGAN SYSTEM

- Integumentary System
- Muscular System
- Skeletal System
- Digestive System
- Urinary System
- Circulatory System
- Respiratory System
- Reproductive System

INTRODUCTION:

There are ten major organ systems in our body that work together and ensure that we can perform all our functions.

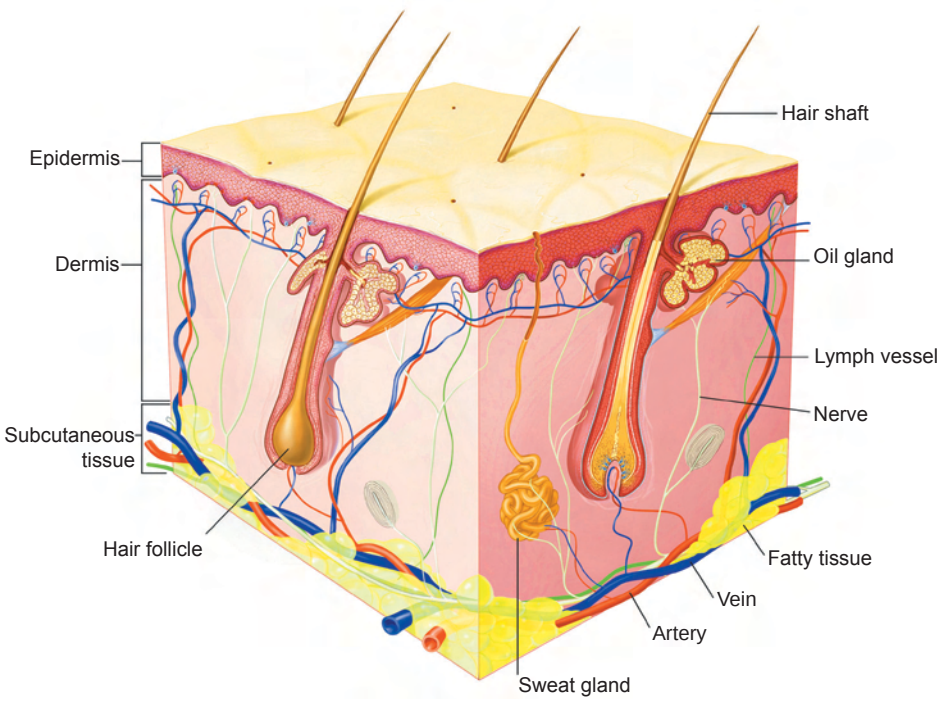
Human Body Organ Systems	
Integumentary system	Circulatory system
Skeletal system	Nervous system
Digestive system	Respiratory system
Reproductive system	Urinary system
Muscular system	Endocrine system

INTEGUMENTARY SYSTEM

Skin, nail and hair form parts of the integumentary system. Skin is exposed to changes in the environment, physical injuries and continuous attacks from micro-organisms. These functions are effectively monitored and carried out with the help of skin appendages like the hair on the head, body hair, nails, sweat glands and sebaceous glands.

2.1 SKIN

The skin is highly essential to protect internal organs and to prevent the entry of pathogens into the body.



Structure of skin

The skin is like an envelope and its complex structure is divided into three layers of tissues: 1. Epidermis 2. Dermis 3. Hypodermis

1. Epidermis

Epidermis is the upper layer of the skin. The outermost layer consists of flat, thin and scale - like dead cells. It is separated from the dermis by the basement membrane.

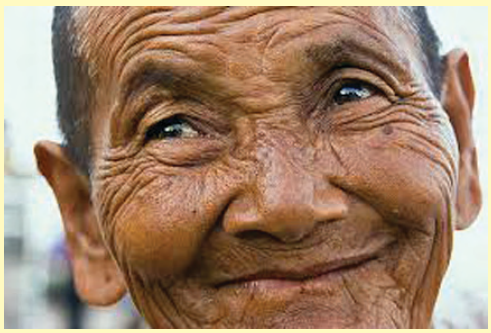
The epidermis contains melanocytes and gives colour to the skin. The deepest layers of epidermis have nerve endings.

2. Dermis

The dermis is the middle layer. It is thick but elastic. The dermis consists of nerves, blood vessels, hair follicles, sweat glands and sebaceous glands (oil glands). Sweat glands separate sweat from the blood.

Sweat glands also help in thermoregulation by cooling the surface of the skin to maintain body temperature. It brings about excretion by eliminating excess water and dissolved salts from the body. It also provides protection from colonization by bacteria and entry of pathogens through the skin surface.

MORE TO KNOW



Wrinkles: If you pinch your skin and let go, it springs back into shape. This happens because the skin contains proteins in the dermis that stretch like elastic. As people get older, their skin becomes less elastic and so it begins to form wrinkles.

Sebaceous glands secrete sebum which keeps the skin smooth and shiny. The arrector pili is the smooth muscle necessary to move the hair.

3. Hypodermis

It is the innermost layer of the skin. It is thick and contains large amounts of adipose tissue. The adipose tissue stores fat and reserves energy. It provides the body with insulation.

Functions of Skin

1. The skin protects the internal organs of our body.
2. It prevents the entry of infectious agents.
3. It reduces water loss.
4. The skin regulates the body temperature.
5. The skin can prepare Vitamin D with the help of sunlight.
6. It helps us to feel touch, pain and temperature.
7. The skin acts as an excretory organ and excretes sweat.

2.2 MUSCULAR SYSTEM

This system is made up of muscles that helps the body to move. Muscle tissue is made of bundles of cells and fibres that work in a simple way. They can contract and relax.

ACTIVITY 2.1 **I DO**

Identify various derivatives of skin like hair, feather, nail and scales in different animals.

MORE TO KNOW

The skin colour of humans is determined by the melanocytes of the basement membrane. The formation of melanocytes is determined by heredity.

SCIENCE

The human body consists of about 700 different muscles. Based on their structure, function and position, they can be divided into skeletal, visceral and cardiac muscles.

Various animals and their locomotory organs

Animals	Locomotory organs
Amoeba	Pseudopodia
Paramecium	Cilia
Euglena	Flagella
Earthworm	Body setae
Star fish	Tube feet
Fish	Fins
Birds	Wings
Bat	Patagium

Skeletal Muscles

The skeletal muscles are those that are controlled consciously. It includes bones of hands and legs, among others. The function of the skeletal muscle is to move parts of the body closer to the bone to which the muscle is attached.

Every skeletal muscle is attached to bones by tendons. These muscles are covered by sheets of connective tissues called fascia.

Tendons

These are connective tissue structures showing slight elasticity. They are like cords or straps, attached strongly to bones. The tensile strength of tendons is nearly that of steel. A tendon having 10 mm diameter can support 600 – 1000 kg.

Skeletal Muscles

Fascia

Fascia is a sheet of connective tissue that forms a lining around skeletal muscles. The fascia may be superficial or deep. The superficial fascia is a layer of loose connective tissue found between the skin and the muscles. The deep fascia are collagen fibres found as a tough, inelastic sheath around the muscle. They run between groups of muscles and connect with the bones.

Distribution of muscles

There are five different sets of muscles in our body:

1. Muscles of the head.
2. Muscles of the neck.
3. Muscles of the trunk region.

4. Muscles of the upper limb.
5. Muscles of the lower limb.

A few muscles and their functions

Facial Expressions

Facial expressions, such as looking, shocked or smiling are tiny voluntary movements made by more than 30 different muscles. Although they are voluntary, we often make these movements without our knowledge.

Breathing

Four important thoracic muscles are associated with the process of breathing. The process of inspiration involves scalene and external intercostal muscles. The expiration is performed by the internal intercostal muscles and the transverse thoracis. The major breathing movement is due to the presence of diaphragm, a curved musculo fibrous sheath that separates the thoracic cavity from the abdominal cavity.

Functions of muscles

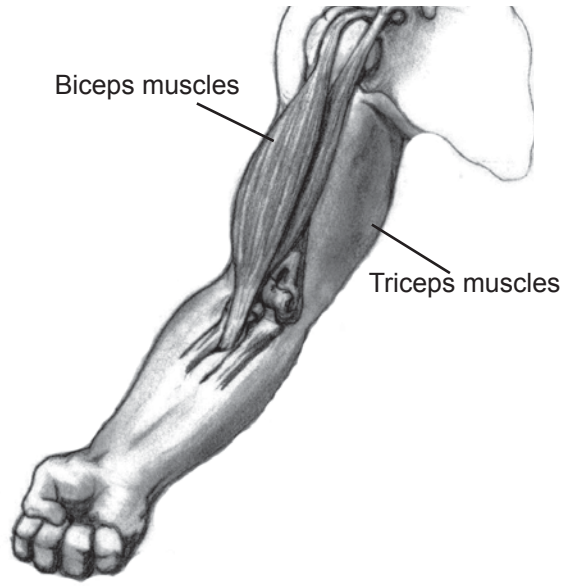
1. Muscles are responsible for locomotion.
2. They provide shape to our body.
3. The inner smooth muscles of the visceral organs make them work like a machine throughout our life.

ACTIVITY 2.2 **WE DO**

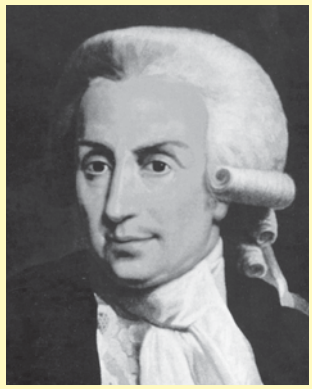
Make a visit to the Government Medical College Hospital and observe the preserved specimens and models of different types of human muscles and organs.

MORE TO KNOW

- *Muscles cannot push, they can only pull.*
- *The tongue is one of the most active muscles in our body.*



Biceps and triceps muscles



LUIGI GALVANI

By accident, the Italian professor of Anatomy, Luigi Galvani (1737-98) discovered that a dead frog's legs contract when they are pegged to an iron frame with brass pins. Galvani thought that the frog's muscle movement made electricity, which had caused the contractions. Galvani was right to think that electricity made the muscle move, but in fact it was the two metals acting together that formed the electricity. We now know that in living animals, electrical signals from the nerve make the muscles contract.

MORE TO KNOW

1 sq.cm. of muscle can lift 3.5 kg. of weight.

SCIENCE

Significant muscles, their location and movement:

S.No.	Name	Location	Movement
1	Trapezius	Upper back and each side of neck	Upper pulling movement
2	Deltoids	Shoulders	Arm raising
3	Pectorals	Chest	Horizontal pressing and drawing of arm across the body
4	Lattismus dorsi	Wide back muscle	Pulling and rowing movement
5	Biceps	Front portion of the upper arm	Arm bending and twisting
6	Triceps	Back of upper arm	Pushing and straightening of upper arm.
7	Calves	Lower leg between ankle and knee	Raising and lowering of toes.

2.3 SKELETAL SYSTEM

The skeletal system gives shape and form to our bodies. It supports and protects our bodies and helps to bring about movement, produce blood cells and store minerals. This system includes bones, cartilages and joints.

The bones can be long, short, flat or irregular in shape.

The human skeletal system is divided into two parts:

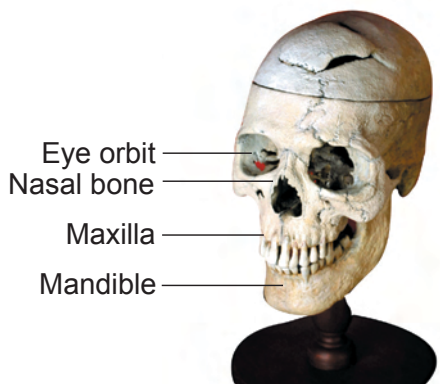
1. The axial skeleton
2. The appendicular skeleton.

Axial Skeleton

It is the upright axis of the body. Axial skeleton consists of the skull, the hyoid bones, the vertebral column and the thoracic cage.

Skull

The human skull consists of 22 bones: 8 bones form the cranium and the remaining 14 are facial bones. The bones of the cranium are flat. They are connected by immovable joints. Cranium protects the brain. The skull also supports the organs of vision, hearing, smell and taste.

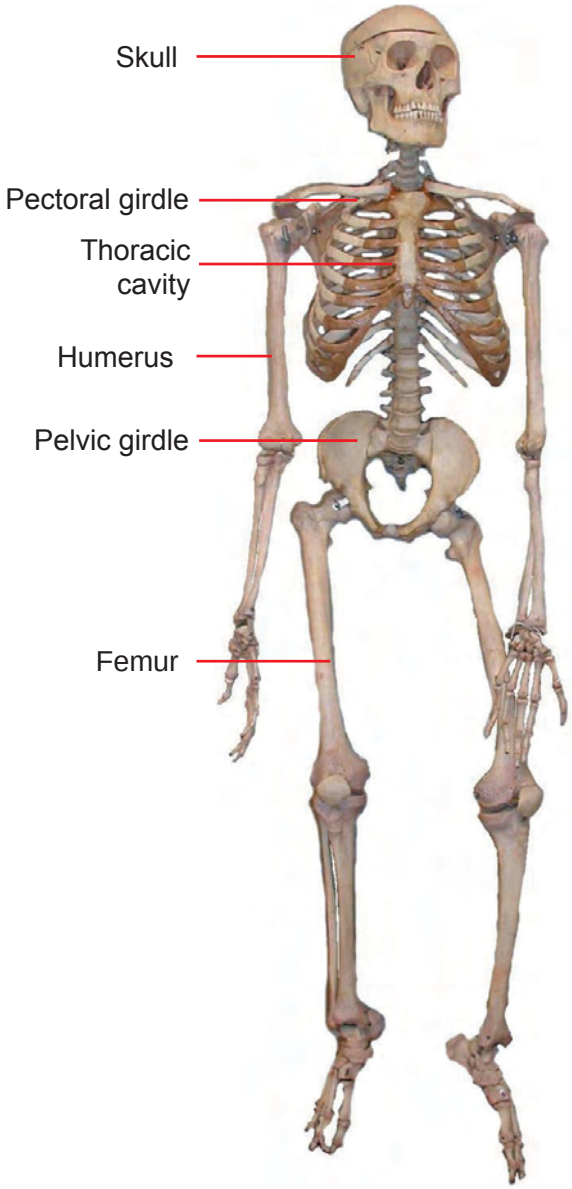


Human Skull

A large opening is found at the base of the skull. Through this opening, the medulla oblongata of the brain descends down as the spinal cord.

MORE TO KNOW

Phylum mollusca is the animal group that does not have internal skeletal system.

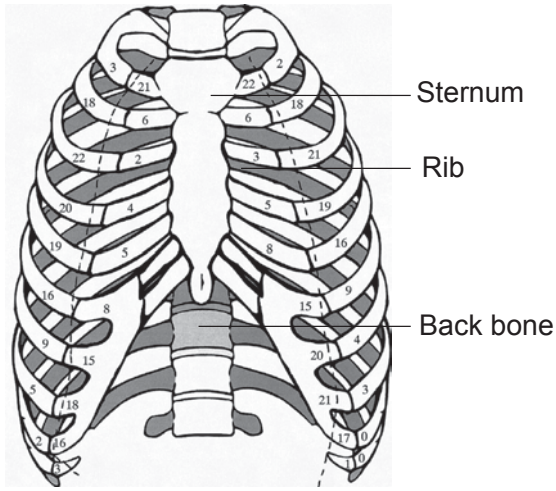


Human Skeleton

Thoracic cage

The thoracic cage or rib cage is made up of ribs that are attached to a long flat bone in front of the chest called the sternum. The ribs are also connected behind the thoracic region of the vertebral column. This thoracic cage encloses a space called the thoracic cavity. The thoracic cage protects the heart and the lungs that are located inside the thoracic cavity.

There are 12 pairs of ribs. Each pair articulates with a thoracic vertebra. In



Thoracic cavity of a human

the front, the first ten pairs are attached to the sternum. The first seven pairs are directly attached to the sternum. They are called the true ribs. The cartilages of the 8th, 9th and 10th are fused and attached to the sternum indirectly. They are called false ribs. The 11th and 12th pairs are not attached to the sternum. They are called floating ribs.

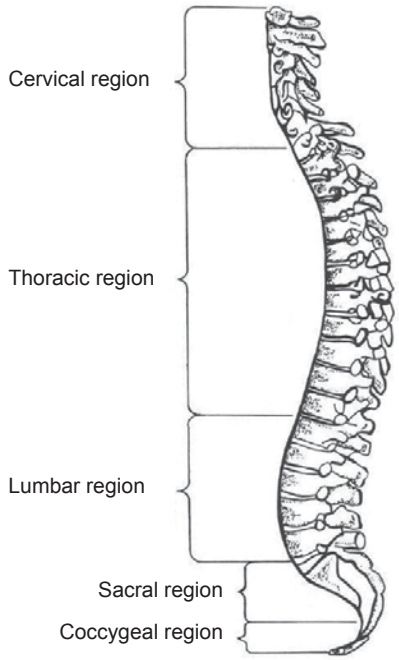
The vertebral column or Spine

The vertebral column has a natural S-shaped curve. It helps to support the weight of the body. The vertebral column consists of 33 vertebrae that can be

MORE TO KNOW

All vertebrates have the ability to move only their lower jaw. Interestingly, the crocodile can keep its lower jaw still and slam down with its upper jaw.

SCIENCE



vertebral column of a human

grouped into five sets based on their location. They are:

1. Cervical vertebrae - 7
2. Thoracic vertebrae -12
3. Lumbar vertebrae - 5
4. Sacral vertebrae - 5
5. Coccygeal vertebrae - 4

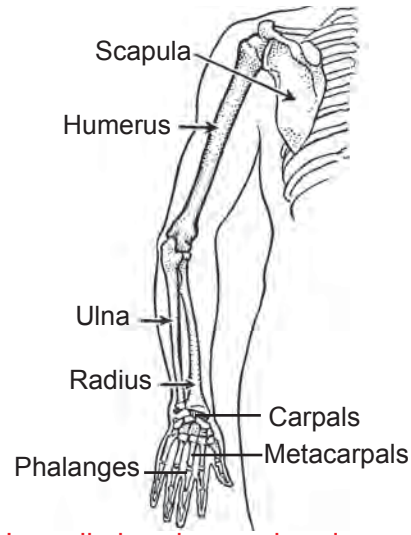
The five sacral bones are joined together to form one bone called the sacrum. The four coccygeal bones are fused together to form another bone called the coccyx. So the total number of vertebrae add up to only 26.

Appendicular skeleton

The appendicular skeleton consists of the pectoral girdle and the upper limb (hand), the pelvic girdle and the lower limb (leg).

Upper limb or hand

The hands are attached to the pectoral girdle. Each pectoral girdle has a pair of scapula or shoulder blade and a clavicle or collar bone.



Upper limb or human hand

The glenoid fossa is located in the superior lateral region of the scapula. It articulates with the head of the humerus.

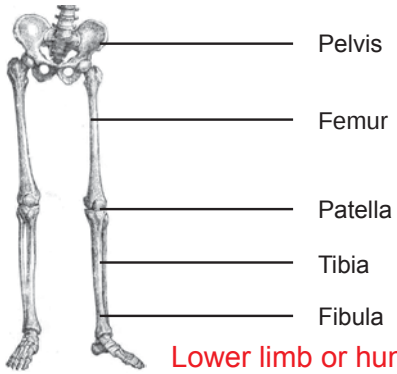
The upper arm has a long bone called humerus. The distal end of the upper arm articulates with the two forearm bones named ulna and radius. The wrist consists of eight carpals, arranged in two rows. The framework of the palm is formed of five metacarpals. Each palm has five digits. They include one thumb and four fingers. Each digit is made up of long small bones called phalanges. The thumb has two phalanges and each finger has three phalanges.

The pelvic girdle and the leg

The pelvic girdle is a ring of bones in the hip region formed by sacrum and paired bones called coxae or hip bones.

A fossa called the acetabulum is located on the lateral surface of the hip bones. It is meant for the articulation of the lower limbs.

Each coxa is formed by the fusion of three bones namely ilium, ischium and pubis. The thigh region contains the longest bone called the femur. The distal end of the femur has connection with tibia and fibula. The knee region has a large flat bone called the patella.



Lower limb or human leg

The ankle consists of seven tarsal bones. The ankle articulates with tibia and fibula at the talus.

The foot is formed by metatarsals and phalanges. They correspond to the metacarpals and phalanges of the hand.

Functions of Bones

- Bones provide a framework for the attachment of muscles.
- It helps to hold the weight of our body.
- They support and protect the internal organs.
- This system is useful for locomotion.
- Bones act as a reservoir for calcium and fat.
- The bone marrow is the site for the production of red blood corpuscles.

Number of bones in human body

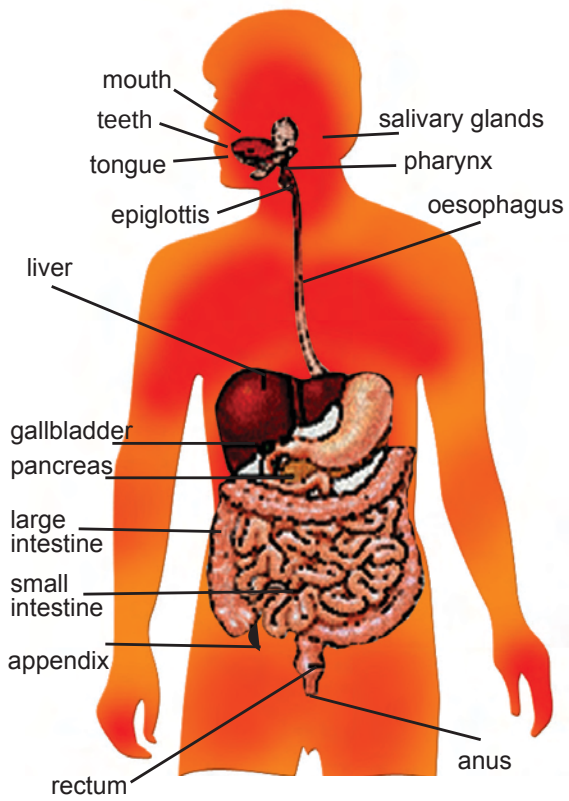
In the human body, there are 206 bones, of which 80 are in the axial skeleton and 126 are in the appendicular skeleton. Among the bones of the axial skeleton, 28 bones are in the skull, 26 bones are in the vertebral column, 25 bones are in the thoracic cage and one remains as the hyoid bone.

2.4 DIGESTIVE SYSTEM

Digestion is the process of conversion of complex compounds like carbohydrates, proteins and fats into simpler molecules like glucose, amino acids, fatty acids and glycerol respectively. These simpler molecules can then be assimilated either by blood or by lymph. The digestive system can be divided into the alimentary canal and the associated glands.

The alimentary canal

It is a coiled muscular tube extending from the mouth to the anus. It is about 6-9 meters long and consists of many specialized sections. Arranged sequentially, they are: mouth, buccal cavity, pharynx, oesophagus, stomach, small intestine, large intestine, rectum and anus. It also includes, some accessory digestive organs like salivary glands, pancreas and liver.



Organs of digestion

Mouth

The mouth opens into the buccal cavity. The roof of the cavity is lined by the palate. The floor bears a muscular tongue. The teeth are found on the upper and lower jaws.

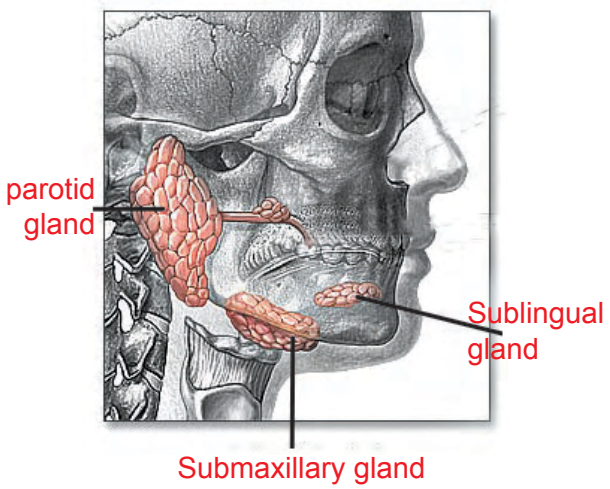
Teeth

Adults have 32 teeth, 16 in each jaw which includes 4 incisors, 2 canines, 4 premolars and 6 molars. The last set of molar teeth grows after the age of 20. Hence they are referred to as the wisdom teeth. Each tooth is made up of a bone-like substance called dentine and is covered with a layer of enamel, the hardest substance in the body. Teeth help to cut and grind food to aid in digestion.

