6. Classification of plants

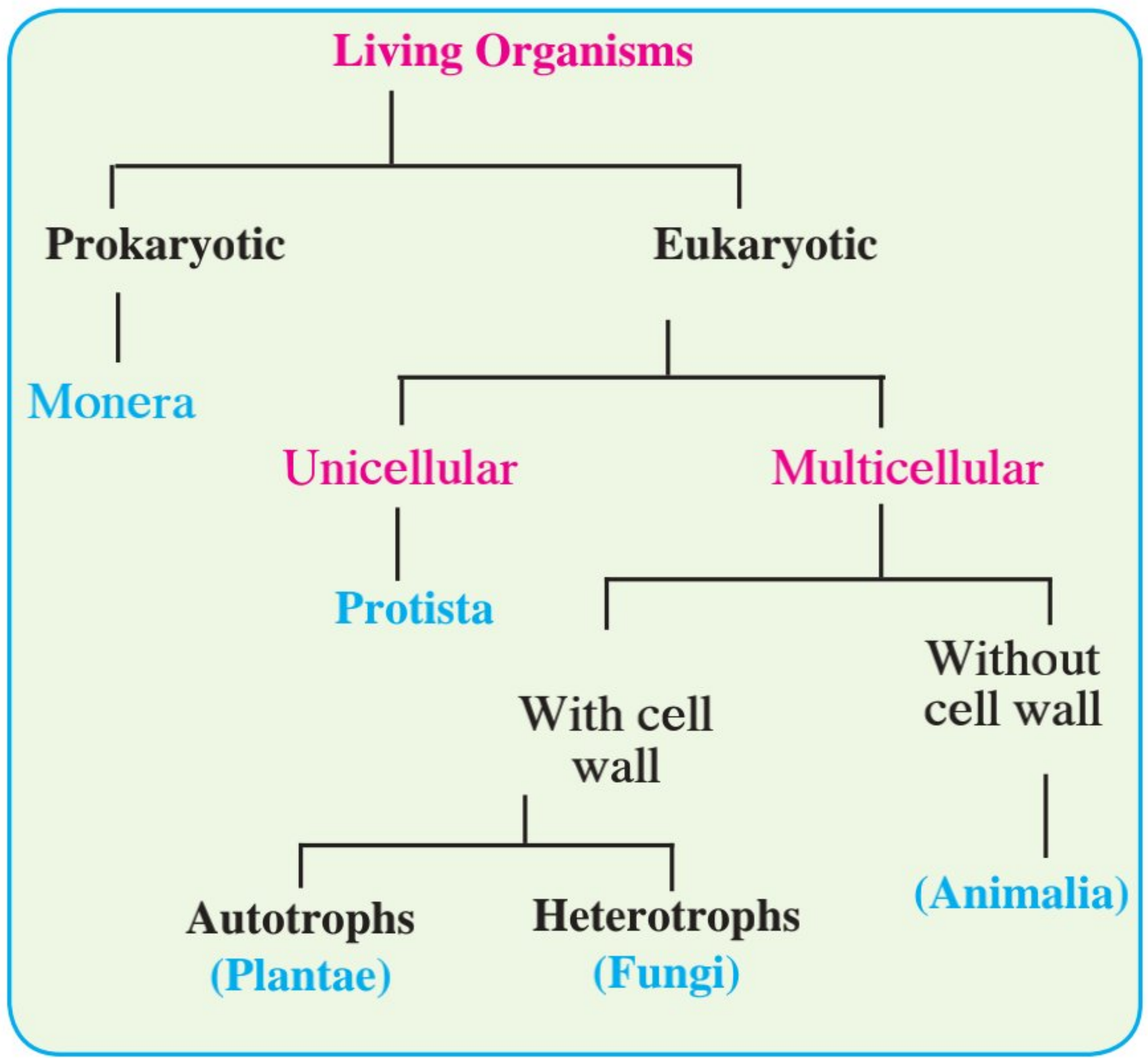
- Kingdom Plantae
- Sub-kingdom: Gymnosperms
- Sub-kingdom: Angiosperms

Can you recall?

How have living organisms been classified?

You have already studied the kingdoms Monera, Protista and Fungi of the 'Five Kingdom' classification system proposed by Robert Whittaker (1959) for the study of living organisms.

What are the hidden secrets of the Kingdom plantae which impart this green freshness to our surroundings? Just how much diversity is there in this Kingdom? Let us see!



Kingdom plantae

Can you tell?

Which are the special cell organelles that differentiate plant cells from animal cells?

The group of autotrophic living organisms having eukaryotic cells with cell walls is the group of plants. Plants have become autotrophic as they can perform photosynthesis with the help of chlorophyll. Living organisms of kingdom plantae are the main source of food for all other living organisms.

Basis for classification :

The presence or absence of organs is the first criterion for classification of plants. The presence or absence of separate conducting tissues for conduction of water and food is the next consideration for classification. Do the plants bear seeds? If they do then, whether the seeds are enclosed in a fruit or not is also an important criterion for classification. Finally, plants are grouped depending upon the number of cotyledons in the seeds.

At the higher levels of plant classification, different characteristics are considered for classification, e.g. depending upon the absence or presence of flowers, fruits and seeds, plants are classified as cryptogams or phanerogams. Depending upon whether seeds are enclosed within a fruit or not, phanerogams are classified as gymnosperms and angiosperms. Angiosperms are further classified as monocots or dicots depending upon the number of cotyledons in seeds.

An introduction to scientists

In 1883, Eichler, a botanist, classified the Kingdom Plantae into two subkingdoms. As a result, two subkingdoms, cryptogams and phanerogams were considered for plant classification.

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Cryptogams

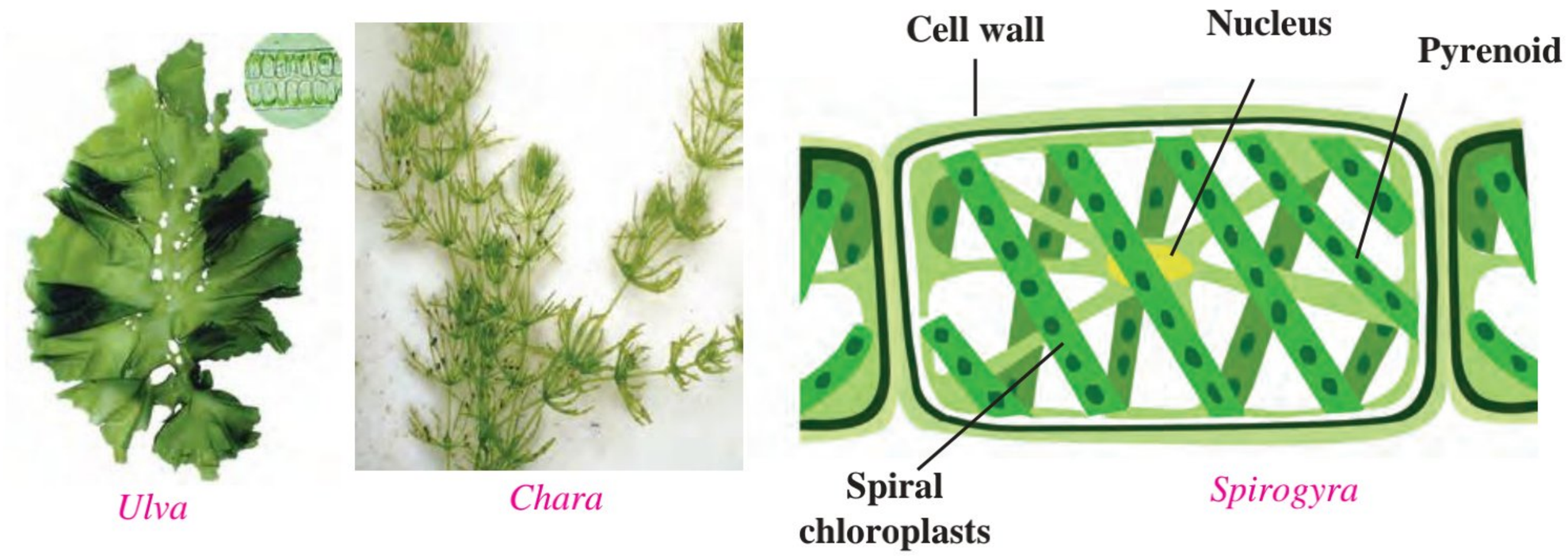
Observe

Search for a pond with greenish water. Collect some of the green fibres from the water. Put the fibres in a Petri dish and wash them clean with water. Put one of the fibres in a drop of water on a glass slide and spread it out straight.

Put a cover-slip over the slide and observe under a compound microscope. Do you see the spirally arranged green thread-like chloroplasts in the cells in that straight fibre? This plant is known as *Spirogyra*.

Division I - Thallophyta

These plants grow mainly in water. This group of plants, which do not have specific parts like root-stem-leaves-flowers but are autotrophic due to the presence of chlorophyll, is called algae. Algae show great diversity. They may be unicellular or multicellular, and microscopic or large. Examples of algae are *Spirogyra*, *Ulothrix*, *Ulva*, *Sargassum*, etc. Some of these are found in fresh water while some are found in saline water. These plants usually have a soft and fibre-like body. Various types of **fungi** like yeasts and moulds which do not have chlorophyll are also included in this group.



6.1 Plants of the Thallophyta division.

Division II - Bryophyta

Observe and discuss.

You may have seen a lush green soft carpet on old walls, bricks and rocks in the rainy season. Scrape it gently with a small ruler, observe it under a magnifying lens and discuss.

This group of plants is called the 'amphibians' of the plant kingdom because they grow in moist soil but need water for reproduction. These plants are thalloid, multicellular and autotrophic. They reproduce by spore formation.The structure of the plant body of bryophytes is flat, ribbon-like long, without true roots, stem and leaves. Instead, they have stem-like or leaf-like parts and root-like rhizoids. They do not have specific tissues for conduction of food and water. Examples are Moss (*Funaria*), *Marchantia*, *Anthoceros*, *Riccia*, etc.

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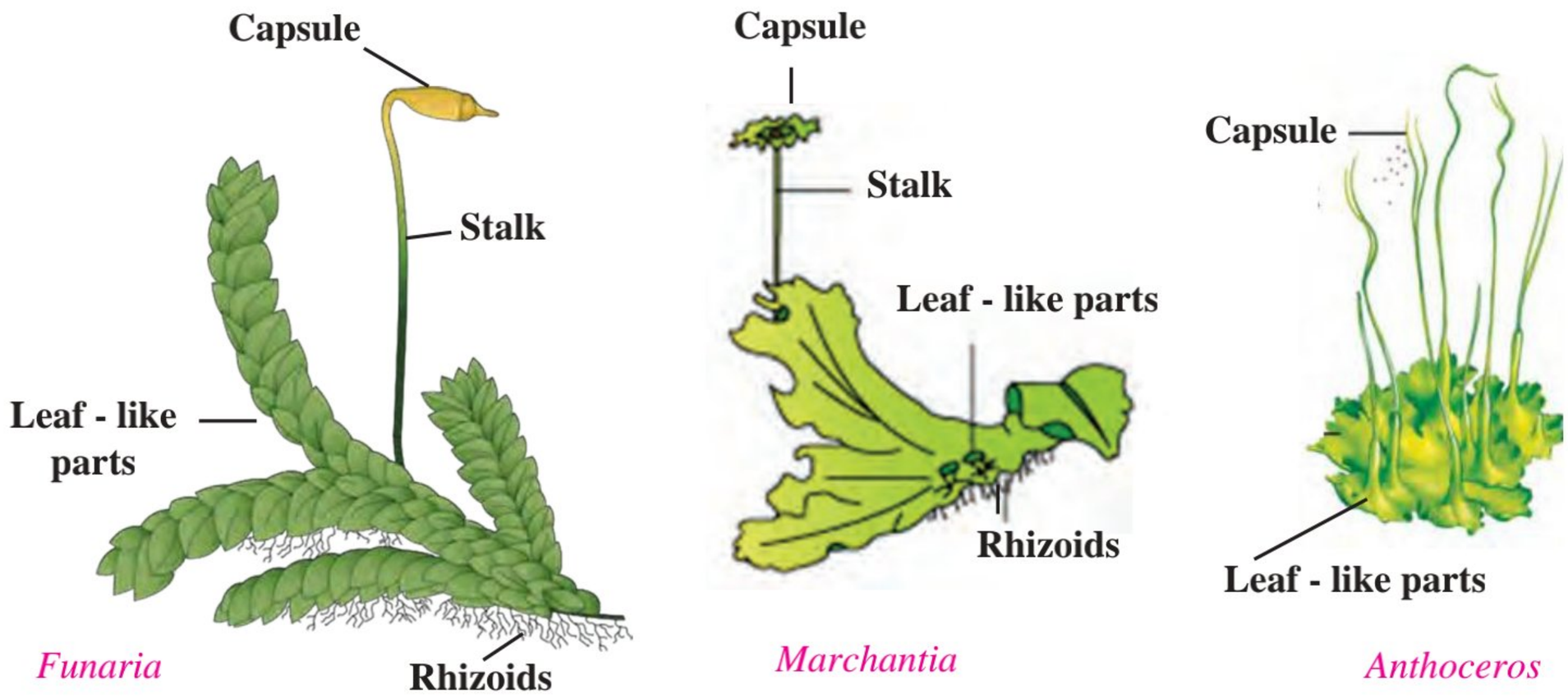

6.2 Plants of the bryophyta division

Observe and discuss.

You may have seen ferns among the ornamental plants in a garden. Take a leaf of a fully grown fern and observe it carefully.

Division III- Pteridophyta

Plants from this group have well-developed roots, stem and leaves and separate tissues for conduction of food and water. But, they do not bear flowers and fruits. They reproduce with the help of spores formed along the back or posterior surface of their leaves. Examples are ferns like *Nephrolepis*, *Marsilea*, *Pteris*, *Adiantum*, *Equisetum*, *Selaginella*, *Lycopodium*, etc.

These plants reproduce asexually by spore-formation and sexually by zygote formation. They have a well-developed conducting system.

6.3 Plants of the pteridophyta division

Use your brain power !

What is the similarity between the plants of the groups Thallophyta, Bryophyta and Pteridophyta irrespective of differences in their body structure?

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All these plants reproduce by spore formation. They are called cryptogams as their reproductive organs cannot be seen. (cryptos: hidden, gams: reproductive organs).

Phanerogams

Plants which have special structures for reproduction and produce seeds are called phanerogams. In these plants, after the process of reproduction, seeds are formed which contain the embryo and stored food. During germination of the seed, the stored food is used for the initial growth of the embryo. Depending upon whether seeds are enclosed in a fruit or not, phanerogams are classified into gymnosperms and angiosperms.

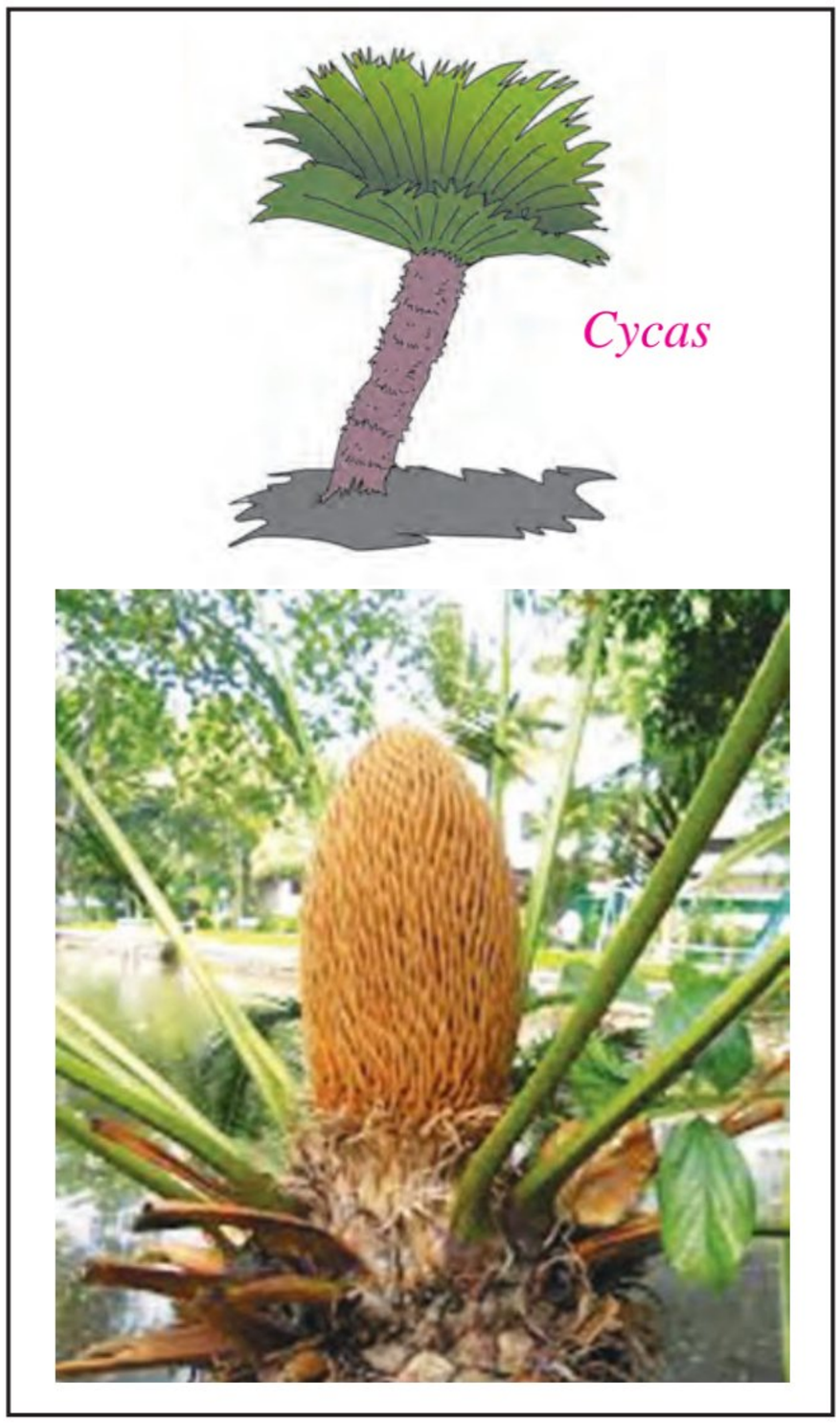
Division I - (Gymnosperms)

Observe

Observe all garden plants like *Cycas*, Christmas tree, *Hibiscus*, lily, etc. and compare them. Note the similarities and differences among them. Which differences did you notice between gymnosperms and angiosperms?

Gymnosperms are mostly evergreen, perennial and woody. Their stems are without branches. The leaves form a crown. These plants bear male and female flowers on different sporophylls of the same plant. Seeds of these plants do not have natural coverings, i.e. these plants do not form fruits and are therefore called gymnosperms. (gymnos: naked, sperms: seeds).

Examples *Cycas*, *Picea* (Christmas tree), *Thuja* (Morpankhi), *Pinus* (Deodar), etc.



6.4 Gymnosperms

Division II- Angiosperms

Try this

Soak the seeds of corn, beans, groundnut, tamarind, mango, wheat, etc. in water for 8 to 10 hrs. After they are soaked, check each seed to see whether it divides into two equal halves or not and categorize them accordingly.

The flowers these plants bear are their reproductive organs. Flowers develop into fruits and seeds are formed within fruits. Thus, these seeds are covered; hence, they are called angiosperms (angios: cover, sperms: seeds).

The plants whose seeds can be divided into two equal halves or dicotyledons are called dicotyledonous plants and those whose seeds cannot be divided into equal parts are called monocotyledonous plants.

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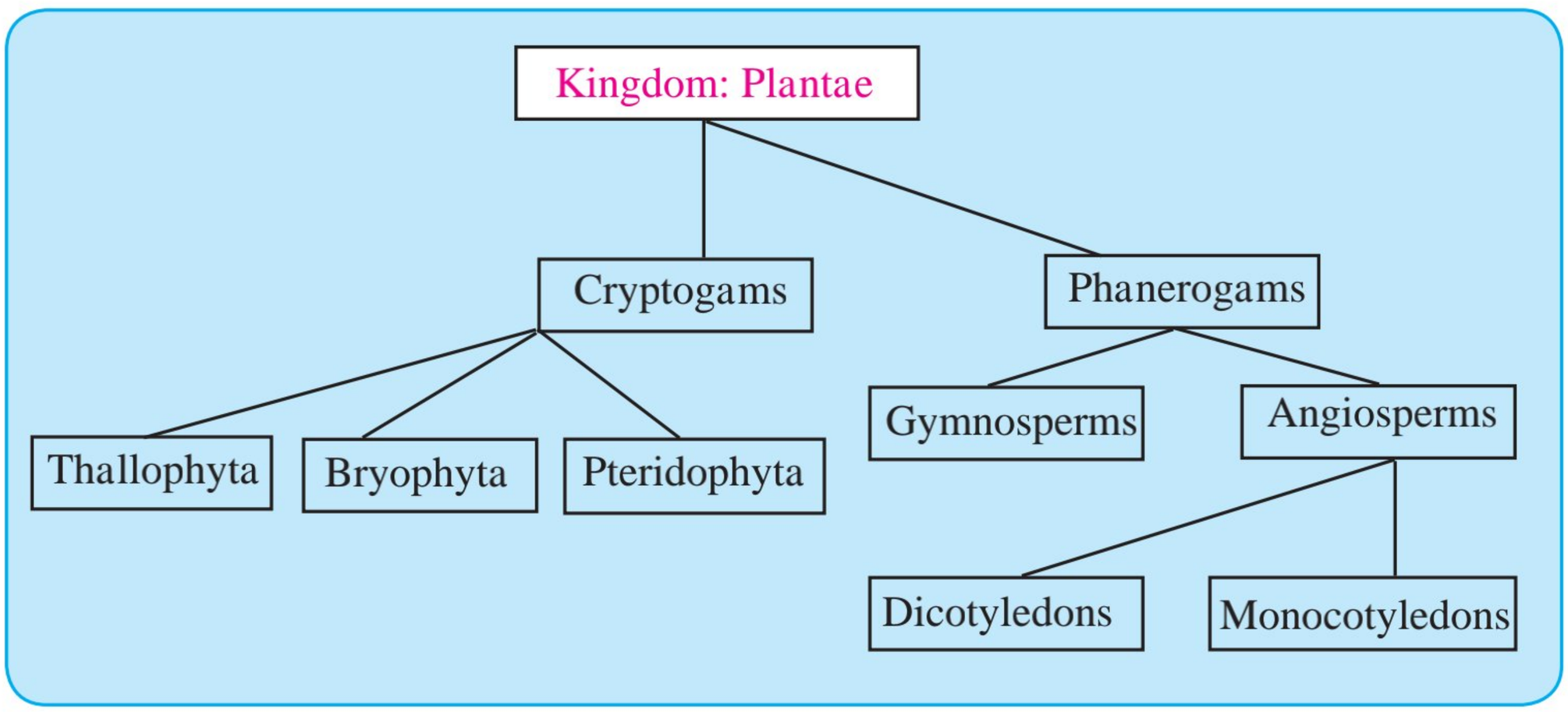
Observe and verify

	Dicotyledonous plants	Monocotyledonous
Seed	Two cotyledons	Single cotyledon
Root	Well developed, primary root (Tap root)	Fibrous roots
Stem	Strong, hard. Ex. Banyan tree	Hollow, Ex. Bamboo False, Ex. Banana Disc-like, Ex. Onion.
Leaf	Reticulate venation	Parallel venation
Flower	Flowers with 4 or 5 parts or in their multiples (tetramerous or pentamerous)	Flowers with 3 parts or in multiples of three (trimerous).

6.4 Mustard and Maize



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Using ICT:

1. Sketch the diagrams of the plants mentioned in the lesson with the help of the drawing software in the computer.
2. Using those sketches, prepare a power point presentation about plant classification and present it in the class.

Exercises

1. Match the proper terms from columns A and C with the description in column B.

'A'	'B'	'C'
Thallophyta	Seeds are formed in fruits.	Fern
Bryophyta	No natural covering on seeds.	Cycas
Pteridophyta	These plants mainly grow in water.	Tamarind
Gymnosperms	These plants need water for reproduction.	Moss
Angiosperms	Tissues are present for conduction of water and food	Algae

2. Complete the sentences by filling in the blanks and explain those statements.

(angiosperms, gymnosperms, spore, bryophyta, thallophyta, zygote)

a. ..... plants have soft and fibre-like body.

b. ..... is called the 'amphibian' of the plant kingdom.

c. In pteridophytes, asexual reproduction occurs by ..... formation and sexual reproduction occurs by .....formation.

d. Male and female flowers of .....are borne on different sporophylls of the same plant.

3. Answer the following questions in your own words.

a. Write the charateristics of subkingdom Phanerogams.

b. Distinguish between monocots and dicots.

c. Write a paragraph in your own words about the ornamental plants called ferns.

d. Sketch, label and describe the *Spirogyra*.

e. Write the characteristics of the plants belonging to division Bryophyta.

4. Sketch and label the figures of the following plants and explain them into brief.

Marchantia, *Funaria*, Fern, *Spirogyra*.

5. Collect a monocot and dicot plant available in your area. Observe the plants carefully and describe them in scientific language.

6. Which criteria are used for the classification of plants? Explain with reasons.

Project :

a. Collect more information about plant classification from the internet, prepare a talk of about 5 to 7 minutes on that topic and present it in school during assembly.

b. Prepare an album of moncot and dicot seeds and display it in the classroom.

c. Collect photographs of 5 plants each of the Thallophyta, Bryophyta and Pteridophyta divisions and write a description of each.

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7. Energy Flow in an Ecosystem

- **Food chain and food web**
- **The energy pyramid**
- **Bio-geo-chemical cycle : Carbon, oxygen and nitrogen cycles**

Looking back

1. What is meant by 'ecosystem'?
2. Which are the different types of ecosystems?
3. How do interactions take place between biotic and abiotic factors of an ecosystem?

Energy flow in an ecosystem

We have already learnt the classification of living organisms according to the mode of nutrition into producers, consumers, saprotrophs (saprophytes) and decomposers. Consider the various trophic levels of the ecosystem around you as given below.

Primary consumers (herbivores)
Ex. Grasshopper, squirrel, elephant, etc. They are directly dependent on autotrophs (producers).

Secondary consumers (carnivores)
Ex. Frog, owl, fox, etc.
These consumers use herbivores as their food.

Apex or top consumers (carnivores)
Ex. Tiger, lion, etc.
These consumers use herbivores and carnivores as their food. No other animals feed on top consumers.

Omnivores (mixed consumers)
Ex. Humans, bear, etc. Feed on herbivores and carnivores

Food chain and food web

Observe

Observe figure 7.1 and explain the relationship between the components.

Construct four chains like the one shown in figure 7.1.

Interactions go on continously between producers, consumers and saprophytes. There is a definite sequence in these interactions which is called the food chain. Each chain consists of four, five or more links. An ecosystem consists of many food chains that are interconnected at various levels. Thus a food web is formed.

7.1 Food chain

Use your brain power !

Explain the food chains of various ecosystems which you have studied last year.

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An organism may be the prey for many other organisms. For example, an insect feeds upon leaves of various plants but the same insect is the prey for different animals like frog, wall lizard, birds, etc. If this is to be shown in a figure, it will form an intricate web instead of a linear food chain. Such an intricate network is called a 'Food Web'. Generally, food-webs are found everywhere in nature.

Use your brain power !

Make a list of the various consumers of the ecosystems around you and classify them according to mode of nutrition.

Pictures of various organisms are given in fig. 7.2. Construct a foodweb from those pictures.

1. Is the number of consumers in a food web fixed?
2. What will be the effect on an ecosystem if only one type of organism in it forms the food for several different consumers in that ecosystem?
3. Why is balance or equilibrium necessary in a foodweb?

7.2 Various living organisans

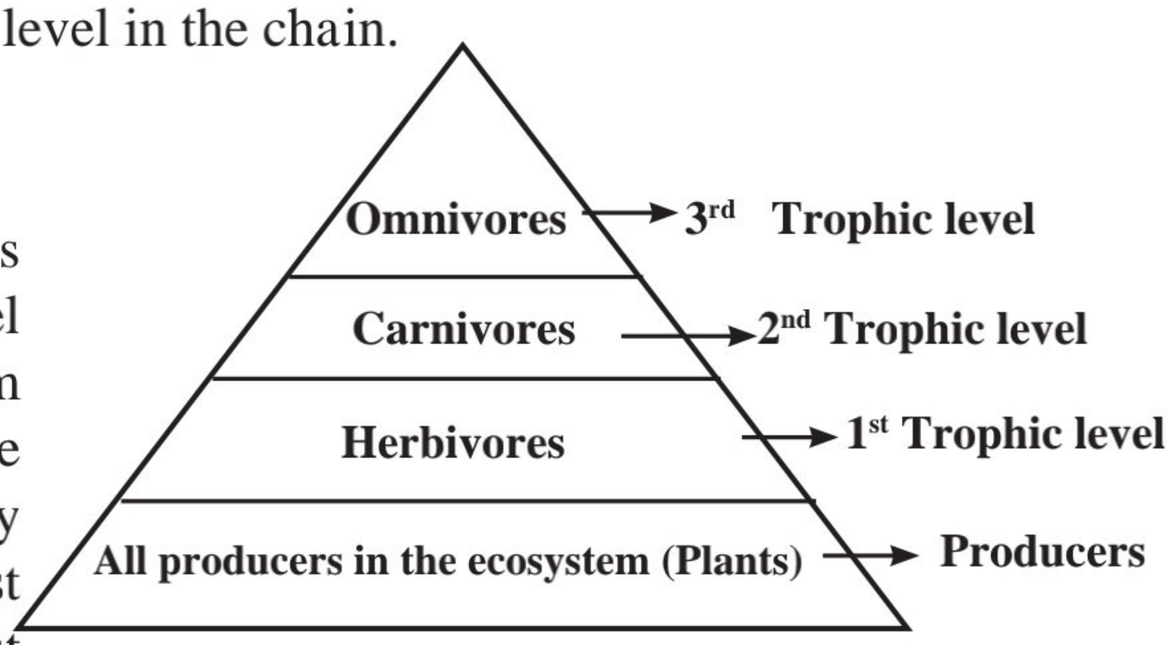
Research

Make some interesting observations while having a meal at home. Identify the trophic level of the various food items in your dish. Identify your own level in the chain.

The energy pyramid

Trophic level

Each level in the food chain is called a trophic level. A trophic level is the step at which the organism obtains its food in the chain. The amount of matter and energy gradually decreases from producers at lowest level to top consumers at the highest level.



7.3 Trophic levels

An introduction to scientists

Lindeman, In 1942 studied the food chain and energy flow through it. Charles Elton, a British scientist first proposed the concept of the Ecological Pyramid in 1927 after his study of the Tundra Ecosystem of the Beer islands in England. Hence, this pyramid is also called the Eltonian Pyramid.

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Think about it

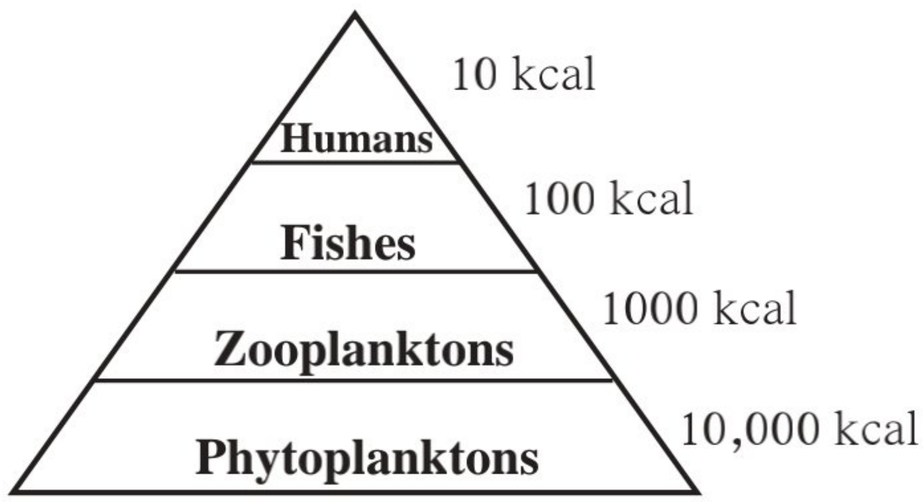
What happens to the energy during its transfer from producers to apex consumers? Does it remain trapped in the apex consumer? Does it remain in the body of apex consumer till its death?

Use your brain power !

What would happen if the energy remains trapped in the body of apex consumers even after their death? What will happen if there were no decomposers like microbes and fungi in nature?

Figure 7.4 shows the energy transfer that takes place at each trophic level. There are different levels of energy exchange in the food chain. The initial quantity of energy goes on decreasing at every level of energy exchange. Similarly, the number of organisms also decreases from the lowest level to the highest level. This pattern of energy exchange in an ecosystem is called a **'Pyramid of energy'**.

After the death of apex consumers, their energy becomes available to the decomposers. Fungi and other micro--organisms decompose the bodies of dead animals. They are called decomposers. In the process of obtaining food from the remains of organisms, decomposers convert them into simple carbon compounds. These substances easily mix with air, water and soil from where they are again absorbed by plants and incorporated into the food chain.



7.4 Pyramid of energy in an aquatic ecosystem

You can now see that due to the food web formed by the various modes of nutrition, energy and various nutrients circulate continuously in the ecosystem.

The sun is the most important source of energy in any ecosystem. Green plants of the ecosystem store some of the solar energy in the form of food. Before reaching the decomposers, this energy is passed on from one trophic level to the next. Decomposers dissipate some amount of energy in the form of heat. However, no part of the energy ever returns to the sun. Hence, such passage of energy is referred to as 'one way' transport.

Use your brain power !

Why are the numbers of tertiary consumers (apex carnivores) always less than those of other consumers?

Institutes at work

The Indian Institute of Ecology and Environment, Delhi, was established in 1980 and is involved mainly in research, training and arranging workshops and seminars. This institute has published the International Encyclopaedia of Ecology and Environment.