Tongue

The tongue is a small muscular organ responsible for the sense of taste. It is attached to the floor of the mouth. The upper surface of the tongue contains several papillae or sensory buds.The tongue helps to push the food and also helps in the process of swallowing.

Salivary glands



There are three pairs of salivary glands that open into the mouth. They are the parotid, the submaxillary and the sublingual.

- Parotid glands - They are the largest of the three pairs of glands. They are found below the ears.
- Submaxillary gland - It is found below the jaw and irregular in shape.
- Sublingual gland - It is the smallest gland found at the base of the tongue.

Salivary glands secrete saliva. The saliva has the following:

1. Ptyalin(Amylase) - enzyme
2. Bicarbonate - salt
3. Mucus
4. Lysozyme - enzyme

Pharynx

The pharynx is found below the nose and the mouth. It is about 11 cm in length. This region has 7 openings. They are: 2 internal nostrils, 2 eustachian tubes, mouth, larynx and oesophagus.

Oesophagus

It is a musculo-membranous canal about 22 cm in length. It extends from the pharynx to the stomach. The inner lining has a mucus coat and it is lined by epithelium.

Stomach

The stomach is an important organ of digestion. It is a muscular sac found on the left side of the abdomen. It can be divided into 3 regions: the cardiac, the fundus and the pylorus. The stomach secretes gastric juice. The gastric juice contains the following:

1. Pepsin 2. Renin 3. Hydrochloric acid

Hydrochloric acid is secreted by a special type of cells called oxyntic cells. Hydrochloric acid and digestive enzymes continue the digestion process of food that begin in the mouth.

Small intestine

The stomach opens into the small intestine through the pylorus. The small

MORE TO KNOW

The hardest part of the human body is the tooth enamel.

If our mouth dries due to dehydration, we will find it difficult to speak.

intestine is a 5 to 7 m long tube coiled like a hose. The inside surface of it is full of many ridges and folds. The small intestine can be divided into three parts:- duodenum, jejunum and ileum.

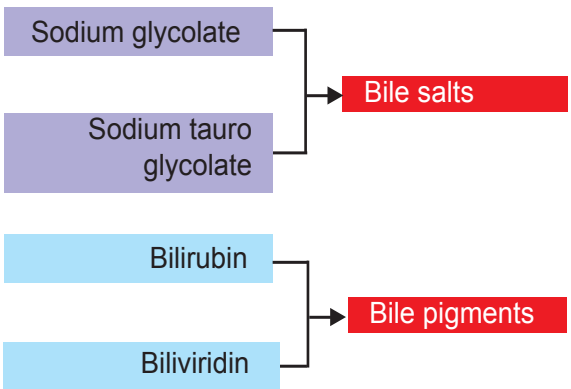
Duodenum

The duodenum is C-shaped and is around 22cms in length.

Liver

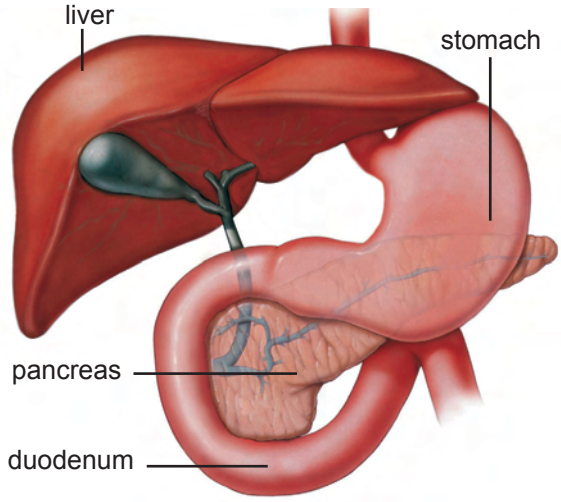
The liver is the largest glandular organ in humans. It weighs about 1500 gms. It contains two unequal lobes. The right lobe is larger than the left. The liver secretes bile juice which is greenish yellow in colour. The bile is temporarily stored in the gall bladder. The gall bladder is attached to the bile duct. The duct opens into the duodenum. Bile juice helps in the digestion of fat. It does not have any enzyme. It has bile salts and bile pigments.

Bile juice



Pancreas

The pancreas is a long, leaf-shaped gland located just below the stomach. The pancreas secretes pancreatic juice.It is connected with the duodenum through the pancreatic duct. The pancreas acts both as an exocrine gland and an endocrine gland. The gland's upper surface bears the islets of Langerhans. The islets of Langerhans are endocrine cells, in which α cells secrete glucagon hormone and β cells secrete insulin.



Liver and Pancreas

As an exocrine gland, it secretes the following enzymes:

1. Trypsin **2. Chymotrypsin**
3. Carboxy peptidase
4. Amylase **5. Lipase**

Jejunum

Jejunum constitutes two-fifths of the small intestine. It starts from the duodenum and ends with the ileum. The secretion of the small intestine is intestinal juice. The intestinal juice contains the following enzymes:

1. Sucrase **2. Maltase**
3. Lactase **4. Lipase**

Ileum

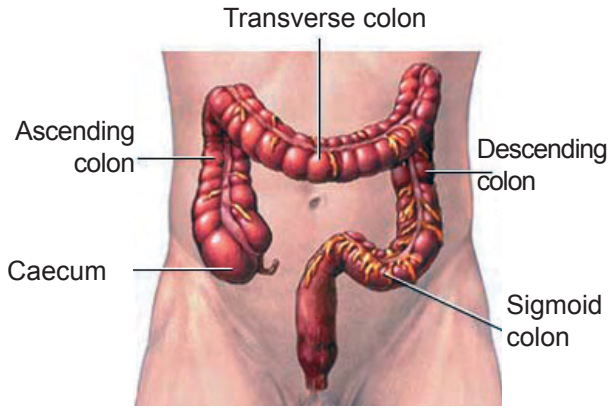
Ileum is a coiled tube-like structure which constitutes three-fifths of the small intestine. It contains numerous minute finger-like projections called villi (1 mm) in length. They are approximately 4 million in number. Internally, each villus contains fine blood capillaries and lacteal tubes where food absorption takes place.

MORE TO KNOW

Parotid gland is the only salivary gland affected by mumps virus.

The three pairs of salivary glands secrete approximately 1.5 litres of saliva everyday.

Large intestine



Large Intestine

It extends from the ileum to the anus. It is about 1.5 metres in length. It is divided into caecum, colon and rectum.

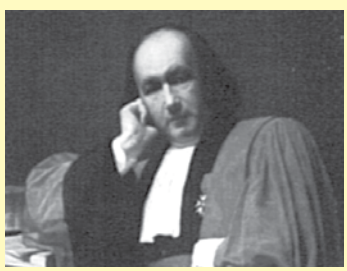
Caecum

Caecum is a large blind pouch and measures about 5 cm in length. The appendix is located near the junction of the small intestine and the large intestine. It is considered to be a vestigeal organ with no specific function.

Functions of alimentary canal

1. Ingestion 2. Digestion 3. Absorption
4. Assimilation 5. Egestion

CLAUDE BERNARD



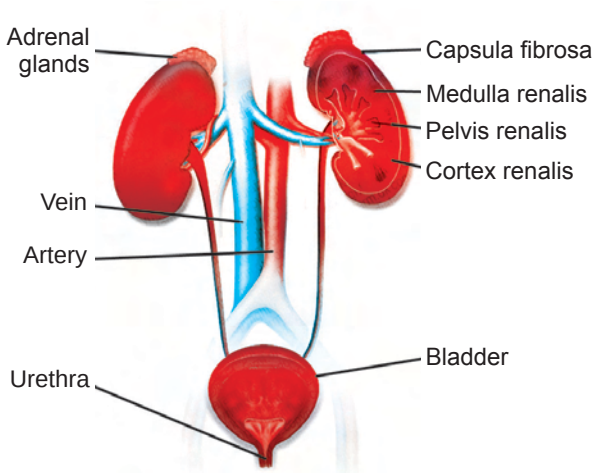
The french scientist Claude Bernard (1813-78) was one of the first people to study physiology. He discovered that glucose, the main source of energy for the body, is stored in the liver as glycogen and released as and when it is needed. He also studied digestion, how drugs change the way the body works and the nervous system.

2.5 EXCRETORY SYSTEM

The excretory system consists of the kidneys, ureters, urinary bladder and urethra. The kidneys filter the blood to remove waste and produce urine.

Kidneys

The kidneys are a pair of dark red, bean-shaped organ placed behind the abdomen on each side of the vertebral column. The average adult kidney measures about 12 cm in length, 6 cm in width and 3 cm in thickness. The outer surface of the kidney is convex and the inner surface is concave and it faces the vertebral column. The right kidney is a little lower than the left kidney because the right side of the body is occupied by the liver. Each kidney is covered by a fibrous membrane called capsule.



Urinary System

The two ureters connect the kidneys with the urinary bladder. It is sac-like in shape and acts as a temporary storage organ of urine. Urine entering the urinary bladder from the ureters slowly fill the hollow space inside the bladder. Urine is expelled from the body through the urethra.

MORE TO KNOW

Eating excess of fatty food leads to the formation of bile stones in the gall bladder.

Nephron

The kidneys are made up of millions of nephrons, which are the structural and functional units of the kidneys. Each kidney consists of about one million nephrons.

Kidneys, lungs, liver and skin together function as excretory organs .

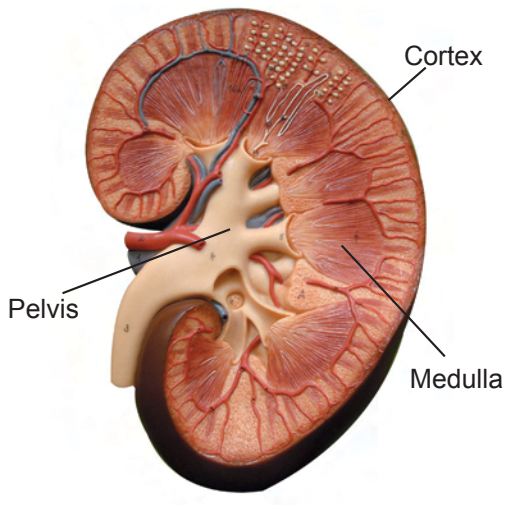
Lungs: Lungs excrete CO_2 and water from the blood.

Skin : Skin excretes sweat. The sweat consists of dissolved urea, uric acid and lactic acid.

Liver : Liver excretes bile pigments formed during the breakdown of haemoglobin.

Functions of the kidney

1. It excretes nitrogenous waste (urea) formed as a result of protein metabolism.
2. It helps to maintain the fluid and electrolyte balance of our body .
3. It helps to regulate acid-base balance of blood.
4. It helps to maintain osmotic pressure in blood and tissue.
5. It helps to retain important plasma constituents like glucose and amino acids.



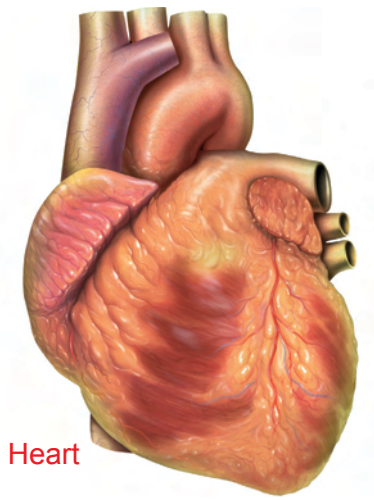
Longitudinal section of the Kidney

MORE TO KNOW

Kidney functions are the basis of blood pressure.

1. *There are approximately 1 million nephrons in each kidney. At least 450,000 of them must remain functional to ensure survival.*
2. *Every minute, kidneys receive one-fifth of blood of the cardiac output that is approximately 1.250 litres every minute.*

2.6 CIRCULATORY SYSTEM



Human Heart

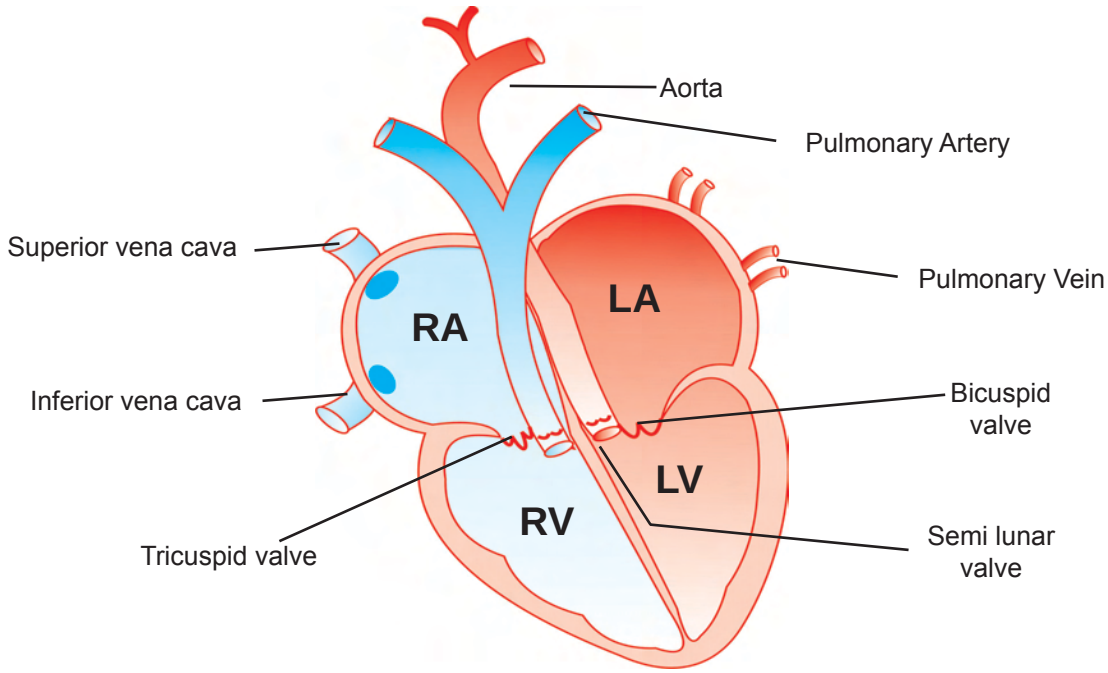
This system is made up of the heart, blood and blood vessels. It is concerned with circulating blood to deliver oxygen and nutrients to every part of the body.

The heart is a hollow, muscular organ. It is somewhat conical in shape. The heart is covered with double walled membrane called pericardium. The space between the pericardial membrane is called pericardial space, which is filled with pericardial fluid. The pericardial fluid protects the heart from shock. The heart is placed inside the thoracic chamber in between the two lungs (mediastinum).

Internal structure of the human heart

The heart is a four-chambered muscular organ that pumps blood. The two upper chambers are called atria (singular-atrium) and the two lower thicker chambers are called ventricles. The left and right sides

SCIENCE



Longitudinal section of the Heart

of the heart are separated by a muscular wall of tissue known as the auriculo-ventricular septum of the heart. The right side of the heart receives deoxygenated blood from the systemic veins and pumps it to the lungs for oxygenation. The left side of the heart receives oxygenated blood from the lungs and pumps it through the systemic arteries to the tissues of the body.

Each heartbeat results in the simultaneous pumping of both sides of the heart, making the heart a very efficient pump.

Right Atrium	a) Superior venacava b) Inferior venacava c) Coronary vein
Right Ventricle	Pulmonary artery (Deoxygenated blood)
Left Atrium	Pulmonary veins (Oxygenated blood)
Left Ventricle	Aorta

Valves in the heart

1. Tricuspid Valve: Located inbetween right atrium and right ventricle.
2. Bicuspid Valve(Mitral valve): Lies inbetween left atrium and left ventricle.
3. Semilunar Valves: Present near the mouth of pulmonary artery and aorta.

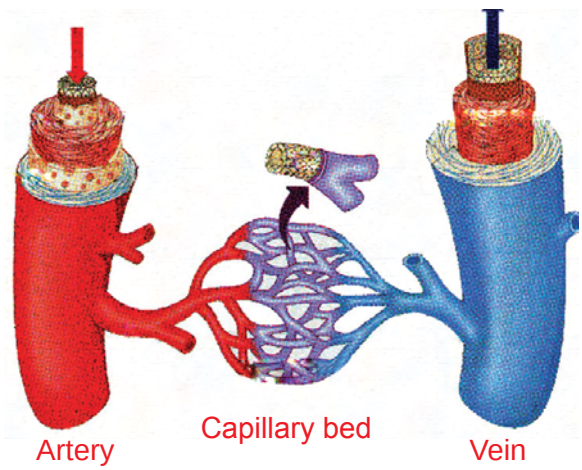
MORE TO KNOW

Among reptiles, only the crocodile has a four-chambered heart.

Circulation:

The circulation of blood can be divided into two main loops: the pulmonary circulation loop and the systemic circulation loop.

1. Pulmonary circulation transports deoxygenated blood from the right side of the heart to where the blood picks up oxygen and returns to the left side of the heart.
2. Systemic circulation carries highly oxygenated blood from the left side of the heart to all the tissues of the body (with the exception of the lungs). Systemic circulation removes waste from body tissues and returns deoxygenated blood to the right side of the heart.



Blood vessels

Arteries

The blood vessels that carry blood away from the heart are called the arteries. Generally, the arteries carry oxygenated blood, the except the pulmonary artery.

Veins

Generally, the veins carry deoxygenated blood, except the pulmonary veins.

Capillaries

Capillaries are fine, small tubes found like a network of tiny blood vessels inbetween cells. They perform all the functions of the blood vascular system. It is considered as the vital tube of the blood vascular system.

Blood

The average human body contains about 4 to 5 litres of blood. Blood is a liquid connective tissue and it transports many substances through the body and helps to maintain homeostasis of nutrients, waste and gases. Blood is made up of red blood cells, white blood cells, platelets and liquid plasma.

Plasma

It is a non-cellular fluid of about 55% of the blood volume. It is a faint yellow colour fluid, which is alkaline in nature. Plasma contains water, proteins, enzymes, hormones, dissolved elements and waste.

Difference between artery and vein

Sl.No.	Arteries	Veins
1.	It carries blood from the heart to the organs.	It carries blood from the organs to the heart.
2.	It carries oxygenated blood except pulmonary artery.	It carries deoxygenated blood except pulmonary veins.
3.	The wall is thick and elastic.	The wall is thin and less elastic.
4.	It is found deep inside the muscles.	It is found superficially.
5.	Valves are absent.	Valves are present.

Plasma functions as a transport medium for all these substances.

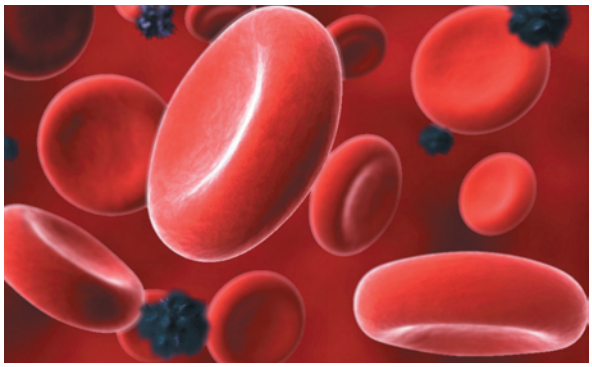
Blood Corpuscles

Nearly 45% volume of blood contains corpuscles. The blood corpuscles are of three types:

1. Erythrocytes or red blood corpuscles (RBC)
2. Leucocytes or white blood corpuscles (WBC)
3. Thrombocytes or blood platelets.

1. Erythrocytes

They are red, biconcave and disc shaped cells. The red colour of the RBC is due to the presence of respiratory pigment haemoglobin. Haemoglobin helps in transporting oxygen and carbon-dioxide in our body. One cubic mm of blood contains 5 millions of RBC. They are produced in the bone marrow. The life span of RBC is 120 days. They are destroyed in the liver and the spleen.



Red Blood Corpuscles (RBC)

2. Leucocytes

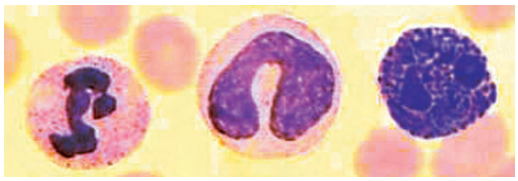
They are colourless, irregular and nucleated cells. The WBCs are fewer in number when compared to RBCs and they are larger in size. One cubic mm of blood contains 8000 WBCs. There are 5 types of WBC which are monocytes, lymphocytes, neutrophils, eosinophils and basophils. The lifespan of WBC is 4 weeks. They play an important role in the body's immune system.

MORE TO KNOW

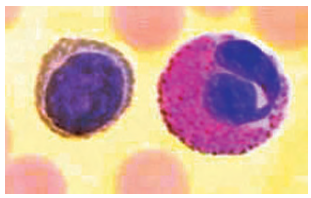
72x60x24x365mx80

This is the number of heart beat for a human living up to the age of 80.

White Blood Corpuscles (WBC)



Neutrophils Eosinophils Monocytes



Basophils Lymphocytes

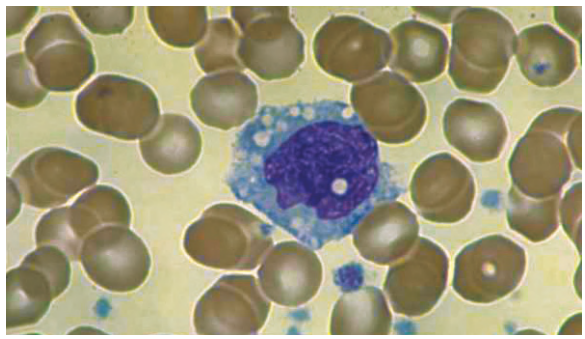
WBCs attack the invading germs and protect our body.

3. Thrombocytes (Blood Platelets)

These are small, non-nucleated and colourless structures floating in the plasma. In one cubic mm of blood, there are 2,00,000 to 4,00,000 thrombocytes. Platelets do not contain a nucleus and survive in the body for only up to a week before macrophages capture and digest them. They are responsible for the clotting of blood.

Functions of Blood

1. Blood distributes the digested food.
2. Blood carries the metabolic waste to the excretory organs.



Blood smear showing
Thrombocytes (Blood Platelets)

ACTIVITY 2.3 **WE OBSERVE**

Observe the blood smear under a compound microscope and identify RBC and WBC.

3. Blood carries hormones, which are the secretions of endocrine glands.
4. Blood distributes the heat evenly throughout the body.
5. Blood keeps all the tissues moist.

2.7 RESPIRATORY SYSTEM

The respiratory system provides oxygen to the cells of the body, while removing carbondioxide. There are three major parts forming the respiratory system: the airway, the lungs and the muscles of respiration. The airway includes the nasal cavity, pharynx, larynx, trachea, bronchi and lungs. It carries air between the lungs and the body's exterior.

The organs responsible for respiration are the nasal cavity, pharynx, larynx, trachea, bronchi and lungs.

The nasal cavity follows the external nose. The nose is a visible prominent structure. The nasal passage opens outside through external nostrils. It opens inside through the internal nostrils at pharynx.

The trachea (or windpipe) is a membranous tube supported by 'C' shaped cartilage rings. The inner wall is lined by mucous membrane. It consists of ciliated columnar epithelium.

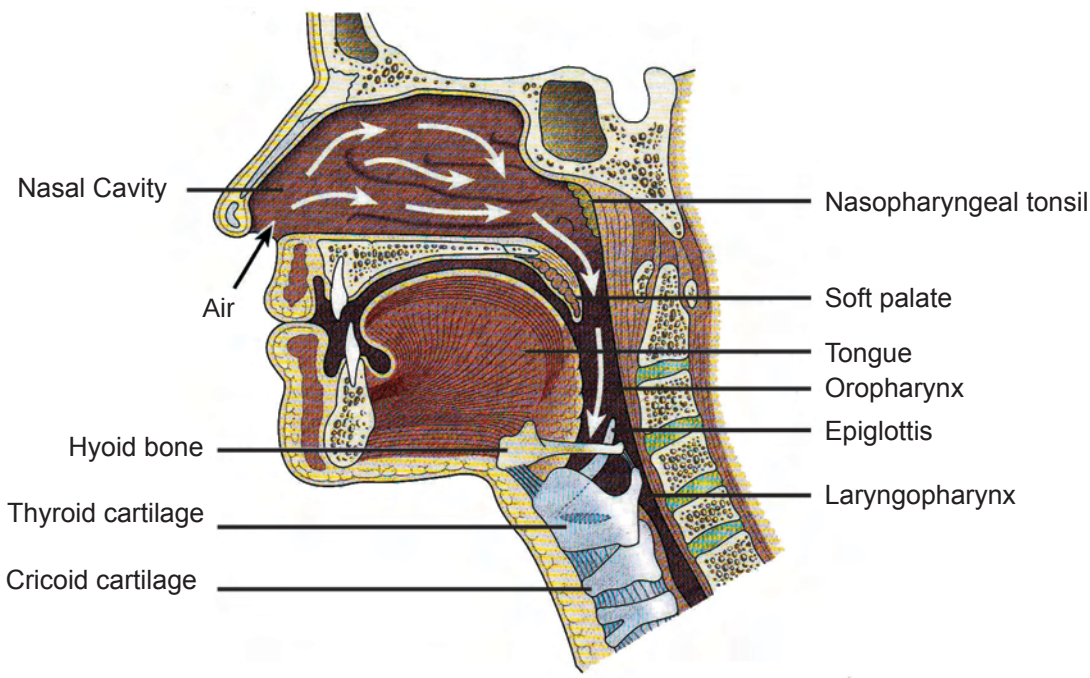
Respiratory area

The total surface of the alveoli will be around 80-100 square metres and is equal to the size of the tennis court.

Lungs

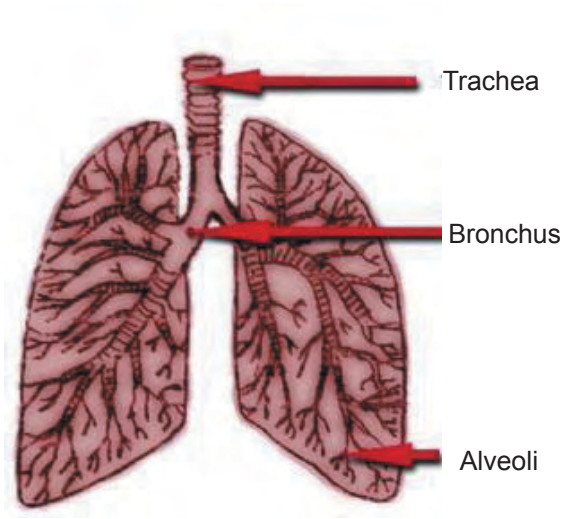
The pair of lungs is the main organ of respiration. It is conical in shape and placed inside the thoracic chamber. The base of the lungs rests on the diaphragm. The right lung has three lobes and the left lung has two lobes.

Each lung is surrounded by a double wall membrane called pleura. The region inside the pleural membrane is named as the pleural cavity. This cavity is filled with pleural fluid.



The pathway of air from the nose to the larnyx

SCIENCE



Structure of Lungs

The primary bronchi on entering into each lung is divided further into the secondary bronchi. The secondary bronchi in turn gives rise to the tertiary bronchi. They divide still further and finally gives rise to bronchioles. The bronchioles divide several times to become smaller terminal bronchioles. The terminal bronchioles end in small air-filled chambers called alveoli. This is the place, where exchange of gases takes place. The exchange of two gases (O_2 and CO_2) occurs by simple diffusion. Human lungs have about 300 million alveoli.

MORE TO KNOW

People suffer due to smoke. Smoke contains a large amount of CO, a toxic gas.

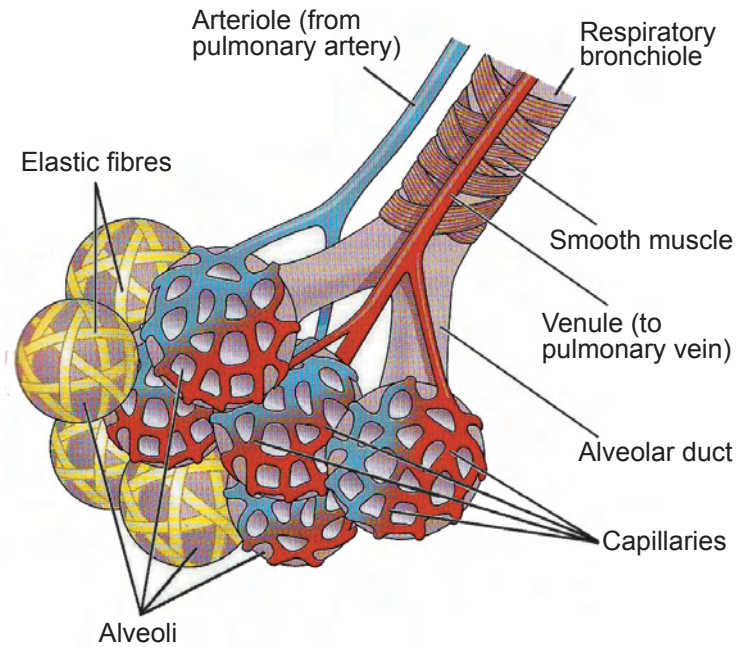
The respiratory pigment haemoglobin has affinity towards O_2 , more affinity towards CO_2 and most affinity towards CO. That is why, people when engulfed in smoke in a place on fire die due to suffocation.

MORE TO KNOW

Dogs regulate body temperature by panting.

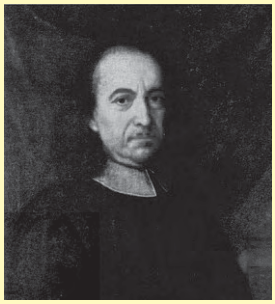
Functions of Lungs

1. The lungs take in oxygen-rich air and expel carbon dioxide from the body.
2. It also excretes water vapour.



Enlarged view of the alveolus and its capillary network

MARCELLO MALPIGHI (1628-1694)



Marcello Malpighi, born in Italy in March 1628, studied Aristotelian Philosophy and graduated as a medical doctor. Malpighi developed an intense interest in scientific research with a fond love for teaching. He is considered as the founder of Comparative Psychology.

In 1669, Malpighi published the result of his work on the silkworm. He discovered that these insects had no lungs, but breathed through a row of holes located on the lateral side of their long bodies. Distribution of air within the insect occurs through a system of tubules that Malpighi termed as 'trachea'. While observing the dissected lung tissue, Malpighi discovered tiny, thin-walled microtubules, which he named as capillaries. He went on to hypothesize that the capillaries are the connection between arteries and veins that allow blood to flow back to the heart, and these are the vital organs which do all the functions of the circulatory system.

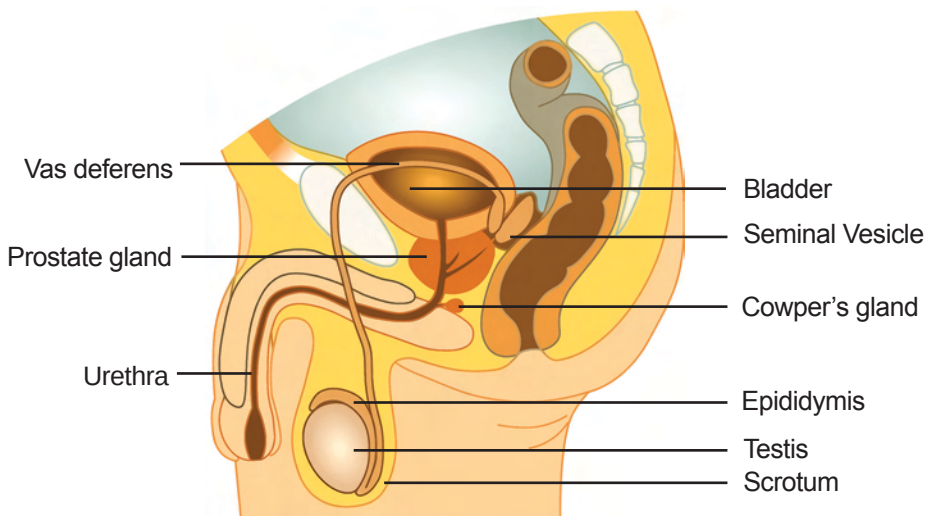
A number of anatomical structures still bear his name - Malpighian corpuscles in the circulatory and lymphatic systems, the Malpighian layer of epidermis (rete malphigi) and the malpighian tube in insects. Excretion of nitrogenous waste such as uric acid and water removal from the faeces is carried out by Malpighian tubules.

MORE TO KNOW

The cartilagenous ridge found at the base of the trachea is called the carina. Foreign objects reaching carina stimulate a powerful cough.

2.8 REPRODUCTIVE SYSTEM

Male reproductive system



Human male reproductive system

SCIENCE

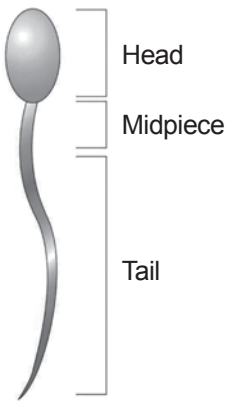
The male reproductive system includes the primary sex organs and accessory organs. The primary sex organs are the testes and the accessory organs are seminal vesicles, prostrate glands, urethra and penis.

A pair of testes is located in the scrotum outside the abdominal cavity because sperm formation requires a lower temperature than the normal body temperature. Each testes contains a coiled mass of tubules known as seminiferous tubules which produce sperms. The process of formation of sperms is known as spermatogenesis. The interstitial cells of the testes also secrete the male sex hormones (androgens) which control spermatogenesis and play a role in the appearance of male traits such as growth of beard, moustache, body hair and hoarse voice.

The sertoli cells of the testis provide nourishment to the developing sperms.

The sperms are delivered through the vas deferens which unites with the urethra which form a common passage for both sperms and urine. Along the path of vas deferens lies the seminal vesicles and the prostrate glands, which add their secretions so that the sperms are released in a fluid called semen. This fluid provides nutrition and helps in the transport of sperms.

Structure of a mature sperm



Sperm

The sperm consists of four parts namely head, neck, midpiece and tail. The head contains a condensed nucleus containing haploid set (n) of chromosomes and a terminal acrosome (Golgi apparatus) containing hyaluronidase and proteolytic enzymes. The neck contains a proximal and a distal centriole. The distal centriole is continuous with axial filament.

The midpiece contains the spirally coiled mitochondria. The tail represents the remnants of cytoplasm and propels the sperm in the liquid medium.

Female reproductive system

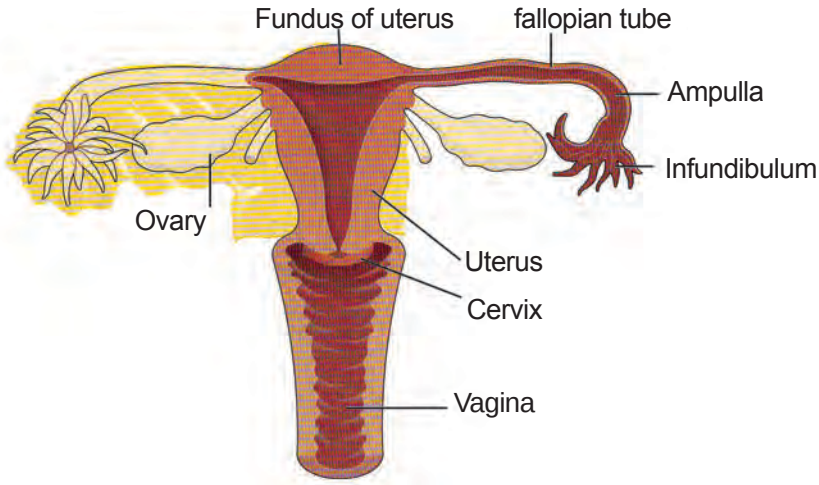
The female reproductive system consists of ovaries and accessory organs such as fallopian tubes, uterus, cervix and vagina. The ovary produces an egg in every 28 days (menstrual cycle) apart from the female sex hormones, oestrogen and progesterone.

Each ovary consists of follicle cells, which produce the ovum by a process known as oogenesis. The uterus is a hollow, thick-walled muscular organ formed of three layers and the fertilized ovum is embedded and nourished in the uterus. Vagina is a muscular tube which connects the cervix and the external genitalia. It receives the sperms and serves as a birth canal. The oestrogen is responsible for oogenesis and for the appearance of female secondary sexual characters such as development of breasts, growth of hair and feminine voice.

The structure of egg of human ovum

The egg of human is alecithal (without yolk) and contains cortical granules and yolk platelets. The egg is surrounded by a number of egg membranes.

1. Vitelline membrane – The ovum is surrounded immediately by a thin transparent membrane.



Human female reproductive system

2. Zona pellucida – It is a thick transparent membrane above the vitelline membrane.
3. Corona radiata – The outermost thick membrane formed by the follicle cells.The fluid-filled cyst inside which an ovum develops is called a Graffian follicle.

Menstrual cycle

The rhythmic series of changes that occur in the female sex organs for about 28 days throughout the reproductive life of women from puberty to menopause (except during pregnancy) is known as the menstrual cycle.

After ovulation, the mature ovum is brought to the fallopian tube and may get fertilized. When the ovum is not fertilized, the ovum along with the uterine wall is ruptured and discharged with blood and the uterine tissue by a process called menstruation.

It involves three phases namely

1. The follicular phase(5^{th} day –14^{th} day)
2. The luteal phase or premenstrual phase (15^{th} day – 28^{th} day)
3. The menstrual phase (1^{st} day – 5^{th} day)

Menstrual cycle

1. Follicular phase: This phase is initiated by the secretion of Follicle Stimulating Hormone (FSH) of pituitary. During this phase primary ovarian follicles begin to grow and the mature graffian follicles burst and release the ovum into the fallopian tube (ovulation).
2. Luteal phase: This stage is influenced by Lutenising Hormone (LH) of the pituitary gland. After the release of the ovum, the ruptured part of graffian follicle is transformed into a transitory endocrine gland called corpus luteum. It secretes the pregnancy hormone called progesterone. This hormone causes the thickness of endometrium and prepares

MORE TO KNOW

Anton van Leeuwenhock *(1632 - 1723) was the first to observe and draw sperm cells.*

MORE TO KNOW

Sperm Bank

Sperms can be collected in the form of semen and can be stored in the sperm bank and kept viable for several years in frozen state in liquid nitrogen at a very low temperature. These sperms are useful in invitro fertilization and artificial insemination techniques.

SCIENCE

the uterus to receive the fertilized ovum. If the ovum is not fertilized, the ovum and uterine wall gets ruptured and discharged during menstrual phase.

3. Menstrual phase: The decline in progesterone and oestrogen initiates the shedding of unfertilized egg and endometrium with severe bleeding in a process called mensus or menstruation. At the termination of menstruation, the corpus luteum is converted into a scar tissue called corpus albicans.

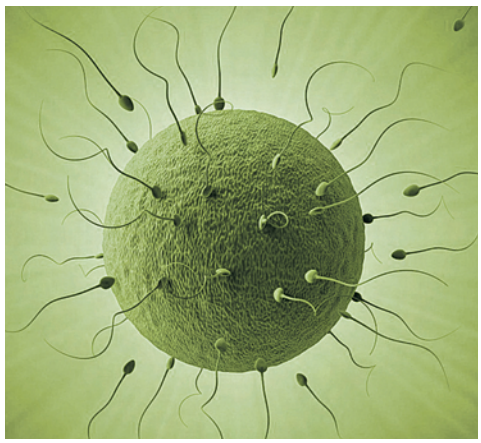
Mechanism of fertilization

At the time of ovulation, the ovum is fully matured and it enters the infundibulum of the uterine tube and passes into the ampulla. Fertilization of the ovum takes place in the ampulla of the uterine tube. Only one spermatozoan pierces the egg membrane Zona pellucida and enters the ovum. Polygamy (entry of more sperms) is prevented by the fertilization membrane around the ovum.

2.8.1 DEVELOPMENT OF EMBRYO

The fertilized ovum is called the zygote. As soon as it is formed, it becomes activated and mitotic divisions set in. This is the first phase of the embryo's development and is called the cleavage. As a result, a ball of cells called the blastula is formed. The outer surface forms the trophoblast and the embryo gets attached to the wall of the uterus. This process is known as implantation.

The implanted embryo develops the extra embryonic membranes such as amnion, allantois, chorion and yolk sac. Amnion provides a fluid medium to the developing embryo. It prevents dessication of the embryo and functions as a shock absorber. The chorion and allantois fuse to form the placenta. It helps in the exchange of gases between the mother



Fertilization

and the foetus and also the elimination of nitrogenous waste from the foetus. The embryo and the placenta are connected by the umbilical cord, which is derived from the allantois.

Stages in the development of the human foetus:

Gestation period : From the fertilization of the ovum to the birth of the baby, it takes about nine months. The period during which the foetus remains inside the uterus is called the gestation period.

The development of foetus can be studied as phases of three month period: The first, second and third trimesters.

First trimester

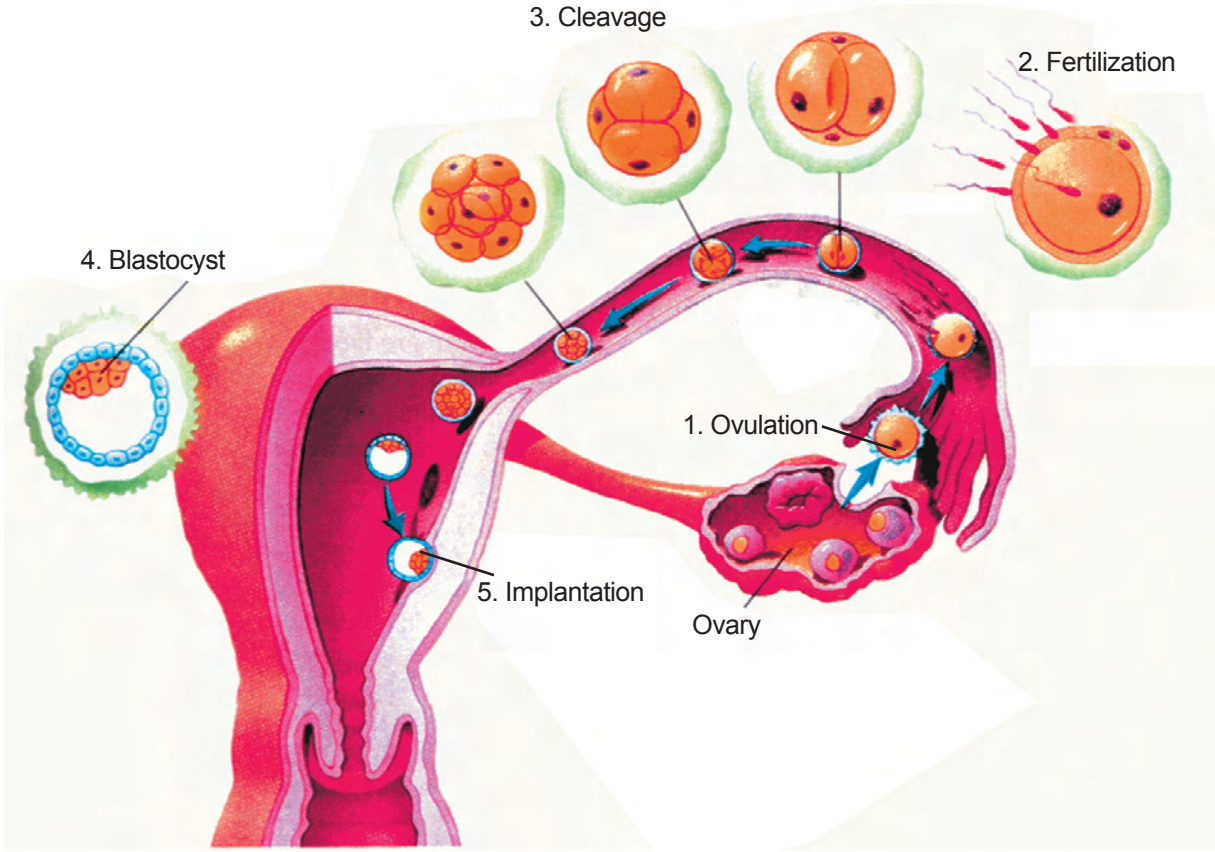
During this period, the proliferation of cells takes place and a single cell is transformed into a foetus gradually. Organogenesis takes place resulting in the formation of organs.

Second trimester

The foetus grows rapidly. The respiratory and circulatory systems become well-developed and functional. The bones and muscles are well formed.

Third trimester

The length and weight of the foetus increases very rapidly and the development is completed.



Blastulation to Implantation

Childbirth

A few days before birth, the foetus turns head downwards in the uterus, just above the cervix.

At the onset of childbirth, the uterus begins to contract rhythmically under the influence of oxytocin hormone. These contractions become stronger and more frequent. This marks the onset of labour pain. With continued powerful contractions, the amnion ruptures and the amniotic fluid flows out through the vagina.

Finally, the muscular contractions of the uterus and the abdomen expel the child through the dilated cervix and vagina. The umbilical cord that still connects the child to the placenta is tied and cut. A few minutes later, the placenta breaks away from the uterus and is expelled as 'after birth'.

Development of Human Embryo

Lactation

The first milk produced by the mother's mammary glands just after childbirth is

known as colostrum. It is rich in proteins and nutrients. It also contains antibodies that provide immunity for the newborn infant. The secretion of milk is stimulated by the pituitary hormone prolactin.

Advantages of mother's milk

- It is clean, uncontaminated, easily available and sterile.
- It is available at a correct temperature for the baby's needs.
- It contains antibodies which shield the baby from external viral and bacterial infections.
- In rural areas, breast milk is used as eye drops for viral conjunctivitis and minor eye infections as a first aid.
- The calorific value of breast milk is 70 per 100 ml of milk and this can meet the requirements of the infant fully.
- Lactoferin, a protein in breast milk, provides considerable protection against intestinal and respiratory infections.

MORE TO KNOW

The test tube babies are formed by the technique of invitro fertilization in which fertilization and early development takes place in an artificial medium outside. Dr. Robert Edwards and Dr.Patrick Steptoe of UK were successful in producing the first test tube baby.

MODEL EVALUATION

Section – A

I. Answer the following questions:

1. Study the relationship between the given pair and write the missing word / sentence

a. Heart : Pericardium ; Lung : _____

b. Mouth : Saliva ; Liver: _____

c. Skin : Prevents the entry of infectious agents; WBC :_____

2. Write the names of the missing muscles:

Inspiration : 1. scalene 2. External intercostal muscles.

Expiration : 1. _____ 2. . _____

3. Renin, Lactase, Lipase : Enzymes, Glucagon, Insulin :_____

4. Choose the correct answer:

The valves present near the mouth of pulmonary artery and aorta are _____ Valves

a. tricuspid b. mitral

c. auriculo-ventricular d. semilunar

5. Circle the odd one out:

a. Oesophagus,	Stomach,	Bronchi,	Ileum,	Colon
b. Capsule,	Platelet,	Nephron,	Ureter,	Urethra
c. Patella,	Incisors,	Canines,	Pre-molar,	Molar
d. Cervical,	Cardiac,	Thoracic,	Lumbar,	Sacral
e. Larynx,	Urethra,	Trachea,	Bronchi,	Alveoli

6. Correct the mistake:

a. Hypodermis helps in thermoregulation.

b. Each lung is surrounded by pericardium.

7. The process of menstrual cycle stops during pregnancy and resumes after childbirth. Name the hormone involved in the process and mention its function.

8. During the time of delivery, the mother undergoes severe labour pain. Name the hormone responsible for it and mention its significance.

9. Fill in the blanks:

a. Smiling involves the working of_____ muscles.

b. The brain is protected by the brainbox called _____

c. The first _____ pairs of ribs are called true ribs.

d. _____ is both an endocrine and an exocrine gland. Justify.

e. The fingerlike projections of the intestinal wall are_____

f. _____ is the large blind pouch of the digestive organ.

g. _____ is the vestigial organ of the alimentary canal.