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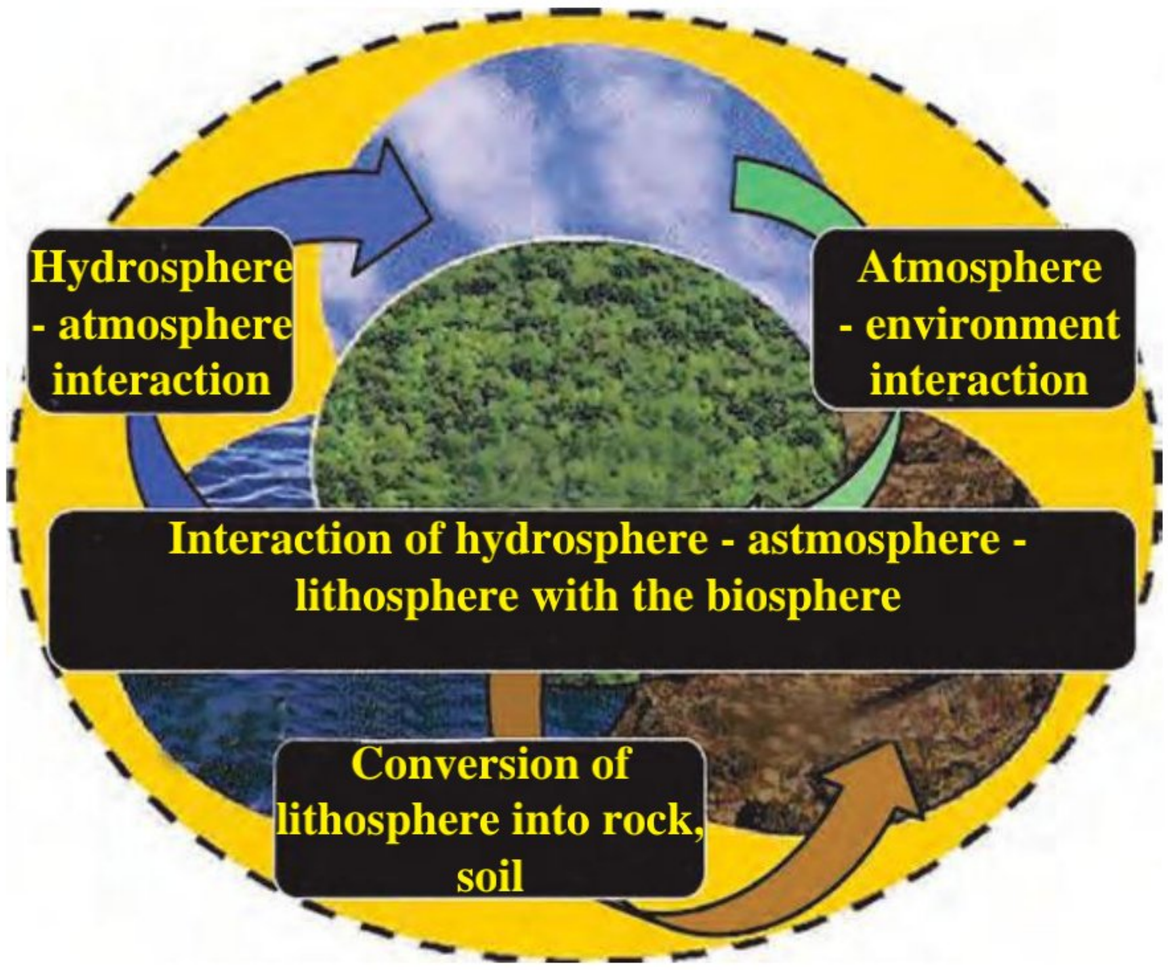

7.5 Bio-geo-chemical cycle

Bio-geo-chemical cycle

Though the energy flow in an ecosystem is one way, the flow of nutrients is cyclical. All organisms need nutrients for their growth. Study the various components in the figure given alongside and explain the bio-geo-chemical cycle in your own words.

The cyclical flow of nutrients within an ecosystem is called the bio-geo-chemical cycle.

Nutrients, necessary for the growth of organisms are continuously transferred from abiotic to biotic factors and biotic to abiotic factors within an ecosystem. This cycle operates continuously through the medium of the biosphere formed by the lithosphere, atmosphere and hydrosphere. The recycling of biological, geological and chemical sources of nutrients in this process is a complex process and depends upon the level of energy transfer in the ecosystem.

Types of bio-geo-chemical cycles

Gaseous cycle	Sedimentary cycle
* An accumulation of the main abiotic gaseous nutrient materials is found in the earth's atmosphere. * Includes nitrogen, oxygen, carbon dioxide, water vapour, etc.	* An accumulation of the main abiotic nutrient materials is found in soil, sediment and sedimentary rocks, etc. of the earth. * Includes soil components like iron, calcium, phosphorus, etc.

The gaseous cycle is a speedier cycle than the sedimentation cycle. For example, if CO_2 has accumulated in an area, it is quickly dispersed with the wind or absorbed by plants.

Climatic changes and human activities seriously affect the speed, intensity and equilibrium of these cycles Hence, various aspects of these cycles are extensively studied nowadays.

Do you know?

The cycle of gases and the sedimentary cycle cannot be completely separated from each other. For example, nitrogen is present in the form of a gas in the atmosphere and in the form of compounds like nitrogen oxide in the soil and sediments. Similarly, carbon occurs in abiotic form mainly in coal, granite, diamond, limestone, etc. in the earth's crust and in the form of carbon dioxide gas in the atmosphere. Generally, carbon is present in plants and animals for a much shorter duration than it is in coal.

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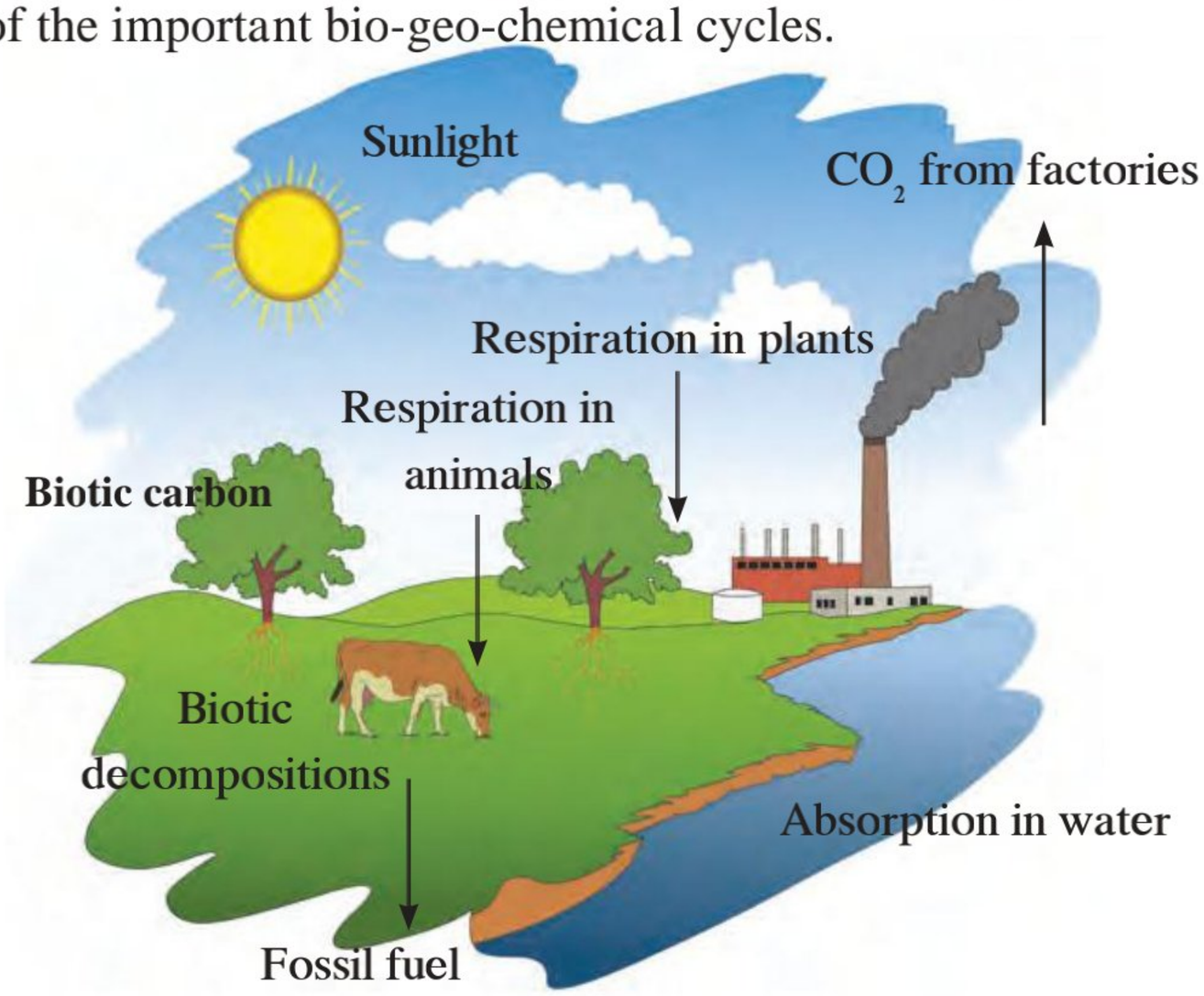
The carbon cycle

The circulation and recycling of carbon from the atmosphere to living organisms and after their death back to the atomsphere is called the carbon cycle. Abiotic carbon atoms are circulated and recycled into biotic form mainly through photosynthesis and respiration. Hence, the carbon cycle is one of the important bio-geo-chemical cycles.

Plants convert carbon dioxide into carbohydrates by the process of photosynthesis. Similarly, they produce carbon compounds like proteins and fats, too. Herbivores feed upon plants. Carnivores feed upon herbivores. In this way, biotic carbon is transported from plants to herbivores, from herbivores to carnivores and from carnivores to apex consumers.



7.6 The carbon cycle

Main processes in the carbon cycle

$$6\,CO_2 + 12\,H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6\,H_2O + 6\,O_2\uparrow$$

$$C_6H_{12}O_6 + 6\,O_2 \xrightarrow{\text{Mitochondria}} 6\,CO_2\uparrow + 6\,H_2O + \text{Energy}$$

Eventally, after death, all types of consumer, are decomposed by decomposers like bacteria and fungi and carbon dioxide is released again into the atmosphere and is used again by living organism. In this way, carbon is continuously passed on from one living organism to another. After the death of living organisms, carbon goes to the atmosphere and is again taken up by living organisms.

Do you know?

Carbon dioxide is released into the atmosphere through abiotic processes like burning of fossil fuels and wood, forest fires and volcanic activity. Oxygen is released into the atmosphere by the biotic process of photosynthesis and CO_2 through respiration. The equilibrium of oxygen and carbon dioxide gases in the atmosphere is maitained by plants.

Think about it

1. The carbon cycle is very effective in the temperate region. Why is it so?
2. Even though the carbon content on earth is constant, why is there a rise in temperature due to carbon dioxide?
3. Identify the relationship between carbon in the air and the rise in atmospheric temperature.

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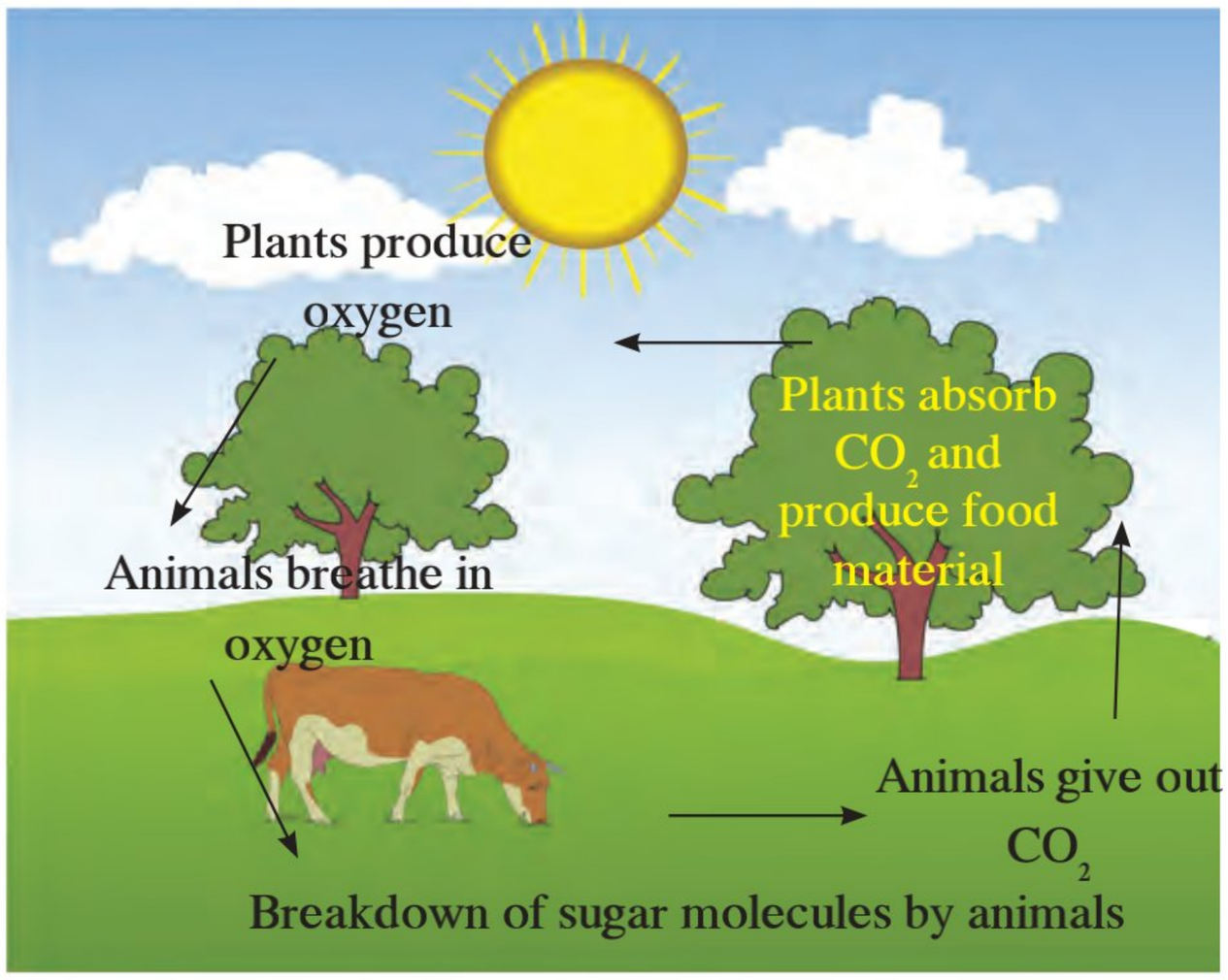
The oxygen cycle

Oxygen forms 21% of the amosphere. It is also present in the hydrosphere and lithosphere. Circulation and recycling of oxygen within the biosphere is called the oxygen cycle. This cycle, too, includes both the biotic and abiotic components. Oxygen is continuously produced as well as used up in the atmosphere.

Oxygen is highly reactive and it readily reacts with other elements and compounds. As oxygen is found in various forms like molecular oxygen (O_2), water (H_2O), carbon dioxide (CO_2), inorganic compounds, etc. the oxygen cycle of the biosphere is extremely complex. Oxygen is released in the process of photosynthesis whereas it is used up in processes like respiration, combustion, decomposition, corrosion, rusting, etc.

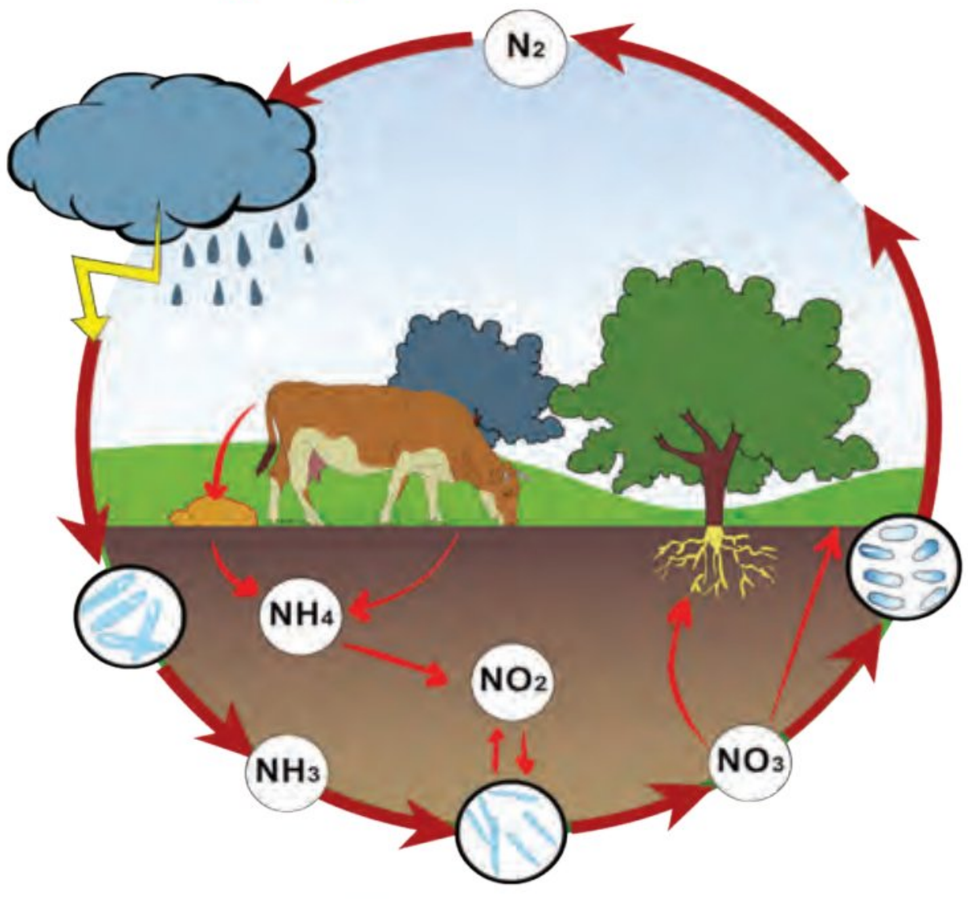


7.7 The oxygen cycle

Do you know?

Most micro-organisms use oxygen for respiration. Such microbes are called aerobes. Microbes which do not need oxygen are called anaerobes. Oxygen is important for the synthesis of proteins, carbohydrates and fats. It is also used in various chemical reactions. Ozone (O_3) is produced from oxygen through various atmospheric processes.

The nitrogen cycle



7.8 The nitrogen cycle

Can you recall?

1. What is meant by nitrogen fixation?
2. Which microbes bring about the process of nitrogen fixation?

Nitrogen forms 78% i.e. the maximum portion of the atmosphere. It is necessary for the maintenance of the cycle of nature. The circulation and recycling of nitrogen gas into the form of different compounds through various biotic and abiotic processes in nature is called the nitrogen cycle.

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All organisms participate in the nitrogen cycle. It is an important component of proteins and nucleic acids. As compared to other elements, it is inactive and does not easily combine with other elements. Most organisms cannot use the free form of nitrogen.

Important processes of the nitrogen cycle

1. Nitrogen fixation: Conversion of nitrogen into nitrates and nitrites through atmospheric, industrial and biological processes.
2. Ammonification: Release of ammonia through decomposition of dead bodies and excretory wastes of organisms.
3. Nitrification: Conversion of ammonia into a nitrite and then nitrate.
4. Denitrification: Conversion of nitrogen compounds into gaseous nitrogen.

Research Surf the internet for information about processes in the oxygen cycle and carbon cycle similar to those of the nitrogen cycle.

Exercises

1. Complete the following table (Carefully study the carbon, oxygen and nitrogen cycles).

Bio-geo-chemical cycles	Biotic processes	Abiotic processes
1. Carbon cycle 2. Oxygen cycle 3. Nitrogen cycle		

2. Correct and rewrite the following statements and justify your corrections.

a. Carnivores occupy the second trophic level in the food chain.

b. The flow of nutrients in an ecosystem is considered to be a 'one way' transport.

c. Plants in an ecosystem are called primary consumers.

3. Give reasons.

a. Energy flow through an ecosystem is 'one way'.

b. Equilibrium is necessary in the various bio-geo-chemical cycles.

c. Flow of nutrients through an ecosystem is cyclic.

4. Explain the following cycles in your own words with suitable diagrams.

a. Carbon cycle.

b. Nitrogen cycle.

c. Oxygen cycle.

5. What would you do to help maintain the equilibrium in the various bio-geo--chemical cycles? Explain in brief.

6. Explain in detail the inter-relationship between the food chain and food web.

7. State the different types of bio-geo-chemical cycles and explain the importance of those cycles.

8. Explain the following with suitable examples.

a. What type of changes occur in the amount of energy during its transfer from plants to apex consumers?

b. What are the differences between flow of matter and of energy in an ecosystem? Why?

Activities :

1. Prepare a model based on any natural cycle and present it in a science exhibition.
2. Write a paragraph on 'Balance in an Ecosystem'.

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8. Useful and Harmful Microbes

- **Useful micro-organisms : *Lactobacilli*, *Rhizobium*, Yeast**
- **Harmful micro-organisms : *Clostridium* and others.**

Can you recall.

1. What is meant by microbes? What are their characteristics?
2. How did you observe microbes?

You are familiar with different types of microbes which are all around us but cannot be seen with our eyes. In what way are they related to our everday life?

Useful micro-organisms

Try this

Lactobacilli

Smear a drop of fresh buttermilk on a glass slide. Stain it with methylene blue and put a coverslip over it.
Observe the smear under the 10X objective of a compound microscope and then with the more powerful 60X objective.

Did you notice the blue rod-shaped organisms moving around? They are lactobacilli, a kind of bacteria. They are minute and rectangular in shape. Lactobacilli are anaerobic bacteria i.e. they can produce energy without the use of oxygen.

8.1 Lactobacilli

Can you tell?

How is yoghurt made from milk? What exactly happens in this process?

The lactobacilli convert lactose, the sugar in the milk, into lactic acid. This process is called fermentation. As a result, the pH of milk decreases causing **coagulation** of milk proteins. Thus, milk proteins are separated from other constituents of milk. This is what happens when milk changes into yoghurt. Yoghurt has a specific sour taste due to lactic acid. The low pH destroys harmful microbes present in the milk.

Use your brain power !

1. Why do doctors advise you to have yoghurt or buttermilk if you have indigestion or abdominal discomfort?
2. Sometimes, yoghurt becomes bitter and froths up. Why does this happen?
3. Which different milk products are obtained at home by fermentation of the cream from the milk?

Do you know?

What is meant by 'probiotic' yoghurt and other foodstuffs that are popular nowadays?

Useful microbes like lactobacilli are added to these eatables. Such eatables are healthy because they kill the harmful bacteria like clostridum in the alimentary canal and help to improve our immunity.

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Uses of Lactobacilli :

1. Various milk products like yoghurt, buttermilk, *ghee*, *cheese*, *shrikhand*, etc. can be obtained by fermentation of milk.
2. Lactobacilli fermentation is useful for large scale production of cider, cocoa, pickles of vegetables, etc.
3. Lactobacilli and some other useful microbes taken together are used to treat abdominal discomfort.
4. Leavened fodder offered to domestic cattle like cows and buffalos, is fodder fermented with the help of lactobacilli.
5. The lactobacilli fermentation process is used to make wine and some types of bread.

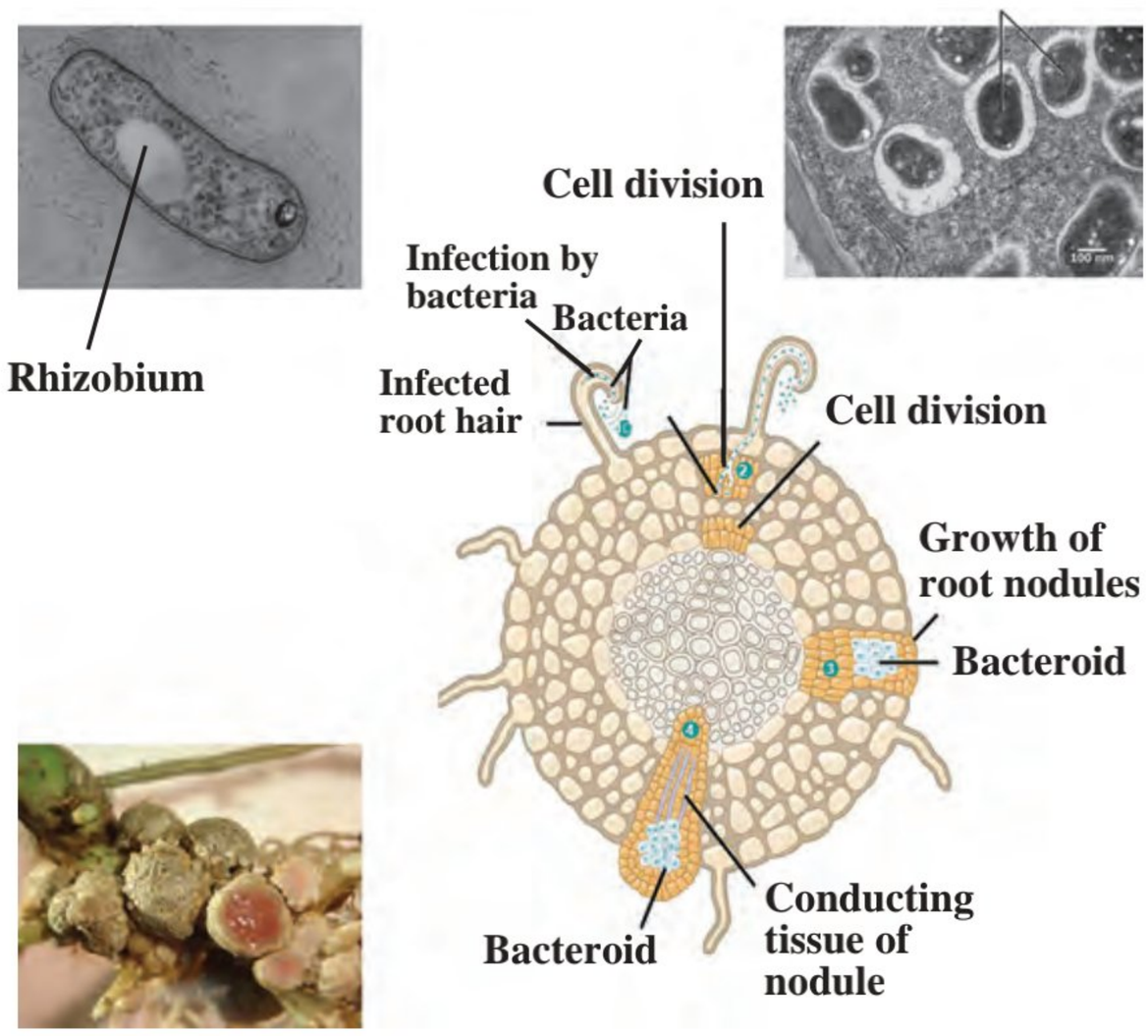
Research

1. How many different industries depend upon the lactobacilli bacteria?
2. Which types of cottage industries and factories can be started in areas with abundant milk production?

Rhizobium : Symbiotic bacteria

Let's try this

Take a plantlet of fenugreek, groundnut or any other bean and sterilize it with a 3 to 5 % solution of hydrogen peroxide.



8.2 Root nodules of soyabean plant

Afterwards, keep it in a 70% solution of ethyl alcohol for 4 to 5 minutes. Clean the roots with sterile water and take thin sections of the root nodules. Select good section and place it in a solution of safranin for 2 to 3 minutes. Place the stained section on a glass slide, cover it with a coverslip and observe it under the compound microscope. The pinkish rod-shaped organisms are the rhizobium bacteria.

Note that we had to search for the root nodules of leguminous plants to obtain these bacteria. Are the rhizobium bacilli useful to these plants or harmful?

Role and importance of rhizobium

Rhizobia living in root nodules supply nitrates, nitrites and amino acids to that plant and in exchange get energy in the form of carbohydrates from it. Such a mutually beneficial relationship is called symbiosis.

Rhizobia produce nitrogenous compounds from atmospheric nitrogen. However, for this process of nitrogen fixation, they need leguminous plants like beans, sweet pea, soyabean, etc. as 'host'. Beans and pulses are rich in proteins due to the nitrogenous compounds made available by rhizobia.

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After harvesting a leguminous crop, the left over roots and other plant parts are deliberately dumped in farm soil to maintain its bacterial population. The use of rhizobium has helped to reduce the use of chemical fertilizers and thereby their adverse effects. It has also helped to reduce expenses on fertilizers and thus works to the benefit of farmers.

Nowadays, seeds are coated with rhizobial solution or powder before sowing. After sowing, rhizobia enter the plantlets. This is called 'rhizobial inoculation'. This experiment has helped in the supply of nitrogen to cereal and other crops, besides leguminous crops.

Yeast

Let's try this

Activity : Bring 'active dry yeast' from the market. Mix a spoonful of yeast, two spoonfuls sugar with a sufficient quantity of lukewarm water in a bottle. Fix a colourless, transparent balloon on the mouth of that bottle.

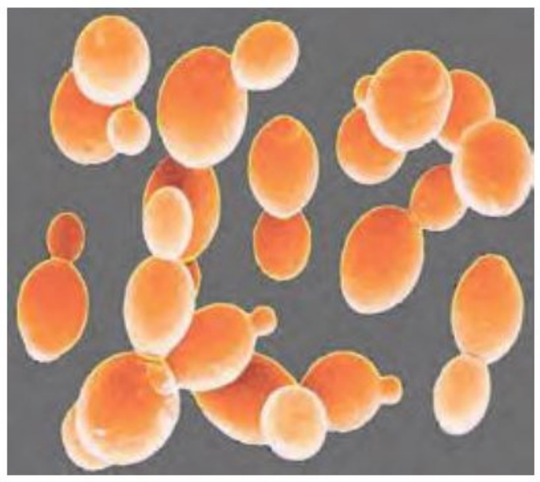
What changes do you observe after 10 minutes? Mix limewater with the gas accumulated in the balloon. Collect that limewater in a beaker and observe it. What do you notice?

Take a drop of the solution from the bottle on a glass slide, put a cover-slip over it and observe it under the compound microscope. Store the solution in the bottle carefully.

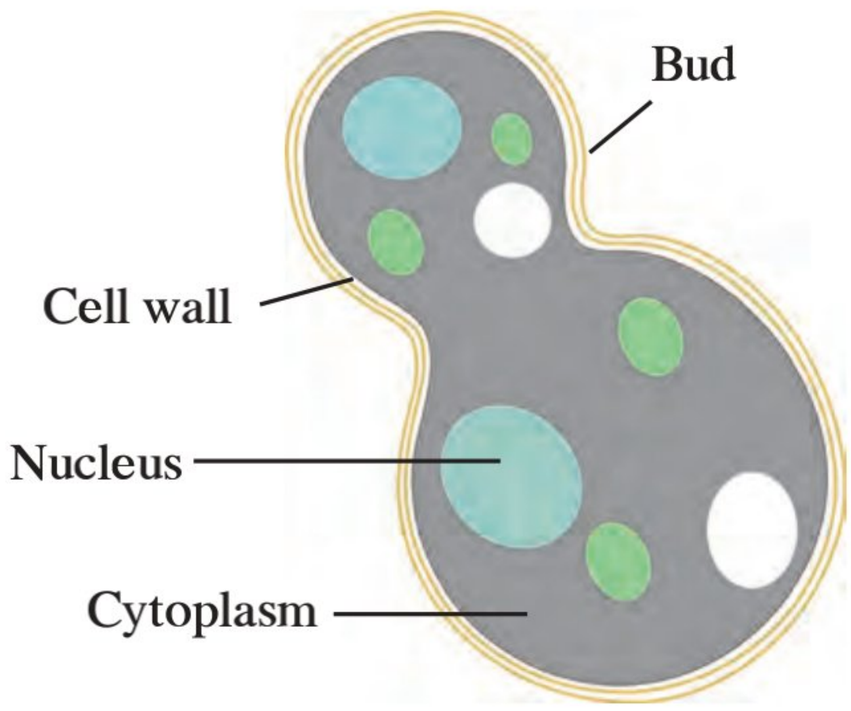
Do you see the colourless, oval cells of yeast on the slide? Some of those cells may have small round bodies attached to them. These are new daughter cells of yeast in the process of formation.

This method of asexual reproduction is called **'budding'**. Yeast is a heterotrophic fungal microbe that grows on carbon compounds.

Yeast is a unicellular fungus with 1500 different species in existence. The yeast cell is a eukaryotic type of cell.



Fungus cells



8.3 Yeast cells

In the above experiment, yeast grows and multiplies very quickly due to the carbon compounds in the sugar solution. In the process of obtaining nutrition, yeast cells convert the carbohydrates in that solution into alcohol and carbon dioxide. This process called fermentation.

How is bread made ?

Find out how to use the solution prepared in the above experiment, to make bread. Follow the recipe and make the bread. Find out and note down the reasons why the dough rises and makes the bread spongy.

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Do you know?

Often, alcohol is produced along with sugar in sugar factories. Molasses is produced from sugarcane juice. It is rich in carbohydrates. Molasses is fermented with the help of the yeast called *Saccharomyces*. In this process, ethanol (C_2H_5OH) alcohol is produced as a primary product and ester and other alcohols as secondary products.

Spirit and other alcohols can be obtained from ethanol. Ethanol is also a smokeless and high quality fuel. Besides molasses, maize, barley, and other grains are also used for industrial production of ethanol.

Glucose and fructose, the sugars present in grape juice, are also fermented with the help of yeast to produce the alcohol which is used for making wines.

Use your brain power !

1. Recently, it has been made compulsory in India and some other countries to mix 10% ethanol with fuels like petrol and diesel. What is the reason for this?
2. Why are wineries located near Nashik in Maharashtra?
3. Chapattis made from wheat only swell up but bread becomes spongy, soft and easy to digest. Why is it so?

Bio-remediation

A yeast, *Yarrowia lipolytica* is used to absorb the toxins released during the production of palm oil and the heavy metals and minerals released in some other industrial processes. *Saccharomyces cereviceae* is used for absorption of a pollutant, arsenic.

Oil spills in oceans are cleaned with the help of *Alcanivorax* bacteria.

Antibiotics

Carbon compounds obtained from some bacteria and fungi for destroying or preventing the growth of harmful micro-organisms are called 'antibiotics'. Antibiotics, a discovery of the 20th century, have brought about a revolution in the field of medicine. Even a disease like tuberculosis has been almost completely eradicated from some countries.

Antibiotics mainly act against bacteria. Some antibiotics can destroy protozoa. Some antibiotics are useful against a wide variety of bacteria. They are called **broad-spectrum antibiotics**. Examples are ampicillin, amoxicillin, tetracycline, etc. When the pathogen cannot be identified even though the symptoms of disease are visible, broad spectrum antibiotics are used.

Whenever a pathogenic micro-organism is definitely known, then **narrow-spectrum antibiotics** are used. Examples are penicillin, gentamycin, erythromycin, etc.

Institutes at work

The National Institute of Virology, established in 1952 in Pune, undertakes research related to diseases like measles, jaundice, fever and diseases of the lungs, with support from the World Health Organization.