10. Arrange the following in logical sequence:

a. Oesophagus, rectum, large intestine, small intestine, stomach

b. ingestion, egestion, absorption, digestion

c. glucose, starch, maltose

d. jejunum, ileum, duodenum

11. Unscramble the jumbled letters and fill in the blanks:

a. The muscular fibrous sheath separating the thorax and the abdomen is _____.(IADPRAHGM)

b. The functional unit of the kidney is _____.(NORHPEN)

Section – B

I. Answer the following questions:

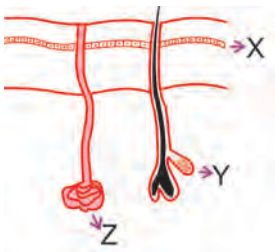
1. Which organ is protected by: a) the skull b) the rib cage

2. Name two parts of the body where you can may find smooth muscles.

3. How does the cardiac muscle differ from the skeletal muscle?
4. Differentiate between systemic and pulmonary circulations.
5. a. The vertebral column has a natural S-shaped curve. Reason out.
   b. The right kidney is slightly lower than that of the left. Reason out.
6. _____ is the first milk produced by the mother's mammary glands. It is rich in _____ and _____.
7. Draw the diagrams of the liver and the pancreas. Mark the parts.
8. Fill in the blanks:
   a. No. of bones in the face - _____
   b. No. of bones in the wrist - _____
   c. No. of lumbar vertebrae - _____
   d. No. of teeth in each jaw - _____
9. Complete the following:

Bile salts < _____ / _____ Bile pigments < _____ / _____

10. Observe the given diagram of the skin.



   a. What are X, Y and Z ?
   b. Write the importance of X.
   c. Name the secretions of Y and Z.
   d. Write the importance of the secretions.

11. a. Match column A with column B:

A	B
Femur	Upper arm bone
Tibia	Shoulder blade
Scapula	Thigh bone
Clavicle	Shin bone
Humerus	Collar bone

   b. Match the Movements into their respective names and locations:

Name	Location	Movement
Pectorals	between ankle and knee	raising of arms
Biceps	shoulders	raising and lowering of toes
calves	chest	bending, twisting of arms
Deltoids	front portion of the upper arm	drawing of the arm across the body

12. Assertion : A) The skin colour of humans is determined by the presence of melanocytes present in the skin.

Reason : B) The skin colour of humans cannot be changed by cosmetics.

a. A is right, B is wrong. b. A is wrong, B is right.

c. B explains A. d. B does not explain A.

13. Which one is not correctly matched?

Organs	Enzymes
1. Salivary glands	Ptyalin
2. Stomach	Pepsin
3. Pancreas	Sucrase
4. Jejunum	Maltase

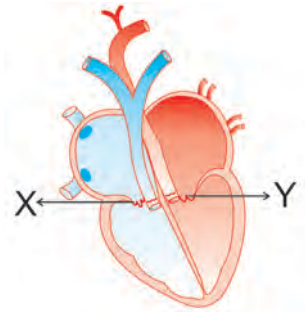
14. Assertion: (A) A pair of testes is located in the scrotum outside the abdominal cavity.

Reason: (B) The sperm formation requires a lower body temperature than the normal body temperature.

a. 'A' is right, 'B' is wrong. b. 'B' explains 'A'.

c. 'B' is right, 'A' is wrong. d. 'B' does not explain 'A'.

15. Look at this picture:



i) Name X and Y.

ii) What are their functions?

16. The testes are located in the scrotum outside the abdominal cavity. Give reason.

17. In higher organisms, the male and the female can be distinguished by certain external features called secondary sexual characters. List some male and female sexual characteristics in humans.

18. Both the Sperm and the Ovum contain haploid set (n) of chromosomes. Give reasons.

19. The developing foetus can communicate with the mother through the placenta. Mention the role of placenta.

20. The gestation period for humans is about nine months, which is divided into three divisions called trimesters. List the changes that occur in woman during the first trimester of pregnancy.

21. Mother's milk is the most wholesome food for the child. Justify your answer.

22. *In insects, during metamorphosis, the outer skin is cast off periodically. Name the process and mention its significance.*

23. *A person with hepatitis is advised not to consume fat rich food.*

    a. *Which part of the body is affected?*

    b. *Name the secretion and its components.*

    c. *Where is the secretion temporarily stored?*

    d. *Does the secretion have any enzymes? Write the functions of the secretion.*

24. *WBC play an important role in the body's immune system. Justify.*

25. *Bleeding occurs immediately after an injury for sometime. Name the process which stops continuous bleeding and name the cells involved.*

26. *Exchange of gases (O_2, CO_2) takes place in the lungs. Name the process involved and define it.*

27. *The entry of dust particles into the nostrils causes coughing and sneezing. Give reason.*

28. a. _____ *artery carries deoxygenated blood.*

    b._____ *vein carries oxygenated blood.*

29. *Sweat glands help in thermoregulation. How?*

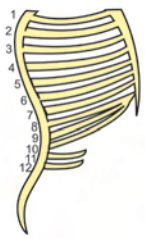
30. *Eating sweets and chocolates causes tooth decay. Is it true? Justify your answer and suggest measures to maintain oral hygiene.*

31. *Smoke causes suffocation. Give reason.*

32. *Babu suffers from anaemia - a condition in which the red blood cells are few. The most common symptom is tiredness. Give reason.*

Section – C

1. *A diagram of the human chest is given below . Copy the diagram and mark the parts.*



   a. *1 to 7 ribs are called _____. Why?*

   b. *8 to 10 ribs are named _____. Give reason.*

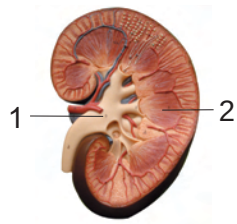
   c. *Write the significance of 11 and 12 ribs.*

   d. *Name the organs in the thoracic chamber.*

2. *L.S. of Kidney*

   a. *Copy the diagram.*

   b. *Mark parts 1 and 2.*

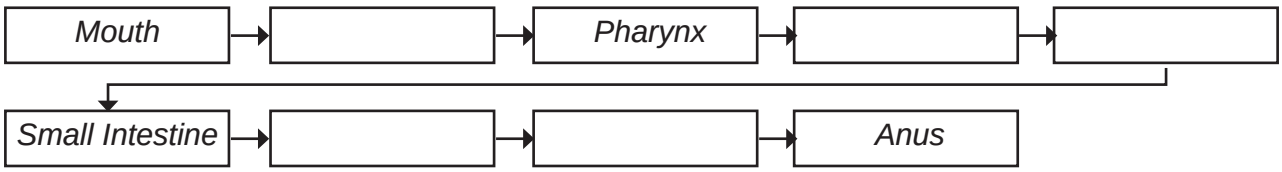


3. *List out the functions of bones.*

4. *Kidneys maintain water-salt balance. Mention its other functions.*

5. *Artery and veins conduct the blood through the body. Mention the differences between them.*

6. *Fill up the boxes sequentially to show the passage of food through the digestive system.*

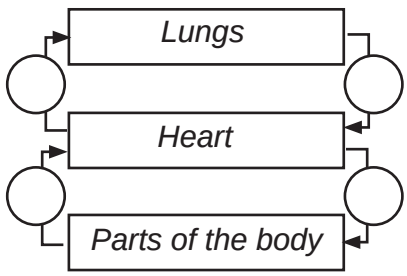


7. *Select words from the given list to complete the paragraph:*

RBC are _____, _____ and disc-shaped cells. The red colour of the RBC is due to the presence of respiratory pigment _____. Haemoglobin helps in transporting _____ and _____ in our body. One cubic mm of blood contains _____ of RBC. They are produced in the _____. The lifespan of RBC is _____. They are destroyed in the _____ and _____.

(120 days, 5 millions, bone marrow, haemoglobin, liver, carbon-dioxide, biconcave, red, spleen, oxygen)

8. *Trace the circulation of blood from the heart to the lungs and to the other parts of the body. Name the blood vessel involved.*



(Aorta, Pulmonary artery, Inferior venacava, Pulmonary vein)

SCIENCE

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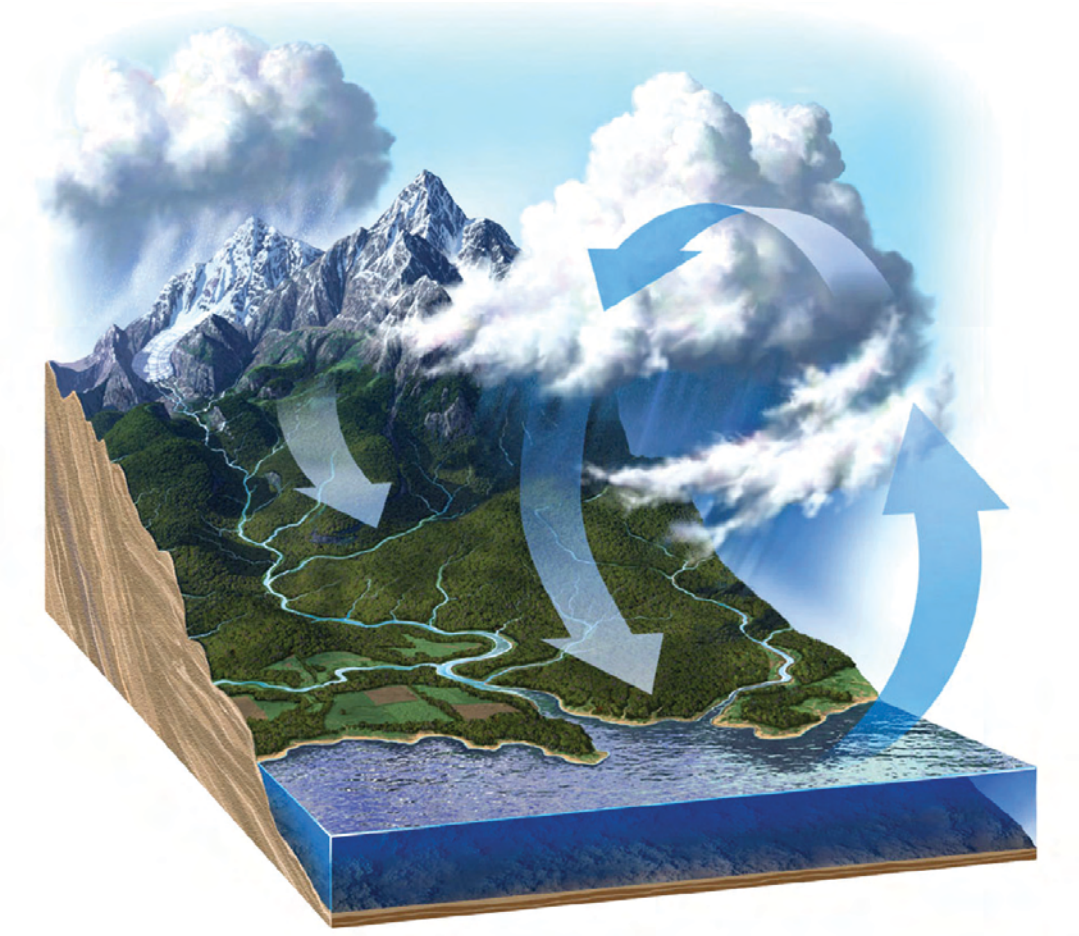
Chapter 3



BIO-GEO CHEMICAL CYCLE

- Water cycle
- Nitrogen cycle
- Oxygen cycle

3. BIO-GEO CHEMICAL CYCLE

The cyclic flow of elements or compounds between the non-living environment (soil, rock, air, water) and the living organisms is known as bio-geo chemical cycle. These chemicals are used by living organisms and released back into the environment when they die and decompose. Thus there is an inter-dependence between the living and the non-living to help them complete a life cycle. Green plants are the producers and the animals that eat them are the consumers. The bacteria and fungi are the decomposers that break down the dead remains and release the chemicals for the plants to use again.

The abiotic or non-living components of the environment are air, water, soil, light and temperature. The biotic or living components of the environment include all living organisms including human beings. The ecosystem (Environmental system) includes these two essential components. The organisms and the physical environment of the habitat form an ecological complex termed the ecosystem. The branch of Biology which deals with the interrelationships between organisms and their environment is called Ecology.

The energy trapped by green plants or autotrophs is relayed through a series of heterotrophic organisms or consumers. This forms the food chain. Living organisms take in oxygen during respiration and give out carbon dioxide. The plants absorb this CO_2 during photosynthesis and liberate oxygen into the atmosphere. Thus, plants and animals are interdependent.

Interaction between insects and plants

WATER CYCLE

Water is an important component of the environment and is essential for living beings. Oceans are the biggest storehouses of water from which water evaporates to form clouds. Water also evaporates from other water bodies like rivers, lakes and ponds to form clouds. On condensation, the water vapour in the clouds comes down as rain. The rainwater flows through rivers and eventually reaches the oceans.

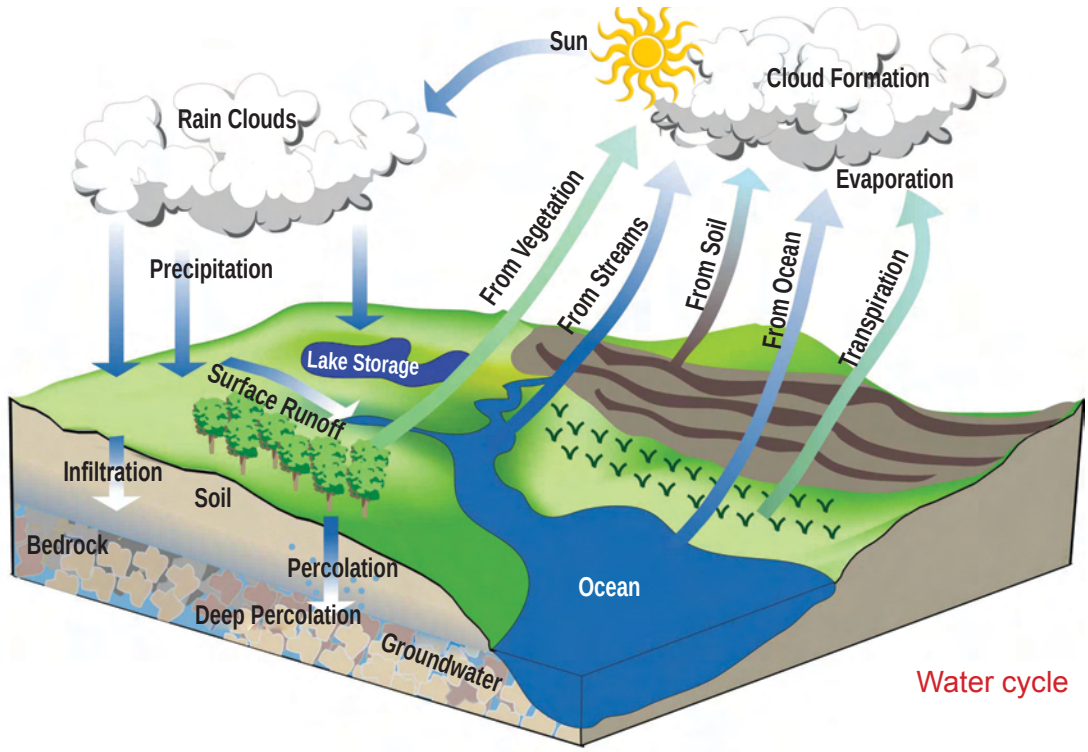
The circulation of water also occurs through plants and animals. Plants absorb water from the soil or a water reservoir and add it to the air (atmosphere) as

Grass

Rabbit

Fox

Tiger



Water cycle

vapour by transpiration. This plays a role in determining the micro climate around them.

Animals take water directly from the reservoir or through food. They release the water back into the environment by evaporation and excretion. Water is also added to the environment by death and decay of organisms.

A large amount of water is recycled directly without the involvement of biotic components. The heat of the sun and the movement of the wind help to evaporate water from the exposed surfaces of oceans and lakes. This water vapour enters the atmosphere and it becomes clouds which later transforms into water in the form of rain or snow. The rivers and lakes act as reservoirs of water which finally collects in the oceans.

MORE TO KNOW

About two-thirds of our body is made up of water.

The Earth's water supply is composed of 97% oceans, 2% ice caps, 1% fresh groundwater.

In 20 minutes, one thunderstorm can send down over 125,000,000 gallons of water. (One gallon is equivalent to 4.5 litres)

NITROGEN CYCLE

Living organisms require nitrogen to create proteins and nucleic acids in their body. The atmosphere consists of almost 78% of nitrogen, but plants and animals can use it only if it is in the form of ammonia, amino acid or nitrates. The process by which these forms get interconverted by physical and biological processes is called the Nitrogen Cycle.

The Nitrogen Cycle involves:

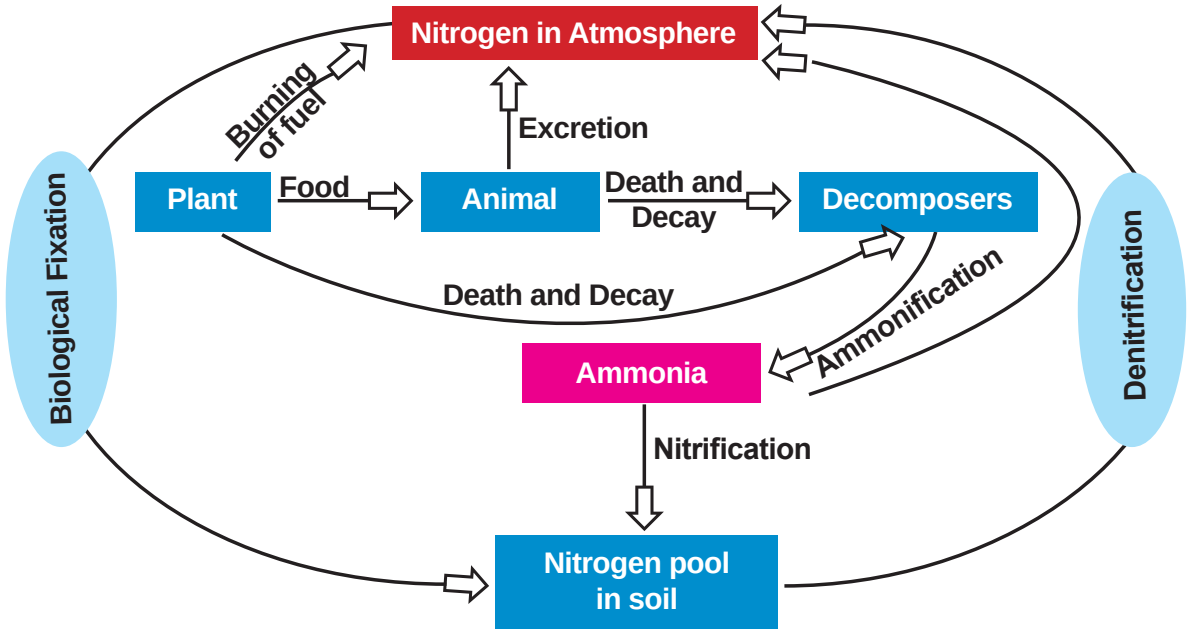
i. Nitrogen fixation

ii. Nitrogen assimilation

iii. Ammonification

iv. Nitrification and

v. Denitrification.



Nitrogen Cycle in Nature

Organisms involved in Nitrogen Cycle

Activity	Name of organism
Nitrogen Fixation	Rhizobium, Azotobacter and Nostoc
Ammonification	Ammonifying bacteria and fungi
Nitrification	Nitrosomonas and Nitrobacter
Denitrification	Pseudomonas

The process of converting nitrogen gas into compounds of ammonia is called nitrogen fixation. Plants cannot use nitrogen directly from the atmosphere. They depend on nitrogen fixing bacteria such as azotobacter, rhizobium and blue green algae like Nostoc that convert gaseous nitrogen into ammonia and nitrates. Nitrogen in the atmosphere is also oxidized by lightning to oxides that dissolve in rainwater and are washed into the soil. Nitrogen fixing bacteria are found in the soil. Some of them are also found in the roots of leguminous plants like peas and beans.

Nitrogen assimilation

The nitrates absorbed by plants are utilized for making organic matter such as proteins and nucleic acids. Plant proteins and other nitrogenous compounds consumed by animals are converted into animal proteins.

Ammonification

Animal proteins are excreted in the form of urea, uric acid or ammonia. When plants and animals die, their proteins are broken down to release ammonia by the action of bacteria and fungi. This process of ammonia formation is called ammonification.

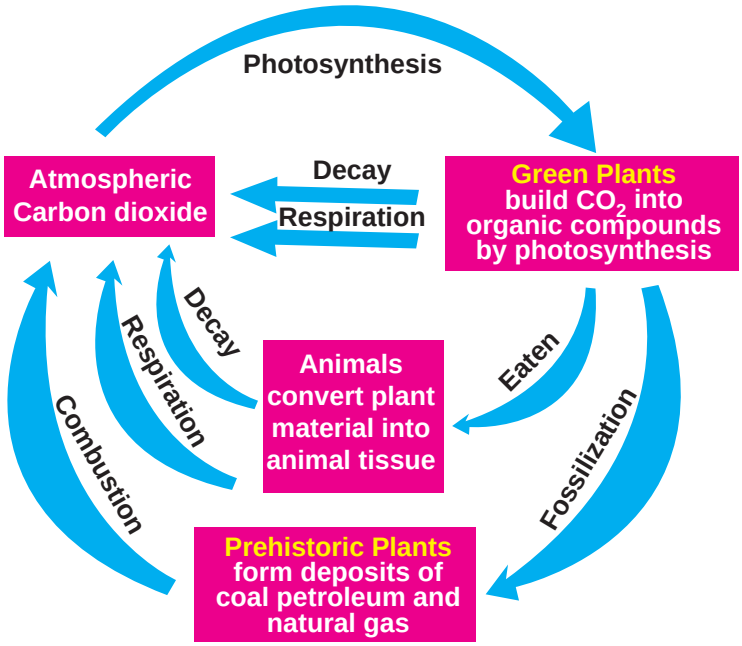
Nitrification

During this process, ammonia is converted into nitrites and nitrates by soil bacteria such as Nitrobacter and Nitrosomonas, which are then absorbed by plants through their roots.

Denitrification

Free living soil bacteria such as Pseudomonas reduce nitrate ions of soil into gaseous nitrogen which returns to the atmosphere.

CARBON CYCLE



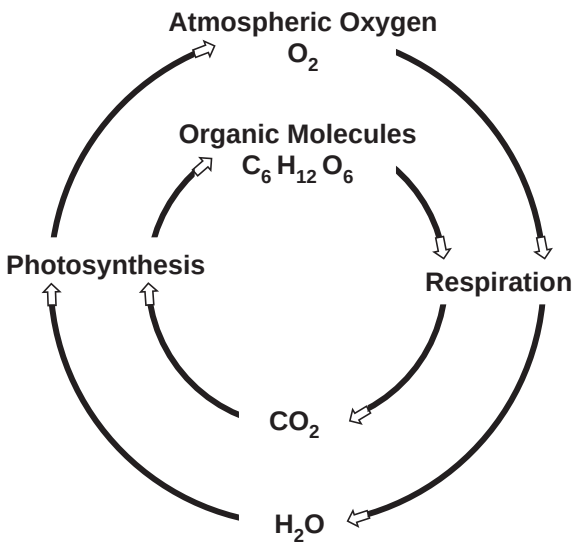
Carbon Cycle

All living organisms are made up of compounds that contain carbon. The three main sources of carbon are: i) CO_2 in the air and CO_2 dissolved in oceans ii) Carbonate rock in the earth's crust iii) Fossil fuels like coal and petroleum. The element carbon moves from the atmospheric reservoir to the producers, to the consumers and then to the decomposers.

The atmospheric carbon dioxide enters into the living world i.e. green plants, through the process of photosynthesis to form carbohydrates (food). Plants are eaten by the herbivores and the carbon is passed to the small and the large carnivores.

Carbon is released back into the atmosphere through respiratory activities at each trophic level. Carbon dioxide is also returned to the atmosphere through decomposition of dead organic materials, burning of fossil fuels and volcanic activities.

OXYGEN CYCLE



Oxygen Cycle

For respiration, oxygen exists as part of water. Oxygen forms about 20% of air in the atmosphere. It enters the living world through respiration. It oxidizes food materials and produces energy. The carbon dioxide that is released in the process is utilized by the plants to produce food materials through photosynthesis and oxygen is libarated back into the atmosphere.

MORE TO KNOW

Without the carbon cycle, carbon would not be recycled, resulting in the inability for living things to survive.

MODEL EVALUATION

Section - A

I. Choose the correct answer:

1. *Oxygen forms about _____ of the air in the atmosphere.*

   a. 20% *b. 30%* *c. 40%* *d. 45%*

2. *The biggest storehouse of water is the _____.*

   a. pond *b. lake* *c. ocean* *d. well*

3. *Plants absorb water from the soil or water reservoir and add it to the atmosphere as vapour by _____.*

   a. Photosynthesis *b. Absorption* *c. Respiration* *d. Transpiration*

4. *Water vapour in the clouds undergoes _____ and comes down as rain.*

   a. Evaporation *b. Condensation* *c. Precipitation* *d. Percolation*

5. *Living organisms require _____ to produce proteins and nucleic acids in their body.*

   a. Oxygen *b. Nitrogen* *c. Carbon* *d. Water*

Section - B

I. Match the following:

1.	*Denitrification*	*a.*	*Fungi*
2.	*Ammonification*	*b.*	*Pseudomonas*
3.	*Nitrogen fixation*	*c.*	*Nitrosomonas*
4.	*Nitrification*	*d.*	*Rhizobium*

II. Define the following :

1. Ecology *2. Environment* *3. Ecosystem* *4. Nitrogen cycle*

5. Nitrification *6. Ammonification* *7. Denitrification* *8. Nitrogen fixation*

9. Condensation *10. Bio-geo chemical cycle*

III. Fill in the blanks:

1. *Grass → _____ → Fox → Tiger (Insect/ Rabbit)*
2. *Animal protein is excreted in the form of _____ (Nucleic acid / Uric acid)*

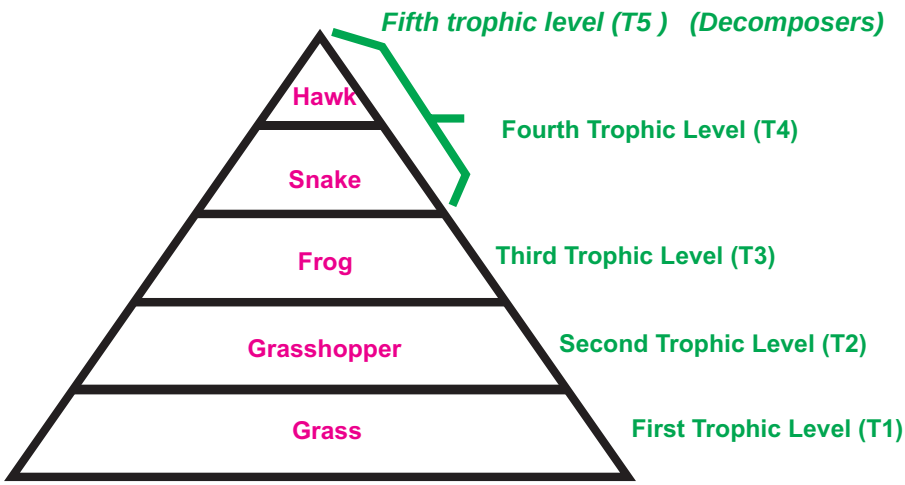
IV. Pick out the odd one and give reason.

1. *Plants, Soil, Water, Air, Light*
2. *Rhizobium, Nitrosomonas, Azotobacter, Nostoc*

V. Answer the following questions:

1. *Leguminous plants improve soil fertility. How?*
2. *What are the various sources of carbon?*
3. *What are decomposers?*
4. *Construct at least two food chains with the organisms given :*

   (lion, tiger, grass, deer, fox, rabbit).
5. *"Carbon is released back into the atmosphere through respiratory activities at each trophic level". Explain in your own words what you understand by the term "trophic level" with the help of the picture given below.*



6. *Why do plants depend on organisms like Nostoc and Rhizobium?*
7. *Plants and animals are interdependent. Do you agree with this statement? Comment.*
8. *Correct the mistakes :*

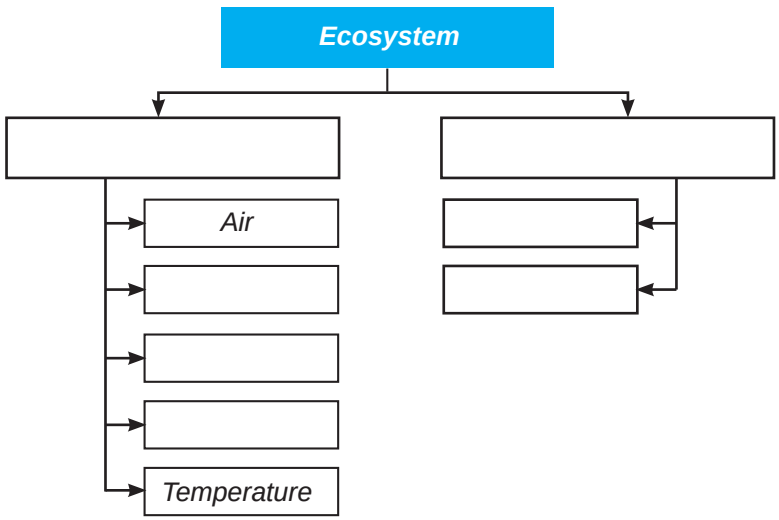
   a. *Green plants require raw materials like chlorophyll, sunlight, water, and oxygen for photosynthesis.*

   b. *The organisms and the physical environment form an ecological complex called habitat.*

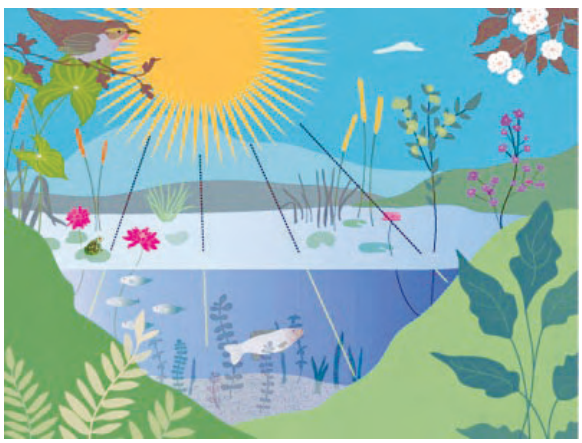
9. *Burning of fossil fuels creates an imbalance in the carbon cycle. Justify.*
10. *Coal and petroleum form a part of carbon cycle. How?*
11. *Depict the circulation of carbon within the different trophic levels of ecosystem.*
    (Producers → Herbivores → Carnivores)
12. *Co_2 and O_2 cycles are interrelated. Justify.*

Section - C

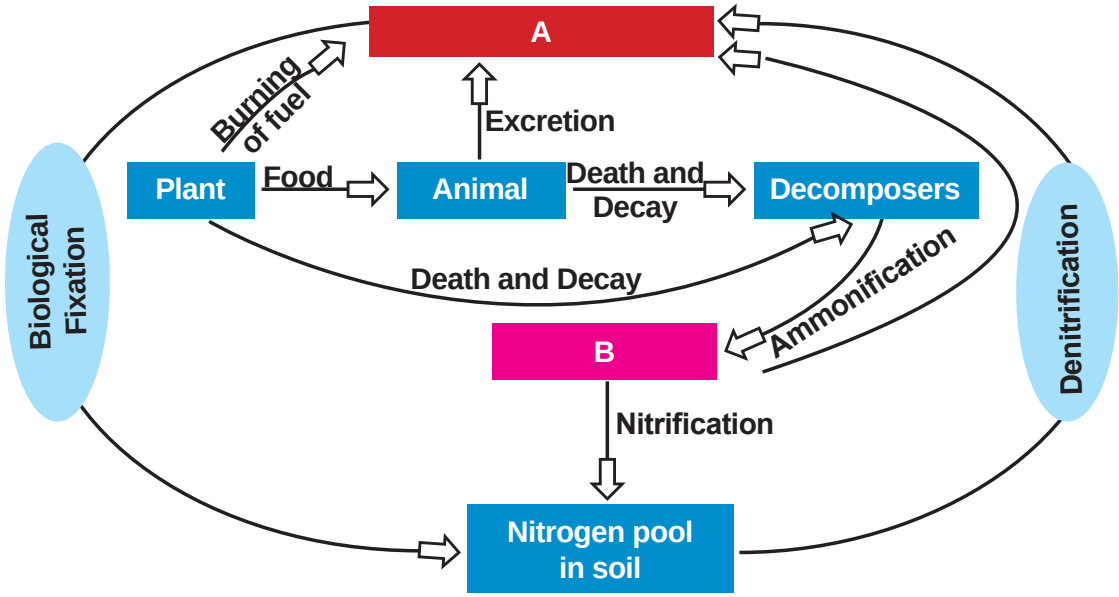
1. *Nitrogen is present in fertilizers. Addition of nitrogen may lead to nutrient imbalance in fruits. Explain how this happens.*
2. *Write the role of transpiration and abiotic factors in the water cycle.*
3. *How is Oxygen recycled? Explain it with a schematic diagram.*
4. *Discuss the role of plants in :*
   a. Nitrogen Cycle b. Carbon Cycle c. Oxygen Cycle
5. *Fill the empty boxes.*



6. *Observe the picture given below and explain the components of ecosystem.*



7. *Draw the given cycle and mark A and B.*



Suggested Activities:

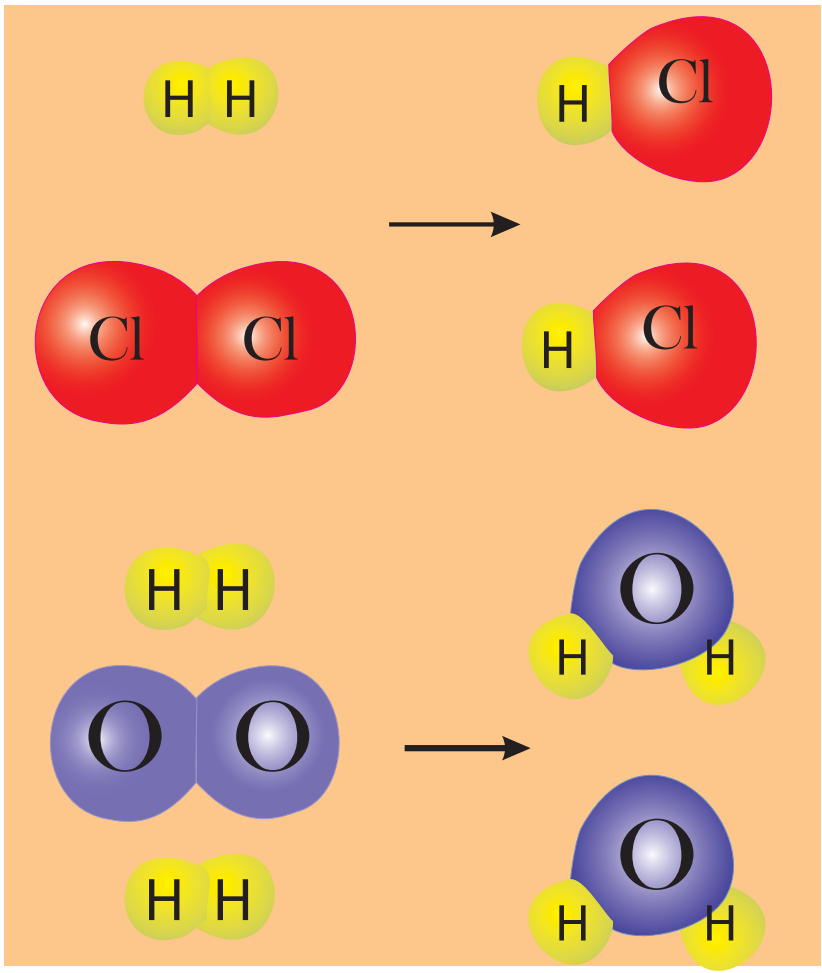
1. *Divide the class into small groups. Ask each group to develop a collage using magazines and newspapers that illustrates the carbon cycle. They should label the sinks, sources and release agents. Each group should present its collage to the class.*
2. *Build a model using an aquarium to depict the movement of water through the water cycle.*
3. *Water is constantly flowing. Where does it go? If Water was a person and wants to tell its story what would it say? "Water – The story of my life".*
4. *Discuss: A thousand years from now, will the Earth contain more water or less than it has now?*
5. *Draw a poster depicting the methods to improve rainfall and to conserve water.*
6. *"As the human population continues to increase, the consequences of human activities continue to threaten our resources. The global biogeochemical cycle has already been significantly altered by this". Create a poster to show its serious consequences.*

FURTHER REFERENCE

Books: Plant Ecology 2008 - Shukla R.S and Chandel P, S.Chand Publishers.

Webliography : http://www.wisegeek.com http://www.ucar.edu

Chapter 4



CHEMICAL EQUATION

- Types of Ions
- Cations and Anions
- Chemical formula
- Writing a chemical formula by crisscross method
- Balancing chemical equations

4. CHEMICAL EQUATION

Plants produce their food (carbohydrate) by a chemical reaction called photosynthesis. The process of photosynthesis requires: (i) carbon dioxide (ii) water (iii) sunlight (iv) chlorophyll. This can be represented by the equation:

$$\text{Carbon dioxide + Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{Carbohydrate + Oxygen} \uparrow$$

Thus, chemical equations summarize information about chemical reactions. To write a chemical equation, you must know the substances that are present before and after the reaction, such as reactants and products.

4.1 TYPES OF IONS

In general, atoms and molecules take part in chemical reactions.

We know that atoms are made up of particles called protons, neutrons and electrons. Protons are positively charged, while electrons are negatively charged. An atom has no net charge. It is said to be electrically neutral, since it has an equal number of protons and electrons.

In chemical reactions, the number of protons in an atom remains unchanged, whereas the number of electrons may increase or decrease. This leads to a difference in the number of protons and electrons giving a net electrical charge to the atom. When an atom acquires a net charge, it is called an ion.

Ions are atoms or group of atoms that carry a net positive or negative charge.

4.1.1 CATIONS

If an atom, which is electrically neutral, loses one or more electrons, it becomes positively charged and is called a cation.

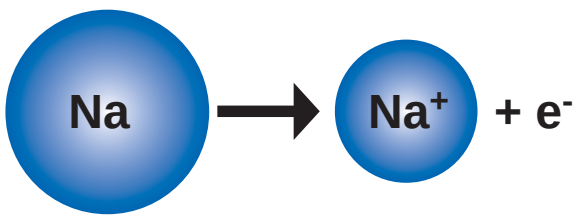
$$\text{Atom} \longrightarrow \text{cation + electron(s)}$$

Typically, when metals are involved in a chemical reaction, they lose electrons to form cations.

Formation of sodium ion from sodium atom

For example, sodium is a metal. The atomic number of sodium is 11. A sodium atom loses one electron and forms a sodium ion.

cation is +ve



Na → Na^+ + e^-

Sodium atom
11 protons &
11 electrons

Sodium ion(cation)
11 protons &
10 electrons

4.1.2 ANIONS

If an atom, which is electrically neutral, gains one or more electrons, it becomes negatively charged and is called an anion.

$$\text{Atom + electron(s)} \longrightarrow \text{Anion}$$

MORE TO KNOW

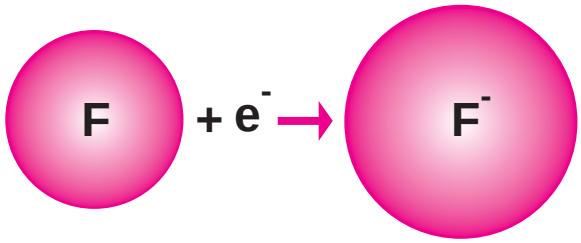
Did you notice that the cation is smaller than the parent atom? This is because the nucleus pulls the electrons towards it, as the number of protons is more than the number of electrons.

Typically, when non-metals are involved in a chemical reaction, they gain electrons to form anions.

Formation of fluoride ion from fluorine atom.

For example, fluorine is a non-metal. The atomic number of fluorine is 9. A fluorine atom gains one electron and forms a fluoride ion.

Fluorine gains one electron



F → F^-

Fluorine atom
9 protons &
9 electrons

Fluoride ion (anion)
9 protons &
10 electrons

MORE TO KNOW

Did you notice that the anion is larger than the parent atom? This is because the number of protons is fewer than that of electrons and thus the nucleus has lesser influence on the valence electrons. The valence electrons move away from the nucleus, which increases the size of an anion.

ACTIVITY 4.1 **I DO**

I shall write the cations and anions present in the following compounds.

1. *Silver nitrite*
2. *Magnesium sulphate*
3. *Aluminium oxide*
4. *Lead nitrate*
5. *Potassium carbonate*
6. *Barium chloride*
7. *Zinc sulphate*
8. *Copper nitrate*

Monoatomic ions

A monoatomic ion is formed from a single atom.

For example, Sodium ion Na^+ is a monoatomic cation and Fluoride ion F^- is a monoatomic anion.

ACTIVITY 4.2 **I DO**

I shall write the formulae of the following monoatomic anions.

1. *Bromide ion*
2. *Chloride ion*
3. *Fluoride ion*
4. *Hydride ion*
5. *Iodide ion*
6. *Oxide ion*
7. *Nitride ion*
8. *Sulphide ion*

MORE TO KNOW

The names of most monoatomic negative ions end with the suffix"-ide".

Polyatomic ions

An ion can also be formed from one or more atoms of different elements. This is called a polyatomic ion. A polyatomic ion exists and behaves as a single unit. It may carry either a positive or a negative charge.

Example: NH_4^+ is Ammonium ion (polyatomic cation)

OH^- is Hydroxide ion (polyatomic anion)

MORE TO KNOW

A molecule formed by the combination or association of two molecules is known as a dimer.

Hg_2^{2+} Mercurous ion exists as a dimer only.

SCIENCE

4.2. IONS AND VALENCY

The valency of an element is the net charge on the ion of that element. For a polyatomic ion, the net charge of the group is its valency.

	Monoatomic ion		Polyatomic ion	
	cation	anion	cation	anion
Monovalent	Na^+	F^-	NH_4^+	OH^-
Divalent	Ca^{2+}	S^{2-}		SO_4^{2-}
Trivalent	Fe^{3+}	N^{3-}		PO_4^{3-}

Monovalent polyatomic ions

Name	Formula
Bisulphate ion	HSO_4^-
Bisulphite ion	HSO_3^-
Chlorate ion	ClO_3^-
Chlorite ion	ClO_2^-
Cyanide ion	CN^-
Hydroxide ion	OH^-
Hypochlorite ion	ClO^-
Nitrate ion	NO_3^-
Nitrite ion	NO_2^-
Perchlorate ion	ClO_4^-
Permanganate ion	MnO_4^-

MORE TO KNOW

Most of the names of polyatomic negative ions end with suffixes "-ite", "-ate".

Bivalent polyatomic ions

Name	Formula
Carbonate ion	CO_3^{2-}
Chromate ion	CrO_4^{2-}
Dichromate ion	$Cr_2O_7^{2-}$
Manganate ion	MnO_4^{2-}
Peroxide ion	O_2^{2-}
Sulphate ion	SO_4^{2-}
Sulphite ion	SO_3^{2-}
Thiosulphate ion	$S_2O_3^{2-}$

Trivalent polyatomic ions

Name	Formula
Borate ion	BO_3^{3-}
Phosphate ion	PO_4^{3-}

Multivalent cations or polyvalent cations

Formula	Name	Formula	Name
Au^{+}	Gold (I) or Aurous	Au^{3+}	Gold (III) or Auric
Ce^{3+}	Cerium (III) or Cerous	Ce^{4+}	Cerium (IV) or Ceric
Co^{2+}	Cobalt (II) or Cobaltous	Co^{3+}	Cobalt (III) or Cobaltic
Cr^{2+}	Chromium (II) or Chromous	Cr^{3+}	Chromium (III) or Chromic
Cu^{+}	Copper (I) or Cuprous	Cu^{2+}	Copper (II) or Cupric
Fe^{2+}	Iron (II) or Ferrous	Fe^{3+}	Iron (III) or Ferric
Mn^{2+}	Manganese (II) or Manganous	Mn^{3+}	Manganese (III) or Manganic
Pb^{2+}	Lead (II) or Plumbous	Pb^{4+}	Lead (IV) or Plumbic
Sn^{2+}	Tin (II) or Stannous	Sn^{4+}	Tin (IV) or Stannic

ACTIVITY 4.3 **I DO**

I shall write the names of the following cations.

(i) Fe^{2+} _____ (ii) Fe^{3+} _____ (iii) Hg_2^{2+} _____ (iv) Hg^{2+} _____

4.3 CHEMICAL FORMULA

A Chemical formula is a symbolic way to represent a compound. To write the chemical formula of a compound, symbols and valencies of constituent elements must be known.

Chemical symbols and valencies

Valency = 1	Valency = 2	Valency = 3	Valency = 4
Bromine (Br) Chlorine (Cl) Fluorine (F) Hydrogen (H) Iodine (I) Lithium (Li) Sodium (Na) Potassium (K)	Barium (Ba) Calcium (Ca) Magnesium (Mg) Oxygen (O) Sulphur (S)	Boron (B) Aluminium (Al)	Carbon (C) Silicon (Si)

4.3.1 WRITING A CHEMICAL FORMULA BY VALENCY CRISS-CROSS METHOD

The chemical formula of a compound is electrically neutral. The charge on the cations and the charge on the anions must be equal. (Remember, the valency can be related to the charge).

The following methods are followed to write a chemical formula.

- The symbols or formulae of the components are written side by side.
- Positive ions are written on the left and negative ions on the right.
- The valencies of ions are written below the respective symbols.
- The criss-cross method is applied to exchange the numerical value of valency of each ion. It is written as subscript of the other ion.

ACTIVITY 4.4 **WE DO**

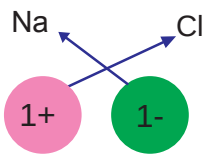
We shall write the chemical formulae of the following compounds.

1. *Sodium hydroxide*
2. *Sodium carbonate*
3. *Calcium hydroxide*
4. *Ammonium sulphate*
5. *Phosphorous trichloride*
6. *Sulphur hexafluoride*
7. *Copper (II) nitrate*
8. *Cobalt (II) chloride*

- For a polyatomic ion, the ion is enclosed within brackets and the subscript is placed outside the lower right corner.
- The common factor is removed.
- If the subscript of the ion is one, it is omitted.

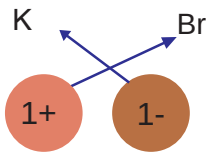
Illustrations

1. Sodium chloride



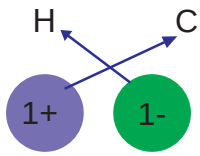
NaCl

2. Potassium bromide



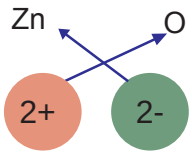
KBr

3. Hydrogen chloride



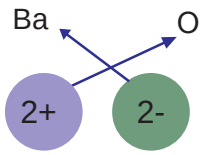
HCl

4. Zinc oxide



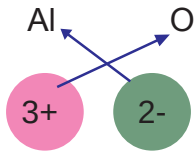
ZnO

5. Barium oxide



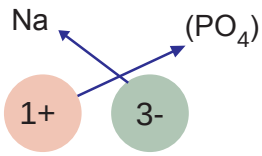
BaO

6. Aluminium oxide



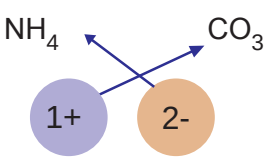
Al_2O_3

7. Sodium phosphate



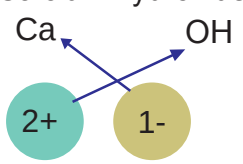
Na_3PO_4

8. Ammonium carbonate



$(NH_4)_2CO_3$

9. Calcium hydroxide



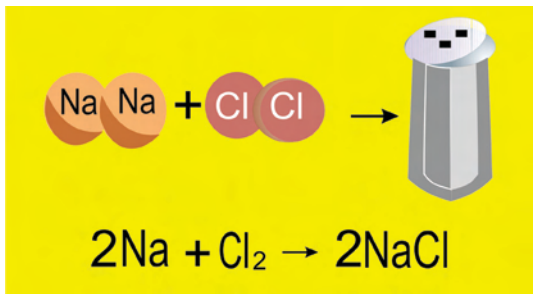
$Ca(OH)_2$

4.4 INTRODUCTION FOR WRITING CHEMICAL EQUATIONS

The symbolic expression of a chemical reaction, using symbols of reactants and products, is called a chemical equation.