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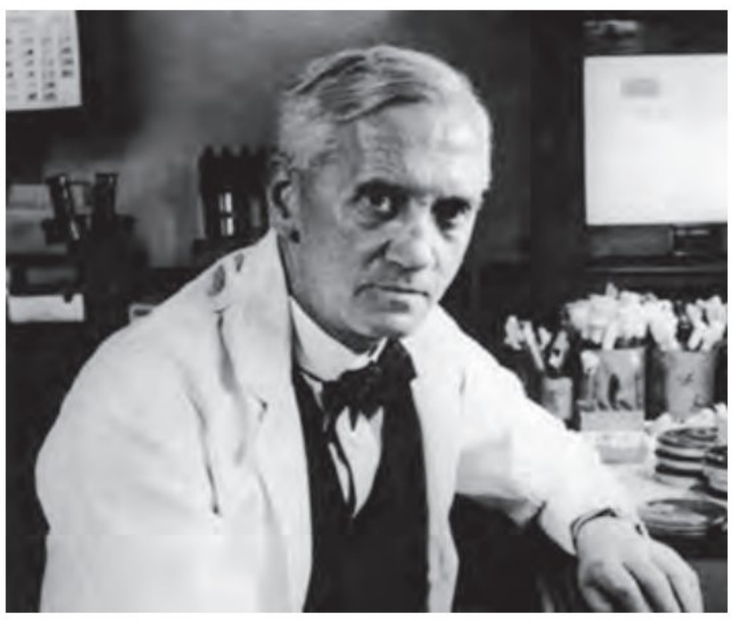
Penicillin

Penicillin is a group of antibiotics obtained from a fungus, *Penicillium*, and is used for controlling the infections caused by bacteria like Staphylococci, Clostridia, Streptococci, etc. Medicines containing penicillin are useful to treat certain bacterial infections of the ear, nose, throat and skin as well as diseases like pneumonia and scarlet fever.

Caution

* Antibiotics should be taken only when prescribed by a doctor.
* Don't purchase any antibiotic from medical stores without a prescription from a doctor.
* Don't consume antibiotics on your own to treat common diseases like a throat infection, common cold or influenza.
* Even if you feel well before completing of the prescribed course of the antibiotic you must continue and complete it.
* Don't suggest to others the antibiotics which were useful to you.



Dr Alexander Fleming

Introduction to scientists

Alexander Fleming, a professor of microbiology at St Mary's Hospital had cultured varieties of bacteria and fungi in Petri dishes in his laboratory.

On 3 September 1928, while observing staphylococci cultures, he made an interesting observation in one Petri dish. In that Petri dish, fungal colonies had grown but the area around those colonies was clean and clear. i.e. bacteria had actually been destroyed. After further studies, he confirmed that the fungus growing there was *Penicillium* and its secretion had destroyed the bacterial colonies.

Thus, the first antibiotic - penicillin had been discovered accidentlly and this formed the basis for attempts to find cures for incurable diseases.

Shouldn't we always be grateful to Alexander Fleming for discovering the life-saving antibiotics?

Wonderful to know

Ants grow fungi in their termitarium (anthill) and obtain food from it. Some species of wasps and other insects lay their eggs in the fungal bodies growing on trees thus ensuring a food supply for their larvae.

Harmful micro-organisms

Fungi

Can you tell?

1. Which changes do you notice in leather articles and gunny (jute) bags during the rainy season?
2. For how long afterwards can you use those articles?
3. Why do these articles not get spoilt during the summer or winter?

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Microscopic spores of fungi are present in the air. If there is sufficient moisture, spores germinate on cotton fabric, gunny bags, leather, wooden items, etc. The fungal hyphae (fibres of the fungus) penetrate deep into the material to obtain nutrition and to reproduce. This causes the materials to wear and become weak. As a result, gunny bags, leather items like shoes, purses, belts, etc. on which fungi have grown do not last long. Wooden items also get spoilt.

Think about it

Sometimes, you may notice a black powder or white discs floating on the pickle or *murabba*, when a jar is opened after a long time. What exactly is this? Why are such food items not good to eat?

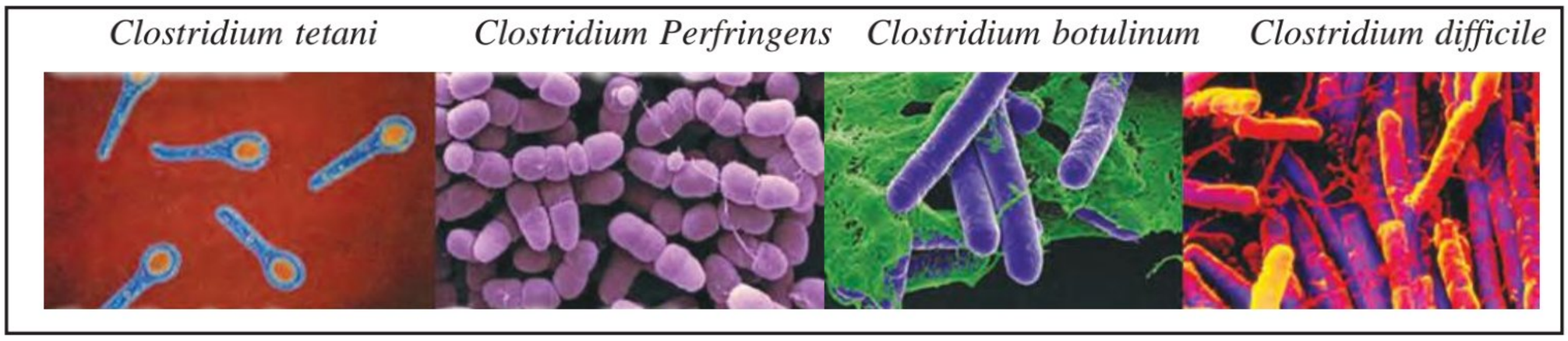
Various species of fungi grow on food items like pickles, *murabba*, jam, sauce, chutney, etc. They use the nutrients in these food items for growth and reproduction. During this activity, fungi release mycotoxins, certain poisonous chemicals, into the food and thus food becomes poisonous. Hence, the food on which fungi have grown cannot be eaten.

Clostridium

Sometimes, cases of food poisoning occur during community feasts. How does the food become poisonous all of a sudden?

The bacteria which spoil cooked food are *Clostridium*. Out of about 100 different species of this bacterium, some are free living in the soil whereas some live in the alimentary canal of humans and other animals.

These bacteria are rod-shaped and produce bottle-shaped endospores in adverse conditions. One special characteristic of these bacteria is that they cannot withstand the normal oxygen level of the air because they grow in anaerobic conditions.



8.4 Clostridium species

Other harmful micro-organisms

Do only the *Clostridium* bacteria cause illness ?

Other kinds of micro-organisms like bacteria, viruses, protozoa and fungi are also responsible for different diseases that affect humans. You have learnt about viruses which are smaller than bacteria and can grow and reproduce only in living cells. Let us see how they are harmful to us.

An Introduction to scientists

It was believed that meat gets spoiled due to some bacteria of the bacillus type but the exact type of bacillius was not known. Van Ermengem proved that the anaerobic bacterium *Clostridium botulinum*, is responsible for food poisoning.

Ida Bengston obtained higher education in biochemistry at Chicago University. She conducted important research on the toxin responsible for gas gangrene and the antitoxin useful for treating it. While she was doing research on the dreaded disease called typhus, she herself contracted the infection. But, she overcame it and continued her research. For this work, she was honoured with the 'Typhus Medal' in 1947.

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The spread and prevention of disease

Name of disease	Pathogen	Mode of infection	Preventive measures
AIDS	Virus	Through blood and semen of infected person and milk of mother suffering from AIDS.	Safe sexual contact, avoid reuse of needles and injections.
Hepatitis	Virus	Contaminated water and food.	Clean and filtered water, proper storage of food.
Influenza	Virus	Contact with infected person	Personal hygiene and avoiding contact with infected person
Measles and Chicken pox	Virus	Contact with infected person	Vaccination, uncontaminated water, clean food
Bird Flu (H_7N_9) Swine Flu (H_1N_1)	Virus	Contact with infected birds and animals	Personal hygiene, properly cooked meat.
Dengue	Virus	Mosquito bite	Cleanliness of surroundings preventing stagnation of water, mosquito control.
Pneumonia	Bacteria	Droplets spread in air by infected person	Vaccination, avoiding contact with infected person
Leprosy	Bacteria	Long term contact with infected person	Avoiding contact with infected persons and their belongings
Cholera	Bacteria	Contaminated food and water.	Clean food and water.
Malaria	Protozoa	Mosquito bite, uncleaned surroundings.	Cleanliness of surroundings, preventing stagnation of water, controlling mosquitoes.
Dandruff, ringworm, scabies	Fungi	Contact with infected person or his/her belongings like clothes.	Personal hygiene, avoiding contact with infected person

Use your brain power !

8.5 A lichen (*dagadphool*)- used as a condiment

1. Salt is applied on the inner surface of pickle jars and the pickle is covered with oil. Why is this done?
2. Which preservatives mixed with ready-to-eat foods to keep them from spoiling?
3. Find out the uses of fungi to plants and animals.
4. What is the structure of lichen, a condiment? Where else is it used?

Collect information

Which plant and animal diseases are caused by micro-organisms and what are the measures to be taken against them?

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Exercises

1. Complete the statements using the proper option from those given below. Explain the statements.

(mycotoxins, budding, rhizobium)

a. Yeast reproduces asexually by the ..... method.

b. Toxins of fungal origin are called ..... .

c. Leguminous plants can produce more proteins due to ..... .

2 Write the names of microbes found in following food materials.

yoghurt, bread, root nodules of leguminous plants, idli, dosa, spoiled potato curry.

3. Identify the odd word out and say why it is the odd one?

a. Pneumonia, diphtheria, chicken pox, cholera.

b. Lactobacilli, rhizobia, yeast, clostridia.

c. Root rot, rust (*tambera*), rubella, mozaic.

4. Give scientific reasons.

a. Foam accumulates on a the surface of *'dal'* kept for a long time in summer.

b. Why are naphthalene balls kept with clothes to be put away.

5. Write down the modes of infection and the preventive measures against fungal diseases.

6. Match the pairs.

'A' group	'B' group
1. *Rhizobium*	a. Food poisoning
2. *Clostridium*	b. Nitrogen fixation
3. *Penicillium*	c. Bakery products
4. Yeast	d. Production of antibiotics

7. Answer the following questions.

a. Which vaccines are given to infants? Why?

b. How is a vaccine produced?

c. How do antibiotics cure disease?

d. Are the antibiotics given to humans and animals the same? Why?

e. Why is it necessary to safely store the pathogens of a disease against which vaccines are to be produced?

8. Answer the following questions in brief.

a. What are 'broad spectrum antibiotics'?

b. What is fermentation?

c. Define 'Antibiotic'.

Activity :

Collect information about generic medicines and discuss them in the class.

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9. Environmental Management

- Weather and climate
- Meteorology
- Solid waste management
- Disaster management

Can you recall.

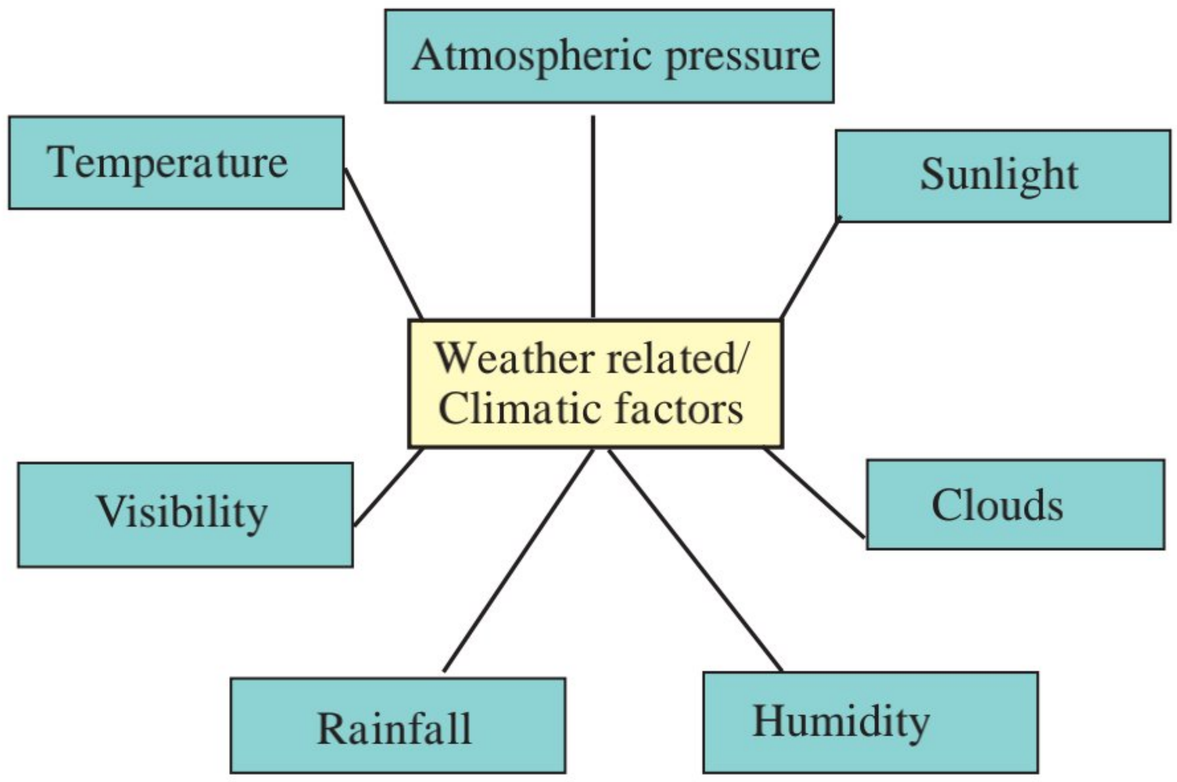
1. How does the atmosphere affect our daily life?
2. Forecasts about which weather related factors are given during the news bulletins on Doordarshan and Akashvani?

Weather and climate

Atmospheric conditions at a specific time at a particular place are referred to as weather. Atmospheric conditions depend upon a variety of factors. (Figure 9.1)

We frequently express our opinion about the weather by making statements like, 'Today, it is too cold' or 'It is very hot today.'

Weather depends upon the prevailing conditions of the air. The climate of a particular region is the average of daily readings of various weather-related parameters recorded for several years. Hence, climate is a long term predominant condition of the atmosphere.



9.1 Weather-related / climatic factors

Changes in weather

Climate does not change continuously. Climate is that which remains constant in a region for a long duration. Thus we see that weather is related to a specific location and specific time whereas climate is related to a longer duration and larger area. Changes in the weather may occur for short periods of time whereas changes in the climate take place slowly over a much long duration.

Climate plays a very important role in our day to day life. It influences our basic needs like food, clothing and shelter as well as our occupations. Climate is especially important for an agrarian country like India. Various climatic factors like direction and speed of wind, temperature, atmospheric pressure, etc. are considered during construction of runways, seaports, huge bridges and skyscrapers, etc.

Use your brain power !

Which factors are affected favourably or unfavourably by climate? What must we do to minimize this effect?

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Think and discuss.

1. Human progress is related to a conducive climate and geography.
2. Human beings have designed a time schedule for their lives based upon centuries of climatic experiences.
3. Scientists find it necessary to study climate in view of its effect on agricultural production.

A special day

23rd March is observed as 'World Meteorological Day'.

Collect information about Meteorology and prepare charts to create awareness about it.

Importance of weather in the living world

1. Daily weather as also long term climatic conditions influence human lifestyle directly or indirectly. Land, water bodies, plants and animals collectively form the natural environment on earth. This environment is responsible for the development of organisms.
2. The climate of a particular region helps to determine the diet, clothing, housing, occupations and lifestyle of the people of that region. For example, the characteristic lifestyle of Kashmiri and Rajasthani people.
3. Salinity of marine water, formation of oceanic currents, water cycle, etc. are all related to various weather and climatic factors.
4. Various climatic factors bring about the weathering of rocks in the earth's crust.
5. Climate plays a very important role in the formation and enrichment of soil.
6. Microbes in the soil play an important role in formation of organic materials. This process depends upon various climatic factors.

   Thus, it is very clear that the study of meteorology is very important from the view point of human life.

While ascertaining the climate of a particular region, a review of earlier studies of various aspects of climate is very important. Most countries in the world have established meteorology departments for making and recording such observations. These departments have 'observatories' which are equipped with modern instruments and technology.

If present climatic conditions are analysed with reference to the past climatic conditions, we can predict climatic changes of the future. However, as climate is the net result of a complex mixture of various atmospheric factors, forecasting it is very complicated and difficult. Forecasting is easy for places where climatic changes are slow and of a limited nature. However, where climatic changes are complex, interdependent and rapid, making forecasts is very difficult.

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Meteorology

The science that studies the inter-relationships between the various components of air, natural cycles, geological movements of the earth and climate is called meteorology.

Meteorology includes the study of storms, clouds, rainfall, thunder, lightning, etc. Depending upon the study of such factors, weather forecasts are made. They are useful to common people, farmers, fisheries, aviation services, water transport and various other organizations.

Institutes at work

The World Meteorological Organization was established by the United Nations Organization on 23rd March 1950. This organization plays an important role in food security, water management, transportation and communication.

Using ICT

With the help of various search engines on the Internet, search for links giving information about the following institutes and prepare a report based upon the information obtained.

World Meteorological Organization (WMO)
Indian Institute of Tropical Meteorology (IITM)
National Oceanographic and Atmospheric Administration. (NOAA)

India Meteorological Department

The India Meteorological Department was founded by the British in 1875 at Shimla. Its head office is at Pune and its Regional Offices are at Mumbai, Kolkata, Chennai, Nagpur and Delhi. Maps are prepared every day which indicate the daily predictions about the weather. Such maps are prepared and published twice in every 24 hours. In this institute, research goes on continuously on various aspects like instruments for climatic readings, predictions about climate made using radar, predictions about climate related to siesmology, predictions regarding rainfall by satellites, air pollution, etc.

The India Meteorological Department provides important information regarding weather and climatic conditions to other departments like aviation, shipping, agriculture, irrigation, marine oil exploration and production, etc. Predictions regarding calamities like dust storms, sand storms, heavy rainfall, hot and cold waves, tsunami, etc. are communicated to various departments, all types of mass communication media and all citizens. For this purpose, India has launched several satellites equipped with highclass technology. Observatories at several locations are doing excellent work in the analysis of the information received from these satellites. (www.imdpune.gov.in)

Monsoon model and climate prediction

The tradition of forecasting the monsoon season in India is older than 100 years. After the famine of 1877, H. F. Blanford, the founder of IMD had made such a prediction for the first time taking the snowfall in the Himalayas as a parameter for this prediction. In the decade of the 1930's the then director of IMD, Sir Gilbert Walker had underlined the relationship between various worldwide climatic factors and the Indian monsoon, and, based on available observations and previous recordings related to this relationship he put forth a hypothesis regarding the nature of the monsoon. With the initiative of Dr Vasantrao Govarikar in the decade of the 1990's a monsoon model based upon 16 worldwide climatic parameters was developed. This model was in use from 1990 to 2002.

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Mathematical model (Dynamic)

Forecasts are made with the help of mathematical models which take into account estimates of current weather related events and ongoing physical interactions between them. Data about current climatic parameters is mathematically analysed with the help of the Param supercomputer. Various mathematical models based upon daily geographic events are developed by supercomputer technology.

Presently, new models are being developed at the IITM. Work is in progress at two levels, namely, designing new models and developing new technology. The main focus is on development of the radar system and satellite technology.

Holistic model

In this model, predictions are based upon those parameters used in other models which have the greatest effect on the monsoon. Nowadays, predictions declared by IMD are the collective outcome of various models. This is called a holistic model.

Statistical model : In this model, current climatic observations in a region are compared with earlier parameters such as oceanic temperature, atmospheric pressure and the nature of the monsoon rainfall of several years. This data is comparatively analysed by statistical methods and predictions are made about the monsoon in the present conditions.

Always remember

Any meteorological model depends upon the inter-relationship between parameters used in that model and the results expected from it. However, as these inter-relationships with reference to the ocean and atmosphere are never constant, meteorological models need to be changed continually.

Solid waste management : need of the hour

Can you tell?

1. What is meant by pollution?
2. In which different ways do our surroundings get polluted?

Try this

Observe the garbage collected in the dustbin of your classroom and make a list of the various materials in it. Discuss with your teacher, how these materials can be properly disposed of.

Can we do the same with the garbage generated in our house? Think about it.

9.2 Solid waste

Scanned with OKEN Scanner

Observe and discuss.

9.3 Area with garbage vs clean area

1. What is main difference between what we see in the two pictures alongside (9.2 A and B)?
2. What should we do to permanently maintain the condition seen in picture B?

Many waste materials are generated through the various daily human activities. This is called solid waste. If these waste materials are properly disposed of, they can be a valuable source of energy. Currently, solid waste is a serious world wide problem as it causes both water and soil pollution. Solid waste is also serious problem from the point of view of economic growth, environmental degradation and health. It has posed a serious threat to nature and human habitat because of the air, water and soil pollution it causes.

Do you know?

Garbage production per day

Solid waste generated in the main metro cities of the state is approximtely as follows- Mumbai: 5000 tons, Pune: 1700 tons, Nagpur : 900 tons.

On 26th July 2005, a serious flood calamity had arisen in Mumbai. Improper solid waste management was one of the main reasons behind that calamity. Thus we see that accumulation of solid waste can lead to various calamities.

Observe

Make a survey of the building or area where you live. Categorise the garbage as degradable and non-degradable waste. Approximately, how much solid waste is generated in a week? Make a list of the factors responsible for it.

Can you tell?

1. What is meant by solid waste?
2. What are the different things included in solid waste?

We make use of many materials and articles in our daily life. They are of different kinds. Some of them are reusable but others have to be discarded. However, if they are not properly disposed of, it affects the environment adversely.

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Make a list and discuss

Read the following table carefully. What do you notice?

Classification	Source
Domestic waste	Waste food, paper, plastic paper, plastic bags, vegetable waste, fruit skins, glass and sheet metal articles, etc.
Industrial waste	Chemicals, pigments, sludge, ash, metals, etc.
Hazardous waste	Chemicals generated in various industries, radioactive materials, explosives, infectious materials, etc.
Farm/Garden waste	Leaves, flowers, branches of trees, crop residues like straw, animal urine and dung, pesticides, remains of various chemicals and fertilizers, etc.
Electronic waste	Non-functional TV sets, cell phones, music systems, computers and their parts, etc.
Biomedical waste	Bandages, dressings, gloves, needles, saline bottles, medicines, medicine bottles, test tubes, body parts, blood, etc. from clinics, hospitals, blood banks and laboratories.
Urban waste	Waste generated through household industries and large commercial and industrial establishments, carry bags, glass, metal pieces and rods, threads, rubber, paper, cans from shops, vegetable and meat markets, construction waste, etc.
Radioactive waste	Radioactive materials like Strontium-10, Cerium-141, Barium-140 and heavy water, etc. generated from atomic energy plants, uranium mines, atomic research centres, nuclear weapons testing sites, etc.
Mining waste	Remains of heavy metals like lead, arsenic, cadmium, etc. from mines.

Think about it.

Into which two categories can the waste materials in the lists above be classified ?

Biodegradable waste : This type of waste is easily degraded by microbes. It mainly includes kitchen waste (spoiled food, fruits, vegetables) ash, soil, dung, parts of the plants, etc. This waste is mainly of organic type and is also called '**wet solid waste**' or '**wet garbage**'. If it is carefully decomposed, we can get compost and fuel of good quality from it. Such bio-fuel projects have been started in many cities.

Non-biodegradable waste : This type of waste is not easily degraded because it requires a very long period of time and the use of various techniques. It includes plastic, metal and other similar materials. This type of waste is also called **'dry solid waste'** or **'dry garbage'**.

Use your brain power !

1. Why is it necessary to recycle non-degradable waste ?
2. Which materials are included in solid dry waste ?

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Make a list of various waste materials and articles in your area and prepare a chart as follows

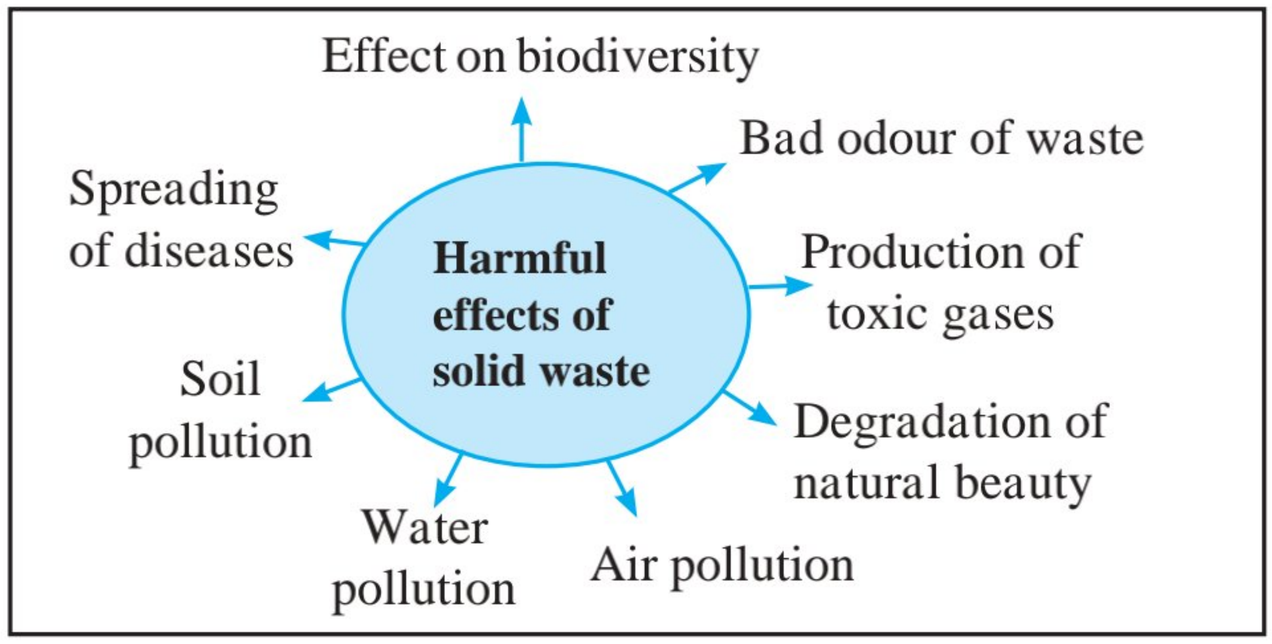
Material	Degradable (Organic)	Non-degradable (Inorganic)	Recycling	Reuse	Toxic
Plastic bottle	No	Yes	Yes	Yes	Yes

Find out

Nowadays, an electronic device – the cell phone – is very popular. From a mobile shop near your house, find out how they dispose of old and broken down cell phones.

Using ICT

Carefully observe figure 9.4 alongside. Based on it, send an e-mail to your friend explaining the importance of solid waste management.

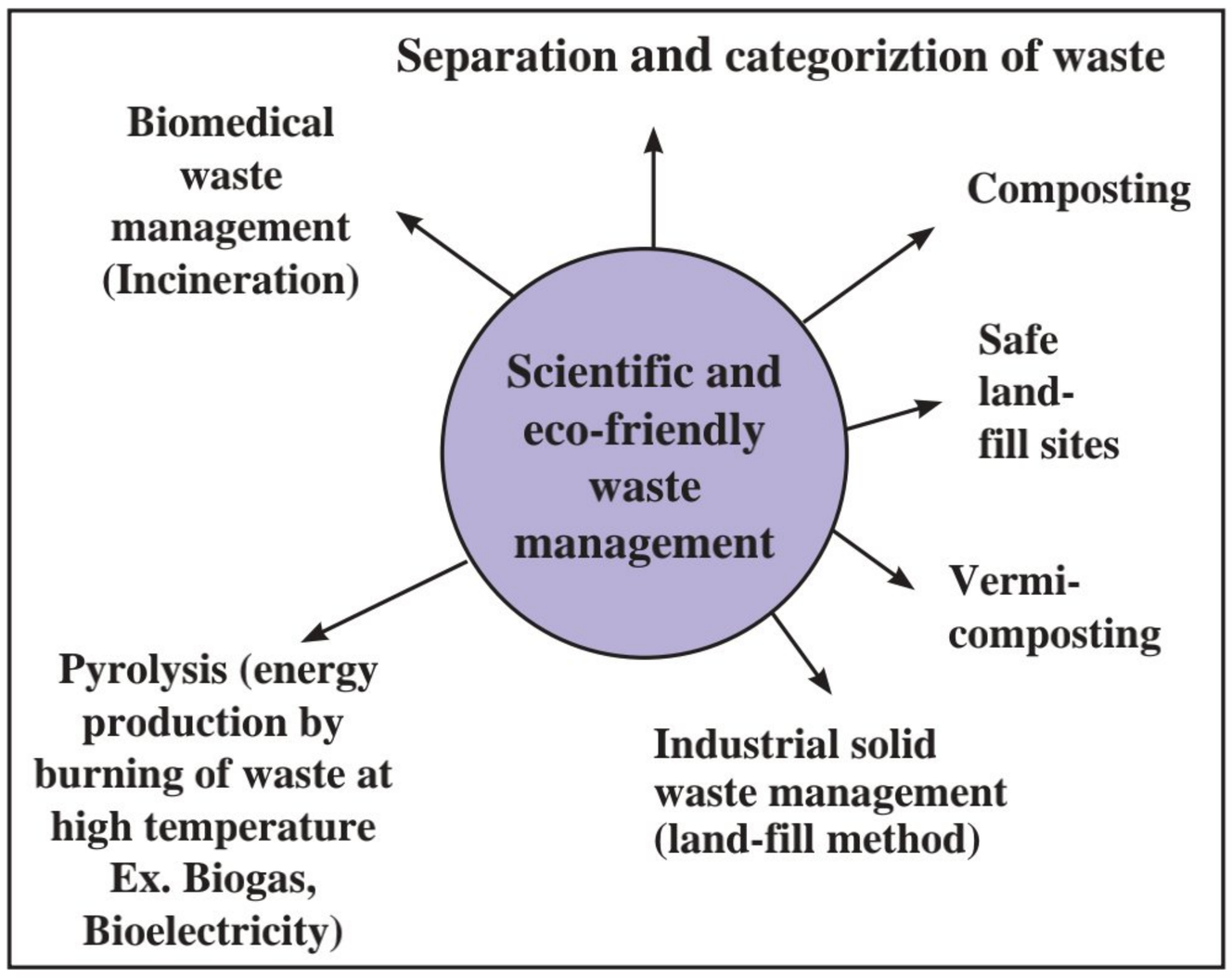


9.4 Harmful effects of solid waste

Necessity of solid waste management :

1. For preventing environmental pollution and to keep the surroundings clean.
2. For energy as well as fertilizer production and through that to generate work and employment opportunities.
3. To reduce the strain on natural resources through treatment of solid waste.
4. To improve the health and quality of life and to maintain environmental balance.

It is the need of the hour to implement solid waste management practices to avoid the possible problems due to solid waste generated from urban and industrial areas and to maintain a clean environment. For this purpose, we should implement measures like increasing the efficiency of production processes so that minimum waste will be generated, reducing garbage production by recycling and reuse of waste materials.



9.5 Solid waste management

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7 Principles of solid waste management -

Reuse

After use materials should be reused for some other proper purposes.

Refuse

Refusal to use articles made from non-degradable articles like plastic and thermocol.

Recycle

Production of useful articles by recycling solid wastes. For example, paper and glass can be recycled.

Rethink

Rethinking our habits, activities and their consequences in connection with the use of various articles of daily use.

Reduce

Restriction the use of resources to avoid their wastage. Old materials should be reused. One thing should be shared by many. Use and throw type of objects should be avoided.

Research

Conducting research realated to reuse of materials that are temporarily out of use.

Regulation and public awareness

Following the laws and rules related to waste management and motivating others to do the same.

Think about it.

Some habits are described below. Do we have those habits? If so, how does it help in waste management?

1. Following the 3 R 'mantra': Reduce (reducing the waste), Reuse (reuse of waste) and Recycle (recycling of waste).
2. Throwing plastic wrappers of chocolates, ice-creams, biscuits, etc. into dustbins. Avoiding littering.
3. Avoiding the use of plastic bags and instead using cloth bags or bags prepared from old sarees, bed-sheets, curtains, etc.
4. Using both sides of a paper for writing. Reusing greeting cards and gift papers.
5. Avoiding use of tissue paper and preferring to use one's own handkerchief.
6. Using rechargeable batteries instead of lead batteries.
7. Implementing various programmes of solid waste management and educating, encouraging the family and society in this regard.
8. Avoiding 'use and throw' type of articles like pens, canned cold drinks, tetra-packs should be strictly avoided.

America is the largest producer of electricity from solid waste. Japan has developed the projects of production of threads, paper and other useful materials from banana peelings. Find out about such projects in our region.

Find out

Which waste management processes are used in your village / town / city?

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Period required for degradation of waste–

Waste Material	Period of Natural Degradation
Banana peelings	3 – 4 weeks
Cloth bags	1 month
Rags	5 months
Woollen socks	1 year
Wood	10 – 15 years
Leather shoes	40 – 50 years
Tin cans	50 – 100 years
Aluminium cans	200 – 250 years
Certain plastic bags	10 lakh years
Thermocol/styrofoam cup	Infinite duration

If the time required for degradation of the solid waste generated around us is long, it seriously affects other environmental factors. What care will you take to avoid this ?

Figure 9.5 A, below shows a method of storing waste and 9.5 B, shows the use of specific dustbins as per the type of waste. Think about how such eco-friendly waste management can be achieved by following these methods in our homes, too.

A

B

9.5 Methods of storing solid waste

A peep into the past.

Ever since ancient times, special attention has been given to garbage disposal. In the Greek city of Athens, in 320 BCE, a law had been enacted regarding garbage disposal. It made throwing garbage in the open an offence.

Disaster management

Can you recall?

1. Which natural calamities have you experienced? How did they affect the conditions in your surroundings?
2. How will you make a plan to be safe from calamities or to minimize the damage?

Various natural disasters like thunderbolts (lightning), floods, fire and man-made disasters like accidents, bomb explosions, chemical accidents in industries, stampedes in mass gatherings, riots, etc. occur around us from time to time. They cause large scale damage to life and property.

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Can you tell?

What are the types of casualties that are seen to occur in differant types of disasters?

First aid to disaster victims :

The main objective of first aid is prevention of death, preventing deterioration of health and starting the process of rehabilitation. Hence, it is important to know about the emergency measures or first aid practices to be followed

Basic principles of first aid :

Life and Rescucitation - ABC

1. **Airway :** If the victim has difficulty breathing, the head should be held in a backward sloping position or the chin should be raised so that the respiratory passage remains open.
2. **Breathing :** If breathing has stopped, the victim should be given artificial ventilation by mouth to mouth rescucitation.
3. **Circulation :** If the victim is unconscious, then after giving mouth to mouth respiration twice, the heart should by pressed down hard by pressing the chest with both the palms. These two actions should be repeated alternately about 15 times. This is called cardio-pulmonary rescucitation (CPR). It helps to bring the circulation back to normal.

Disaster management is action implemented through proper planning, organized activitiy and co-ordination. It includes the following -

1. Prevention of losses and danger.
2. Improving tolerance.
3. Providing relief from disaster, minimising the intensity and extent of harm.
4. Preparation to face the disaster.
5. Immediate action in the disaster situation.
6. Assessment of damages and intensity of the disaster.
7. Arranging for rescue work and help.
8. Rehabilitation and rebuilding.

9.6 Artificial breathing

Bleeding : If the victim is injured and bleeding through the wound, then the wound should be covered with an antiseptic pad and pressure applied on it for 5 minutes with either thumb or palm.

Fracture and impact on vertebrae : If any bone is fractured, it is essential that the fractured part be immobilized. It can be done with the help of any available wooden rods/batons/rulers. If there is an impact on the back or vertebral column, the patient should be kept immobile on a firm stretcher.

Burns : If victims have burn injuries, it is beneficial to hold the injured part under clean and cold flowing water for at least 10 minutes.

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For injuries like sprains, twisting and contusion, the 'RICE' remedy should be applied :

Rest : Allow the victim to sit in a relaxed position.

Ice : Apply an ice-pack to the injured part.

Compression : After the ice-pack treatment, the injured part should be massaged gently.

Elevate : The injured part should be kept in a raised / elevated position.

How to trnsport victims / patients?

Cradle method : Useful for children and under-weight victims.

Carrying piggy back : Useful for carrying patients who are unconscious.

Human crutch method : If one of the legs is injured, the victim should be supported with minimum load on the other leg.

Pulling or lifting method : This is used for carrying an unconscious patient, through a short distance.

Carrying on four-hand chair : This is useful when support is needed for the part below the waist.

Carrying on two-hand chair : Useful for those patients who cannot use their hands but can hold their body upright.

Methods used by the fire-brigade

Stretcher : In an emergency, if a conventional stretcher is not available, then a temporary stretcher can be made using bamboos, blanket, etc.

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Other emergency measures: Boats are used by the civil administration to rescue people trapped in a flooded area. As an emergency measure, wooden boards, bamboo floats, air-filled rubber tube from a tyre can be used to advantage.

Find out

A fire-extinguisher is a portable appliance that can be easily carried anywhere. Various appliances are used to put out a fire. Visit the fire department in your city and collect detailed information. (For more information, refer to lesson 13.)

Exercises

1. Match the items in column 'A' with the proper ones in coloum 'B' and explain their impact on the environment.

Column 'A'	Column 'B'
1. Harmful waste	a. Glass, rubber, carry bags, etc.
2. Domestic waste	b. Chemicals, pigments, ash, etc.
3. Biomedical waste	c. Radioactive material
4. Industrial waste	d. Left over food, vegetables, peelings of fruits.
5. Urban waste	e. Bandages, cotton, needles, etc.

2. Complete the statements using the given options and justify those statements.

(Geographic favourability, climate, weather, observatory)

a. Of the abiotic factors that affect biodiversity by far the most important is ..... .

b. A description of the climatic conditions of short duration in a particular area is ..... .

c. Irrespective of the progress of human beings, we have to think about ..... .

d. Establishments where various climatic factors are recorded are called ..... .

3. Answer the following questions.

a. How is first aid provided to victims of disasters who are injured?

b. State the scientific and eco-friendly methods of waste management.

c. Explain with suitable examples, the relationship between weather forecasting and disaster management.

d. Why is e-waste harmful? Express your opinion about this.

e. How will you register individual your participation in solid waste management?

4. Write notes.

Meteorology, Climatic factors, Monsoon model, Industrial waste, Plastic waste, Principles of first aid.

5. Give examples of the importance of climate in the living world with explanations, in your own words.

6. Explain with suitable examples, the care to be taken when using the methods of transporting patients.

7. Explain the differences.

a. Weather and climate

b. Degradable and non-degradable waste

Activity :

1. Visit a nearby hospital and collect information about how waste is managed.
2. Establish a vermi compost project in your school under the guidance of your teachers.

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10. Information Communication Technology : The new direction of progress

- **Important components of a computer**
- **Different types of software**
- **Importance of information communication in science and technology**
- **Opportunities in the field of computers**

Can you tell?

Which devices do we use directly or indirectly for collecting, sharing, processing and communicating information?

The term Information Communication Technology (ICT) includes communication devices and the use of those devices as well as the services provided with their help. The store of information generated due to the advances in science and technology is increasing at a tremendous rate. If we ignore this explosion in information, the knowledge that we have will become outdated.

Think about it

How is information communication technology important for dealing with the explosion of information?

Devices used in information communication technology : Different devices are used for producing information, for communicating, classifying, saving/storing information, managing information etc. For example, the telephone is used for sharing information by conversing with someone.

Complete the table

The following table has names of some ICT devices. Complete the table based on the questions asked. Also, enter the names of any additional devices that you know of.

Name of the device	What is it used for?	Where is it used?	Benefits from its use
Computer / laptop			
Mobile			
Radio			
Television set			

The computer, which is the most important device for information communication, is considered to have gone through five generations, since it was first created. The computers used during the period between 1946 and 1959 are said to be 'first generation computers.' The ENIAC computer was made in this period. Valves were used in its construction. These valves were large in size. They also consumed a lot of electricity. That generated heat and computers would shut down many times. Today's computers are 5th generation computers.

Find out

Use the Internet to collect information about all the generations of computers and their types. Make a note of the differences in their characteristics.

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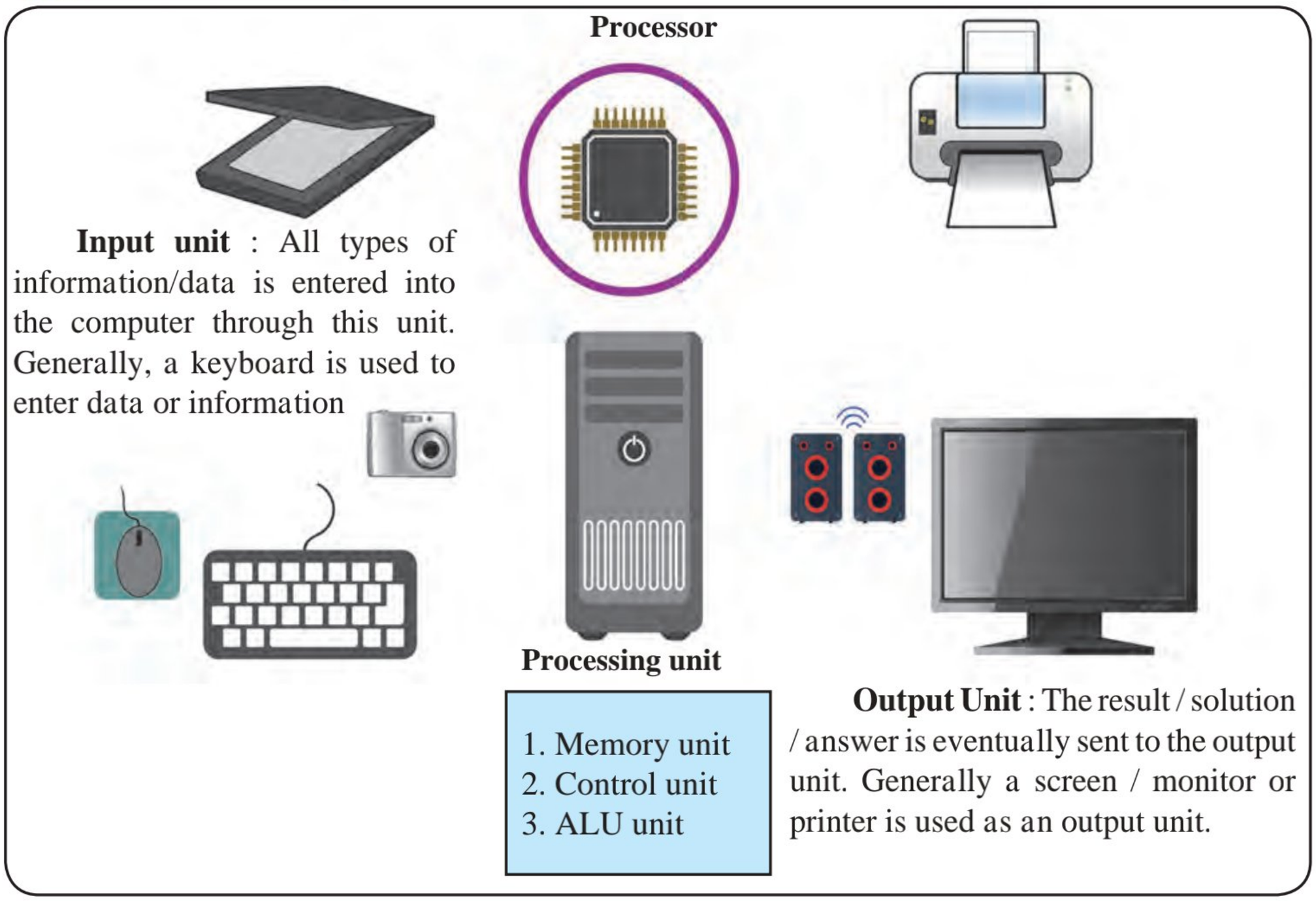
The entry of computers in all fields in this age of technology has been possible only due to the increased speed of computers. In which fields of work eo we see computers being used?

Can you tell? How does a computer work?



10.1 Working of a computer

Important components of a computer

Memory : Memory is the place for storing data obtained from the input and also the generated solution or answer by the computer. There are two types of memories in a computer.

1. Internal Memory 2. External Memory

The internal memory is of two types.

1. RAM (Random Access Memory): This is created from electronic components. Any electronic component can function only as long as it is supplied with electricity.

2. ROM (Read Only Memory): The information stored here can only be read. We cannot make changes to the information originally stored here.

Operating system : This is a program which provides a means of communication between the computer and the person working on it. It is called the DOS (Disk Operating System). We cannot use a computer without its operating system.

Program : A program is a group of commands to be given to a computer.

Data and information : Data is information in its raw (unprocessed) form.

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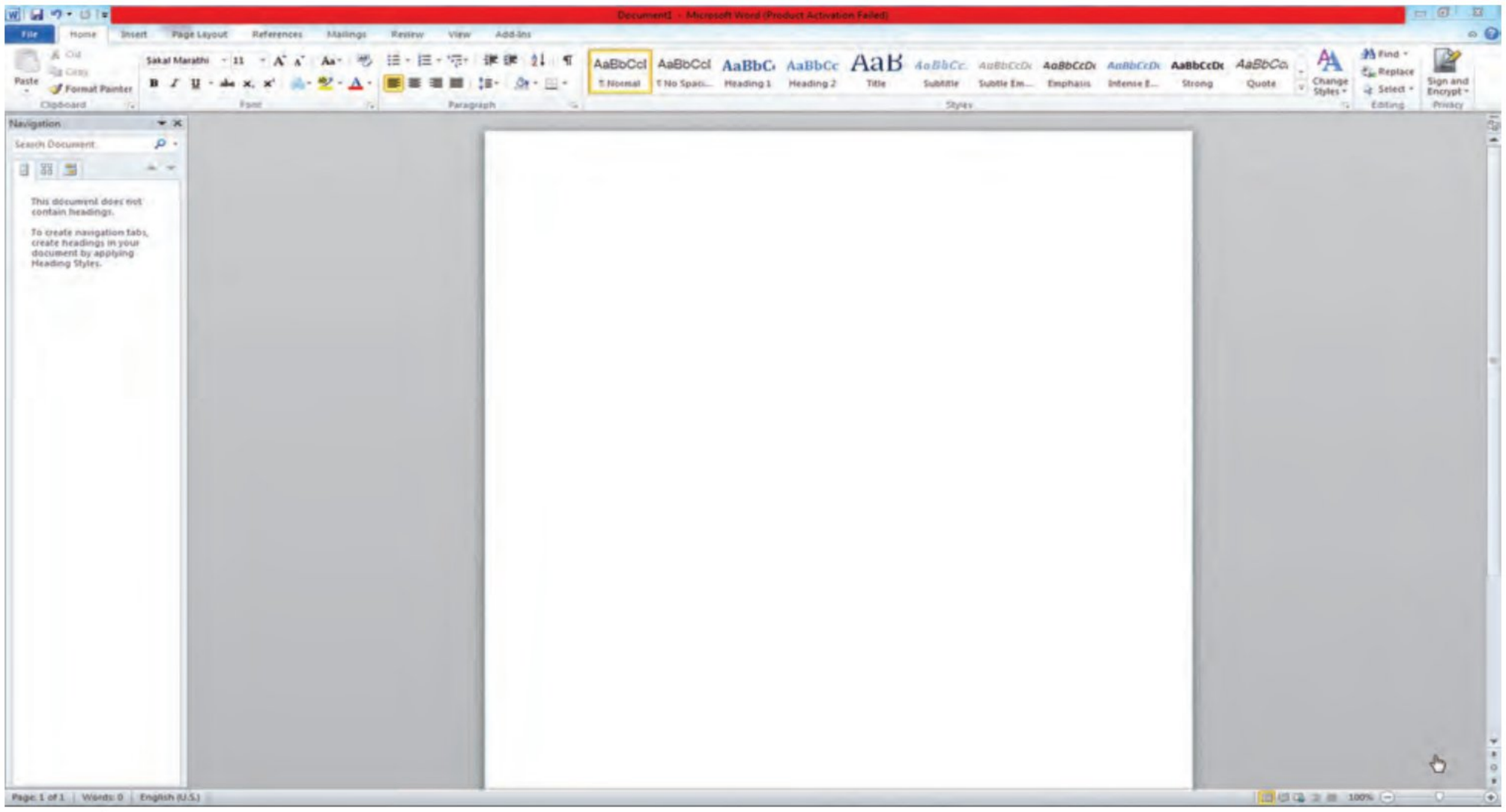
Two main components of computers

Hardware : Hardware consists of all the electronic and mechanical parts used in computers.

Software : Software refers to the commands given to the computer, information supplied to it (input) and the results obtained from the computer after analysis (output).

Make a list and discuss

Make a list of the various hardware and software items of a computer and discuss their working in the class.



Try this **Using Microsoft Word to create a document and write equations.**

1. Click on the icon on the desktop.

2. Select the 'New' option in the 'File' tab, and then select the 'Blank document' option.

3. Type your material on the blank page on the screen using the keyboard. Use the language, font size, bold, etc. options in the Home tab to make the typed material attractive.

4. To type equations in the text, select the 'Equation' option in the 'Insert' tab.

5. Select the proper equation and type it using mathematical symbols.

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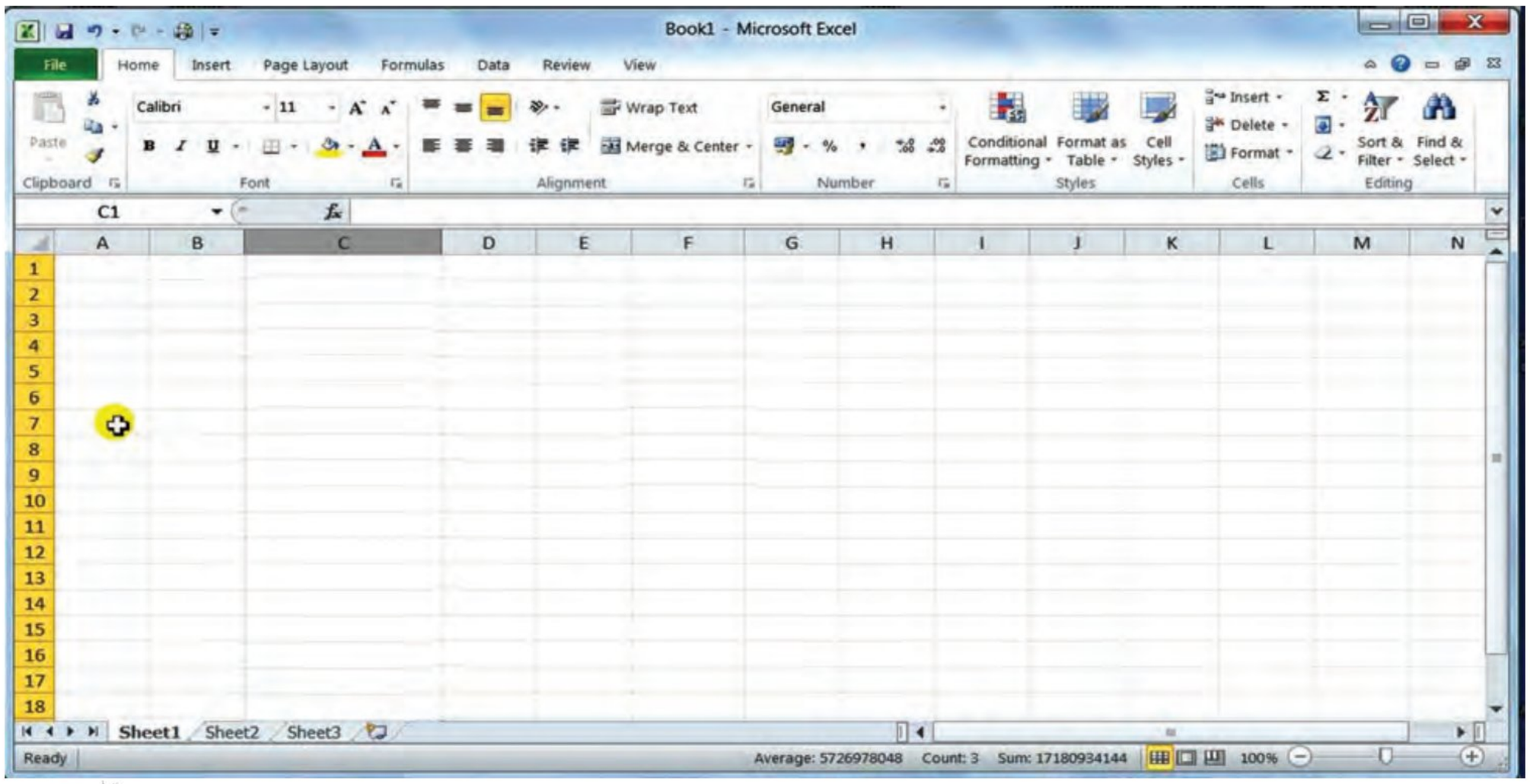
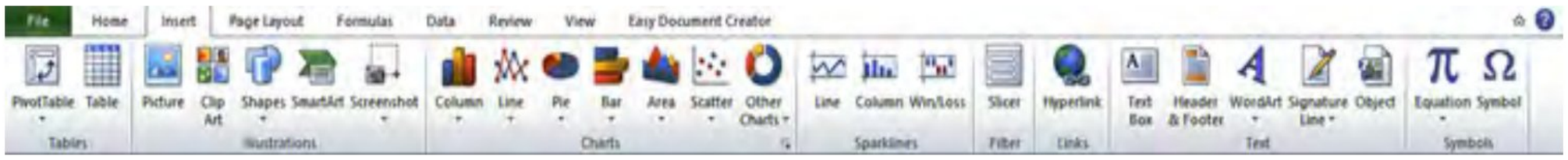


Try this

Using Microsoft Excel to draw graphs based on the obtained numerical information

1. Click on the icon on desktop.

2. Select the 'New' and then 'Blank' option from the 'File' tab.
3. Type the information which is to be used to draw the graph, on the 'sheet' on the screen.
4. After you have finished typing,'Select' the information and click on the required graph in the 'Insert' tab.



5. Analyze the information using the graph.

What precautions will you take when entering data?

1. As far as possible, the data should be kept in tabular form. Different types of data should be entered in different cells. Data should be entered neatly and in one 'flow'. Unnecessary space and special characters should not be used.
2. Many times we 'drag and fill' data. At such times, the 'smart tag' can be used after 'drag data' to fill any data in any manner as required.
3. Once the data has been entered it can be formatted in different ways. Similarly, we can perform different types of calculations, using different formulae.
4. While using a formula, the '=' sign should be typed first. Similarly, no space should be inserted while typing any formula.

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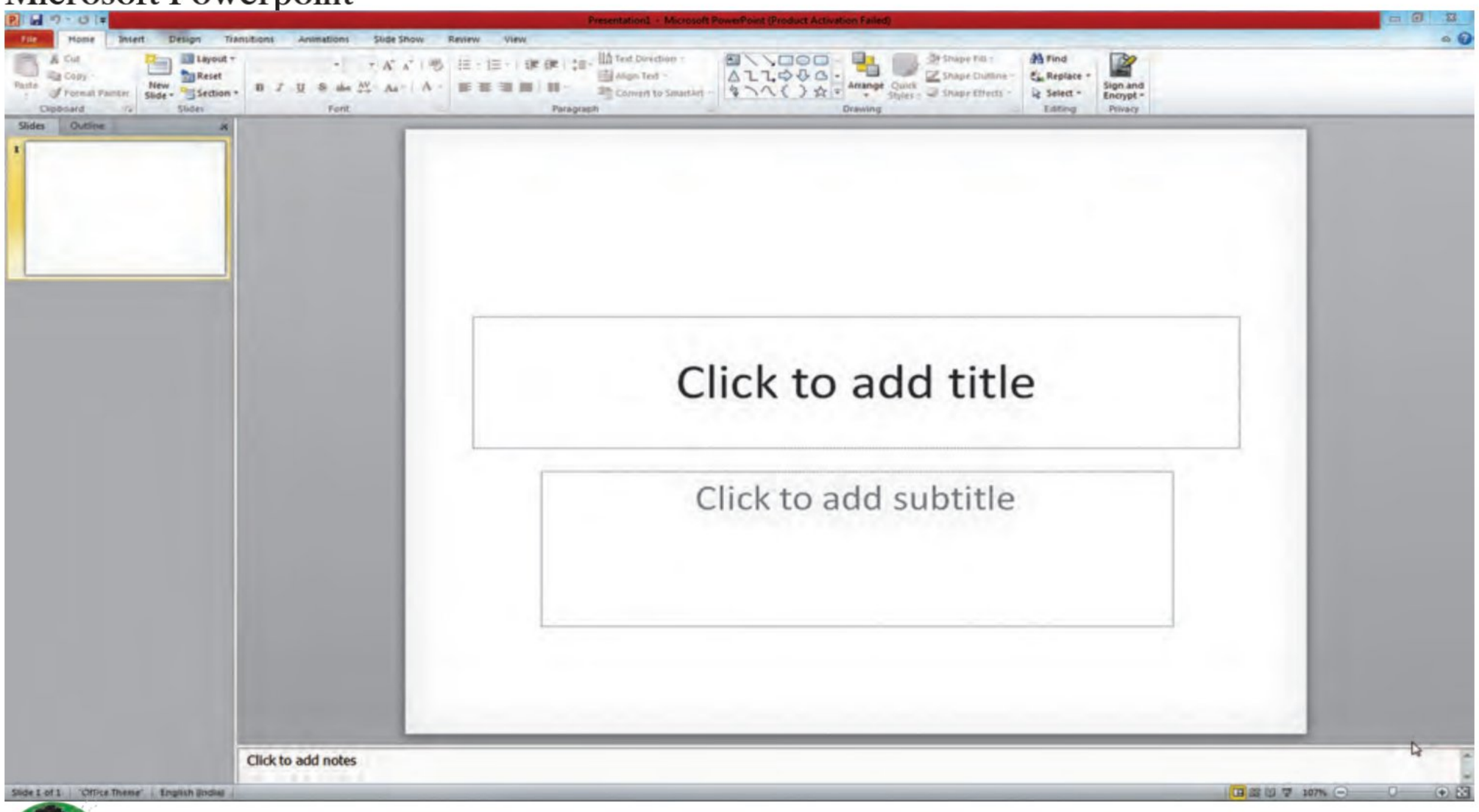
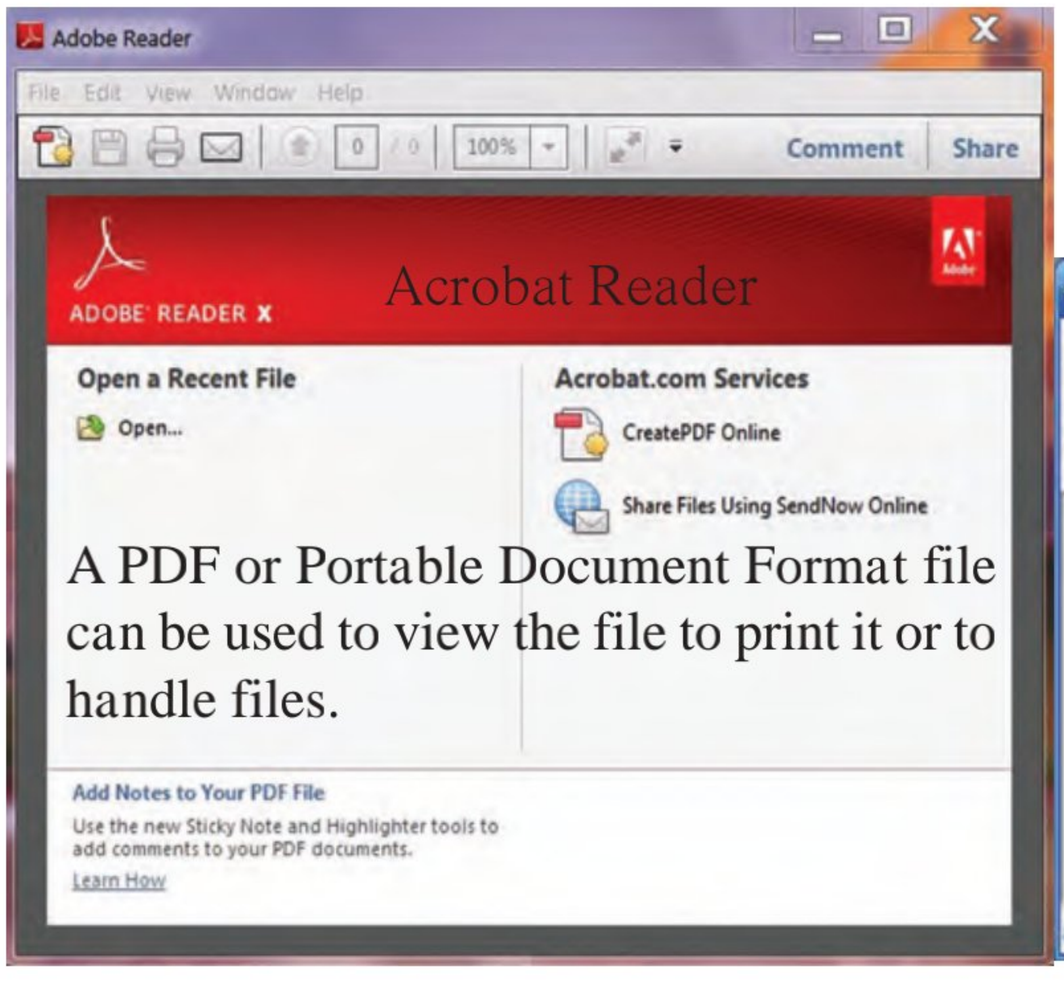
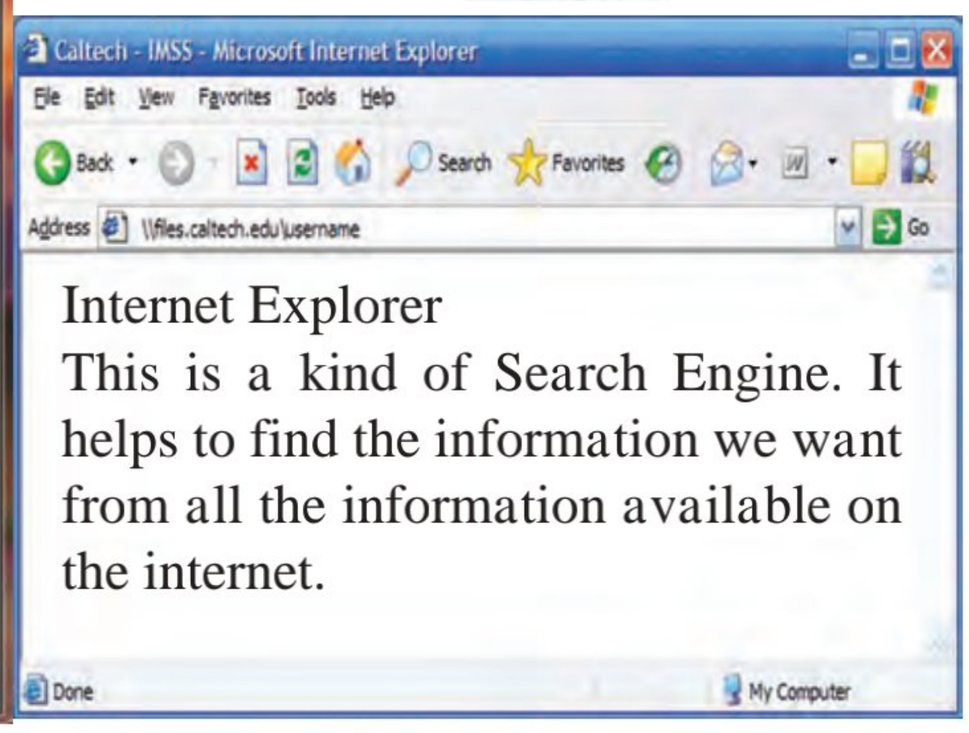
Microsoft Powerpoint



Using Microsoft Powerpoint to create a presentation

1. Click on the icon on the Desktop.
2. You must have with you the material and pictures related to the topic on which you wish to make the presentation.
3. Select the 'New' option under the 'File' tab and choose the 'Blank slide' option. (You can select the kind of slide you need according to your presentation.)
4. Type the information you need on the blank slide and insert pictures.
5. Use the 'Design' tab to design your slide.
6. Use the 'Animation' tab to animate the slide and make a slide show.





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Note: While studying the subject of science and technology you have to actually make use of the information communication technology that you learnt in this lesson. Do take the help of your teachers as well as your parents and friends if you need it.

Some uses of information communication technology are given in the boxes below. What are its other uses?

Demonstration
Some experiments and concepts in science can be demonstrated easily and effectively by using simulation and animation e.g. functioning of the nervous system.

Prediction
Predictions can be made after compiling and processing information e.g. meteorology .

Collecting scientific information
Internet, emails, newsgroups, blogs, chat rooms, Wikipedia, video conferencing, etc.

Opportunities in the of computers field

1. Software field : This is an important field. Having accepted the challenge of creating software, many companies have entered this field. The opportunities in the software field can be classified as follows - application program development, software package development, operating systems and utility development, special purpose scientific applications.

2. Hardware field : Today, there are several companies in our country too, which make computers. They sell computers that they have themselves made. Others sell computers brought from outside as well as repair them and take maintenance contracts to keep computers in big companies working efficiently without a break. Plenty of jobs are available here. There are job opportunities in hardware designing, hardware production, hardware assembly and testing, hardware maintenance, servicing and repairs, etc.

3. Training : The training of new entrants for various jobs is a vast field. It is very important to have dedicated teachers who are competent in the field of computers.

4. Marketing : There are many establishments which make and sell computers and related accessories. They need good sales personnel who are experienced in the working of computers as well as skilled in marketing.

Institutes at work

C-DAC, the welknown Centre for Development of Advanced Computing, situated in Pune, is the leading institute in India which conducts research in the field of computers. The first Indian supercomputer was made with help from this institute. Valuable guidance for making this computer (the Param computer) was received from the senior scientist Vijay Bhatkar. Param means the supreme. This computer can perform one billion calculations per second. It is used in many fields like space research, movements in the interior of the earth, research in oil deposits, medicine, meteorology, engineering, military etc. C-DAC has also participated in developing the ISCII code for writing different language scripts. (Indian Script Code for Information Interchange)

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Exercises

1. Fill in the blanks to complete the statements. Justify the statements.

a. While working with a computer we can read the information stored in its memory and perform other actions in …… memory.

b. While presenting pictures and videos about the works of scientists, we can use ……..

c. To draw graphs based on the quantitative information obtained in an experiment, one uses …..

d. The first generation computers used to shut down because of …….

e. A computer will not work unless …. is supplied to it.

2. Answer the following questions.

a. Explain the role and importance of information communication in science and technology.

b. Which application software in the computer system did you find useful while studying science, and how?

c. How does a computer work?

d. What precautions should be taken while using various types of software on the computer?

e. Which are the various devices used in information communication? How are they used in the context of science?

3. Using a spreadsheet, draw graphs between distance and time, using the information about the movements of Amar, Akbar and Anthony given in the table on page 4 , in the lesson on Laws of Motion. What precautions will you take while drawing the graph?

4. Explain the differences between the different generations of computers. How did science contribute to these developments?

5. What devices will you use to share with others the knowledge that you have?

6. Using information communication technology, prepare powerpoint presentations on at least three topics in your textbook.

Make a flowchart of the steps you used while making these presentations.

7. Which technical difficulties did you face while using the computer? What did you do to overcome them?

Project :

Taking help from your teachers, make a documentary about ISRO the institute mentioned in Chapter 18, using information comunication devices.

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15. Life Processes in Living Organisms

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

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

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

Transportation

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

Transportation in plants

Discuss

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

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

Use your brain power !

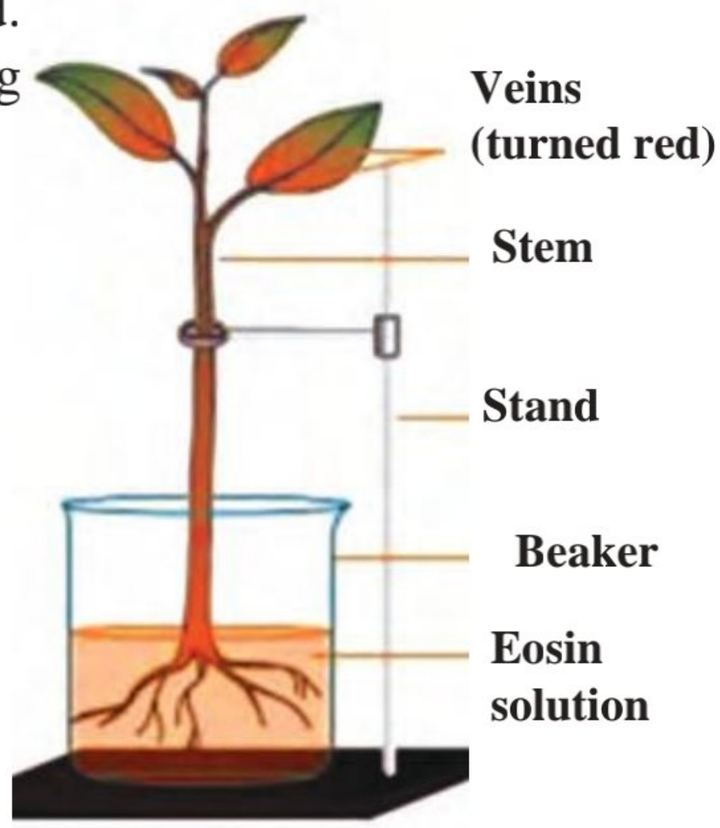
Which types of plant tissues are xylem and phloem?