Reactant A+ Reactant B ⟶ Product(s)

- Reactants are the starting substances.
- Products are the substances that are formed in a reaction.
- The arrow sign means “react to form”.
- The plus sign means “and”.



Remember the following points while writing a chemical equation:

(i) Nature of reactants and products

The physical state of a substance can be indicated using the following symbols as a subscript:

Physical state	Symbol	Example
solid state	(s)	$NaCl_{(s)}$
liquid state	(l)	$H_2O_{(l)}$
gaseous state	(g)	$O_{2(g)}$
solution in water	(aq)	$NH_{3(aq)}$

The following arrows are used to show the nature of the substances:

(↑) gas is released. Example: $O_{2(g)}\uparrow$

(↓) precipitate is formed. Example: $BaSO_4\downarrow$

MORE TO KNOW

Common Greek Prefixes

Prefix	Number
Mono -	1
Di -	2
Tri -	3
Tetra -	4
Penta -	5
Hexa -	6
Hepta -	7
Octa -	8
Nona -	9
Deca -	10

(ii) Reaction conditions:

Favourable conditions like temperature, pressure, presence of catalyst and light can be indicated above or below the arrow.

Example:

$$4NH_3 + 5O_2 \xrightarrow[Pt]{750^\circ\text{-}900^\circ C} 4NO + 6H_2O$$

(iii) Heat changes:

Some reactions involve heat changes.

Example:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3 + \text{heat}$$

Heat is released. This is an exothermic reaction.

4.5 BALANCING THE CHEMICAL EQUATION

The “Law of conservation of mass” requires that the number of atoms present

SCIENCE

before the reaction (reactants) must be equal to the number of atoms present after the reaction (products). In other words, the equation must be "balanced".

In order to balance an equation:

1. Identify the reactants and the products and write the skeleton equation. For example:

   Reactant A + Reactant B ⟶ Product C + Product D

2. Count the number of atoms on either side. If they are not equal, balance them by adjusting the number of reactants or products.

3. If the coefficients have a common divisor, simplify.

Example 1: Balance the reaction between Sodium and Chlorine.

Skeleton equation:

$$Na + Cl_2 \longrightarrow NaCl$$

Balance Cl atom:

$$Na + Cl_2 \longrightarrow 2NaCl$$

Balance Na atom:

$$2Na + Cl_2 \longrightarrow 2NaCl$$

Example 2: Balance the reaction of Sodium Carbonate with Hydrochloric Acid.

Skeleton equation:

$$Na_2CO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$$

Balance sodium atom:

$$Na_2CO_3 + HCl \longrightarrow 2NaCl + H_2O + CO_2$$

Balance hydrogen, chlorine and oxygen atoms:

$$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$$

Example 3: Balance the reaction of Aluminium Hydroxide with Sulphuric Acid.

Skeleton equation:

$$Al(OH)_3 + H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2O$$

Balance aluminium atom:

$$2\,Al(OH)_3 + H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2O$$

Balance sulphate group:

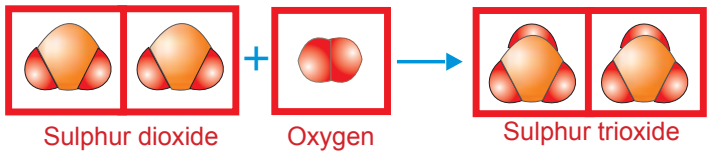
$$2\,Al(OH)_3 + 3\,H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2O$$

Balance hydrogen and oxygen atoms:

$$2\,Al(OH)_3 + 3\,H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6H_2O$$

Illustration : 1

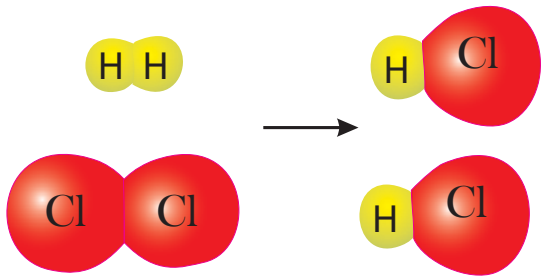
Reaction between Sulphur dioxide and Oxygen to form Sulphur trioxide:



$2SO_2 + O_2 \longrightarrow 2SO_3$

Illustration : 2

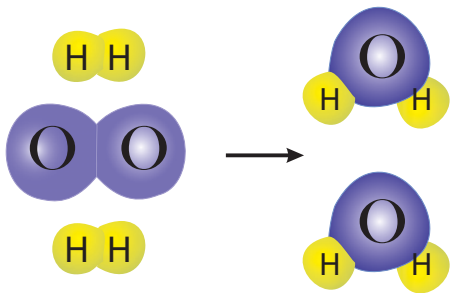
Reaction between Hydrogen and Chlorine to form Hydrogen chloride:



$H_2 + Cl_2 \longrightarrow 2HCl$

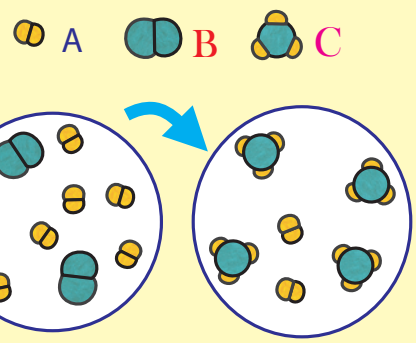
Illustration : 3

Reaction between Hydrogen and Oxygen to form water:



$2H_2 + O_2 \longrightarrow 2H_2O$

ACTIVITY 4.5 **I DO**



From the diagram. I shall write the equation for the reaction between A and B to give product C.

ACTIVITY 4.6 **WE DO**

We shall balance the chemical equations.

1. $N_2 + O_2 \longrightarrow NO$
2. $CaCO_3 + HCl \longrightarrow CaCl_2 + H_2O + CO_2$
3. $Na + H_2O \longrightarrow NaOH + H_2$
4. $KClO_3 \longrightarrow KCl + O_2$
5. $N_2 + H_2 \longrightarrow NH_3$
6. $NH_3 + O_2 \longrightarrow N_2 + H_2O$

SCIENCE

Let's know the occurrence of a natural chemical reaction.

Some chemical reactions take place naturally during lightning. Nitrogen in the atmosphere combine with oxygen to form nitrogendioxide.

$$N_2 + 2O_2 \longrightarrow 2NO_2$$

Oxygen present in the atmosphere is converted to ozone.

$$3O_2 \longrightarrow 2O_3$$

This acidic oxide like nitrogendioxide mixes with tiny droplets of water vapour to produce acid rain which is harmful to plants.

$$4NO_2 + O_2 + 2H_2O \longrightarrow 4HNO_3$$

ACTIVITY 4.7 **WE OBSERVE**

Mix ammonia solution and hydrochloric acid. Observe what happens. Write a balanced chemical equation for the reaction.

ACTIVITY 4.8 **WE OBSERVE**

Mix barium chloride solution and sodium sulphate solution. Observe the reaction. Write a balanced chemical equation for the reaction.

MODEL EVALUATION

Section - A

I. Choose the correct answer:

1. *The atomic number of sodium is 11. Then the number of electrons in sodium ion is _____. (9,10,12)*
2. *While forming Fe, the number of electrons lost by Fe^{2+} ion is _____. (2,3,0)*
3. *Identify the polyatomic ion . _____. (Cl^- , O^{2-} , Na^+ , NH_4^+)*
4. *Select the monoatomic anion. _____. (CN^- , PO_4^{3-} , I^- , NO_2^-)*

5. An ion is produced as a result of gain or loss of electrons by an atom. In Au^{3+} ion, 3 electrons are _____. *(gained, lost)*
6. Identify the anion from $KClO_3$ _____. *(Cl^-,O^{2-},ClO_3^-)*
7. The molecular formula of ferric oxide is _____. *(FeO,Fe_2O,Fe_2O_3)*
8. Acid rain is due to the formation of _____.*(ozone, nitric acid, carbon dioxide)*
9. Cations carry _____ charge *(positive, negative, neutral)*
10. Anions are formed due to gain of electrons by _____.*(metals, non-metals, noble gases)*
11. As the valencies of lead are 2,4, the charge carried by plumbic ion is _____.*(+1,+2,+3,+4)*
12. When sulphur becomes sulphide ion ,it _____ two electrons. *(loses, gains)*
13. The valency of phosphorous is five, then the molecular formula of oxide of phosphorous is _____.*(PO_5 , P_2O_5 , P_5O_2)*
14. An example for molecular diagram is  _____.*(CO_2,H_2O,SO_3,CO_2)*
15. The harmful substance to the plants is_____.*(urea, HNO_3,Co_2)*

II. Fill in the blanks:

1. The total number of atoms present in CO_3^{2-} is_____.
2. If a monovalent polyatomic ion contains one hydrogen atom, one sulphur atom, and three oxygen atoms, then its name is _____ion.
3. A molecule formed by combination or association of three molecules of the same substance is known as _____.
4. The net charge on the ion of an element is called as _____of that element.
5. The size of anion is _____ than that of the parent atom.
6. The valency of sulphur in sulphur hexa fluoride is _____.
7. The molecular formula of potassium dichromate is _____.
8. Reactions, involving liberation of heat, are called. _____.
9. In polyatomic ions,NH_4^+ is an example of _____ion.
10. A polyatomic ion exists and behaves as a _____.
11. The formation of an ion is due to _____.
12. An element has six electrons in its outermost shell, then its valency is _____.
13. The process by which plants produce their food is _____.
14. The size of cation is smaller than its parent atom. This is due to _____.

15. The suffix used to express monoatomic negative ion is _____.

16. The chemicals required during photosynthesis are _____.

17. A cation carries positive charge due to _____.

18. An ion carries the charge of X^{3-}, then the number of electrons in its valence shell is _____.

Section - B

I. Answer the following:

1. $Na \longrightarrow Na^+ + e^-$

   $Cl + e^- \longrightarrow Cl^-$

   a) Is sodium a metal or a non-metal?

   b) Write the name of Cl^- ion.

2. A compound is formed by the combination of cations and anions. What are the cations and anions present in the following compounds?

   a) K_2CO_3 b) $BaCl_2$

3. Match the following:

Cl^-	-	polyatomic anion
Cr^{2+}	-	monoatomic anion
NH_4^+	-	monoatomic cation
PO_4^{3-}	-	polyatomic cation

4. Name the cations and anions present in the following compounds.

   a) $MgSO_4$ b) KNO_3

5. Pick the odd one out

   a) NO_3^- , NO_2^- , MnO_4^- , Cl^-

   b) $BaCl_2$, $NaNO_3$,$MgSO_4$,CuO (based on the charge of the cation)

6. Identify the valency of element X in the following compounds.

   a) XH_3 b) XCl_5

   c) X_2O_3 d) XO_2

7. Classify the following into monovalent, divalent and trivalent ions.

   a) Ammonium b) Oxide c) Nitride

8. The element 'B' is trivalent. Write the formulae of its:

   a) Oxide b) Chloride

9. Write all possible chemical formulae for the following ions.

   Cu^{2+}, Fe^{2+},SO_4^{2-},Cl^-

10. Fill in the blanks:

a) During lightning, the oxygen present in the atmosphere is converted into_____?

b) $N_2 + 2O_2 \longrightarrow$ _____?

11. Correct the following statements:

a) The valency cannot be related to the charge.

b) A polyatomic ion can be formed from two or more atoms of same elements.

12. Identify and correct the mistakes in the following sentences: While balancing a chemical equation,

a) change the formulae wherever necessary.

b) use the upward arrow mark (↑) if the product formed is a precipitate.

13. Pick out the polyatomic anions from the following and write the formula.

a) Chloride ion b) Fluoride ion

c) Phosphate ion d) Sulphate ion

14. The atomic number of fluorine is 9. Explain the formation of fluoride ion.

15. The valency of Zn is 2. and the valency of Oxygen is also 2. Construct the formula for zinc oxide by using these hints.

16. The formula of Aluminium oxide is Al_2O_3. Find the valencies of Aluminium and Oxygen.

17. Correct the statements:

i) The positive ions are written on the right and the negative ions on the left.

ii) For a monoatomic ion, the net change of the group is its valency.

18. Complete the table:

S.No	Formula of the ion	Polyatomic ion	Name of the ion
1.	CO_3^{2-}	tetraatomic	Carbonate ion
2.	MnO_4^-		
3.	HSO_4^-		
4.	O_2^{2-}		
5.	ClO^-		

19. Classify the following as mono, di, tri and tetravalent cations:

i) Stannic ii) Ferrous iii) Cobaltic iv) Aurous

20. Give reasons:

a) In the formation of ammonia, heat is released.

b) Cyanide ion is a polyatomic ion

21. Aluminium reacts with sulphuric acid to form Aluminium sulphate. Answer the following

i) Write the molecular formula of Aluminium sulphate.

ii) What is the charge carried by sulphate ion?

22. Supply the missing details:

	Molecular formula	Name of the compound
a)	$SiCl_4$	
b)	HgO	
c)	$Fe(OH)_2$	
d)	$Cr_2(SO_4)_3$	

23. Identify the cations and the anions in the following compounds:

i) Auric chloride ii) Ammonium sulphite

iii) Potassium permanganate iv) Sodium thiosulphate

24. Differentiate polyvalent ion from polyatomic ion.

25. An atom is electrically neutral. Give reasons.

26. Explain why magnesium forms Mg^{2+} ion.

27. Give the equation for Photosynthesis.

28. In an equation, what do the symbols "aq" and "↓" signify?

29. Give the balanced equations for the following:

i) Reaction that takes place during lightning.

ii) In the atmosphere, oxygen is converted into ozone.

iii) Reaction involved in the formation of acid rain.

30. Match the following:

A	B
Potassium chromate	H_2O_2
Hydrogen peroxide	$Mg_3(PO_4)_2$
Magnesium Phosphate	K_2CrO_4

31. The metal strontium forms ions with the symbol Sr^{2+}. Write down the formula for each of the following :-

i) Strontium oxide ii) Strontium chloride iii) Strontium nitrate iv) Strontium sulphate

32. Pb^{2+} N_2 B PH_3 Ag I^-

a) From the list above, select two

i) atoms ii) molecules iii) ions

b) Name the compound formed from Pb^{2+} and I^- ions and write a formula for it.

33. Classify the cations and anions

(i) nitride ion (ii) stannous ion (iii) ferric ion (iv) hydroxide ion

34. A chemical formula of a compound is electrically neutral. Give reason.

35. Reactants are the substances that are present before any chemical reaction takes place.

$2Fe + 3Cl_2 \longrightarrow 2FeCl_3$. Name the reactants of this chemical equation

36. Construct the formula of the following compounds using crisscrossing valency.

(a) Calcium hydroxide (b) Ammonium carbonate

(c) Zinc oxide (d) Aluminium oxide

37. The valency of sodium is 1. The valency of chlorine is 1.Write the formula of sodium chloride.

38. The number of atoms of the reactants and the products of various elements on both sides are equal in a balanced chemical equation. Balance the following equation.

$HNO_3 \longrightarrow H_2O + NO_2 + O_2$

Section – C

1.Balance the following equations:

1. $MnO_2 + HCl \longrightarrow MnCl_2 + Cl_2 + H_2O$
2. $NH_4Cl + Ca(OH)_2 \longrightarrow NH_3 + CaCl_2 + H_2O$
3. $BaCl_2 + Al_2(SO_4)_3 \longrightarrow BaSO_4 + AlCl_3$
4. $NaAlO_2 + H_2O + CO_2 \longrightarrow Al(OH)_3 + Na_2CO_3$
5. $NH_3 + O_2 \longrightarrow NO + H_2O$
6. $Zn + HNO_3 \longrightarrow Zn(NO_3)_2 + NO_2 + H_2O$
7. $H_2S + O_2 \longrightarrow H_2O + SO_2$
8. $PbO + C \longrightarrow Pb + CO_2$
9. $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + HCl$
10. $CH_4 + O_2 \longrightarrow CO_2 + H_2O$

2. Complete the table:

Ions	Phosphate	Chlorate	Bisulphate
Na^+	_____	$NaClO_3$	_____
Mg^{2+}	$Mg_3(PO_4)_2$	_____	_____
Al^{3+}.	$AlPO_4$	_____	$Al(HSO_4)_3$

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3. Complete the below table:

For magnesium it is solved and shown the formulae, in the same way do for the rest of the metal.

	Chloride	Sulphate	Oxide	Phosphate
Magnesium	$MgCl_2$	$MgSO_4$	MgO	$Mg_3(PO_4)_2$
Sodium				
Aluminium				
Iron(II)				

4. Name the following:

i) An element which loses electron to form cation

ii) An element which gains electron to from anion

iii) The ion formed by the loss of an electron

iv) The ion formed by gain of an electron from its neutral atom

v) Ion(s) involved during the formation of ionic compounds

5. Ramu has an element X with an Atomic Number of 13, while somu has an element Y with an Atomic Number of 16. If Ramu and Somu mix those elements and heat it, a new compound of Z is formed.

Keeping this mindy and answer the following question.

i) Write the electronic configuration of X.

ii) Write the electronic configuration of Y.

iii) Which one is a metal and which is a non metal?

iv) What is the valency of X?

v) What is the valency of Y?

vi) Write the formula of Z.

6. Car battery contains sulphuric acid. Swati has taken this acid using a dropper and placed it in the bottle shown in the adjoining diagram. The bottle has some aluminium foil. After the addition of acid, a colourless gas is evolved which is collected by placing a balloon around the mouth of the bottle.

Answer the following now:

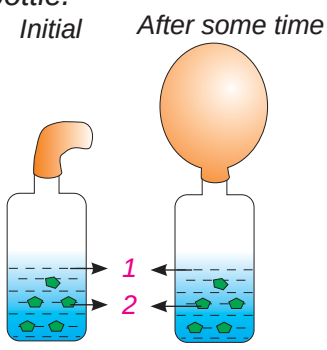
i) Aluminium is a _____.

ii) The formula of Sulphuric acid is_____.

iii) The formula of Aluminium Sulphate is_____.

iv) The chemical reaction is given below in word equation: Now write the same using symbols.

Aluminium + Sulphuric acid ⟶ Aluminium Sulphate + Hydrogen gas



1. Dilute sulphuric acid

2. Aluminium foil

7. *Baking soda mainly contains sodium bicarbonate. When this is treated with dilute hydrochloric acid, the following reaction occurs.*

   $NaHCO_3 + HCl \longrightarrow NaCl + CO_2 \uparrow + H_2O$

   Answer the questions below.

   i) What is the valency of the sodium ion?

   ii) What is the valency of the bicarbonate ion?

   iii) Is the chloride ion monovalent or divalent?

   iv) What do the symbols ⟶ and ↑ imply in the reaction.

   v) If one more H^+ ion is removed from bicarbonate ion gives carbonate ion. Write the formula of the carbonate radical.

   vi) The bicarbonate ion is _____ anion.(Monoatomic / Polyatomic)

   vii) Name the products formed in the above reaction.

   viii) Identify the cation and the anion in the formula of Sodium chloride.

   ix) What is the difference between sodium and sodium ion.

   x) State the law which must be fulfilled, while balancing the chemical equation.

8. *Given below are word equations. Convert them into chemical equations using symbols and valencies. Balance the equations. Use appropriate signs for gases and precipitates in the reaction.*

   i) Zinc Sulphide + Oxygen gas ⟶ Zinc oxide solid + Sulphur dioxide gas

   ii) Silver nitrate solution + Sodium chloride solution ⟶ Silver chloride precipitate + Sodium nitrate solution

   iii) Sulphur solid + Concentrated nitric acid ⟶ Sulphuric acid + Nitrogen dioxide gas + Water

   iv) Barium chloride Solution + Potassium sulphate Solution ⟶ Barium sulphate Precipitate + Potassium chloride solution

   v) Silver nitrate on heating ⟶ silver metal + nitrogen dioxide gas + Oxygen gas.

   vi) Aluminium hydroxide + Nitric acid ⟶ Aluminium nitrate + Water.

9. *From the given list of cations and anions, write atleast 10 compounds each with its formula and name:*

Cations	Anions
NH_4^+	ClO_3^{1-}
Pb^{2+}	SO_3^{2-}
Fe^{3+}	CrO_4^{2-}
K^+	HSO_4^{1-}

Formula	Name	Formula	Name
1. _____	_____	6. _____	_____
2. _____	_____	7. _____	_____
3. _____	_____	8. _____	_____
4. _____	_____	9. _____	_____
5. _____	_____	10. _____	_____

10. MSO_4 is the formula of sulphate of metal M. Write down the formula of its :

i) hydroxide ii) chlorite iii) chloride iv) nitrate

v) nitrite vi) peroxide vii) chromate viii) phosphate.

11. Find the valency of each element mentioned in the following substances:

i) Aluminium in $Al_2(SO_4)_3$ ii) Lead in PbO_2 iii) Calcium in CaO

iv) Nickel in $NiCO_3$ v) Barium in $BaSO_3$ vi) Iron in $FeCl_2$

vii) Iron in $FeCl_3$ viii) Gold in $AuCl_3$ ix) Cobalt in $Co(NO_3)_3$

x) Tin in $Sn(SO_4)_2$

12. Balance the following equations:

i) $CaCO_3 + HCl \longrightarrow CaCl_2 + CO_2\uparrow + H_2O$

ii) $Na + H_2O \longrightarrow NaOH + H_2\uparrow$

iii) $(NH_4)_2 SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + NH_3\uparrow + H_2O$

iv) $Hg(NO_3)_2 \longrightarrow Hg + NO_2\uparrow + O_2\uparrow$

v) $Pb_3O_4 + HCl \longrightarrow PbCl_2 + Cl_2\uparrow + H_2O$

13. An atom is composed of three subatomic particles namely protons, electrons and neutrons.

Answer the questions based on the above information.

i) The subatomic particle which remains unchanged during the chemical reaction is / are _____

ii) The subatomic particle which increases or decreases in an atom during the reaction is / are _____

iii) Generally, atoms are electrically _____.

FURTHER REFERENCE

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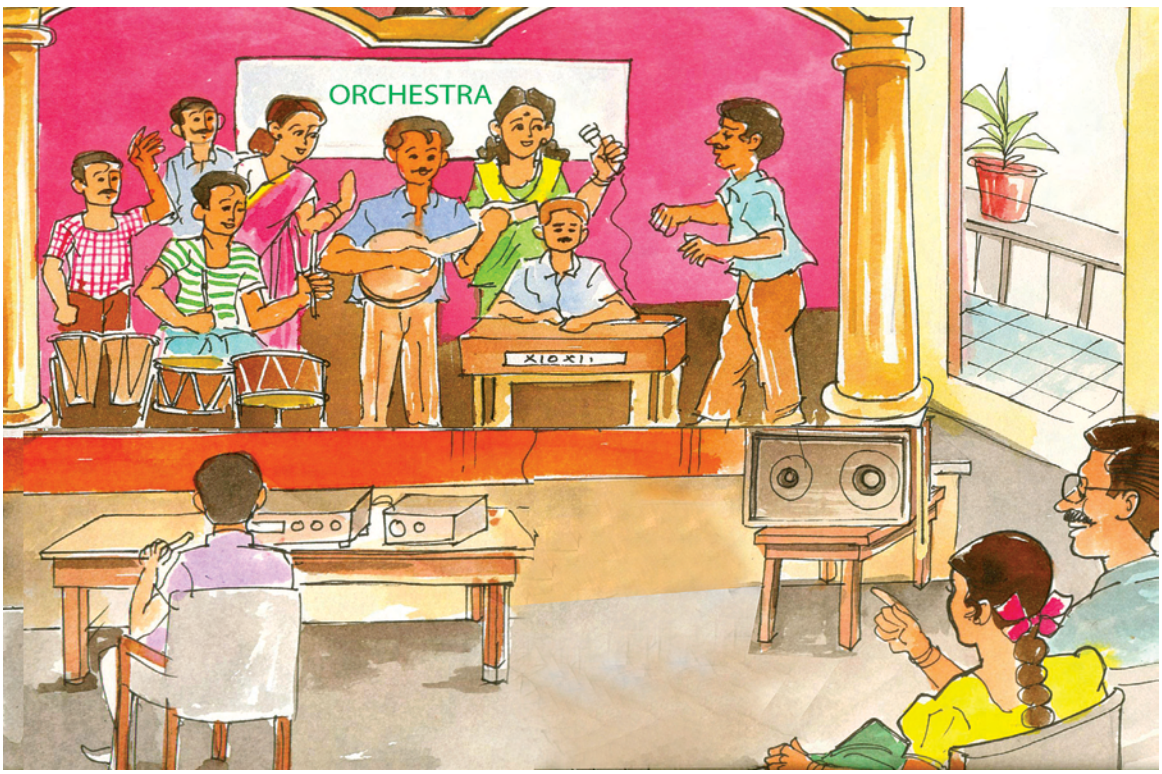
Webliography: http://www.visionlearning.com
http://www.chymist.com

Chapter 5

SOUND

- Importance of sound
- Production and propagation of sound waves
- More about propagation of sound waves
- Characteristics and types of waves
- Reflection of sound waves
- Range of hearing
- Application of ultrasound
- Doppler effect

SOUND



Meena and her parents went to attend a wedding reception. She saw the members of the orchestra adjusting their instruments by plucking, tapping, striking etc., before the music programme began. Meena asked her father. What they were doing and why they were doing it. Her father explained that the musicians were 'tuning' their instruments; that is, adjusting the pitch of their instruments in order to produce synchronized and melodious sound effect. The sounds they produce are related to the vibrations that are created by the musical instruments. Let us help Meena understand more about sound, what it means to 'tune' instruments and what vibrations are we talking about.