Transportation of water in plants :

Try this

Root pressure

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



15.1 Root pressure

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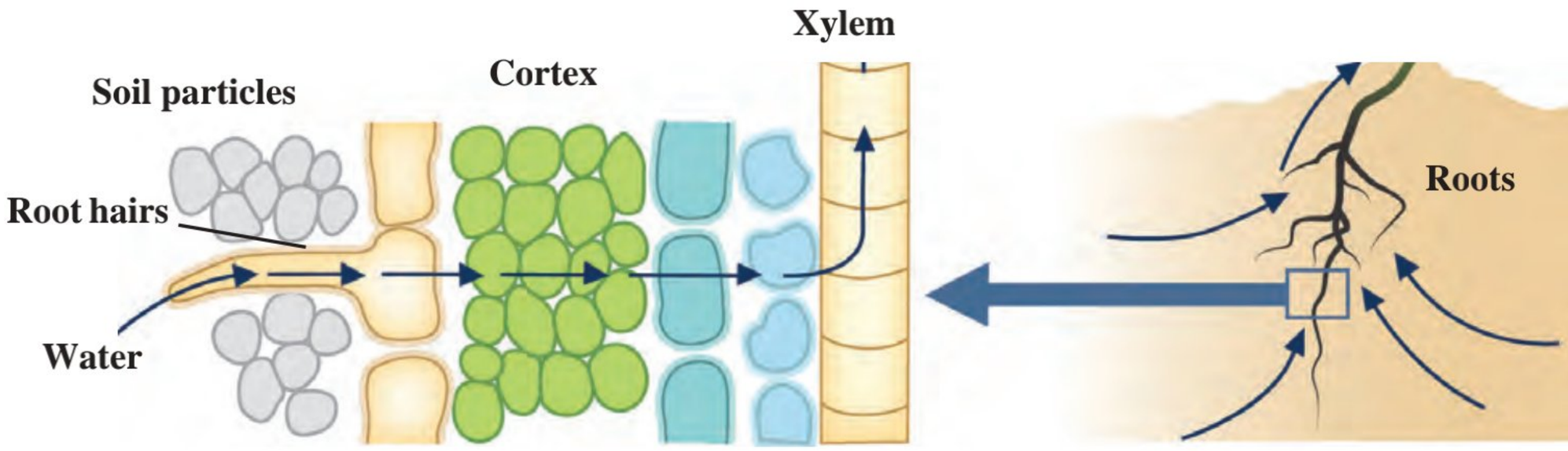
Observe

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



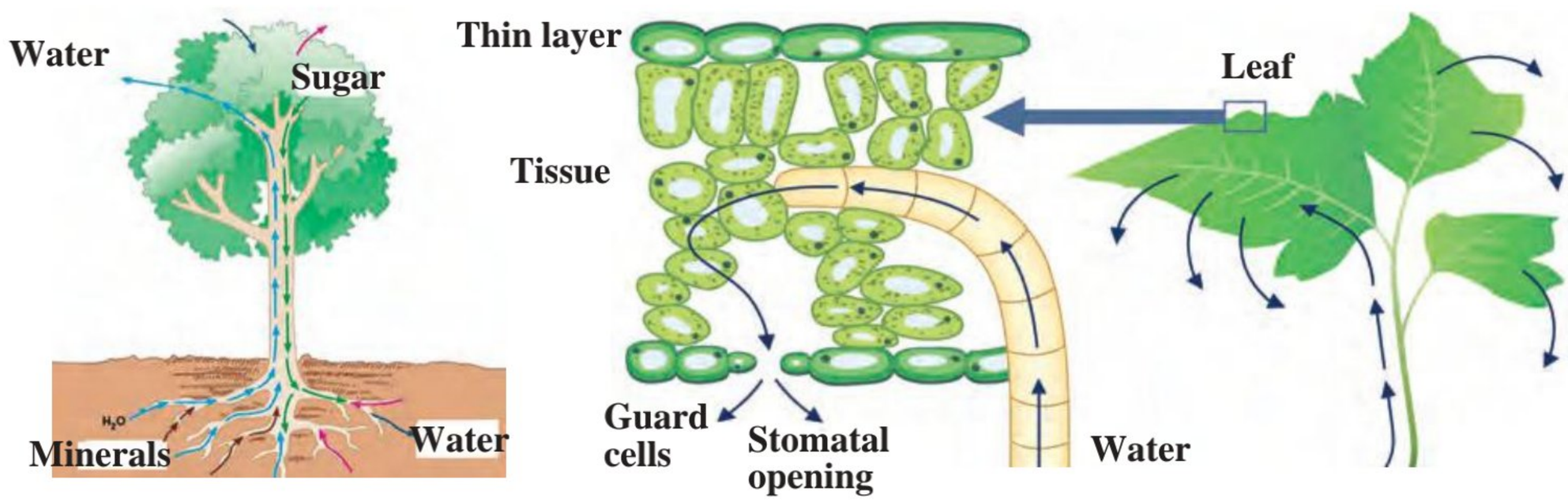
15.2 Absorption with the help of roots

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

Transpiration pull

Can you recall?

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



15.3 Transpiration through Leaves

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

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Do you know?

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

Transportation of food and other substances in plants :

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

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

Excretion

Think about it

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

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

Always remember

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

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Excretion in plants

Can you tell? Why does this happen?

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

15.4 Leaf fall

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

Observe and find out.

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

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

15.5 Gum and latex

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

Excretion in human beings

Can you tell?

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

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

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

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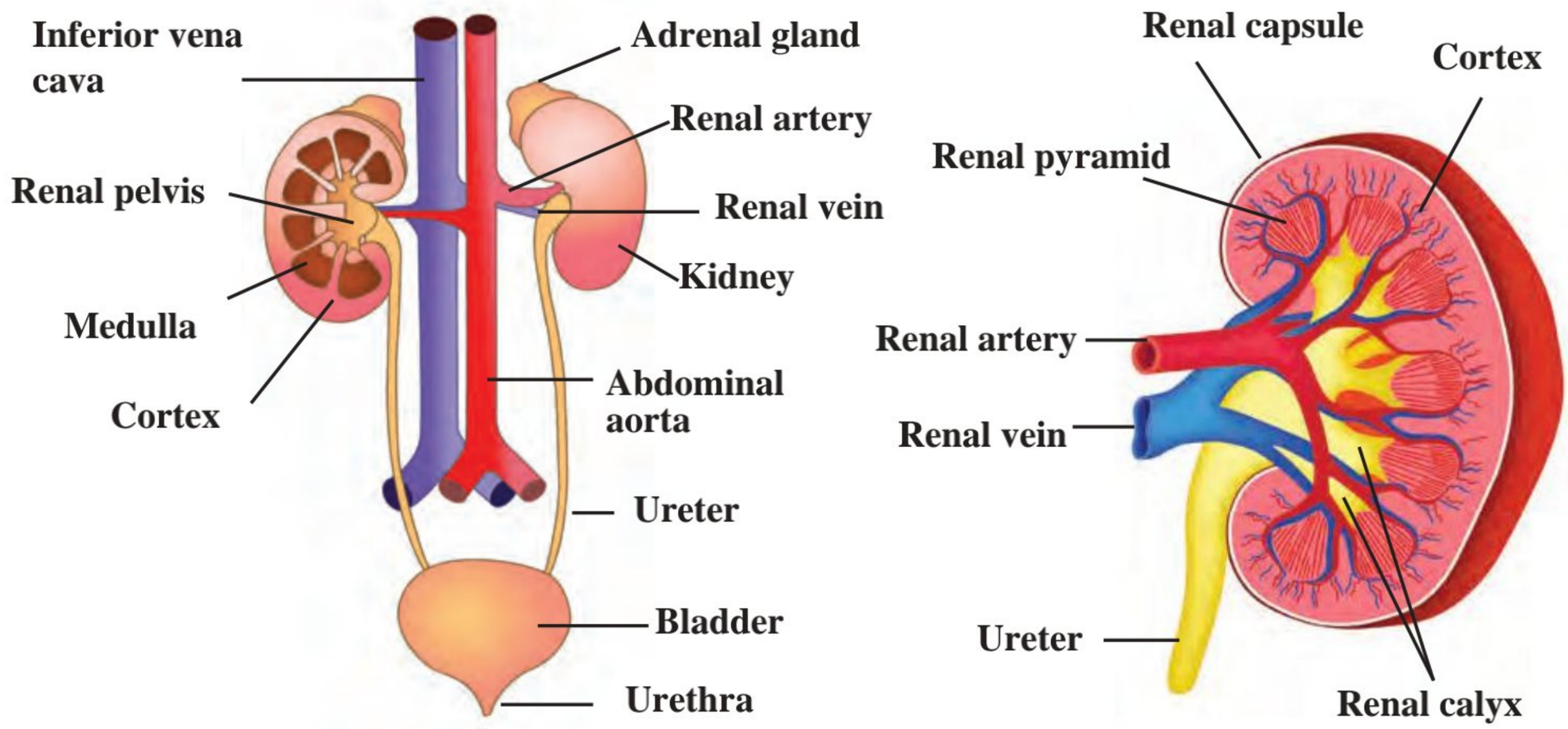
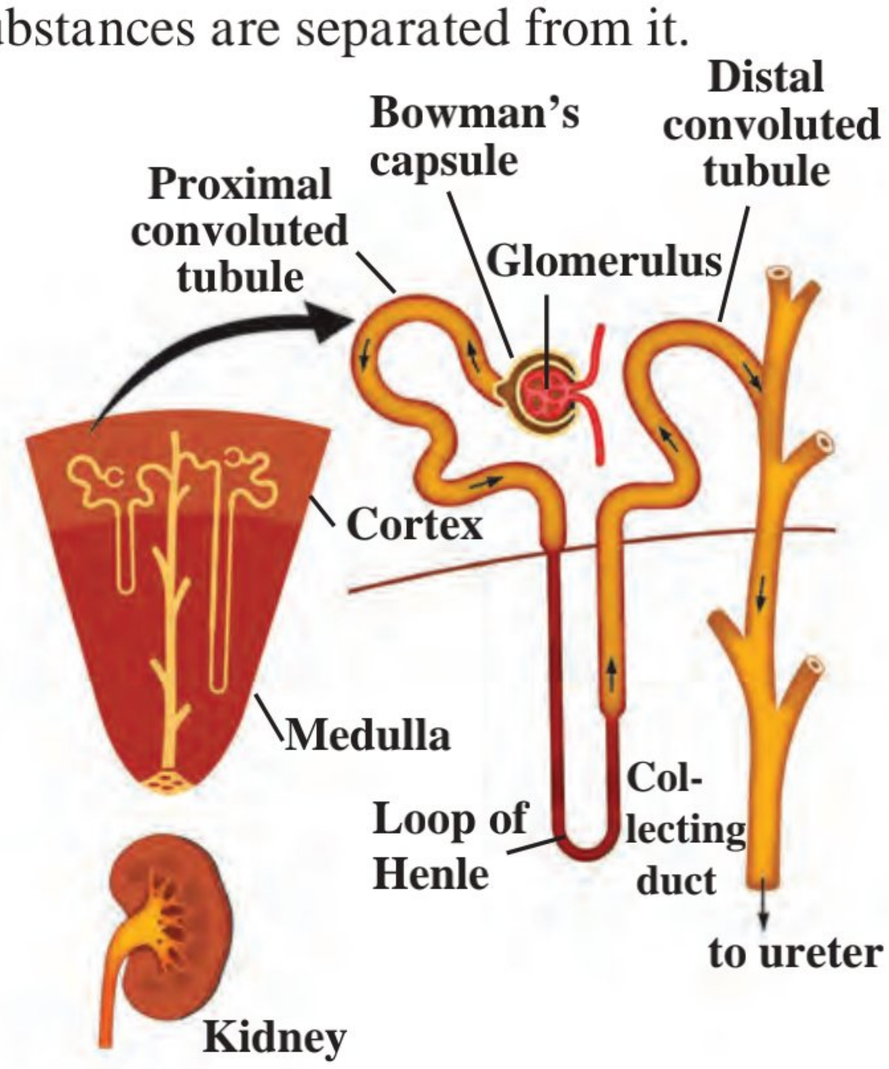


15.6 Excretory system and kidneys

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



15.7 Nephron

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

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

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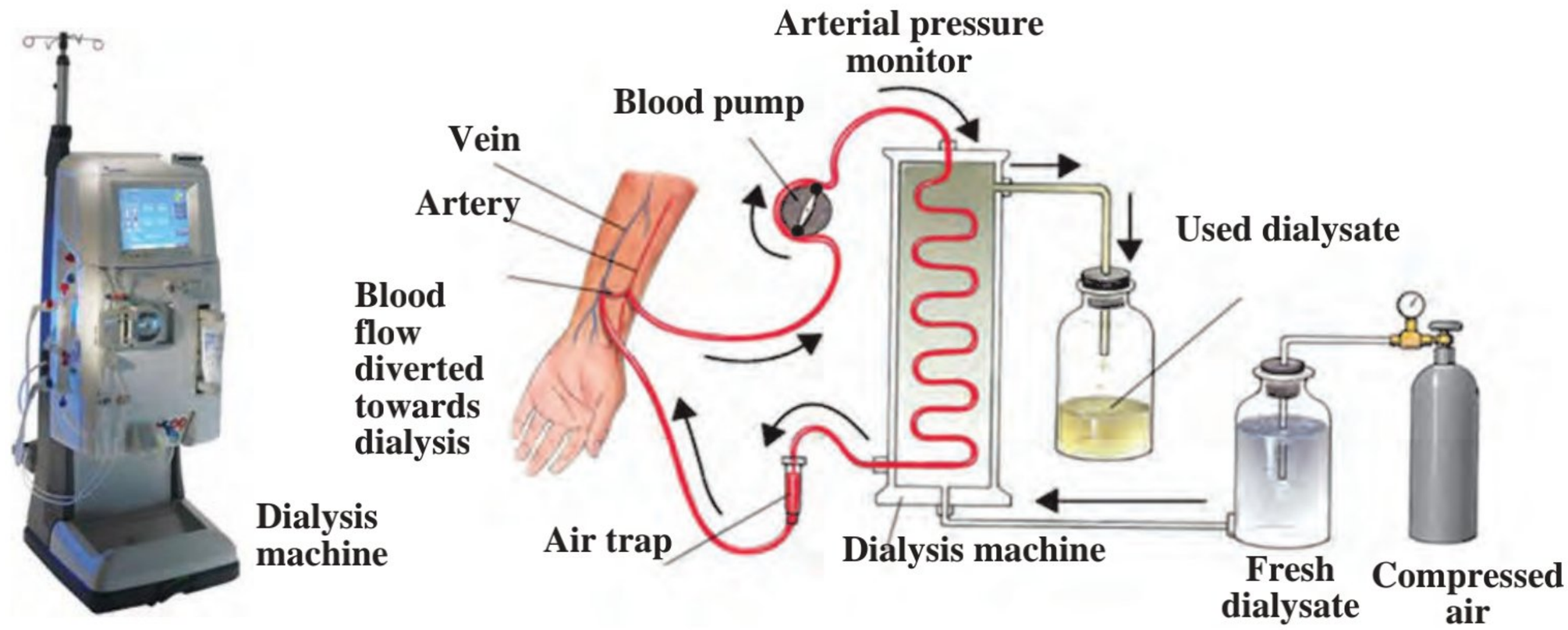
Dialysis



15.8 Dialysis of blood

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

Use your brain power !

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

Co-ordination

Think about it

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

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

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

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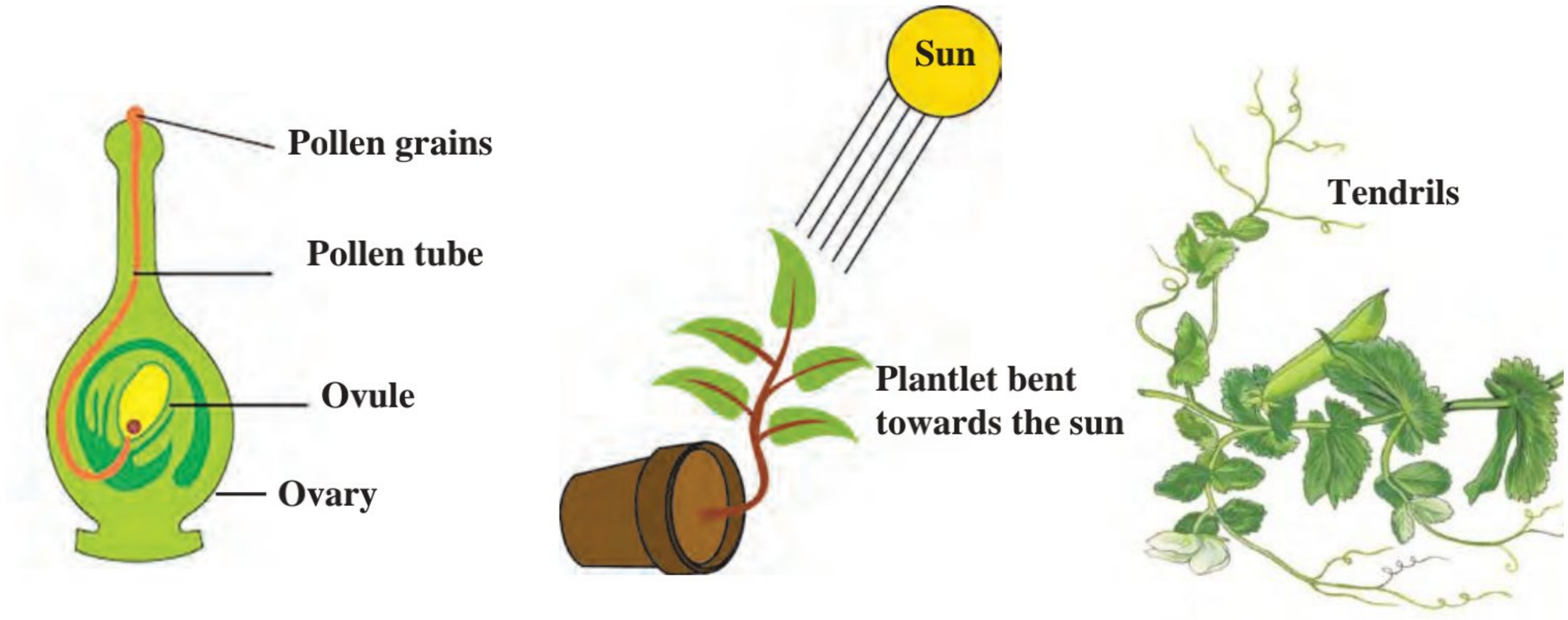
Co-ordination in plants

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

Observe Observe the following figures carefully.



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

15.9 Co-ordination in plants

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

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

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

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

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

Do you know?

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

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Observe Observe the pictures carefully and think about them.

Touch-me-not

Venus fly trap

Lotus

Balsam

15.10 Various plants

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

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

Do you know?

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

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

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

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

Co-ordination in human being

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

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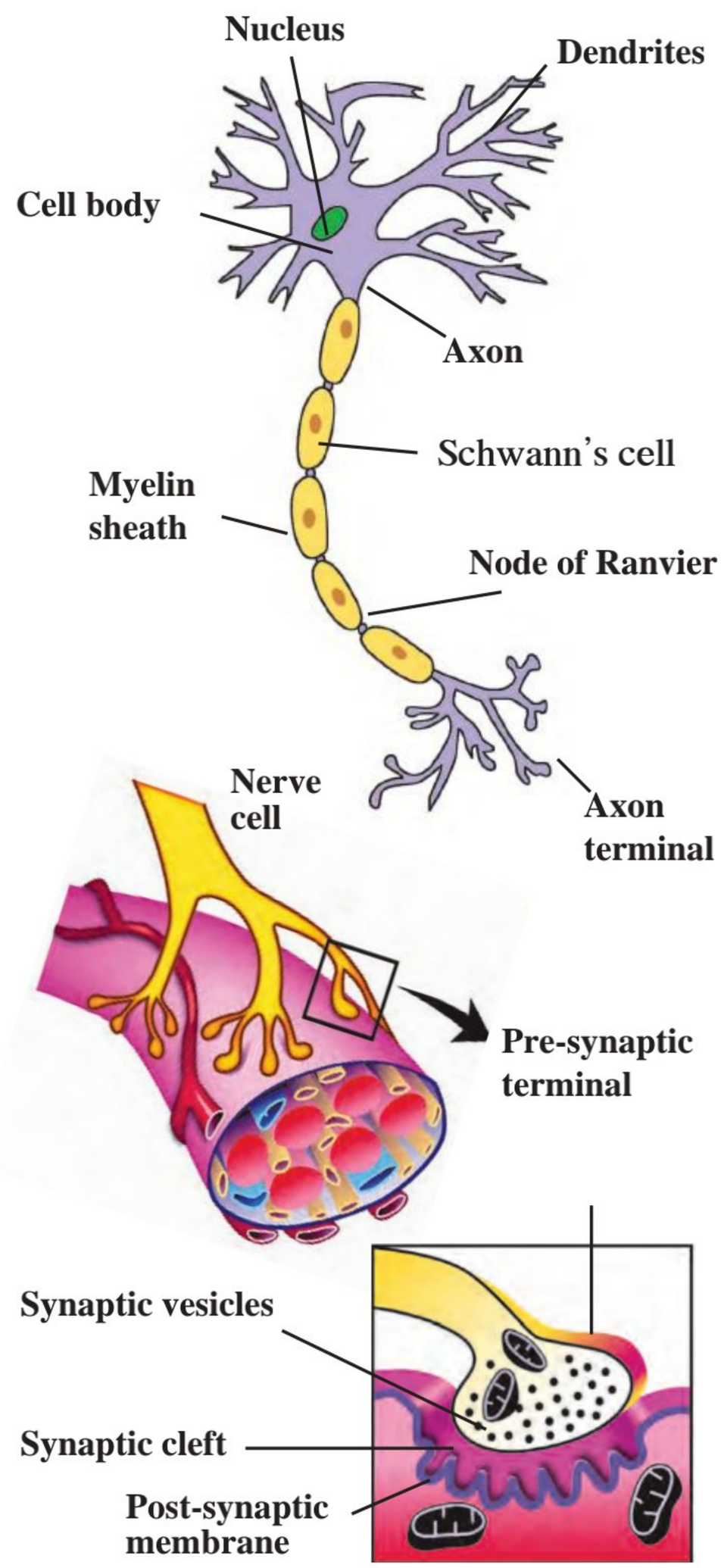
Different processes go on simultaneously in the human body. All these process need to be efficiently and effectively conrolled and co-ordinated. This is done with the help of two systems.

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

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

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



15.11 Nerve cell and neuro-muscular junction

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

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

Can you tell?

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

Types of nerve cells/neurons

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

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

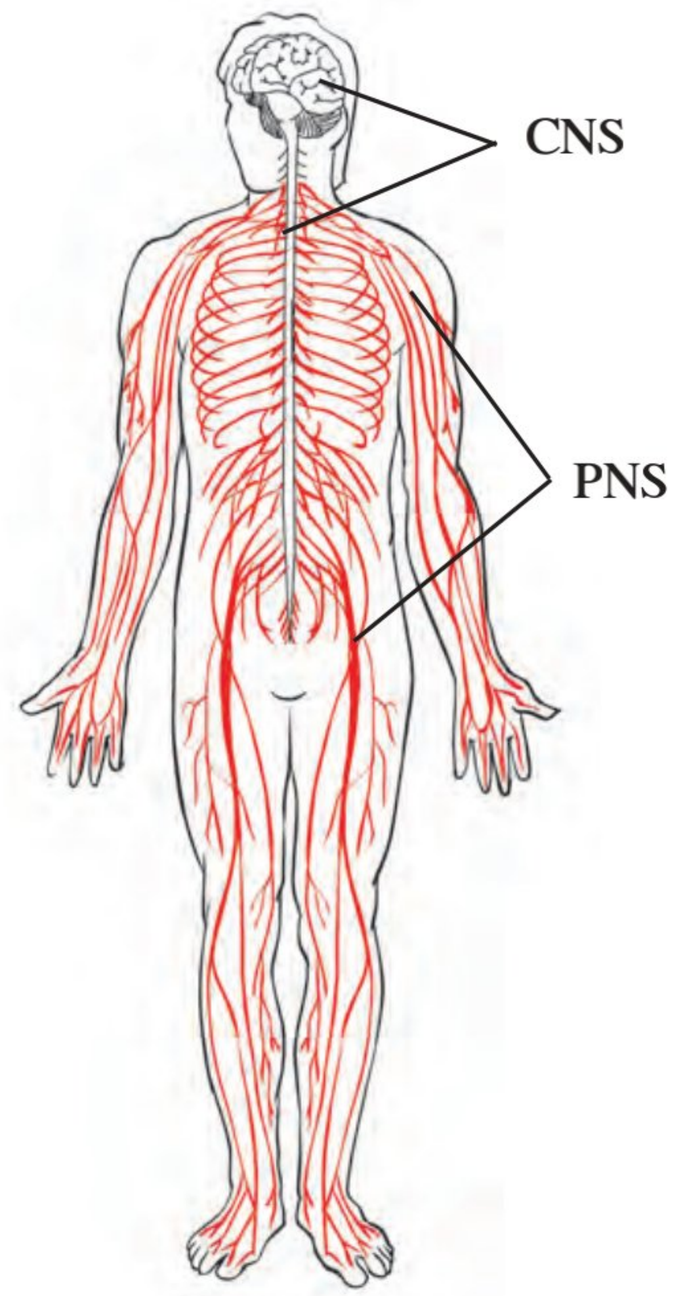
The human nervous system

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

1. Central nervous system

2. Peripheral nervous system

3. Autonomic nervous system



15.12 Human nervous system

Central Nervous System or CNS

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

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

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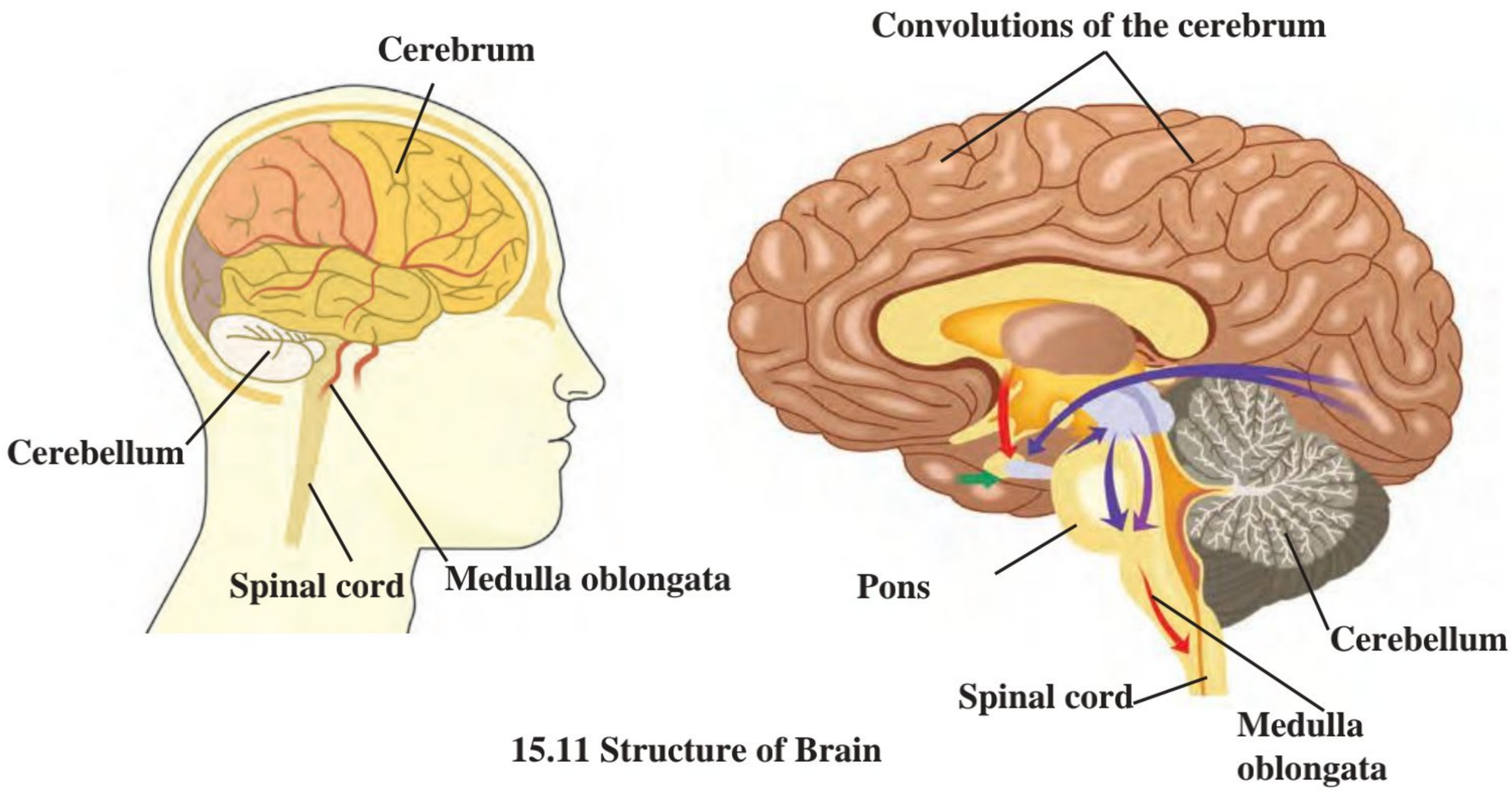
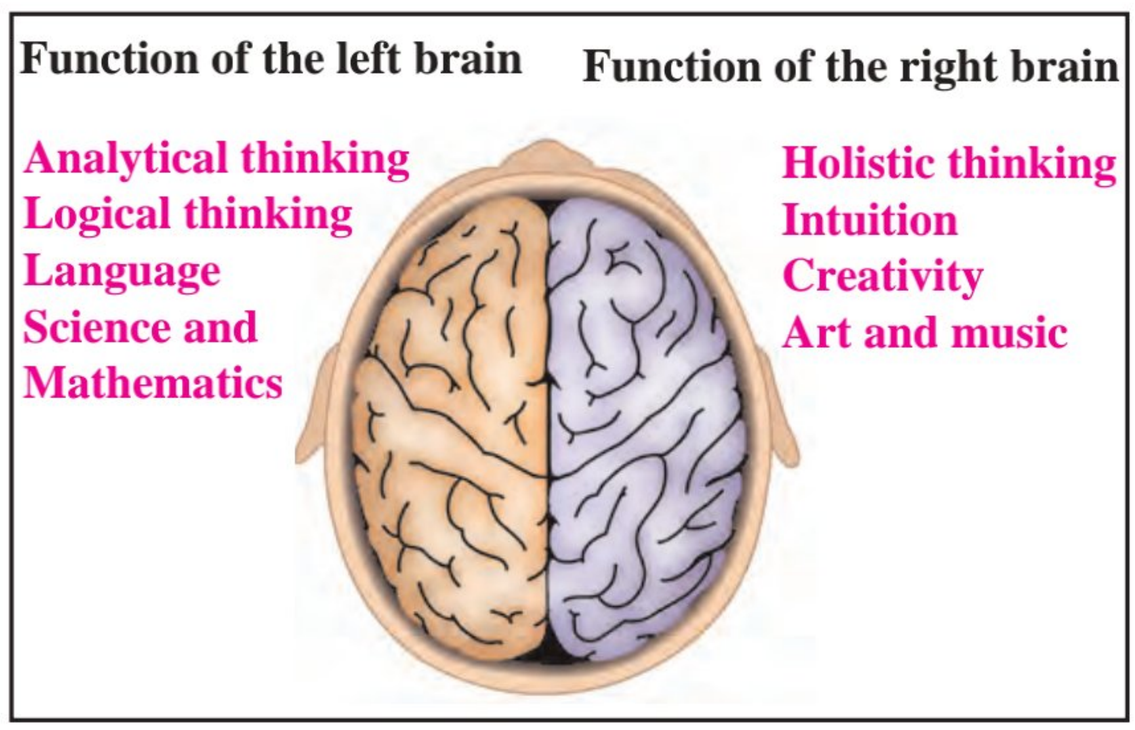


15.11 Structure of Brain

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

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



15.14 Left and right sides of brain

Cerebrum :

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

Cerebellum :

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

Medulla oblongata :

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

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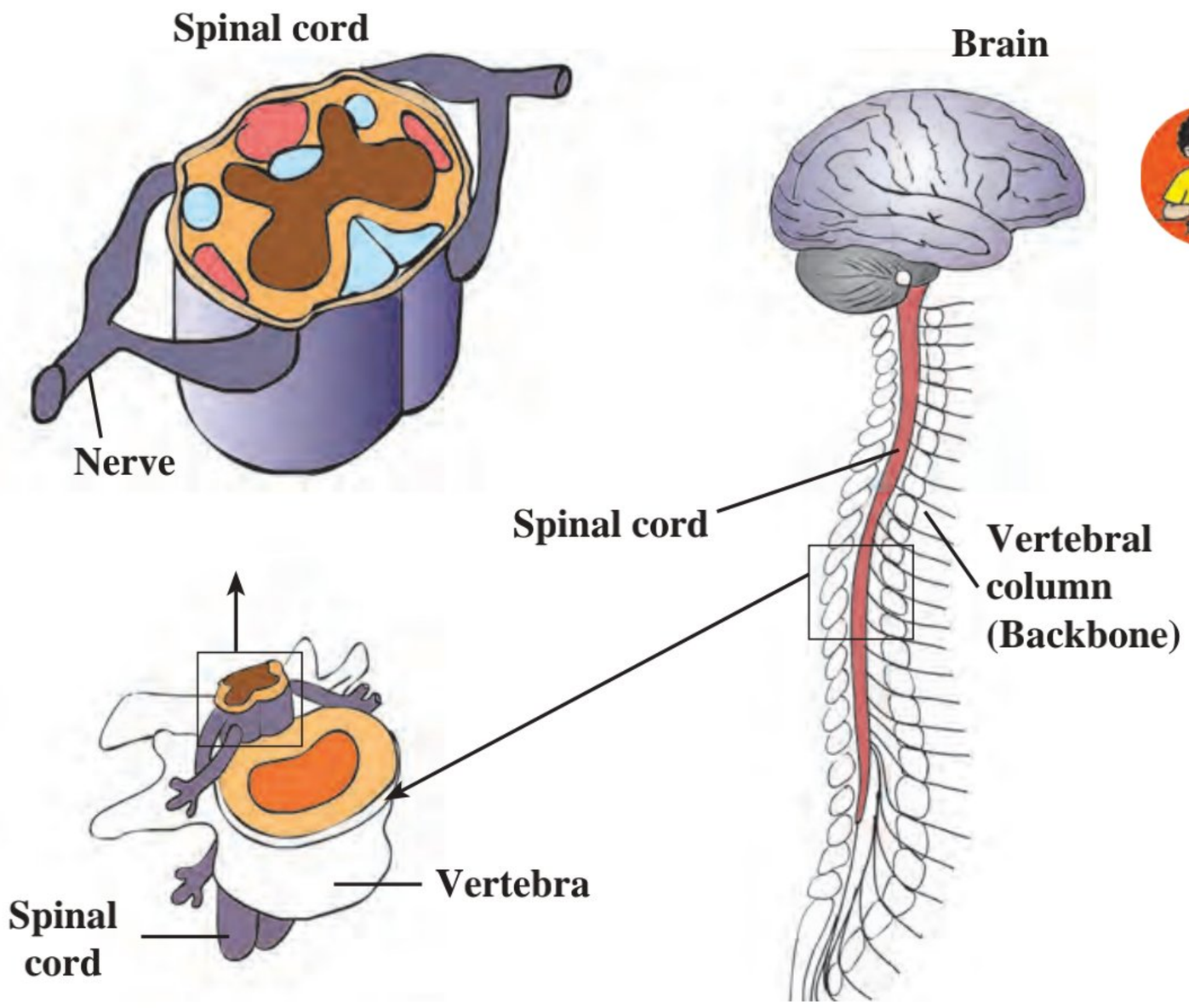
Think about it An injury to the medulla oblongata can lead to death. Why?