5.1 SIGNIFICANCE OF SOUND

Sound has great importance in our daily life.

- Sound makes it possible for us to communicate with one another through speech. It enables us to share our thoughts and ideas with others.
- Musical sound gives us pleasure.
- Sounds from radio and television give us information and entertainment.
- Horn sounds (honking of vehicles) alert us and keep us safe on the road.

ACTIVITY 5.1 **I DO**

Pluck the string of the Veena or the Guitar. Rub the Violin string by drawing the bow across it. Observe the vibrating string and listen to the sound.

Veena

Violin

Guitar

ACTIVITY 5.2 **I DO**

(i) Ring the bell / set the alarm clock and hear the sound.

(ii) Strike a drum with its stick, observe the vibrating skin and listen to the sound.

Bell

Drums

Alarm Clock

ACTIVITY 5.3 **I DO**

(i) Blow a whistle.

(ii) Press the horn bellow and listen to the sound.

Whistle

Horn

5.2 PRODUCTION AND PROPAGATION OF SOUND WAVES

From the above activities, we understand that by plucking, striking, rubbing and blowing we can produce sounds. Scratching and shaking different objects are other ways of producing sounds.

- All these activities set the objects vibrating. Vibrations are “repeated small to and fro motion of objects”.
- These vibrations disturb the air particles close to the vibrating object, which in turn pass it on to other particles.
- Each to and fro movement causes a disturbance of air particles so that the continuously vibrating body causes a series of disturbances. The series of disturbances move through the atmosphere from the source in different directions. The series of

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disturbances travelling through the atmosphere are called sound waves.

- When these sound waves enter the ear of the listener, it sets the tympanic membrane in the ear vibrating, causing a sensation of sound in our ears.

Therefore, remember, sound waves are created by vibrating bodies and sound is a sensation 'heard' by the listener.

ACTIVITY 5.4 **I DO**

Make a list of all the sounds you can think of and fit them into their families.

Sl. No.	*Being Rubbed*	*Being blown*	*Being Plucked*	*Being Struck*
1.	*Violin*	*Whistle*	*Guitar*	*Drums*
2.				
3.				
4.				

5.3 MORE ABOUT PROPAGATION OF SOUND WAVES

Sound waves can travel through liquids, solids as well as gases. The substance (solid, liquid or gas) through which the sound waves travel is called a medium. Sound waves need a material medium to propagate; they cannot travel through vacuum.

Robert Boyle, the scientist, proved that sound waves cannot pass through vacuum or empty space. He kept an electric bell inside a glass container, as shown in fig 5.1. He sucked the air slowly from the container using a vacuum pump. The volume of sound gradually decreased and no sound was heard, when the air was removed completely. By pumping the air back into the container the sound was once again heard.

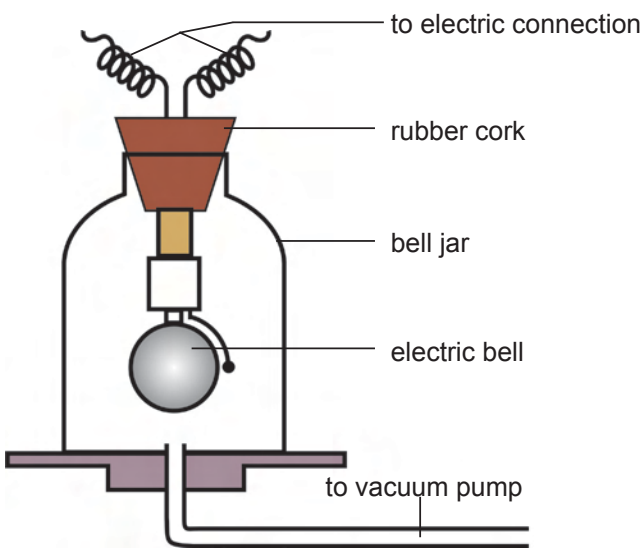


Fig. 5.1.Electric bell in jar

ACTIVITY 5.5 **I DO**

Throw a stone into a wide vessel or bucket of still water. The stone will create a disturbance, when it strikes the surface of the water. Observe how the disturbance, spreads out from the point of origin and travels outward in the form of circles (ripples) as shown in the figure. Sound too travels in a similar manner through the atmosphere in the form of waves. There is however, a difference between the manner in which waves travel in water and the way sound waves travel in air. We shall learn about this in this chapter later.

5.4 CHARACTERISTICS AND TYPES OF WAVES

In general, a wave is a series of disturbances that move through a medium. The particles of the medium do not move from the source to the destination, but the disturbance alone is carried from the source to the destination.

Waves that require a material medium to propagate, such as sound waves, are referred to as mechanical waves. Mechanical waves are of two kinds - longitudinal waves and transverse waves. Some waves such as electromagnetic waves do not require a medium to propagate and can travel through vacuum. Radio waves are an example of electromagnetic waves. You will learn more about this in higher classes.

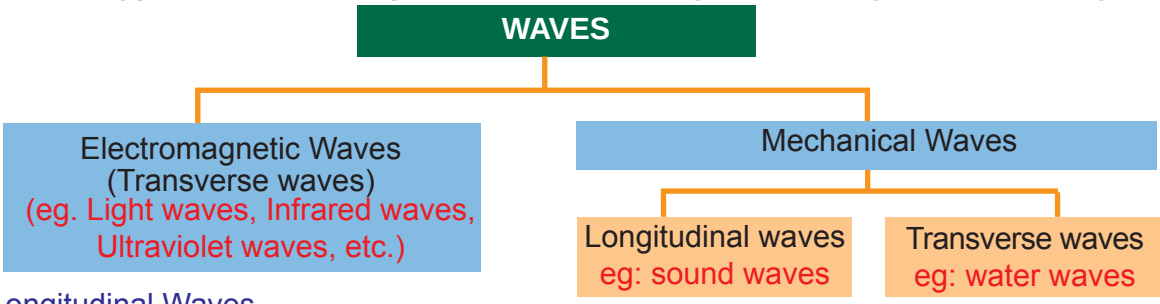
ACTIVITY 5.6 **WE DO**

Divide the whole class into two groups, one group will do the activity and the other group will observe the activity. The groups can later change roles so that both the groups will get their turn to observe. Get all the students of one group to stand in a line. Keep some objects in a basket or tray by the side of the first person in the line.

Let the first person in the line pass all the objects, one at a time to the person next to him or her. The second person in turn has to pass it on to the third and so on till all the objects are passed to the last person, who places all of them in another basket or tray in that end. Now imagine that each student standing in the line is a particle belonging to the medium. Also imagine that, each object being passed is a disturbance.

You will notice the "disturbance" being passed on from the source (basket/tray) to the destination (basket / tray) but no "particle" physically moves from the source (basket / tray) to the destination (basket / tray). This is exactly how a series of disturbances (called a wave) travels in a medium.

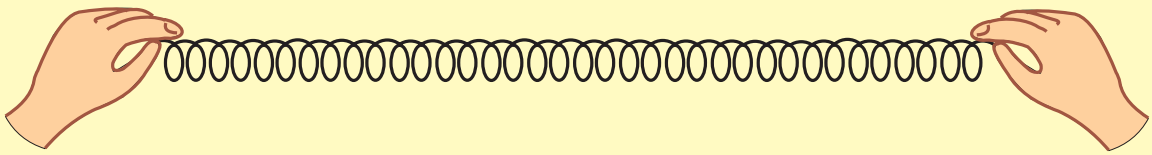
The types of waves are presented in this diagram for easy understanding.



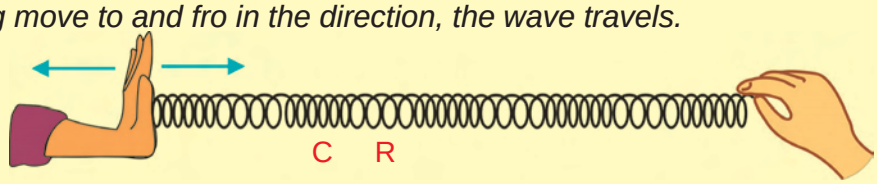
Longitudinal Waves

ACTIVITY 5.7 **WE DO**

Take a spring. Hold one end of it and ask your friend to hold the other end. Stretch the spring as shown in the figure. Note that the coils of the spring are evenly spaced.

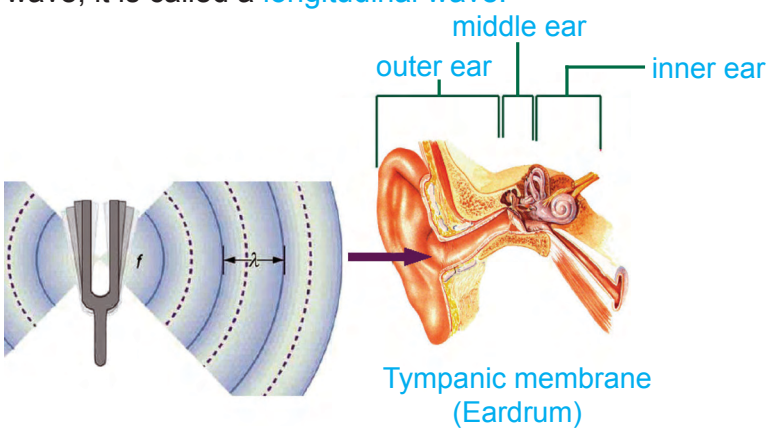


Press your end of the spring for a very short distance towards your friend and then release it. This movement of contraction and expansion must be quick and repeated. You will observe that, the disturbances caused by this movement travel through the spring in the form of compressions and rarefactions as shown in the figure below. Compression is an area where the coils of the spring are close together and rarefaction is an area where the coils of the spring are farther apart. Note that the individual coils of the spring move to and fro in the direction, the wave travels.



C – Compression R - Rarefaction

"If the particles of a medium vibrate in a direction, parallel to or along the direction of the propagation of wave, it is called a longitudinal wave."



Sound waves travel in the form of longitudinal waves through gases.

Longitudinal waves propagate in a medium in the form of compressions and rarefactions as shown in fig. 5.2.

Compression is the area with maximum pressure, rarefaction is the area with minimum pressure.

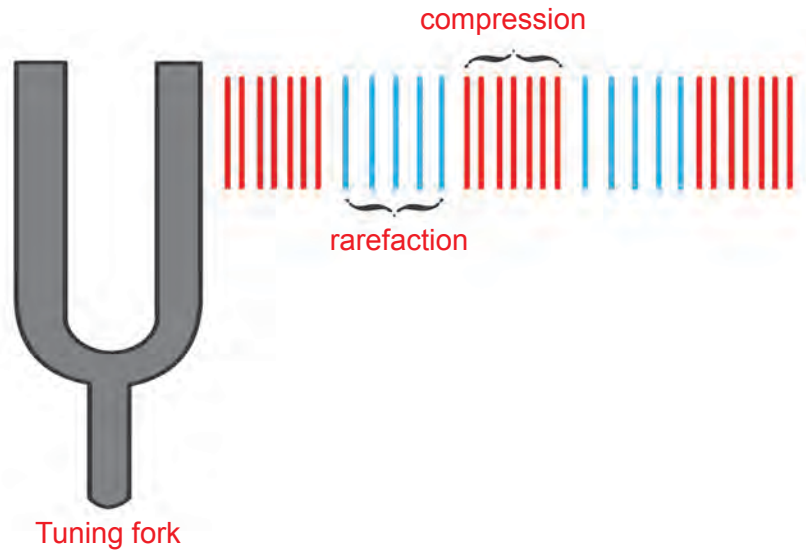
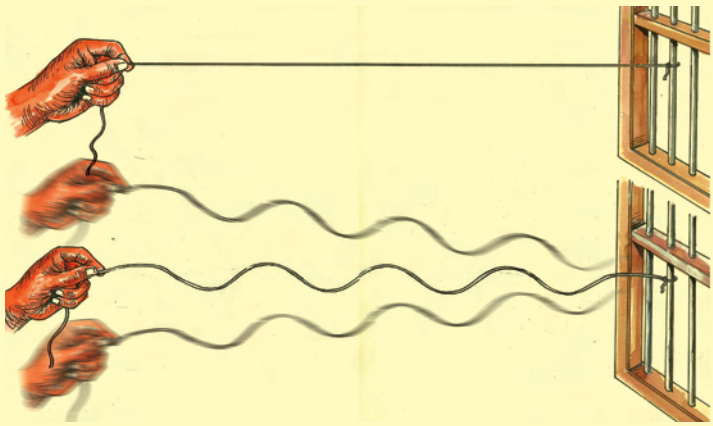


Fig. 5.2. Longitudinal waves

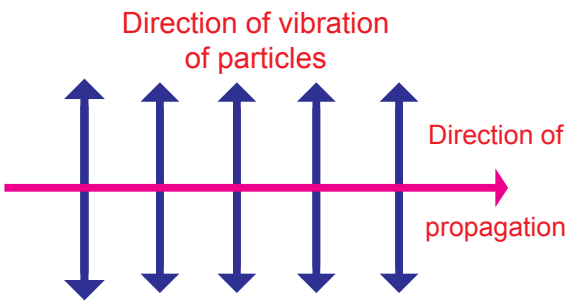
Transverse waves

ACTIVITY 5.8 **I DO**

Stretch a long rope with one end tied fixedly and hold the other end firmly. Move your hand up and down rapidly. You can see the up and down movements travelling along the rope and forming a wave as shown in the figure. Note that, every point on the rope travels up and down while the wave moves forward.



"If the particles of the medium vibrate in a direction, perpendicular to the direction of propagation, the wave is called a transverse wave."



Examples of transverse waves are water waves and the vibration of stretched strings.

Transverse waves propagate in a medium in the form of crests and troughs as shown in fig 5.3.

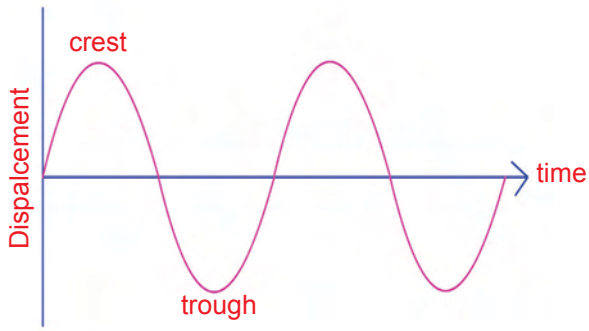


Fig 5.3. Transverse waves

Difference between Transverse and Longitudinal waves

Transverse waves	*Longitudinal waves*
Particles of the medium vibrate in a direction which is perpendicular to the direction of propagation.	*Particles of the medium vibrate in a direction which is parallel to the direction of propagation.*
Crests and troughs are formed.	*Compressions and rarefactions are formed.*
Can travel through solids and surfaces of liquids.	*Can travel through solids, liquids and gases.*
eg. Water waves	*eg. Sound waves.*

Definitions of some terms used in relation to waves:

Amplitude (a): The maximum displacement of a particle from the mean position is called amplitude. Its unit is metre.

Time period (T) : Time taken by a particle of the medium to complete one vibration is called Time period. Its unit is second.

Frequency (n) : The number of vibrations completed by a particle in one second is called frequency . Its unit is hertz.

$$n = \frac{1}{T}$$

Wave Length (λ) : Distance moved by a wave during the time a particle completes one vibration. Its unit is metre.

Relation between Velocity of a wave, wavelength and Frequency

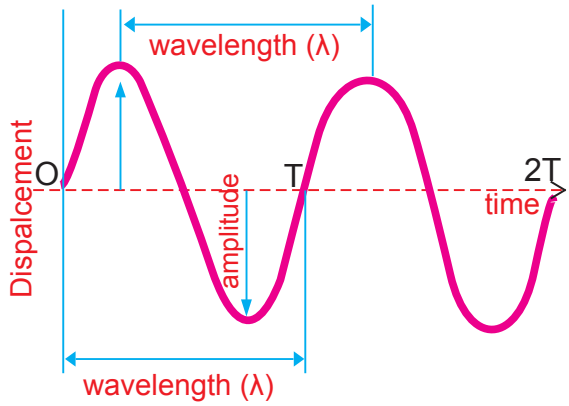
Distance travelled by a wave in one Time period, T = λ (wavelength)

$$\text{Velocity, } V = \frac{\text{Distance}}{\text{Time}} = \frac{\lambda}{T}$$

$$\text{but Frequency } n = \frac{1}{T}$$

$$\therefore \quad v = n\lambda$$

Velocity = frequency x wavelength



MORE TO KNOW

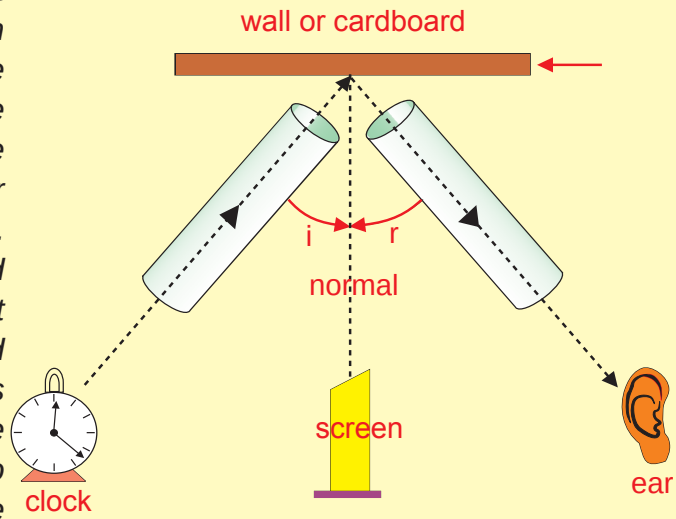
Sound travels almost five times faster through water and twenty times faster through iron than it travels in air. Speed of light ($3x10^8$m/s) is even faster than the speed of sound (340 m/s). This is why? Lightning flash is seen first and thunder sound (created by the lightning) is heard much later during thunderstorms.

MORE TO KNOW

When we say we tune instruments, we mean that we adjust the instruments to have the same frequency or an exact multiple of it.

ACTIVITY 5.9 **I DO**

Make two identical pipes out of any waste paper. Arrange them pointing towards a wall or a large cardboard sheet as shown in the diagram. At the end of the left side pipe place an alarm clock. Put your ear to the end of the right side pipe. Place a screen between the clock and your ear. Adjust the angle of the right side pipe ('r') till the ticking sound heard through the pipe reaches its maximum volume. Measure angle 'r'. It will be approximately equal to angle 'i'. From this activity, we realise that, sound too can be reflected like that of light and it obeys the laws of reflection.



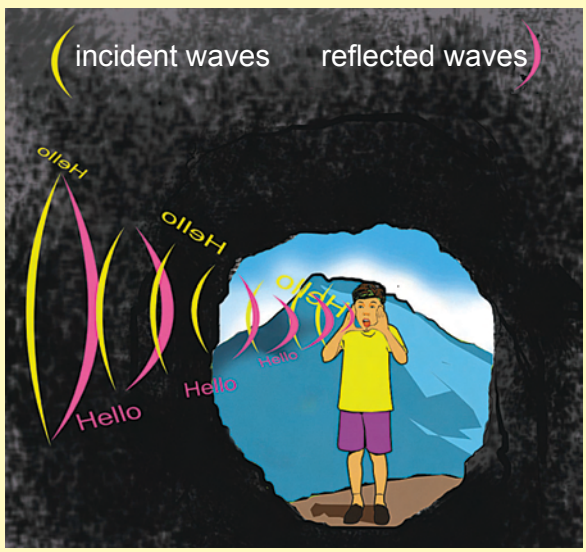
5.5 REFLECTION OF SOUND WAVES

5.5.1 Echo

Sound waves can be reflected from large surfaces such as large walls of a building, sides of a hill or the walls of a cave. When reflected sound waves reach the ear, it can be heard distinctly after the original sound has stopped. This is called an Echo. The sensation of sound persists in our brain for about 1/10th of a second. If the reflected sound wave reaches the ear in less than 1/10th of a second, the brain cannot make out the difference between the original sound and the echo. If the reflected sound wave reaches the ear after 1/10th of a second, then a distinct echo can be heard.

ACTIVITY 5.10

When you go inside a cave, a tunnel or a subway and shout, you can hear your own voice again , a moment later. The repetition of sound heard, after the original sound has died is called an echo.



SCIENCE

Given that, sound waves travel at about 340 m/s at a temperature of 15°C, sound waves must travel about 34m, if it is to be heard as an echo. Therefore, to hear a distinct echo, the surface reflecting the sound should be at least 17 meters away.

Distance = velocity X time

= 340 X 1/10

= 34 m.(17 m going and 17 m returning)

5.5.2 Reverberation

Echoes may be heard more than once due to successive or multiple reflections. The rolling of thunder is due to the successive reflections of the sound waves from a number of reflecting surfaces, such as clouds and lands. A sound wave created in a big hall will persist due to repeated reflections from the walls, until it is no longer audible.

The repeated reflections that result in the persistence of sound, often referred to as 'rolling sound' is called reverberation.

In auditoriums, big halls, theatres and audio recording theatres, excessive reverberation is highly undesirable, as it will not be possible to enjoy the music or hear the speeches clearly. To reduce reverberation, the roofs and walls of auditoriums are generally covered with sound absorbing materials like compressed fibreboard, rough plaster or draperies. The seat materials are also selected on the basis of their sound absorbing properties, so that very little sound is reflected.

Audio recording theatre

5.6 RANGE OF HEARING

Human beings can hear sound waves of frequencies ranging from 20 Hz to 20,000 Hz. This range of frequencies, sensed by the human ear is known as the audible range of sound. (one Hz= one cycle/second)

Sound waves of frequencies above 20,000 Hz are known as ultrasonic (the prefix 'ultra' is used to indicate 'higher'.) 'Ultrasonic' therefore, means frequencies higher than those heard by human beings. Sound waves of frequencies below 20Hz are called infrasonic (the prefix 'infra' is used to indicate 'lesser than'). Thus 'infrasonic' means frequencies lesser than those heard by human beings. Certain animals can produce and detect ultrasonic and infrasonic frequencies.

Heinrich Rudolf Hertz (1857 - 94)

Hertz, a German scientist, gave the first experimental proof of the existence of radio waves. He did research on the evaporation of liquids. He had a keen interest in meteorology also. The frequency of sound, which used to be measured in cycles/second was changed to hertz (Hz), in honour of Heinrich Hertz.

Audible range of sound for humans and certain animals

Human

20 - 20,000 Hertz

Bat

1000 - 1,50,000 Hertz

Elephant

16 - 12,000 Hertz

Dolphins

70 -1,50,000 Hertz

Cow

16- 40,000 Hertz

Seal

900 – 2,00,000 Hertz

Cat

100 - 32,000 Hertz

Dog

40 - 46,000 Hertz

Rabbit

1000 - 1,00,000 Hertz

5.7 APPLICATIONS OF ULTRASOUND

5.7.1 SONAR (SOund Navigation And Ranging)

The word "SONAR" is an acronym for "SOund, Navigation And Ranging". A sonar consists of transmitter, detector, and display. The transmitter produces and transmits pulses of ultrasonic waves. These waves travel through water and after striking some underwater object such as the seabed or a shoal of fish, get reflected and are received by the detector. If the speed of sound in water is approximately 1440 metres per second, the time lapse between the transmitted signal and the received echo can be measured and the distance to the object can be calculated.

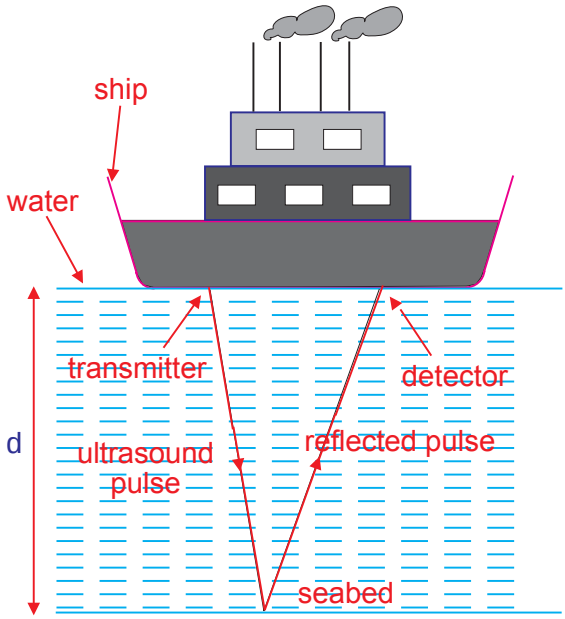


Fig 5.4. Ultrasound sent by the transmitter and received by the detector

Example: Let us assume that the time interval between the transmitted pulse and the reflected pulse is 3 seconds and that the speed of sound in water is 1440 m/s then, the distance to the object would be:

$$\frac{(1440 \text{ m/s} \times 3 \text{ seconds})}{2} = 2160 \text{ m}$$

This method of finding the distance is called Echo Ranging. It is used to determine the depth of the sea and to locate underwater objects, submarines, icebergs, sunken ships etc.

5.7.2 ULTRA SONOGRAPHY

'Ultrasonic waves' can be used to visualize inner organs of the human body. Pulses of ultrasonic waves are passed through parts of the body, which get reflected by organs. When several pulses are sent and received, it is possible to build a picture of the object reflecting the wave pulses. This is called ultrasonography and is used to visualize different organs, especially the human foetus inside the

uterus before the baby is born. Doctors can monitor the condition of the baby by looking at the ultrasonographic image. The

picture of a medical professional carrying out an ultrasonic scan and an image of the baby in the uterus are shown here.

5.8 DOPPLER EFFECT

When you stand on a railway platform and listen to a train engine blow its whistle you will notice that the sound is shriller and higher pitched, when the train approaches. (When the term 'higher pitched' is used, it implies that the frequency is higher). When the train moves away from your position, the same whistle will sound less shrill and lower pitched (When the term 'lower pitched' is used, it implies that the frequency is lower). Have you ever wondered why this happens?

Christian Johann Doppler (1803 – 53)

Christian Andreas Doppler was born on November 29, 1803, in Salzburg, Austria. After his death, he was referred to as Christian Johann Doppler for some reason.

In 1842, Doppler published the paper "Concerning the Coloured Light of Double Stars", which contained his first statement describing the Doppler Effect. He theorized that since the pitch of sound from a moving source varies for a stationary observer, the colour of light from a star should alter, according to the star's velocity relative to the Earth. Christian Doppler died on March 17.

Doppler was the first to explain this phenomenon and hence, it has been named after him as the Doppler Effect.

If an observer is situated at a fixed distance from a sound source, the frequency of sound heard by him/her is the same as that produced by the source. But if there is relative motion between the source of sound and the observer, the frequency of the sound appears to be changed to the observer. When the source approaches the observer, the frequency seems higher than that produced and when the source moves away from the observer, the frequency seems lower than the frequency produced.

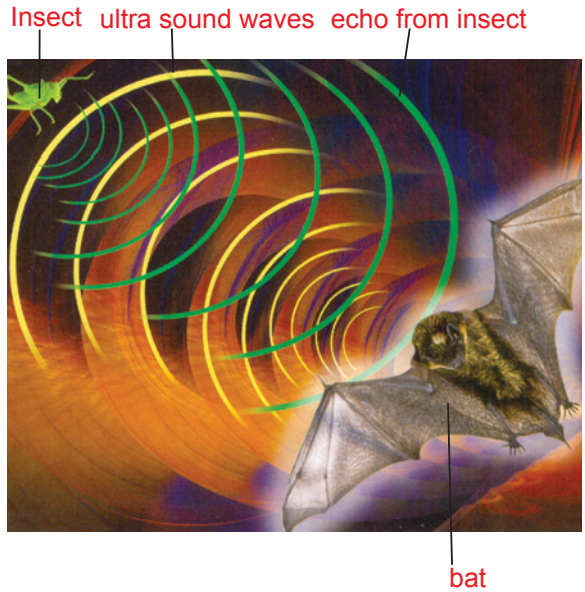
Uses of Doppler Effect in Sound

We studied that by measuring the time delay between a transmitted pulse and the reflected pulse, we can estimate the distance of the object reflecting the sound. By measuring the change in the frequency of the transmitted pulse and the reflected pulse, it is possible to estimate the velocity of the object reflecting the pulse. This is called Doppler Processing. Doppler Processing is used in SONAR to find the velocity of the object reflecting the transmitted pulse.

Bats send out and receive the ultrasonic waves reflected by the prey and obstacles. Bats therefore can not only detect the location, but can accurately predict the movement of the prey by the Doppler shift in frequency.

In airports, Doppler shift is used to distinguish the echoes received from the moving aircraft from the echoes received from stationary objects and to accurately find the height, speed and distance of approaching aircrafts.

Traffic control vehicles direct microwaves on speeding vehicles. From the Doppler shift in frequency, the speed of a vehicle is accurately calculated.



SCIENCE

MODEL EVALUATION

Section – A

I. Fill in the blanks, selecting answers from the options given:

1. The principle on which a stethoscope works is _____ .
   (reflection, multiple reflection)
2. In a transverse mechanical wave, the particles of the medium vibrate in a direction _____to the direction in which the wave travels.
   (parallel, perpendicular)
3. Wave velocity= frequency X _____
   (amplitude, time period, wavelength)
4. The time taken by a particle of the medium to complete one vibration is called_____. (time period, frequency, wavelength)
5. The sensation of sound persists in the human brain for about _____ of a second.
   ($1/100^{th}$, $1/1000^{th}$, $1/10^{th}$)
6. Bats send out and receive _____ waves reflected by the prey and other obstacles.
   (supersonic, infrasonic, ultrasonic)
7. The SI unit of amplitude is _____ (hertz, metre, second)
8. A sound wave is travelling from East – West in air. The air molecules move along in the _____ direction.
   (North – south, East – west, East – south)

II. Match the following:

a) ripples on the surface of water	-	longitudinal waves
b) light waves	-	hertz
c) sound waves	-	electromagnetic transverse waves
d) frequency	-	metre
e) wavelength	-	mechanical transverse

III. Find the odd one out:

1. From the following instruments pick the odd one out on the basis of how sound is produced.

Mouth organ

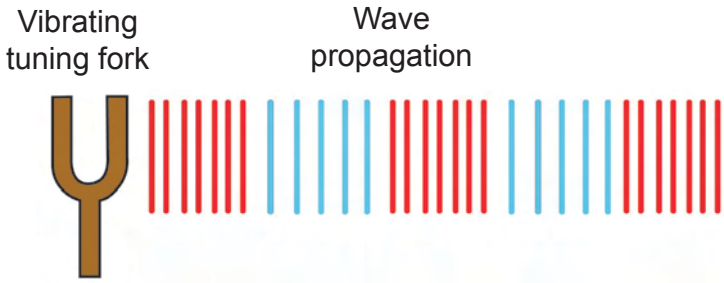
Veena

Flute

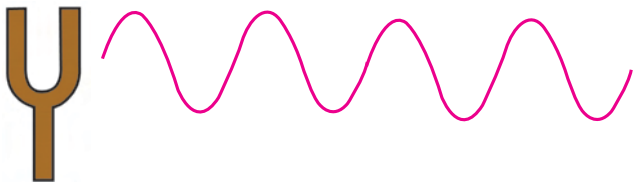
Clarinet

2. *Study the type of waves shown in the diagrams below and select the one that represents how sound is propagated through air.*

a)



b)



3. *Find the odd one out based on their audible range*

Elephant

Bat

Dolphin

Rabbit

4. *From the graph given below, express the distance travelled and the time taken by the wave between the following points in terms of ' λ ' and ' T ' respectively.*

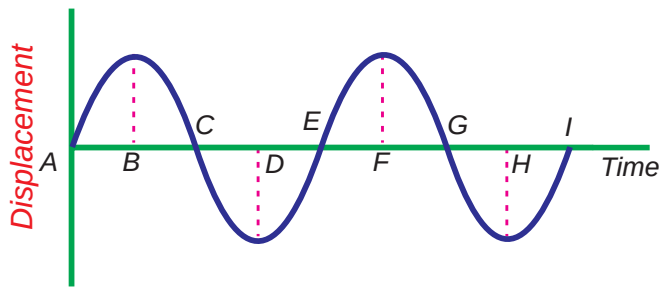
a) Between A and E

b) Between C and E

c) Between B and F

d) Between D and E

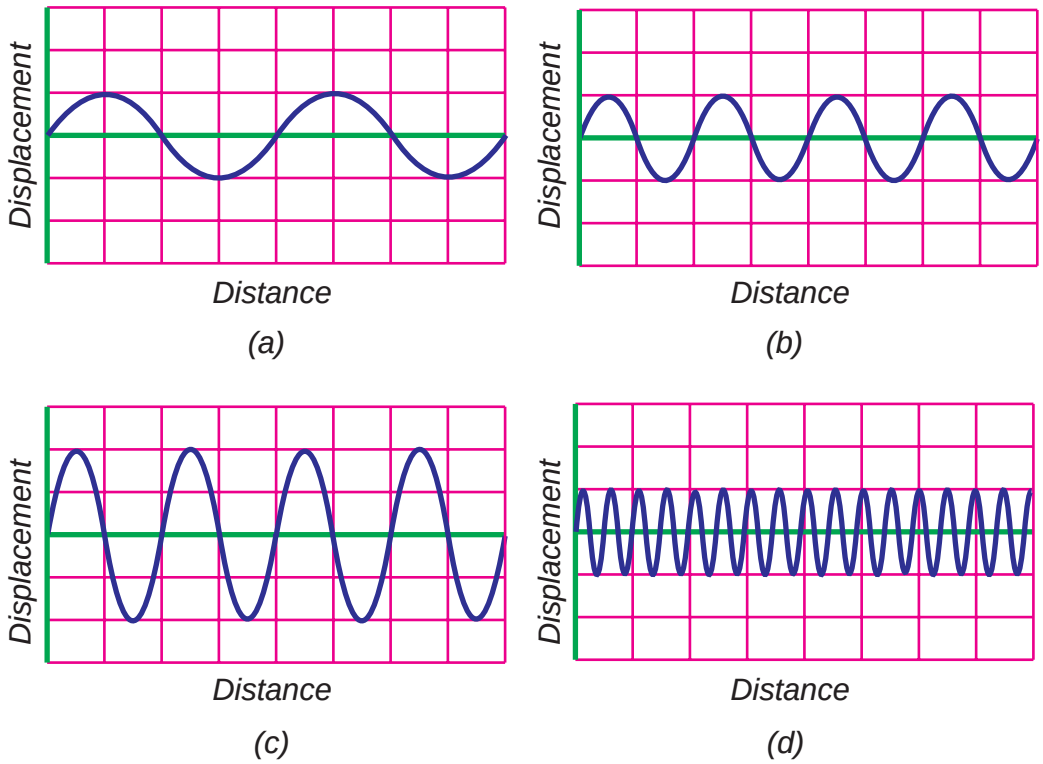
e) Between E and H



5. a. Out of the following waveforms, which has the highest

(i) wavelength (ii) frequency (iii) amplitude (iv) pitch

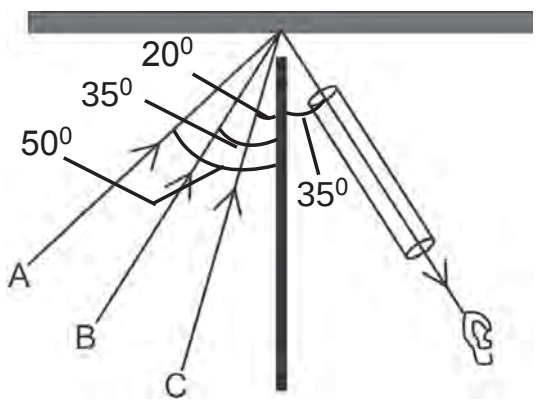
b. Give reason for your answer.



Section – B

1. a. In which of the given positions A, B or C, should an alarm clock be placed, so that the maximum sound can be heard by the observer?

b. Give reasons for your answer.



2. A sound wave whose frequency is 220 Hz has a speed of 440 ms^{-1} in a given medium. Find the wavelength of the sound.

3. *Define Amplitude.*

4. *Why do we see the lightning a few seconds before we hear the thunder?*

5. *The echo of our voice is not heard in our living room, but it is heard distinctly in a big hall. Why it is so?*

6. *In an auditorium or a cinema hall, the roof and walls are covered with draperies or compressed fibreboard. Why?*

7. *Can we hear the explosions that take place on the surface of the moon? Why?*

8. *If you place your ear close to an iron railing which is tapped some distance away, you will hear the sound twice, Can you explain why this happens?*

9. *The time interval between a lightning flash and the first sound of thunder was found to be 5 s. If the speed of sound in air is 330 ms^{-1}, find the distance of the flash from the observer.*

10. *The heart of a man beats 75 times a minute. What is its frequency and time period?*

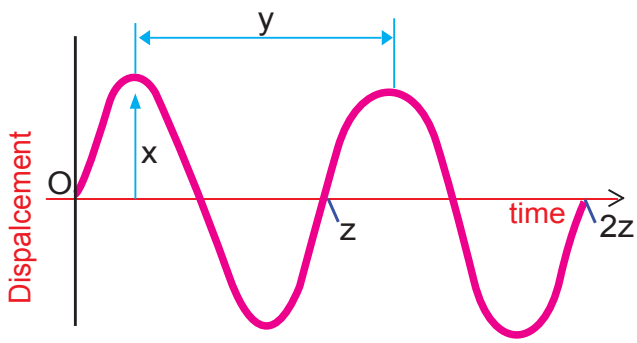
11. *Mention the type of waves produced in the air and the wire when the wire of a guitar is plucked. Support your answer with a suitable reason.*

Section – C

1. *The following figure represents a sound wave.*

   a. *Draw and mark the name of the variables x, y and z.*

   b. *Write the expression for velocity of a wave using the above variables.*



   c. *Write any two differences between the transverse and the longitudinal waves.*

2. *How do bats locate their prey? Explain in detail.*

3. *Derive the relation between the velocity of wave, wavelength and frequency.*

4. *"Sound waves cannot pass through vacuum or empty space". Describe an experiment to Illustrate the above statement.*

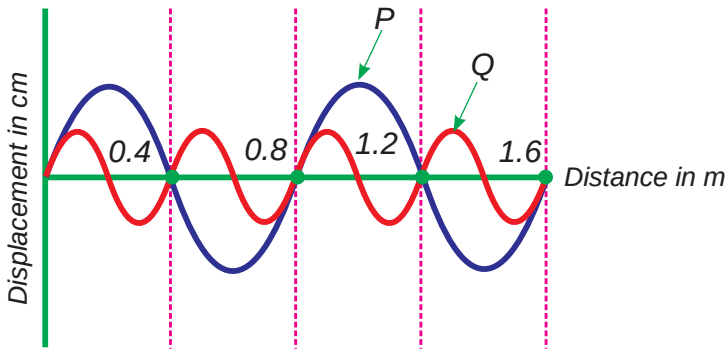
5. *The sound of an explosion taken place on the surface of a lake was heard by a boatman who was 100m away from the point of explosion and a diver who was 100m below the point of explosion.*

   (i) Who would have heard the sound first the boatman or the diver? why?

(ii) If the sound takes 't' seconds to reach the boatman, how much time will it take to reach the diver approximately?

6. The following diagram represents, two sound waves P and Q, travelling in the same direction. If the frequency of P is 512 Hz, then find the :

(i) frequency of Q (ii) velocities of P and Q



7. A disturbance is created on the surface of water, which has a small cork floating on the surface.

(i) Describe the motion of the cork.

(ii) Name the kind of wave produced in water.

(iii) Is it possible to have the same kind of wave in air?

8. A man stands between two cliffs and fires a gun. He hears two successive echoes after 3s and 5s. Find the distance between the two cliffs?

9. Explain how the speed of a vehicle is measured by a traffic control vehicle.

10. A boat is fitted with an echo-sounder, which uses ultrasound with a frequency of 40 KHz.

(i) What is the frequency of the ultrasound in Hz?

(ii) If ultrasound pulses take 0.03 s to travel from the boat to the seabed and return, how deep is the water under the boat.

(iii) What is the wavelength of ultrasound in water?

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PRACTICALS

LIST OF PRACTICALS

S.No.	Name of the Experiment	Aim of the Experiment	Apparatus/ Materials required	Time
1	Pollen Grain	To dust the pollen grains on the slide and observe under the dissection (simple) microscope. Draw and label the parts	flowers, dissection (simple) microscope, glass slide and needle	40 minutes
2	Purity of Milk	To measure the strength (purity of milk) by using lactometer	milk, lactometer	40 minutes
3	Preparation of saturated, unsaturated and supersaturated solutions	To prepare solutions of different concentrations like unsaturated, saturated and supersaturated solutions	100 ml beakers, distilled water, sodium chloride	40 minutes
4	Studying the characteristics of metals	To determine the relative strengths (electropositive characters) of given metals	test tube Lead , Zinc and Copper, Pb $(NO_3)_2$ $ZnSO_4$, $CuSO_4$	40 minutes
5	Finding the relation between length and time period of a simple pendulum	To find the period of oscillation and proving (l/T^2) is a constant	simple pendulum apparatus (stand, bob, twine, split cork), stopwatch	40 minutes

1. TO OBSERVE THE POLLEN GRAINS

Aim:

To dust the pollen grains on the slide and observe under the dissection (simple) microscope. Draw and label the parts.

Materials Required:

Flowers, dissection (simple) microscope, glass slide and needle.

Procedure:

a. Collect the pollen grains from a given flower.

b. With the help of a needle, place the pollen grains on the slide.

c. Observe the slide under a microscope.

Observation:

a. It is a single celled structure.

b. It has two layers. The outer exine is spiny and the inner intine is thin and smooth.

c. It contains a single nucleus and cytoplasm.

Draw the structure of the pollen grain as observed through microscope. Label the parts Exine, Intine, Cytoplasm and Nucleus.

2. TO FIND OUT THE PURITY OF MILK

Aim:

To find out the strength (purity) of milk by using a lactometer.

Requirements:

Milk, lactometer.

Principle:

100ml of milk is taken in a beaker. The meter bulb is dipped into the beaker. The bulb just sinks and then begins to float. The reading on the meter _____indicates the purity of milk.

Observation:

If the bulb sinks deeper, it indicates that the milk contains more water and if the reading is at mark, it shows that the milk is very rich and pure.

Sl.No	Milk	Water	Lactometer reading
1	100 ml	Nil	
2	100 ml	10ml	
3	100 ml	20ml	
4	100 ml	30ml	

Result: Thus the lactometer is used to find out the strength (purity) of the milk.

3. TO PREPARE UNSATURATED, SATURATED AND SUPER SATURATED SOLUTIONS

Aim:

To prepare solutions of different concentrations like ***unsaturated, saturated*** and ***supersaturated*** solutions.

Required Materials:

100 ml beakers, distilled water, sodium chloride

Principle:

- A solution which can dissolve more of the solute at a given temperature is known as an ***unsaturated solution.***
- A solution which cannot dissolve any more of the solute is known as a ***saturated solution.***
- A solution which contains much greater quantity of the solute that can be normally present in the saturated solution is known as a ***supersaturated solution.***

Procedure:

Take about 25 ml of distilled water in a 100 ml beaker. Add about 2g of ***sodium chloride*** to it and stir well. The salt dissolves completely. Now note the nature of the solution obtained.

Repeat the addition of salt to the above solution, till some of the added salt remains at the bottom of the beaker. Now note the nature of the solution.

Add more and more quantity of salt to the above solution. Heat the solution for few minutes to dissolve the salt. Now stop heating and allow it to settle. Observe the separation of crystals of the salt. Note the nature of the solution.

Tabulation:

Sl. No.	Name of salt added	Weight of salt added	Volume of water	Nature / Concentration of Solution

Report:

The solutions obtained are classified as _____, _____ and _____ solutions.

4. TO STUDY THE CHARACTERISTICS OF METALS

Aim:

To determine the relative strength (electropositive characters) of the given metals.

Principle:

The relative strength of metals can be determined by the precipitation of one metal by another.

Chemicals required:

- Small pieces of ***copper***, ***lead*** and ***zinc***
- Solutions of ***lead nitrate***, ***copper sulphate*** and ***zinc sulphate.***

Procedure:

Trial 1: Take about 5ml each of ***lead nitrate*** and ***zinc sulphate*** in two separate test tubes. Add pieces of ***copper*** to both the tubes and observe the changes and record. (No chemical change occurs in both the tubes).

Tabulation:

Sl. No.	Solutions taken	Metal added	Observation

Trial 2 : Take about 5ml each of ***copper sulphate*** and ***zinc sulphate*** solutions in two separate test tubes. Add pieces of ***lead*** to both the tubes and observe the changes. (lead reacts with copper sulphate and not with zinc sulphate).

Tabulation:

Sl. No.	Solutions taken	Metal added	Observation

Trial 3 : Take about 5ml each of ***copper sulphate*** and ***lead nitrate*** solutions in two separate test tubes. Add pieces of ***zinc*** to both the tubes and observe the changes. (Zinc reacts with both copper sulphate and lead nitrate).

Tabulation:

Sl. No.	Solutions taken	Metal added	Observation

Report:

The order of the relative strength of the metals are____ >____ >____.

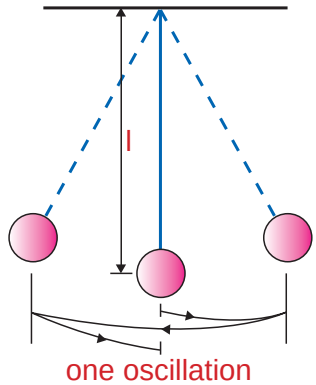
5. FINDING THE RELATION BETWEEN LENGTH AND TIME PERIOD OF SIMPLE PENDULUM

Aim:

To find the period of oscillation of a simple pendulum and to prove that l/T^2 is a constant.

Apparatus required:

Simple pendulum apparatus, stopwatch.



Formula:

l/T^2 is a constant

where, l is the length of the simple pendulum (m)

T is the period of oscillation of the simple pendulum (s)

Procedure:

- Suspend the simple pendulum for a length of 70cm.
- Make the pendulum oscillate with small amplitude.
- When the pendulum crosses the mean position towards the right, start a stop watch and count zero.
- When it crosses the mean position towards the right next time, count one.
- Like this, count up to twenty and stop the stopwatch.
- Find the time taken for 20 oscillations and record in the tabulation.
- Repeat the experiment by changing the length to 80cm, 90cm, 100cm and 110cm.
- Tabulate the readings and find T, T^2 & l/T^2.
- The last column of the tabulation is found to be constant, hence proving l/T^2 is a constant.

Observation:

S. No.	Length of the simple pendulum m	Time taken for 20 oscillations s	Period T s	T^2 s^2	l/T^2 $m\ s^{-2}$
1	0.7				
2	0.8				
3	0.9				
4	1.0				
5	1.1				

Result:

From the table, it is found that l/T^2 is a constant.

'I can, I did'

Student's Activity Record

Subject:

Sl.No.	Date	Lesson No.	Topic of the Lesson	Activities	Remarks