Spinal cord

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



15.15 Brain and spinal cord

Find out.

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

Brain: different regions and functions

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

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Peripheral nervous system

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

A. Cranial nerves

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

B. Spinal nerves

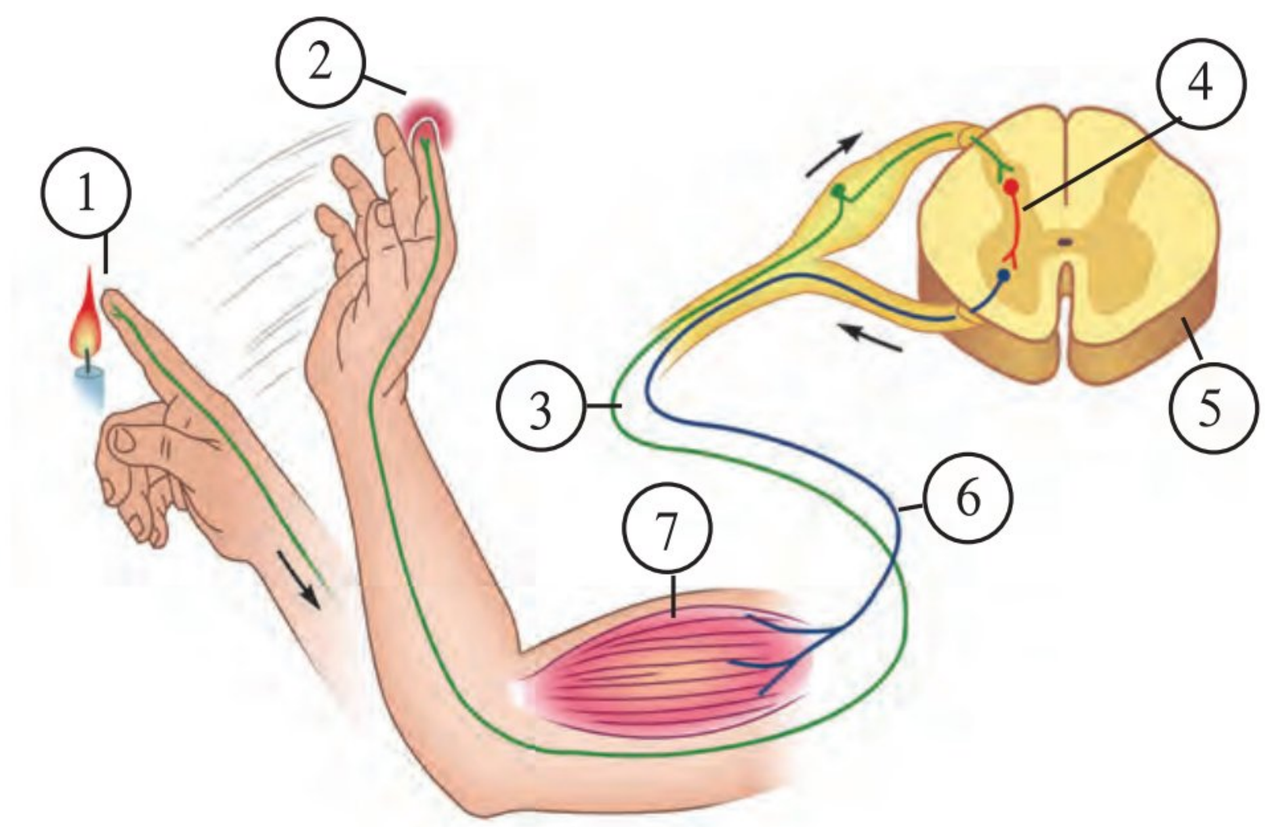
Nerves originating from the spinal cord are called spinal nerves. These are associated with arms, legs, skin and some other parts of the body. There are 31 pairs of spinal nerves.

3. Autonomic nervous system

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

Reflex action

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



15.16 Reflex action

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

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

Try this

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

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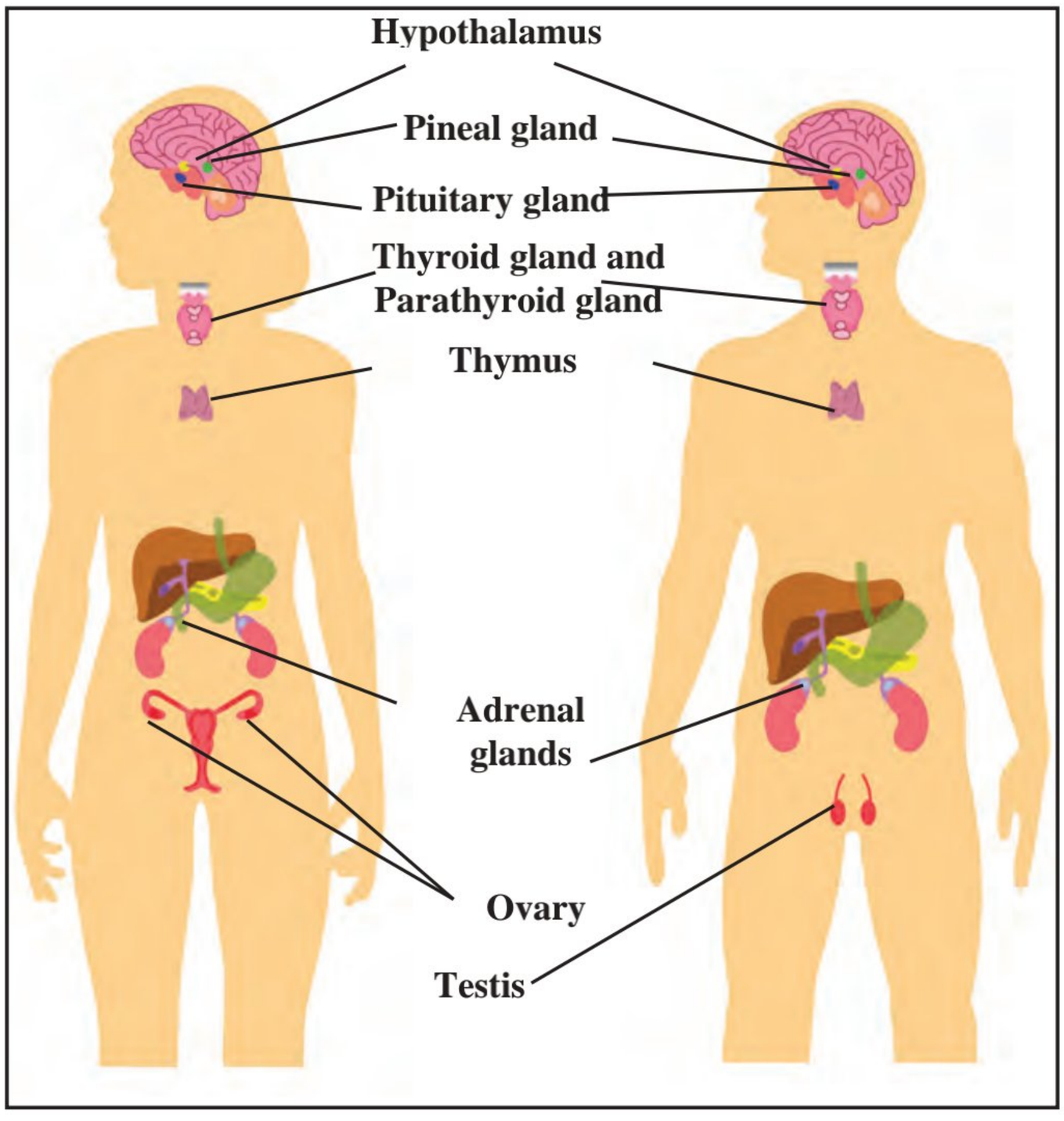
B. Chemical control

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

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



15.17 Endocrine glands

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

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

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Exercises

1. Match the pairs and explain.

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

2. Complete the paragraph.

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

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

3. Write notes on-

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

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

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

5. Draw and label the diagrams.

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

6. Answer the following.

a. Explain chemical co-ordination in humans and give the names and functions of some hormones.

b. Explain the difference between the excretory system of humans and plants.

c. Explain co-ordination in plants with the help of suitable examples.

7. Explain in your own words with suitable examples.

a. What is meant by co-ordination?

b. How does excretion occur in human beings?

c. How is excretion in plants useful to human beings?

d. Describe the transportation system in plants.

Activity :

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

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16. Heredity and Variation

- **Inheritance**
- **Heredity: Characteristics and their appearance**
- **Mendel's laws of inheritance**
- **Diseases due to chromosomal aberrations**

Think about it

1. Do all the boys and girls of your class look alike?
2. Think about the following characteristics and note similarities and differences. (Teachers should help in this activity.)

Sr. No.	Personal characteristics	Own	Grandfather	Granmother	Father	Mother
1	Colour of skin					
2	Shape of face (Round/ Oblong)					
3	Height					
4	Colour of eyes					
5	Orientation of thumb					

Earlier, we have seen that there is great variation within every species in nature. In this chapter, we shall study the factors that give rise to these variations.

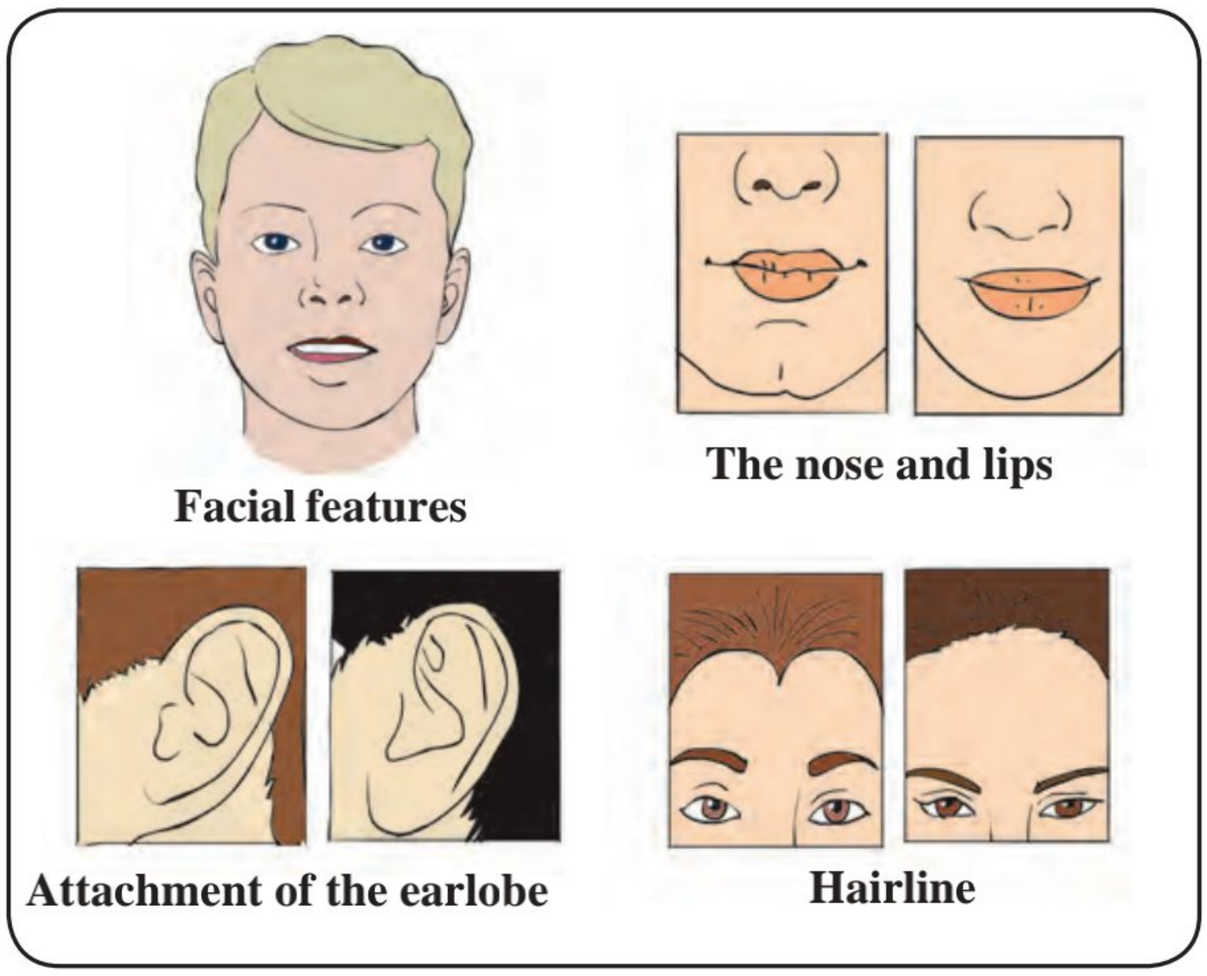
Inheritance

The branch of biology which studies the transfer of characteristics of organisms from one generation to the next, and genes in particular, is called 'genetics'.

New progeny is formed through the process of reproduction. Except for a few minor differences, the offspring shows great similarities with parents. Organisms produced by asexual reproduction show minor variations. However, offspring produced through sexual reproduction, show comparatively greater variations.

Observe

1. Carefully observe your classmate's earlobes.
2. Irrespective of all of us being humans, what difference do you notice in our skin colour?
3. All of you are in std. IX. Why then are some students tall and some short?



16.1 Some differences in facial features

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Heredity :

Transfer of characteristics from parents to offspring is called heredity. It is due to heredity that puppies are similar to dogs, squabs are similar to pigeons and infants are similar to humans.

Inherited traits and expression of traits :

Can you tell? How do specific traits or characteristics appear in organisms?

Though there are many similarities between parents and their offsprings there are some differences too. These similarities and differences are all the effect of heredity. Let us study the mechanism of heredity. Information necessary for protein synthesis in the cell is stored in DNA. The segment of DNA which contains all the information for synthesis of a particular protein is called a 'gene' for that protein. It is necessary to know the relationship of these proteins with the characteristics of organisms.

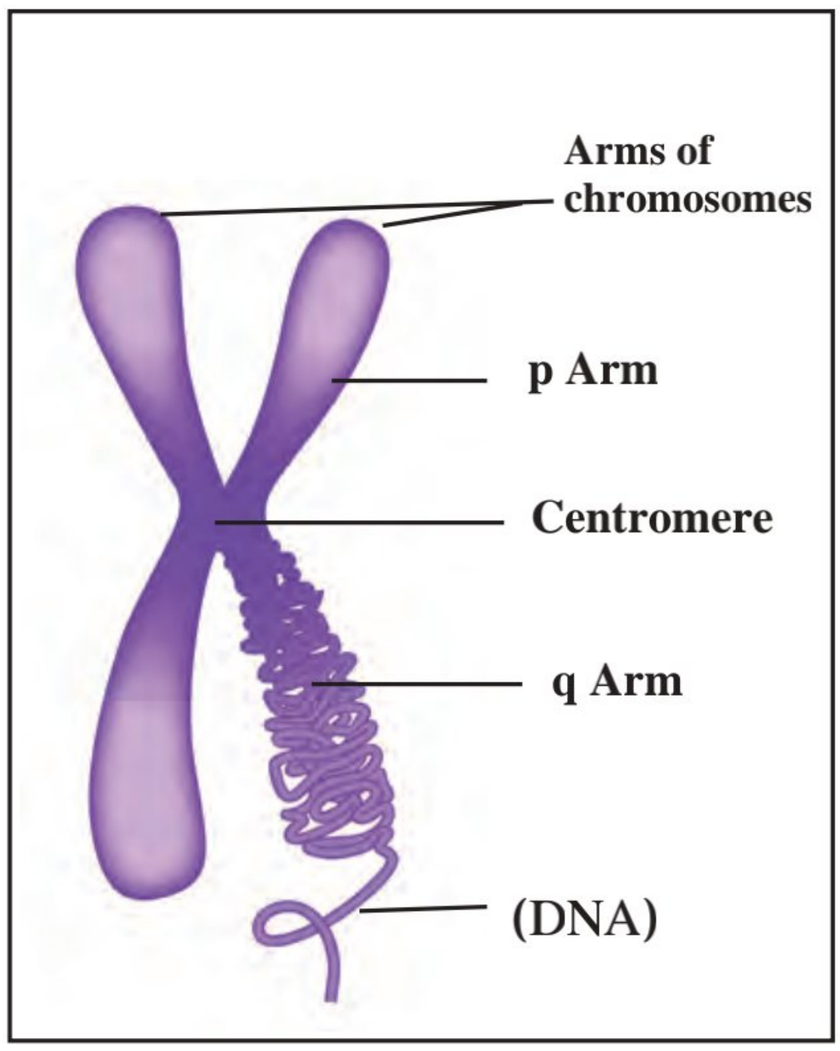
To understand the concept of heredity let us consider the characteritic 'plant height'. We know that there are growth hormones in plants. Increase in height of plants depends upon the quantity of growth hormones.

The quantity of growth hormones produced by a plant depends upon the efficiency of the concerned enzyme. Efficient enzymes produce a greater quantity of the hormone due to which the height of the plant increases. However, if the enzymes are less efficient, a smaller quantity of hormone is produced leading to a stunting of the plant.

Chromosomes

The structure in the nucleus of cells that carries the hereditary characteristics is called the chromosome. It is made up mainly of nucleic acids and proteins. During cell division chromosomes can be clearly seen under the compound microscope. 'Genes' which contain the information about hereditary characteristics in coded form are located on chromosomes. Each species has a specific number of chromosomes.

Each chromosome is made up of DNA and it appears dumbell-shaped midway during cell division. There is a constricted region on each chromosome. It is called the **'Primary constriction'** or **'Centromere'**. This divides the chromosome into two parts. Each part is called an 'arm'. The centromere has a specific position in each chromosome. Depending upon this, there are four types of chromosomes.



16.2 Organization of chromosome

Types of chromosomes :

Find out

Number of chromosomes in different organisms

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Types of chromosomes can be easily identified during cell division.

1. Metacentric : The centromere is exactly at the mid-point in this chromosome, and therefore the chromosome looks like the English letter 'V'. The arms of this chromosome are equal in length.

2. Sub-metacentric : The centromere is somewhere near the mid-point in this chromosome which therefore looks like English letter 'L'. One arm is slightly shorter than the other.

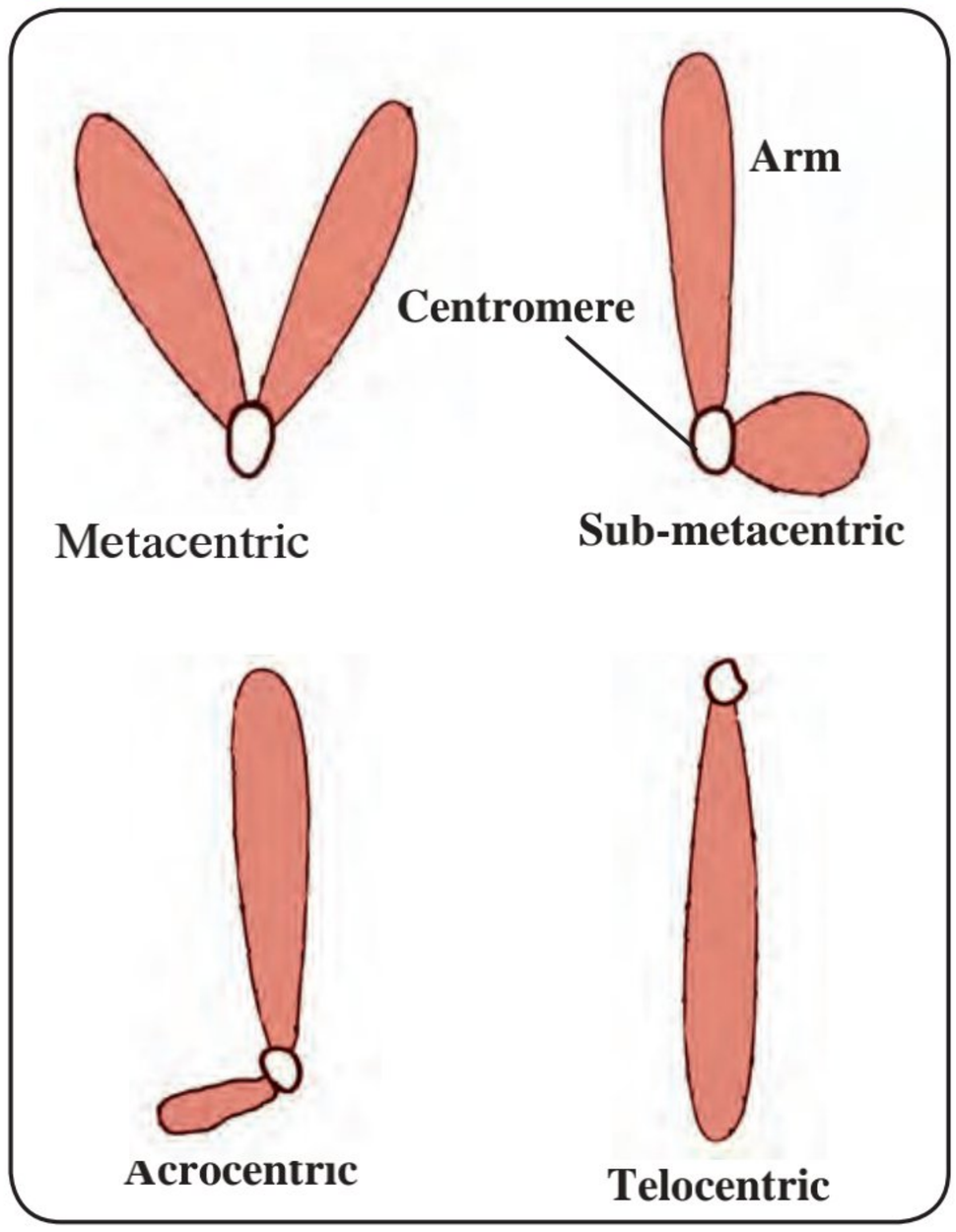
3. Acrocentric : The centromere is near one end of this chromosome which therefore looks like the English letter 'j'. One arm is much smaller than other.

4. Telocentric : The centromere is right at the end of this chromosome making the chromosome look like the English letter 'i'. This chromosome consists of only one arm.

Generally, in somatic cells chromosomes are in pairs. If the pair consists of similar chromosomes by shape and organization, they are called **'homologous chromosomes'** and if they are not similar they are called **'heterologous chromosomes'.** In case of organisms that reproduce sexually one of the chromosomal pairs is different from all than others. Chromosomes of this different pair are called **'sex chromosomes'** or **allosomes** and all other chromosomes are called **'autosomes'**.

Chromosome number of some organisms has been given in the following table -

Sr. No.	Organism	No. of Chromosomes
1	Crab	200
2	Maize	20
3	Frog	26
4	Roundworm	04
5	Potato	48
6	Human	46



16.3 Types of chromosomes

Deoxyribonucleic acid (DNA)

Chromosomes are mainly made up of DNA. This acid was discovered by the Swiss biochemist, Frederick Miescher in 1869 while studying white blood cells. Initially this acid was reported to be only in the nucleus of cells. Hence, it was named nucleic acid. However, it was later realized that it is present in other parts of the cell too. Molecules of DNA are present in all organisms from viruses and bacteria to human beings. These molecules control the functioning, growth and division (reproduction) of the cell and are therefore called 'Master Molecules'.

The structure of the DNA molecule is the same in all organisms. In 1953, Watson and Crick produced a model of the DNA molecule. As per this model, two parallel threads of nucleotides are coiled around each other. This arrangement is called a 'double helix'. This sturcture can be compared with a coiled and flexible ladder.

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Each strand in the molecule of DNA is made up of many small molecules known as **'nucleotide'**. There are four types of nitrogenous bases adenine, guanine, cytosine and thymine. Adenine and guanine are called as **'purines'** while cytosine and thymine are called **'pyrimidines'**.

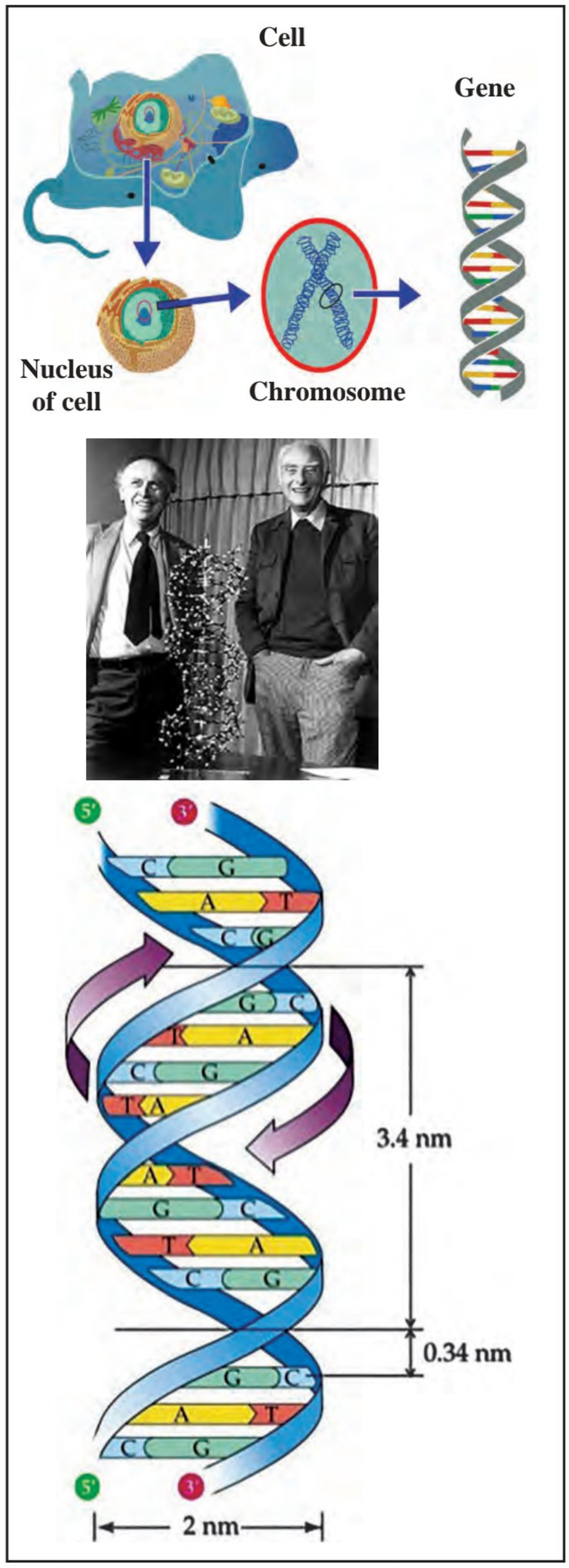
In the structure of the nucleotide, a molecule of a nitrogenous base and phosphoric acid are each joined to a molecule of sugar.

As there are four types of nitrogenous bases, nucleotides also are of four types.

Nucleotides are arranged like a chain, in a molecule of DNA. The two threads of the DNA molecule are comparable to the two rails of a ladder and each rail is made up of alternately joined molecules of sugar and phosphoric acid. Each rung of the ladder is a pair of nitrogenous bases joined by hydrogen bonds. Adenine always pairs with thymine and cytosine always pairs with guanine.

Gene

Each chromosome is made up of a single DNA molecule. Segments of the DNA molecule are called genes. Due to variety in the sequence of nucleotides, different kinds of genes are formed. These genes are arranged in a line. Genes control the structure and function of the cells and of the body. Also, they transmit the hereditary characteristics from parents to offspring. Hence, they are said to be the functional units of heredity. That is why, many similarities are seen between parents and their offspring. Information about protein synthesis is stored in the genes.



16.4 DNA (Watson and Crick's Model)

DNA fingerprinting : The sequence of the genes in the DNA of a person i.e. the genome of the person is identified. It is useful to identify the lineage and to identify criminals because it is unique to every person.

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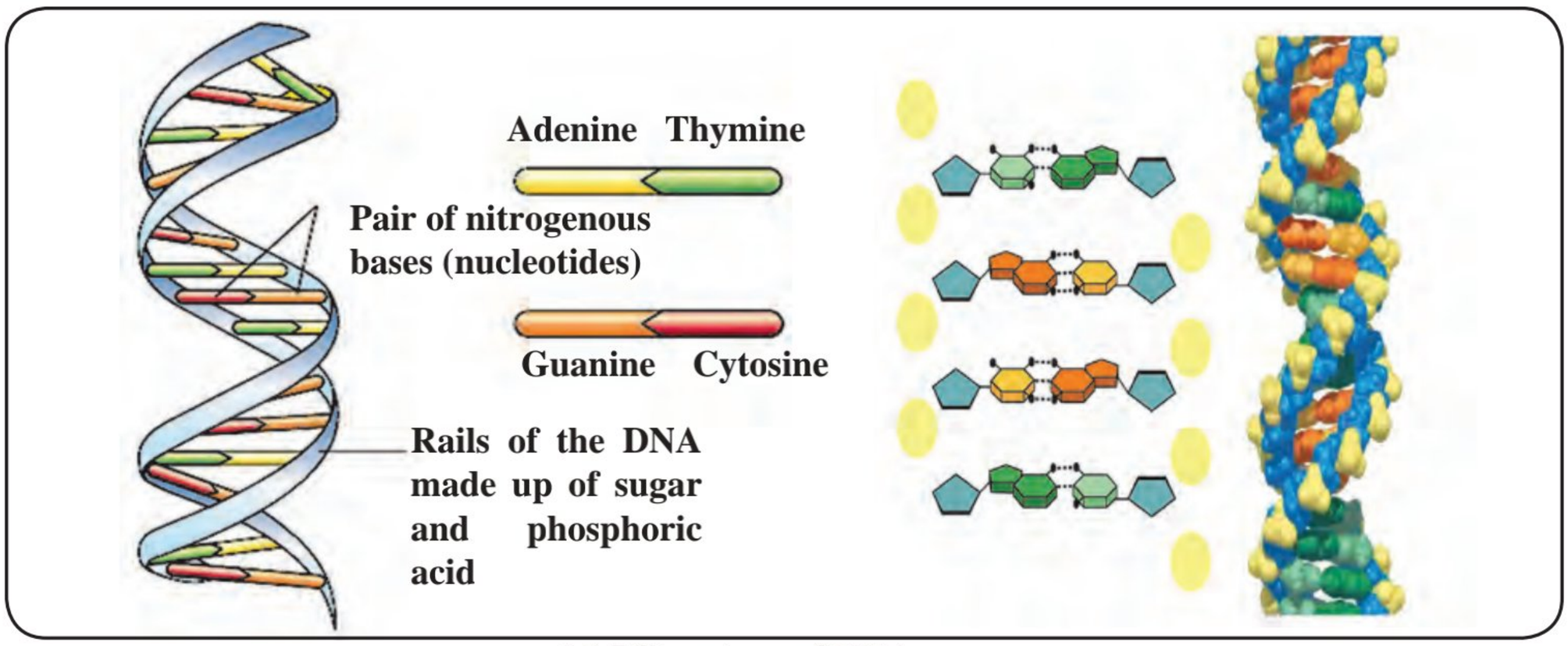


16.5 Structure of DNA

Seeds of technology :

In 1990, the **'Human Genome Project'** was together undertaken by all the geneticists of the world. In June 2000, scientists of this project and Celera Genomics Corporation (a private industry in USA) collectively announced the discovery of the complete DNA sequence of the human genome. Depending upon the findings of this project, scientists confirmed that the number of genes in the human genome is about 20,000 to 30,000. Later, scientists discovered the genomic sequence of many micro-organisms. Due to research in genomics, disease causing genes can be identified. If disease causing genes are identified, genetic diseases can be diagnosed and properly treated.

Website : www.genome.gov

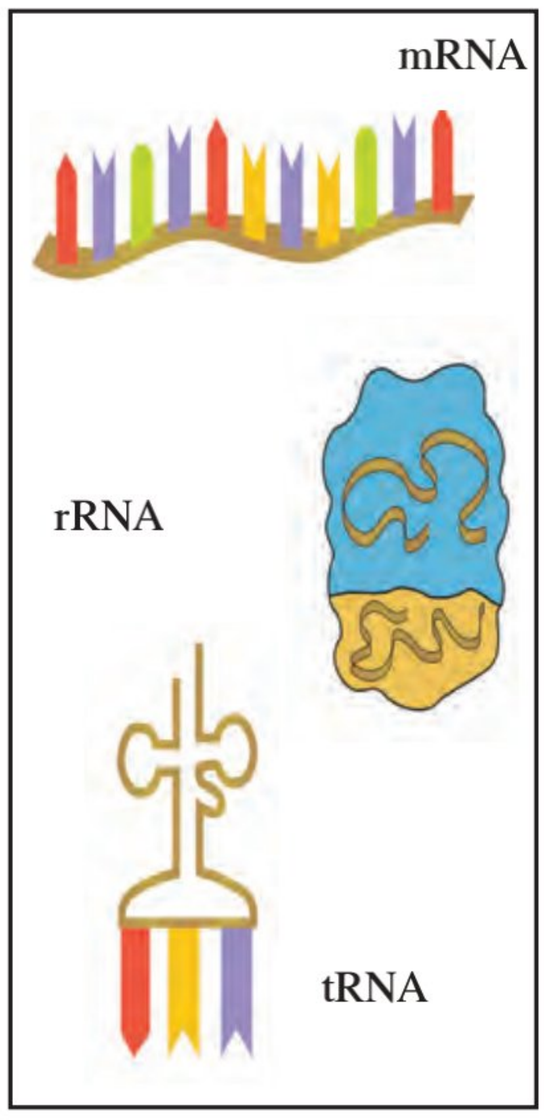
Ribonucleic acid (RNA) :

RNA is the second important nucleic acid of the cell. This nucleic acid is made up of ribose sugar, phosphate molecules and four types of nitrogenous bases adenine, guanine, cytosine and uracil. The nucleotide i.e. smallest unit of the chain of the RNA molecule is formed by combination of a ribose sugar, phosphate molecule and one of the nitrogenous bases. Large numbers of nucleotides are bonded together to form the macromolecule of RNA. According to function, there are three **types of RNA.**

1. Ribosomal RNA (rRNA) : The molecule of RNA which is a component of the ribosome organelle is called a ribosomal RNA. Ribosomes perform the function of protein synthesis.

2. Messenger RNA (mRNA) : The RNA molecule that carries the information of protein synthesis from genes i.e. DNA chain in the cell nucleus to ribosomes in the cytoplasm which produce the proteins, is called messenger RNA.

3. Transfer RNA (tRNA) : The RNA molecule which, according to the message of the mRNA carries the amino acid up to the ribosomes is called transfer RNA.



16.6 Types of RNA

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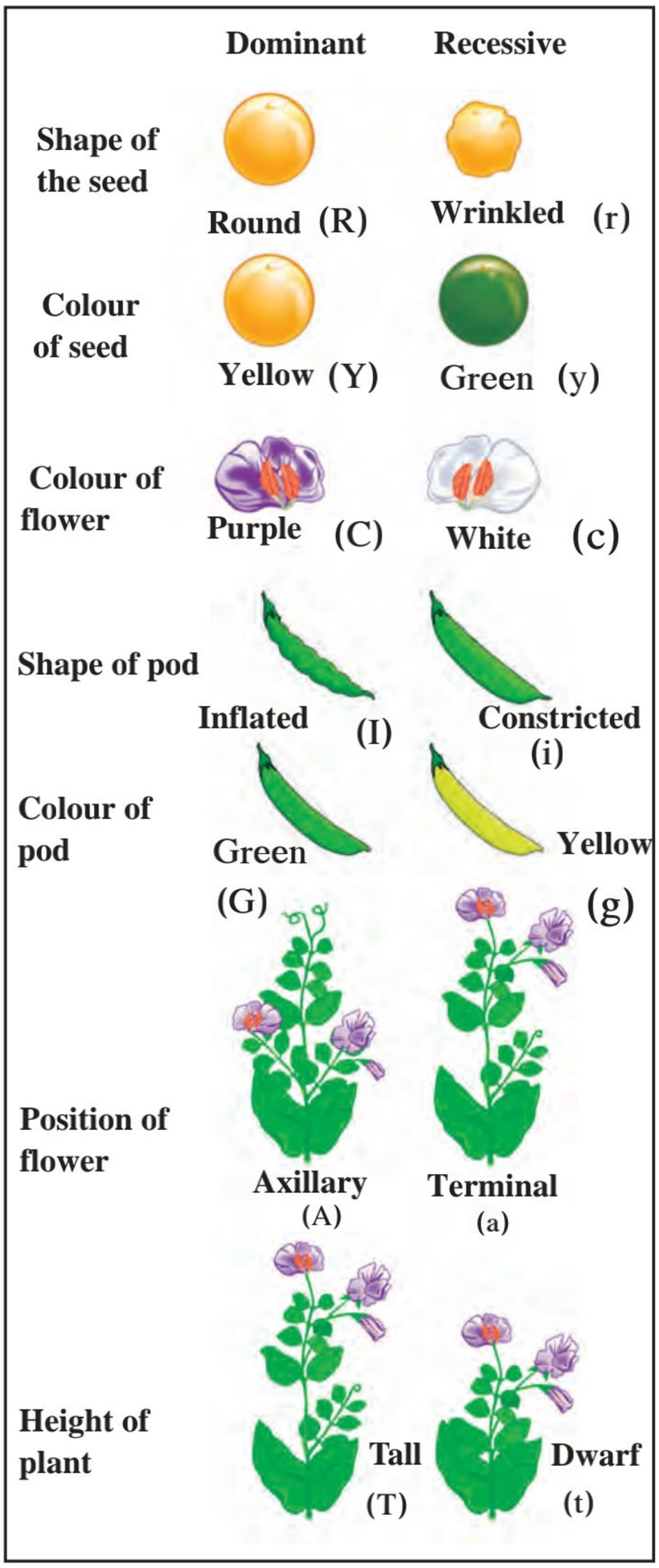
Mendel's principles of heredity

Genetic material is transferred in equal quantity from parents to progeny. Principles of heredity are based upon this fact. If both the parents make equal contribution to inheritance of characteristics, which characteristics will appear in the progeny? Mendel carried out research in this direction and put forth the principles of heredity responsible for such inheritance. The experiments performed by Mendel, almost a century ago are quite astonishing. All of Mendel's experiments were based upon the visible characteristics of the pea plant (*Pisum sativum*). These characteristics are as follows -



16.7 Seven mutually contrasting visible characteristics

An introduction to scientists

Gregor Johann Mendel

(Birth: 20th July 1822, Death: 6th Jan 1884)

Gregor Johann Mendel was an Austrian scientist. He studied the inheritance of some characteristics of the pea plant. He showed that inheritance of these characteristics follows certain principles. Later, these principles becomes popular by his name. Mendel's work was recognized only in the 20th century. After a reconfirmation of these principles, the same principles now form the basis of modern genetics.

Do you know?

Some dominant and recessive characteristics of human beings

Dominant	Recessive
Rolling tongue	Non-rolling tongue
Presence of hair on arms	Absence of hairs on arms
Black and curly hair	Brown and straight hair
Free earlobe	Attached earlobe

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We shall study the following crosses to clearly understand the conclusions of Mendel's experiments.

Monohybrid cross

In this experiment, Mendel brought about the cross between two pea plants with only one pair of contrasting characters. This type of cross is called a monohybrid cross.

So as to study the monohybrid ratio, let us consider the characteristic 'plant height' with a pair of contrasting characteristics tall plant and dwarf plant.

Parental generation (P_1) :

Tall pea plants and dwarf pea plant were used in this cross. Hence, this is parent generation (P_1). Mendel referred to the tall and dwarf plants as dominant and recessive respectively. The tall plant was referred to as dominant because all the plants in the next generation were tall. The dwarf plant was referred to as recessive because this characteristic did not appear in next generation at all. This experiment has been presented by the **'Punnet Square'** method as shown below.

Mendel's experiment of the Monohybrid Cross

Parental Generation (P_1)

Phenotype:	Tall	Dwarf
Genotype:	T T	t t
Gametes:	T	t

First Filial Generation (F_1) Tt

Phenotype: Tall

Parental Generation (P_2) Selfing in F_1

Phenotype:	Tall	Tall
Genotype:	Tt	Tt
Gametes:	T and t	T and t

First Filial Generation (F_2)

Male gamete / Female gamete	T	t
T	TT (Tall)	Tt (Tall)
t	Tt (Tall)	tt (Dwarf)

Depending upon these observations, Mendel proposed that the factors responsible for inheritance of characteristics are present in pairs. Today, we refer to these factors as genes. Dominant genes are denoted by capital letters whereas recessive genes are denoted by small letters. As genes are present in pairs, tall plants are denoted by TT and dwarf plants are denoted by tt. During gametogenesis, these genes separate from each other. Due to this, two types of gametes one containing factor T and other containing factor t are formed.

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First filial generation (F_1) :

In this experiment, Mendel observed that all plants of first filial generation (F_1) were tall. But, he realised that tall plants of F_1 generation were different from the tall plants of P_1 generation because parents of F_1 tall plants are tall as well as dwarf plants. Depending upon observations of F_1 generation, Mendel concluded that factors of tall plants are dominant over the factors of dwarf plants. Though all the plants in F_1 generation were tall, they contained the factor responsible for dwarfness. i.e. though the phenotype of F_1 plants is tall, their genotype is mixed. Phenotype means external appearance or visible charactersistics of organisms, for example, tallness or dwarfness of plants whereas genotype means the pairs of genes (factors) responsible for the visible characteristics. Genotype of P_1 tall plants is TT and produces only one type of gametes (T). Genotype of F_1 tall plants is Tt and it produces two types of gametes, T and t. Thus, based on this, we can say that in case of tall plants of F_1 and P_1 generations, though they show similar phenotype, their genotypes are different. Mendel further continued this experiment and brought about self-fertilization in F_1 plants from which a second filial (F_2) generation was produced.

Second filial generation (F_2):

In the second filial generation (F_2), both i.e. tall and dwarf types of plants appeared. According to the data collected by Mendel, out of 929 pea plants, 705 were tall and 224 were short. Thus, the phenotypic ratio of these plants is 3(tall):1(dwarf) and genotypic ratio is 1(TT):2(Tt):1(tt). Thus, it can be inferred that in the F_2 generation, phenotypically there are two types of plants whereas genotypically there are three types. These types are shown in the following table.

F_2 Pure dominant (TT) - tall plants	Homozygous
F_2 Pure recessive (tt) - dwarf plants	Homozygous
F_2 Hybrid plants (Tt) –tall plants	Heterozygous

Mendel's experiment on dihybrid cross:

In the dihybrid cross, two pairs of contrasting characteristics are under consideration. Mendel performed more experiments on hybridization in which he considered more than one pair of contrasting characteristics. He brought about a cross between a pea plant producing rounded and yellow coloured seeds and a pea plant with wrinkled and green coloured seeds. In this cross, two pairs of contrasting characteristics were considered colour of seeds and shape of seeds. Hence, it is called a dihybrid cross.

Parental generation (P_1) :

Mendel selected the pea plants producing rounded yellow seeds and wrinkled green seeds as parent plants, as shown in the chart -

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Mendel's experiment of dihybrid cross

Parental Generation (P_1)

Phenotype: Rounded-yellow seeds Wrinkled-green seeds

Genotype: RRYY rryy

Gametes RY ry

First Filial Generation (F_1) RrYy

Phenotype: (Rounded-yellow seeds)

Parental Generation (P_2) Selfing in F_1

Phenotype: Rounded-yellow seeds Rounded-yellow seeds

Genotype: RrYy RrYy

Gametes RY, Ry, rY, ry RY, Ry, rY, ry

Second Filial Generation (F_2)

Male gamete / Female gamete	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

During gamete formation in P_1 generation, the pair of gametes separate independently i.e. in RRYY plants, only RY type gametes are formed and not RR and YY. Similarly, in rryy plants, only ry gametes are formed. Thus we can say that each pair of genes is represented in the gamete by only one gene from that pair.

Use your brain power !

Phenotypic ratio:

1. Round-Yellow:
2. Wrinkled-Yellow:
3. Round-Green:
4. Wrinkled-Green:

Genotypic ratio :

Genotypic ratio :

RRYY -
RRYy -
RRyy -
RrYY -
RrYy -
Rryy -
rrYY -
rrYy -
rryy -

Ratio

= : : : : : : : :

1. Show the monohybrid cross between (RR) and (rr) and write the phenotypic and genotypic ratio of F_2 generation.
2. Why did the characteristic of the Rounded-Yellow seeds alone appear in the F_1 generation but not the characteristic of the wrinkled-green seeds?

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Based on the conclusions from the monohybrid cross, Mendel expected that in the F_2 generation of dihybrid cross, plants would produce rounded-yellow seeds. He was proved right. Though the genotype of these plants was RrYy, their phenotype was like the parents producing rounded-yellow seeds, because yellow colour is dominant over green and round shape is dominant over wrinkled. Due to the combination of two different characteristics in the F_1 generation of the dihybrid cross, these plants are called dihybrid plants.

Plants of the F_1 generation of dihybrid cross produce four types of gametes RY, Ry, rY, ry. Of these gametes, RY and ry are similar to those of the P_1 generation.

F_2 generation is formed through the selfing of F_1 plants. The pattern of inheritance of charactistics from F_1 to F_2 is shown in brief in the table given on page 187 and an activity about its presentation in the form of a ratio has been given in a box, beside it. The 16 different possible combinations through the union of 4 types of male gametes and 4 types of female gametes are shown in a chess-board like table (Punnet Square / Checker board) on page 187. Male gametes are shown at the top of table and female gametes are shown in left column. Observations based on a study of the F_2 generation will be according to the table on page 187.

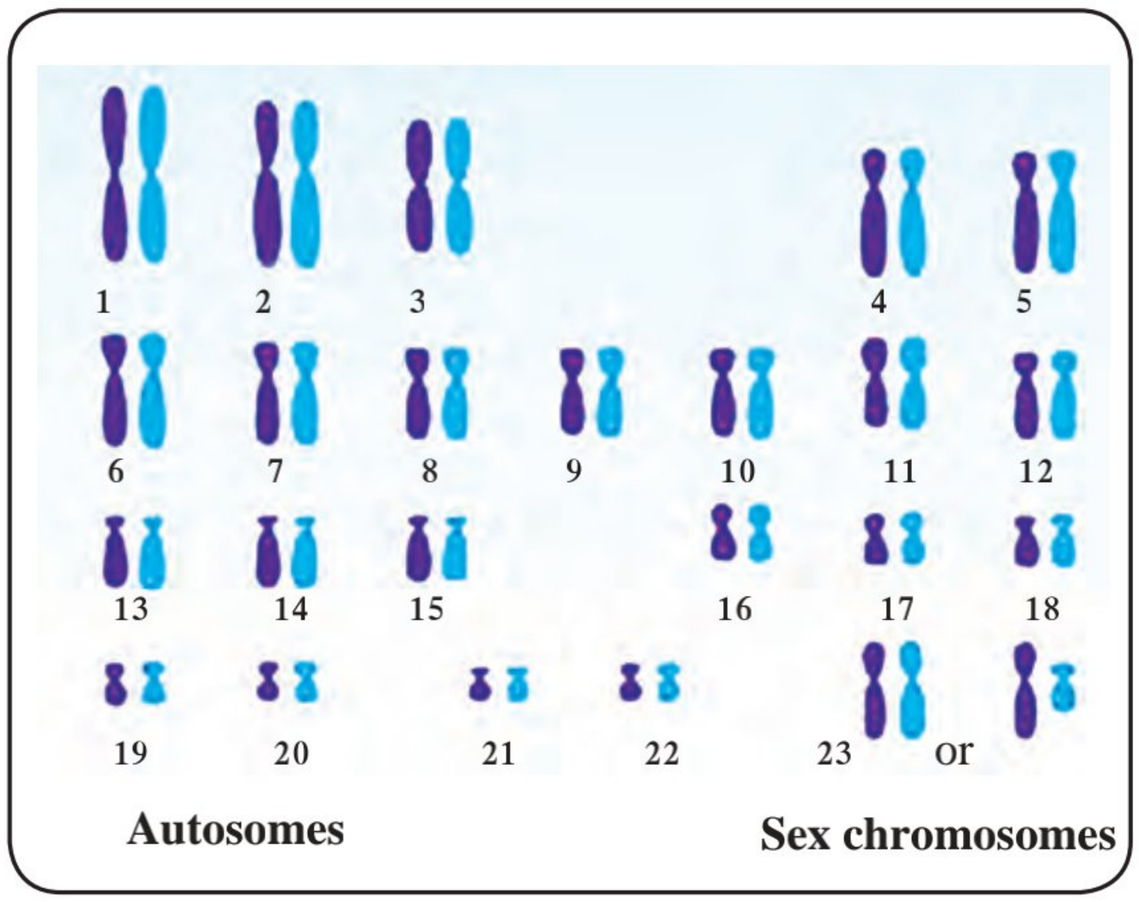
Genetic disorders

Diseases or disorders occurring due to abnormalities in chromosomes and mutations in genes are called genetic disorders. Chromosomal abnormalities include either increase or decrease in numbers and deletion or translocation of any part of the chromosome. Examples are physical disorders like cleft lip, albinism and physiological disorders like sickle cell anaemia, haemophilia, etc.

Human beings have 46 chromosomes in the form of 23 pairs. There is great variation in the size and shape of these chromosomal pairs. These pairs have been numbered. Out of 23 pairs, 22 pairs are autosomes and one pair is of sex chromosomes (allosomes). Chromosomes in women are represented as 44+XX and in men as 44+XY.

Mendel has shown in his experiments that there exist two type of genes, dominant and recessive.

If we take into account the number of chromosomes in human cells, their sex-related types, the types of genes on the chromosomes - dominant and recessive - we can see where genetic disorders originate and how they are inherited.



16.8 Human karyotype (Chromosome chart)

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A. Disorders due to chromosomal abnormalities:

Following are the disorders that occur due to numerical changes in chromosomes. Offspring are not sterile if there is change in the number of autosomes is less. Instead, if there is an increase in number of any autosomal pair, physical or mental abnormalities arise and the lifespan is shortened with a shortened life span. Following are some disorders.

1. Down syndrome (46+1, Trisomy of 21st Chromosome) :

Down syndrome is a disorder arising due to chromosomal abnormality. This is the first discovered and described chromosomal disorder in human beings. This disorder is characterised by the presence of 47 chromosomes. It is described as trisomy of the 21st chromosome. Infants with this disorder have one extra chromosome with the 21st pair in every cell of their body. Therefore they have 47 chromosomes instead of 46. Children suffering from Down's syndrome are usually mentally retarded and have a short lifespan. Mental retardation is the most prominent characteristic. Other symptoms include short height, short wide neck, flat nose, short fingers, scanty hair, single horizontal crease on palm, and a life expentancy of about 16–20 years.

16.9 Child with Down syndrome

2. Turner syndrome (Monosomy of X chromosome) :

As with autosomes, abnormalities in sex chromosomes also cause some disorders. Turner syndrome (or 44+X) arises due to either inheritance of only one X chromosome from parents or due to inactivation of the gender-related part of X-chromosomes. Instead of the normal 44+XX condition, women suffering from Turner syndrome show a 44+X condition. Such women are sterile i.e. unable to have children due to improper growth of the reproductive organs.

16.10 Hand of a child with Turner syndrome

3. 3. Klinefelter syndrome (44+XXY) :

This disorder arises in men due to abnormalities in sex chromosomes. In this disorder, men have one extra X chromosome; hence their chromosomal condition becomes 44+XXY. Such men are sexually sterile because their reproductive organs are not well developed.

National Health Mission

Under the National Health Mission, the National Rural Health Mission has been started since April 2005 and the National Urban Health Mission since 2013.

The main objectives of this mission are strengthening of the rural and urban health facilities, controlling various diseases and illnesses, increasing public awareness about health, and offering financial assistance to patients through various schemes.

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B. Diseases occuring due to mutation in single gene (monogenic disorders) :

Disorders or diseases occurring due to mutation in any single gene into a defective one are called monogenic disorders. Approximately 4000 different disorders of this type are now known. Due to abnormal genes, their products are either produced in insufficient quantity or not at all. It causes abnormal metabolism that may lead to death at a tender age. Examples of such disorders are Hutchinson's disease, Tay-Sachs disease, galactosaemia, phenylketonuria, sickle cell anaemia, cystic fibrosis, albinism, haemophilia, night blindness, etc.

1. Albinism :

This is a genetic disorder. Our eyes, skin and hair have colour due to the brown pigment, melanin. In this disease, the body cannot produce melanin. The skin becomes pale, hairs are white and eyes are usually pink due to absence of melanin pigment in the retina and sclera.

16.11 Hair and eyes of child with albinism

2. Sickle-cell anaemia :

Even minor changes in molecular structure of proteins and DNA may lead to diseases or disorders. Normal haemoglobin has glutamic acid as the 6th amino acid in its molecular structure. However, if it is replaced by valine, the shape/structure of the haemoglobin molecule changes. Due to this, the erythrocytes or red blood corpuscles (RBC), which are normally biconcave become sickle-shaped. This condition is called 'sickle-cell anaemia'. The oxygen carrying capacity of haemoglobin in such individuals is very low.

In this condition, clumping and thereby destruction of erythrocytes occurs most often. As a result blood vessels are obstructed and the circulatory system, brain, lungs, kidneys, etc. are damaged. Sickle-cell anaemia is a hereditary disease. It occurs due to changes in genes during conception. If the father and mother are both affected by sickle-cell anaemia or if they are carriers of this disorder, their offspring are likely to suffer from this disease. Hence, marriages between the persons who are carriers of or suffering from sickle-cell anaemia should be avoided.

There are two types of persons affected by sickle-cell anaemia :

1. Sickle-cell anaemia carrier (AS)
2. Sufferer from sickle-cell anaemia (SS)

Symptoms of sickle-cell anaemia :

Swelling of hands and legs, pain in joints, severe general body aches, frequent colds and cough, constant low grade fever, exhaustion, pale face, low haemoglobin content.

Do you know?

In Maharashtra, there are more than 2.5 lakh people suffering from sickle-cell anaemia and about 21 districts including 11 districts from Vidarbha are affected by this disorder.

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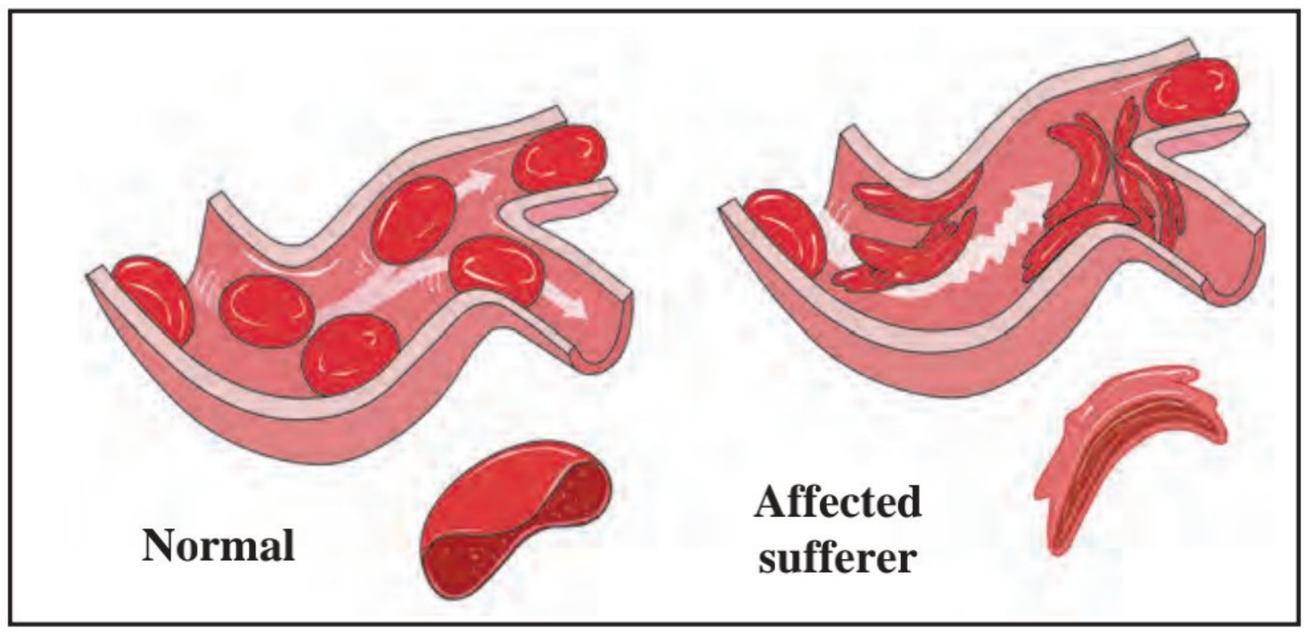
Let's get our blood tested !
Let's overcome sickle cell anaemia !



16.12 Sickle cells

Sickle cell anaemia occurs as follows :

Symbols: AA = Normal, AS = Carrier, SS = Sufferer

Sr. No.	Man	Woman	Progeny
1	AA	AA	Normal progeny if both parents are normal.
2	AA or AS	AS or AA	50% progeny normal and 50% carrier, if one parent is normal and one is a carrier.
3	AA or SS	SS or AA	All progeny will be carrier, if one parent is normal and one is a sufferer.
4	AS	AS	25% progeny normal, 25% sufferer and 50% carrier if both parents are carriers.
5	AS or SS	SS or AS	50% progeny carrier and 50% sufferer if one parent is carrier and one is a sufferer.
6	SS	SS	All progeny will be sufferers if both parents are sufferers.

Diagnosis of sickle-cell anaemia : Under the National Health Mission scheme, the 'Solubility Test' for diagnosis of sickle-cell anaemia is available at all district hospitals. Similarly, the confirmatory diagnostic test- 'Electrophoresis' is performed at rural and sub-district hospitals.

Remedies :

This disease is spread in only one way i.e. reproduction. Hence, husband and wife should get their blood exmined either before marriage or after it.

1. A carrier or sufferer should avoid marriage with another carrier or sufferer.
2. A person suffering from sickle cell anaemia should take a tablet of folic acid daily.

16.13 Hand of a child with sickle-cell anaemia

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C. Mitochondrial disorder :

Mitochondrial DNA may also become defective due to mutation. During fertilization, mitochondria are contributed by the egg cell (ovum) alone. Hence, mitochondrial disorders are inherited from the mother only. Leber hereditary optic neuropathy is an example of a mitochondrial disorder.

D] Disorders due to mutations in multiple genes : (Polygenic disorders)

Sometimes, disorders arise due to mutations in more than one gene. In most such disorders, their severity increases due to effects of environmental factors on the foetus. Common examples of such disorders are cleft lip, cleft palate, constricted stomach, spina bifida (a defect of the spinal cord), etc. Besides, diabetes, blood pressure, heart disorders, asthma, obesity are also polygenic disorders. Polygenic disorders do not strictly follow Mendel's principles of heredity. These disorders arise from a complex interaction between environment, life style and defects in several genes.

Always remember

Inter-relationship between tobacco addiction and cancer (Uncontrolled growth of cells)

Many people consume tobacco, either by smoking or by chewing. Consumption of tobacco in any form can cause cancer. Smoking of cigarettes and *bidi* adversely affects the process of digestion. It causes a burning sensation in the throat and a cough. Excessive smoking causes instability and trembling of fingers. A dry cough causes sleeplessness. Tobacco consumption can also lead to shortening of life span, chronic bronchitis, pericarditis, cancer of the lungs, mouth, larynx (voice box), pharynx, pancreas, urinary bladder, etc.

Harmful effects of smoking are due to the nicotine present in tobacco. It affects the central and peripheral nervous system. Arteries become hard i.e. it causes arteriosclerosis and hypertension.

Tobacco smoke contains harmful chemicals like pyridine, ammonia, aldehyde furfural, carbon monoxide, nicotine, sulphur dioxide, etc. They cause uncontrolled cell division. Tobacco smoke is full of minute carbon particles which causes normal tissue of the lung to transform into thickened black tissue. This causes cancer. While chewing tobacco or tobacco products much of the extract is absorbed into the body. Excessive tobacco consumption may cause cancer of lips or tongue, visual disorders or tremors.

To protect one's body from cancer one must avoid smoking and consumption of tobacco and tobacco products in any form.

Compose and present a street play against tobacco consumption and participate in a drive against tobacco.

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Exercises

1. Complete the following sentences by choosing the appropriate words from the brackets.

(Inheritance, sexual reproduction, asexual reproduction, chromosomes, DNA, RNA, gene)

a. Hereditary characters are transferred from parents to offsprings by ....., hence they are said to be structural and functional units of heredity.

b. Organisms produced by ..... show minor variations.

c. The component which is in the nuclei of cells and carries the hereditary characteristics is called .....

d. Chromosomes are mainly made up of .....

e. Organisms produced through ..... show major variations.

2. Explain following.

a. Explain Mendel's monohybrid progeny with the help of any one cross.

b. Explain Mendel's dihybrid ratio with the help of any one cross.

c. Distinguish between monohybrid and dihybrid cross.

d. Is it right to avoid living with a person suffering from a genetic disorder?

3. Answers the following questions in your own words.

a. What is meant by 'chromosome'. Explain its types.

b. Describe the structure of the DNA molecule.

c. Express your opinion about the use of DNA fingerprinting.

d. Explain the structure, function and types of RNA.

e. Why is it necessary for people to have their blood examined before marriage?

4. Write a brief note on each.

a. Down syndrome

b. Monogenic disorders

c. Sickle cell anaemia: symptoms and treatment.

5. How are the items in groups A, B and C inter-releated?

A	B	C
Leber hereditary optic neuropathy	44+XXY	Pale skin, white hairs
Diabetes	45+X	Men are sterile
Albinism	Mito-chondrial disorder	Women are sterile
Turner syndrome	Polygen-ic disorder	This disorder arises during development of zygote.
Klinefelter syndrome	Mono-genic disorder	Effect on blood-glucose level.

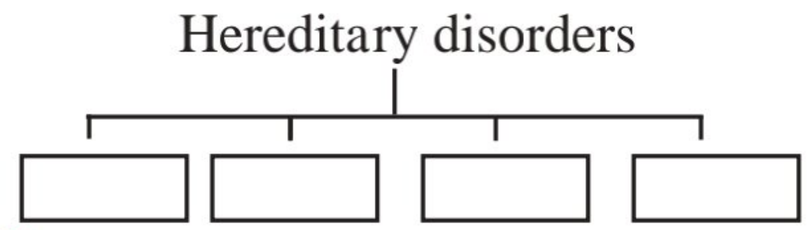
6. Filling the blanks based on the given realationship.

a. 44+X:Turner syndrome: :44+XXY:- .....

b. 3:1 Monohybrid: : 9:3:3:1 : .....

c. Women : Turner syndrome : : Men : .....

7. Complete the tree diagram below based on types of hereditary disorders.



Activity

a. Prepare a model of the DNA and give a presentation based on it.

b. Prepare a power point presentation on awareness about tobacco consumption and cancer and present it in the class.

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17. Introduction to Biotechnology

- **Tissues: animal tissues and plant tissues**
- **Tissue culture**
- **Agritourism**
- **Agri-business**

Can you recall?

1. Which components bring about important processes in the living organisms?
2. Which is the smallest structural and functional unit of the body of living organisms?

Tissue

In the case of amoeba-like unicellular organisms, all functions are performed by organelles of that single cell. However, most of the organisms are multicellular. How are the various processes brought in their body? Groups of cells come together, so as to perform the various functions of the body.

Are you familiar with the sequence- letters → words → sentences → lessons → text book?

Similarly, organization of the body of organisms follows a definite hierarchy. You have already studied cells and cell organelles in that hierarchy.

'A group of cells having the same origin, same structure and same function is called 'tissue'. Millions of cells are present in the body of multicellular organisms. These cells are divided into different groups and each group performs a definite function. For example, we can perform movements due to contraction-relaxation of muscles. Conducting tissues in plants transport water and food to all its parts. All functions of the body occur with full efficiency due to the specific organization of cells and their division of work.

Types of tissue

Simple tissue
Simple Tissues
Made up of only one type of cells
Ex. Epithelial tissue of animals, Meristematic tissue of plants

Complex tissue
Complex Tissues
Made up of more than one type of cells Ex. Blood of animals, Xylem and phloem of plants

Think about it

Are the sturcture and functions of the bodies of plants and animals the same?

Plants being sedentary, most of their tissues are of the type that give support. There are dead cells in some tissues and these do not need much attention. Growth of the plants occurs in specific parts of their body where the tissues contain dividing cells. As animals have to move from place to place in search of food, shelter and partners, their energy needs are greater. Most of the tissues of animals are made up of living cells. Uniform growth occurs through out the body of an animal and they do not have different dividing and non-dividing tissue. This means that plants and animals have different types of tissue to performing the necessary functions.

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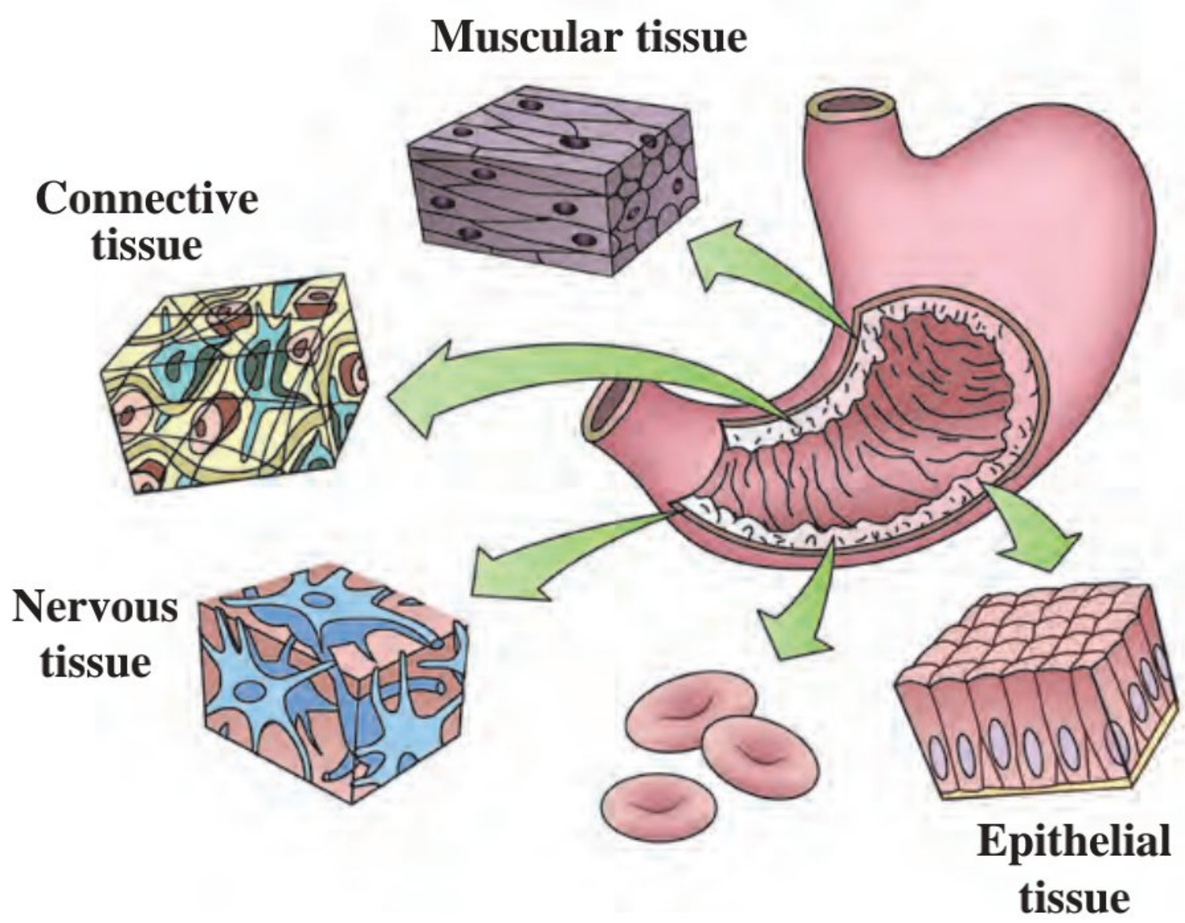
Animal tissue

Think about it

Why can we not see our organs like the heart, blood vessels and intestines?

In the body of animal different organs come together to perform a specific function. Organs like the lungs and trachea, with the help of the contraction and relaxation of some muscles bring about the function of respiration. Different tissues perform different functions in the organs. Accordingly, tissues are classified into different types.

There are four main types of animal tissues, namely epithelial tissue, connective tissue, muscular tissue and nervous tissue.



17.1 Types of animal tissues

Do you know?

Blood is also a type of connective tissue. It circulates in our body from one part to another and transports different materials. For example, it transports oxygen and nutrients to all cells in the body. Similarly, it transports waste materials generated all over the body to the kidney for excretion.

Observe

Observe the skin of the back of your hand with the help of a magnifying lens. Do you see the closely attached squarish and pentagonal shapes?

Epithelial tissue

Protective coverings in the animal body are called epithelial tissues. Cells in this tissue are closely packed and form continuous layers. Any material that enters the body first encounters epithelial tissue. Cells of epithelial tissue are separated from the cells of other underlying tissues by a fibrous membrane. The skin, mucous layer of the mouth cavity, inner surface of blood vessels, walls of the alveoli, etc. are made up of epithelial tissues.

Use your brain power !

What keeps the various organs and organ systems separate from each other? How?

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Types of epithelial tissues

Name	Appearance (diagrammatic)	Location	Sturcture	Function
Squamous epithelium		Inner surface of mouth, oesophagus, blood-vessels, alveoli	Thin, small, flat cells form semipermeable membrane.	Selective transport of substances.
Stratified epithelium		Outer layer of skin	Many layers of cells	Prevention of wearing of organs, protection of organs.
Glandular epithelium		Inner layer of skin, etc.	Cells contain vesicles packed with secretory material	Secretion of sweat, oil (sebum), mucus, etc.
Columnar epithelium		Inner surface (mucosa) of intestine, alimentary canal	Column-like tall cells. Upper free surface bears folds made of these cells at places of absorption	Secretion of digestive juice, absorption of nutrients
Ciliated Epithelium		Inner surface of respiratory tract	Upper free surface of cells bears minute hair-like processes	Push mucus and air forward to keep the air passage free
Cuboidal epithelium		Tubules of kidney (nephron), salivary gland	Cells are cuboidal	Reabsorption of useful materials from urine, secretion of saliva

Use your brain power ! Why are epithelial tissues said to be simple tissues?

Observe

Observe a permanent slide of a blood smear under a compound microscope. What did you see?

Cells of different types, colour and shape are mixed together. Hence, blood is a type of complex tissue.

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Connective tissue : Tissues which join different parts of the body are called connective tissues. Cells in this type of tissue are loosely arranged with a ground substance in the free spaces in between. The ground substance may be solid, liquid like water or jelly-like.

Types of connective tissue

Type	Appearance (diagrammatic)	Location	Structure	Function
Blood		Closed circulatory system	Erythrocytes, leucocytes and platelets in a liquid plasma	Transport of oxygen nutrients, hormones and waste.
Lymph		All around the cells in the body.	Fluid oozed out of blood capillaries, contains leucocytes and liquid ground substance	Protection of body from infections.
Areolar Tissue		Between the skin and muscles, around blood vessels	Different types of cells loosely arran-ged and supported by a jelly-like ground substance and elastic fibres	Supports internal organs
Adipose Tissue		Below the skin and around internal organs.	Cells filled with fat droplets, jelly-like ground substance	Insulation, supply of energy, storage of fats
Cartilage		Nose, ear, larynx, trachea	Cells supported by fibrous, flexible Jelly-like ground substance	Lubricates the surfaces of bones, gives support and shape to organs
Bones		Skeleton (A specific structure extending throughout the body	Osteocytes embedded in solid ground substance made up of calcium phosphate	Supports and protects different organs, helps in movement
Tendons and liga-ments		At the joints	Tendons: fibrous, strong, less elastic Ligaments: strong and highly flexible	Tendons: join muscles to bones Ligaments: join two bones to each other

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Use your brain power !

1. Why do slim persons feel more cold in winter than those who are obese?
2. Why can bones not be folded?

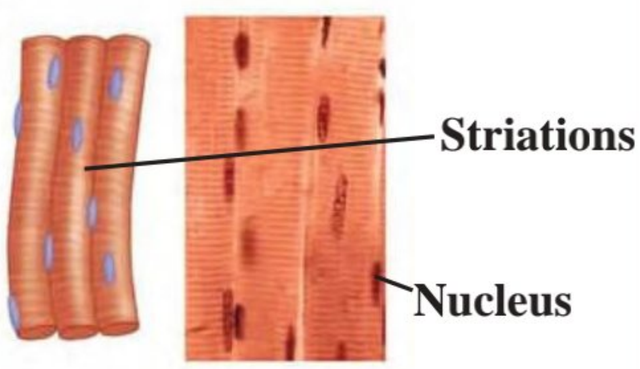
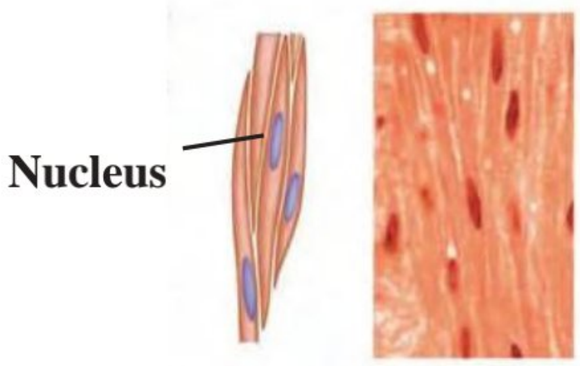
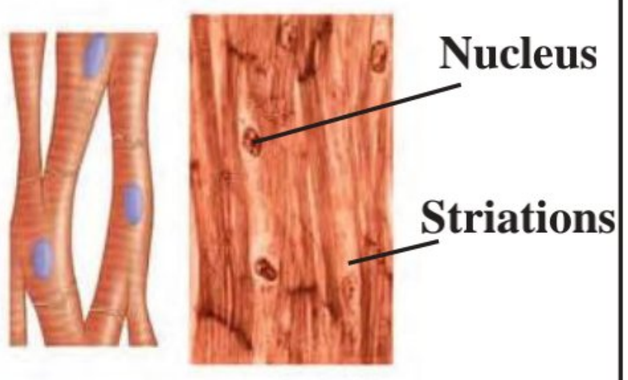
Muscular tissue

Try this

Bend your arm at elbow. Observe the muscles in the front and the back of the arm. Straighten the arm and observe the same muscles again. Do the same with your leg folding it at the knee joint. Did you experience the contraction and relaxation of muscles at every movement?

Muscle fibres and muscular tissues are formed from special type of contractile proteins due to which this contraction and relaxation is possible. Muscular tissues are made up of the long cells of muscle fibres. Muscular movement occurs due to contraction and relaxation of the contractile proteins in these cells.

Types of muscular tissues

Straited muscles	Non-striated muscles	Cardiac muscles
		
Muscle cells are long, cylindrical, multinucleate and have no branches.	Muscle cells are short, spindle-shaped, uninucleate and have no branches.	Muscle cells are cylindrical, uninucleate and branched.
Structure: There are alternate dark and light bands on these muscles at they are attached to bones, they are also called skeletal muscles. They move as per our will, hence they are called voluntary muscles.	Structure: Dark and light bands are absent. Not attached to bones. Their movements are not under the control of our will, hence they are called involuntary muscles. They are present in the alimentary canal, blood vessels, etc.	Structure: Dark and light bands are present. The heart is made of these muscles. Their movements are not under the control of our will. They contract and relax rhythmically.
Function: These muscles bring about movements of arms and legs, running, speaking, etc.	Function: Movements of eye lids, passage of food through alimentary canal, contraction and relaxation of blood vessels	Function: Contraction and relaxation of the heart.

Can you recall?

Which type of muscle is the diaphragm of the respiratory system?

Try this

Close your eyes and try to identify different objects by feeling them with your hand. Why is it possible for you to identify things like a note-book, text-book, bench, compass-box, etc, only by touching them?

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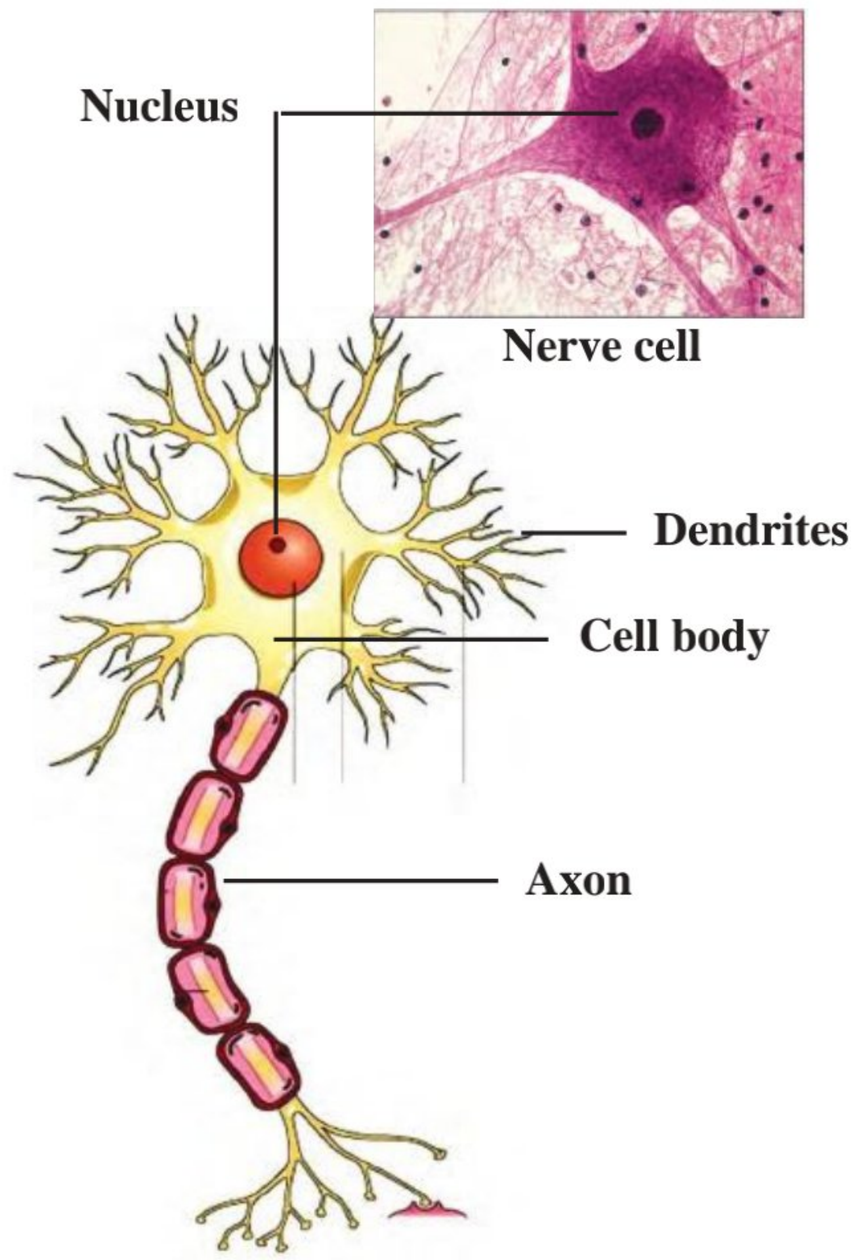
Nervous tissue

Often you must have identified the singer by merely listening to the song or identified what is being cooked in the kitchen by the mere smell! What helps us do this?

Nervous tissue enables us to respond to stimulii like touch, sound, odour, colour, etc.

Cells of the nervous tissue are specially made to be come excited and to conduct that excitation form one part of body to other. The cell body which contents the cytoplasm and the nucleus is the main part of each nerve cell. Numerous, small, branched fibres called dendrites arise from the cell body. One of the fibres, however, is extremely long. It is called as the axon. The length of a nerve cell may even be up to one meter. Many nerve cells are bound together with the help of connective tissue to form a nerve. Nervous tissue is present in the brain, spinal cord and the network of nerves spread all through the body. In most animals, action in response to a stimules occurs due to the integrated functioning of nervous tissue and muscular tissue.



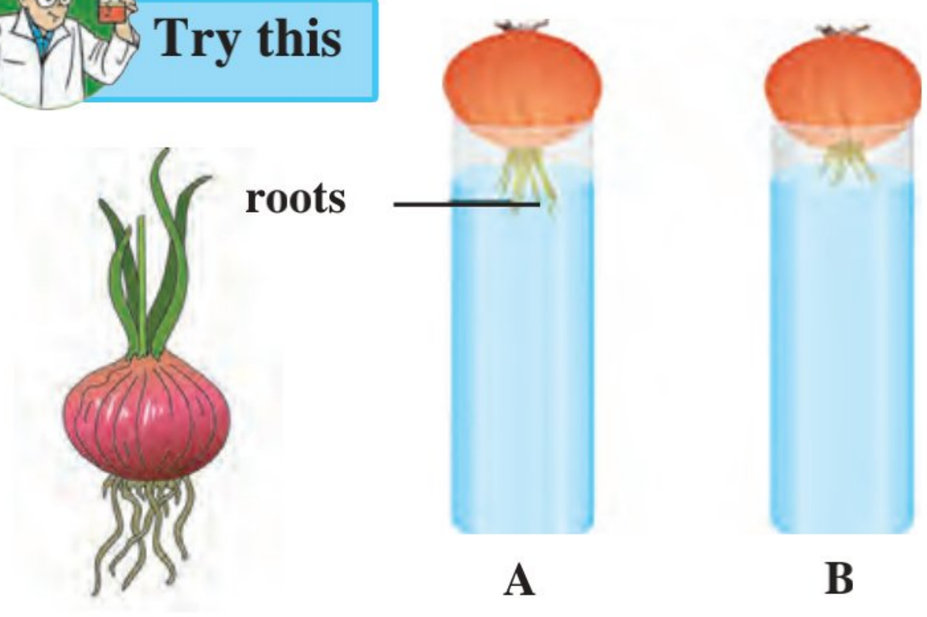
17.2 Nerve cell : A unit of nervous tissue

Plant tissue

Can you recall?

1. What is the main difference between the growth of animals and plants?
2. Why does the growth of a plant occur only at specific parts of the plant body?

Try this



17.3 Changes in roots of onion

As shown in the figure 17.3, place an onion on each gas jar in such a way that its base (roots) will remain dipped in water. Measure and record the length of the roots of both onions on the first, second and third day. On the fourth day, cut off 1 cm of the roots of the onion in flask B.

Measure the length of the roots of both onions for the next five days and record your observations in the following table.

Length (cm)	Day 1	Day 2	Day 3	Day 4	Day 5
Flask A					
Flask B					

1. Which onion has longer roots? Why?
2. Why did the roots of the onion in jar B stop growing?

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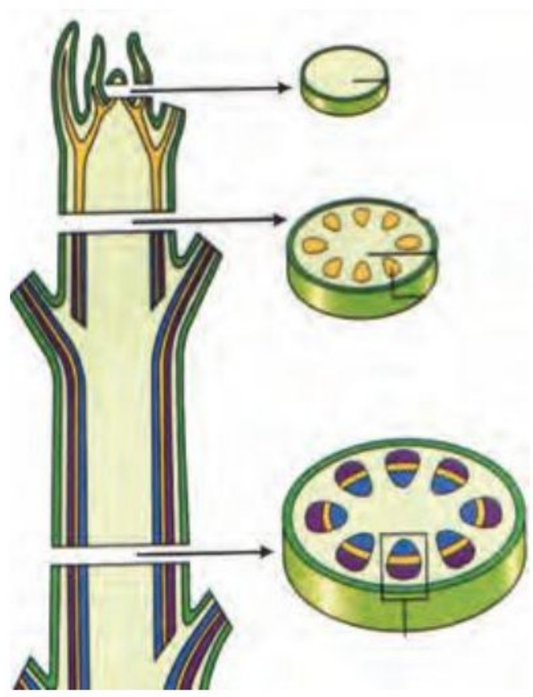
Meristematic tissue

As meristematic tissue is present in specific parts of a plant, growth occurs in those parts only. Cells of meristematic tissue contain thick cytoplasm, a conspicuous nucleus and a thin cell wall and are compactly packed together. Vacuoles are usually absent in these cells. These cells are highly active. To bring about plant growth is the main function of meristematic tissue. According to the location, meristematic tissue is of three types as given below.

Figure	Location	Function
	**Apical meristem :** At the tip of the root and stem	Increases the length of the root and stem.
	Intercalary meristem : At the base of the petiole of leaves and of branches.	Growth of branches, formation of leaves and flowers.
	Lateral meristem : Lateral sides of root and stem	Increases girth (diameter) of the root and stem.

17.4 Location of meristematic tissues in plants

Permanent tissue

After their growth is complete, new cells formed by division of meristematic tissue lose their ability to divide and start to perform a specific function at specific place. Thus, they permanently acquire a specific structure, shape and location and perform a specific function. This is called as differentiation and permanent tissues are formed from these differentiated cells. There are two types of permanent tissues-simple permanent and complex permanent tissue.

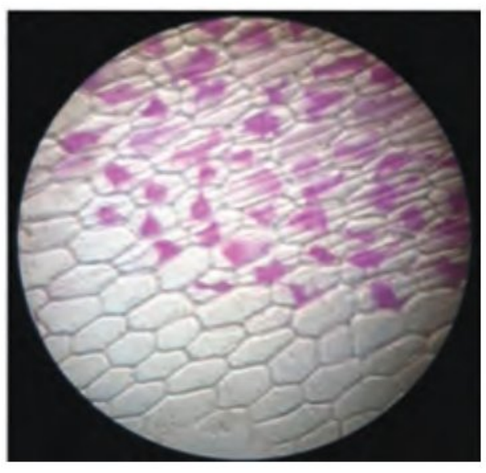
Simple permanent tissues

These are made up of only one type of cells. According to function, they are of the following different types.

Epidermis

Try this

Take a fresh and fleshy leaf of *Rhoeo*, lily or any other plant. Pull and press it, tearing it obliquely in such a way that its transparent epidermis will be visible at the cut margins. Take the transparent epidermis with the forceps and keep it in dilute safranin solution. for 1 minute. Spread it on a slide, cover with a cover-slip and observe it under a compound microscope.



17.5 Tissue of *Rhoeo* plant

The entire outer surface of a plant is made up of only one layer of cells. That layer is called 'epidermis'. Cells of the epidermis are flat and as there are no intercellular spaces between them, a single continuous layer is formed. The epidermis of the stem and leaves is covered by a waxy layer of 'cuticle' due to which water in the underlying parts is retained.

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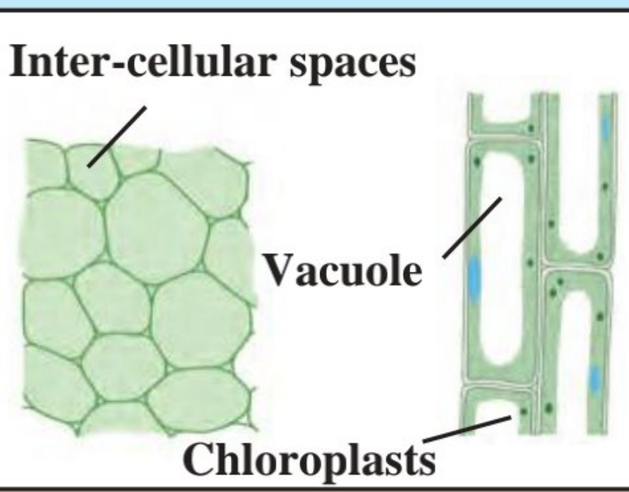
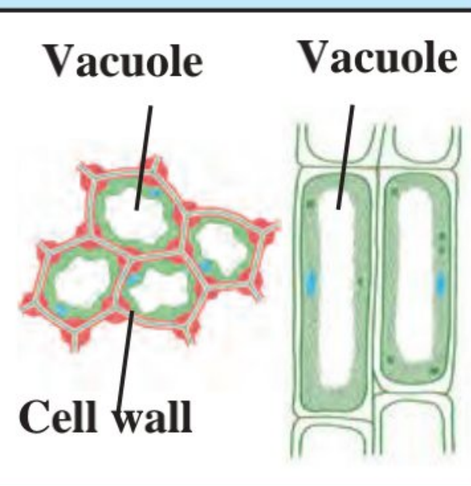
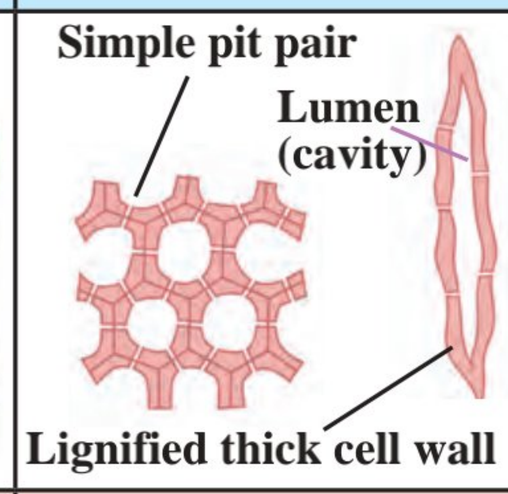
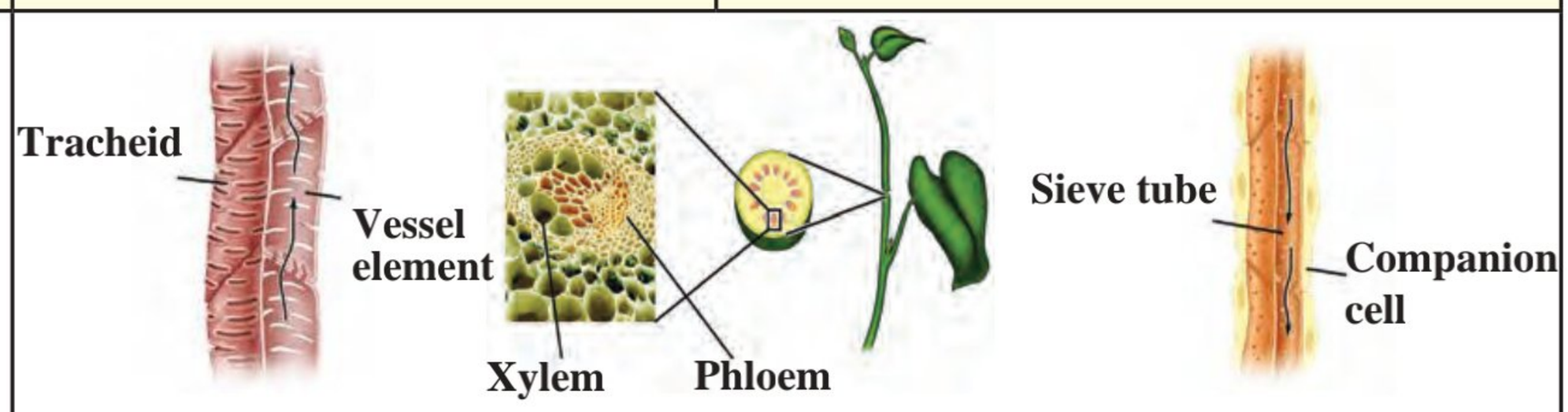
Types of simple permanent tissues

Name of Tissue	Parenchyma	Collenchyma	Sclerenchyma
Figure			
Structure of Cells	Living cells with thin cell wall and intercellular spaces	Elongated living cells with thickened cell wall at corners due to cellulose and pectin	Dead and fibrous cells with tapering ends, cell wall contains lignin
Location	All parts like roots, stem, leaves, flowers and seeds	At the base of leaf petiole, branches and stem	Stem, veins of leaves, hard coats of seeds, outer covering of coconut
Functions	Support, storage of food and filling vacant spaces	Support and flexibility to various parts	Give strength and rigidity to parts of the plants.
Sub-types	**Chlorenchyma:** Leaves, performs photosynthesis. **Aerenchyma :** Helps aquatic plants, leaves and stem to float		

Types of complex permanent tissues

Name of tissue	Xylem	Phloem
Figure		
Characteristics	Consists of thick-walled dead cells	Consists of cytoplasm containing living cells
Types of cells	Tracheids, vessels and xylem fibres-dead cells Xylem parenchyma-living cells	Sieve tubes, companion cells, phloem parenchyma- living cells Phloem fibres- dead cells
Function	Structure like interconnected tubes,conduct water and minerals only in upward direction.	Tubes joined to each other, conduct sugar and amino acids from leaves to various parts in upward and downward direction

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Some cells in the body of living organisms are **'totipotent'**, that is if provided a proper environment, a new organism can grow from these cells. It was realized that with the help of this property of the cells and their genetically controlled biochemical processes, varieties of high yielding crops and new species of animals and various vaccines could be produced. This led to the rise of a new branch in biology, 'biotechnology'.

Biotechnology

With the help of this technique it has become possible to produce plants and animals bearing some new characterstics in addition to their natural ones. The techniques of bringing about improvements in living organisms by artificial genetic changes and by hybridization for the welfare of human beings, are together called 'Biotechnology'. It includes the techiques of genetic engineering and tissue culture. Its uses are in the production of cash crops, improvement in varieties of cash crops, increase in abilities of plants to withstand environmental stresses, vaccine production, early diagnosis of congenital diseases, organ transplant, cancer research, production of artificial skin, cartilage, etc. in laboratories.

Tissue culture

Can you tell?

Suppose you want to grow a garden like the one shown in the picture, around your home or school. What would you do to achieve that? By which methods will you cultivate those seedlings?

17.6 Tissue culture: Plantlets of banana and farming with their help

You must have seen flowers of same variety but of 2 or 3 different colours borne by same plant. How is this possible?

Let us learn about a modern technique related to farming and gardening.

'*Ex vivo* growth of cells or tissues in an aseptic and nutrient-rich medium' is called tissue culture. Nowadays, a complete organism can be developed from a single cell or from tissue with help of the tissue culture technique.

A liquid, solid or gel-like medium prepared from agar, which supplies nutrients and energy necessary for tissue culture is used in this technique.

Using ICT

With the help of the following websites, collect information about tissue culture and make a presentation in the class.

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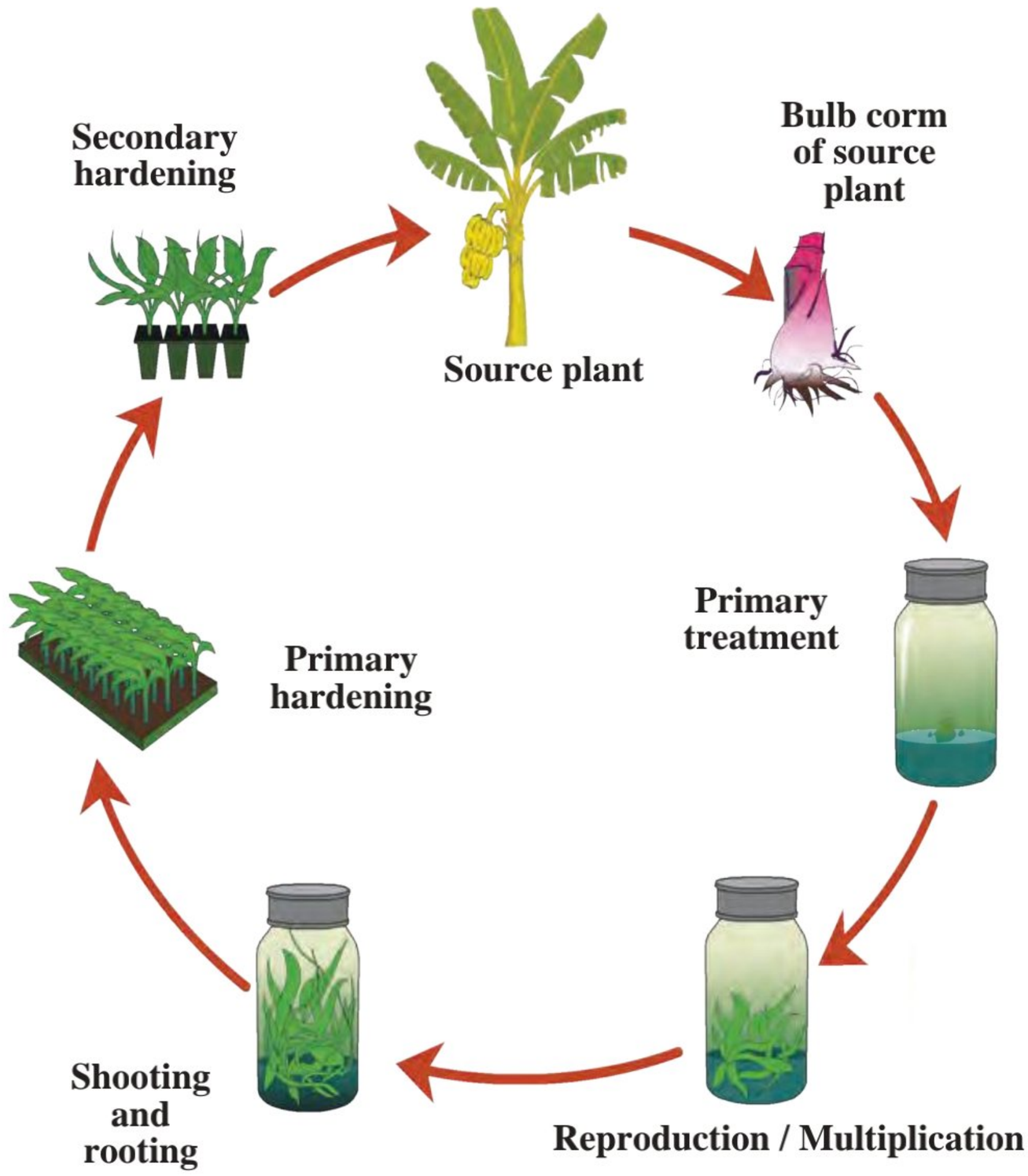

17.7 Various processes in tissue-culture

An introduction to scientists

Frederick Campion Steward (1904–1993) was a British Botanist. He had shown that cells and tissues can be grown *ex vivo*. To prove this, he isolated the cells from carrot root and cultured them in a nutrient medium. He also proved that each cell has the ability to produce a new plant.

Changes in agricultural management due to biotechnology

1. Genetically Modified Crops (GM crops) are being produced by introducing changes in DNA of natural crops. Normally, such varieties are not found in nature. Thus, new varieties are produced artificially. Different useful characters are introduced in such varieties.
2. Ability to withstand environmental stress- Some naturally occurring varieties cannot withstand envioromental stresses like frequently changing temperature, wet and dry famines, changing climate, etc. However, GM crops can grow in any of such adverse conditions.
3. As GM crops are resistant to insect pests, pathogens, chemical weedicides, etc, the use of harmful chemicals like pesticides can be avoided.
4. Due to use of seeds of GM crops, there is improvement in nutritive value and decrease in loss of crops.

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In this way, as seeds of a better quality of crops are being produced, farmers all over the world are cultivating the GM crops on large scale. The area under its cultivation is increasing day by day. High Yielding Varieties of GM crops like banana, maize, rice, potato, soybean, tomato, cotton, apple, brinjal, papaya, beet, rose, tobacco, wheat, etc. are available. Pest-resistant genes have been introduced in some of these GM crops. For example,

Maize : MON 810, MON 863.
Potato : Amflora
Rice : Golden Rice
Soybean : Vistive Gold
Tomato : Vaishali
Cotton : BT cotton

Find out

Collect information about GM varieties of crops in your area and make a note of them. Also find out if there are any adverse effects of GM crops on human beings and the environment.

In this way, a 'green evolution' is being achieved through tissue culture and a country like India with a huge population is meeting with success in producing sufficient food-grains for all.

Try this

Establish your own plant nursery near your school or home. Prepare the seedlings of flowering plants, fruit plants, and ornamental plants being grown in your area. Can you start a business in the future with the help of this activity? Think it over.

Application of biotechnology in floriculture, nurseries and forestry

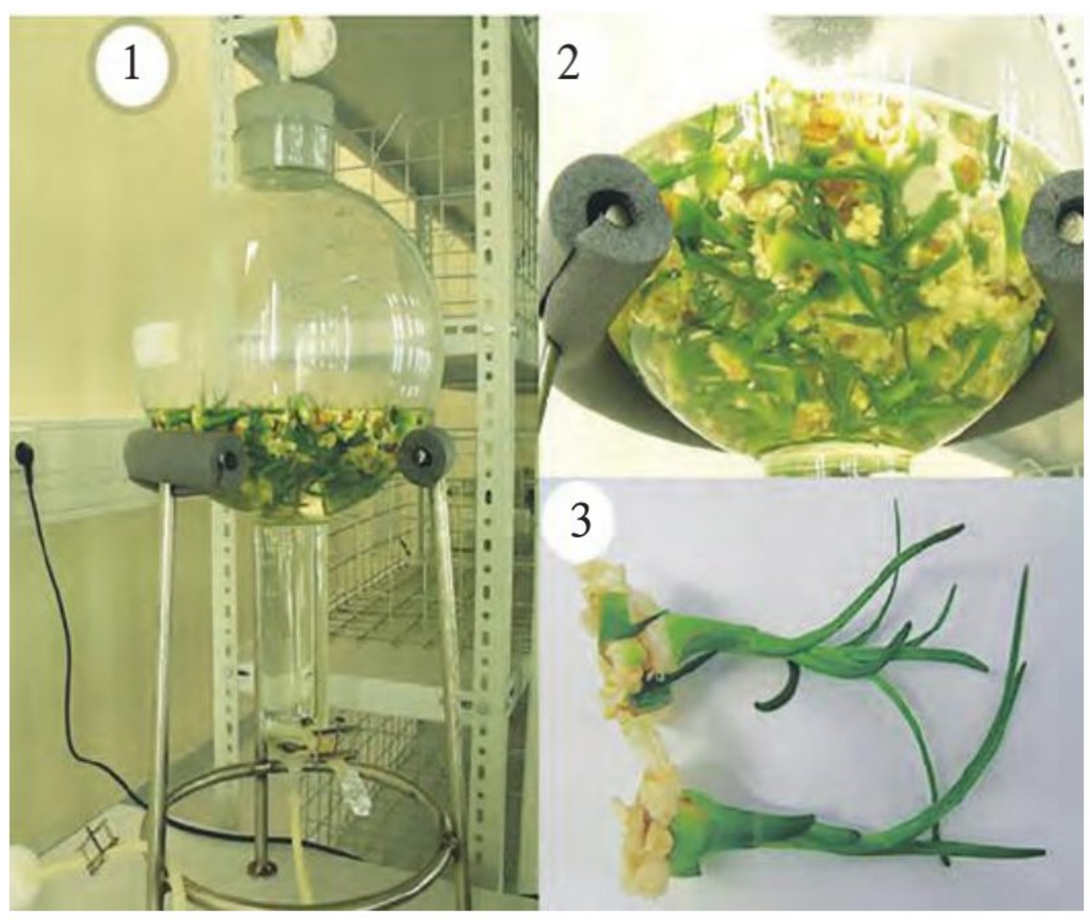
Nurseries are necessary for various purposes like growing gardens on a large scale, afforestation, reforestation, etc. Seedlings have to be supplied in large numbers for all these purposes. It is profitable in such cases to produce plantlets with the help of tissue culture techniques.

1. Tissue culture can be used to grow those plants on a large scale, which bear flowers, fruits of excellent quality.

2. Fully grown plants can be produced in shorter durations.

3. Plants can be grown on a large scale even if means of pollination or germinating seeds are not available. For example, orchids or pitcher plant do not germinate but these plants can easily be produced by means of tissue culture.

4. In a bioreactor, cells can be grown in a more nutritive medium and protected from pathogens. Bioreactors are useful for producing plantlets on a very large scale.



17.8 Bioreactor and production of plantlets

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5. Large numbers of seedlings/plantlets can be produced in a short time using minimum resources and materials.
6. Usually, plants produced by tissue culture and genetic modification techniques are disease-free. Plantlets produced by tissue culture of the meristem are virus-free.
7. Embryos formed by conventional hybridization technique between two or more varieties may not grow fully for some reasons. However, embryos produced by tissue culture technique always complete their growth.
8. Rare and endangered plants can be grown by tissue culture technique and can thus be protected from extinction. Similarly, various parts and seeds of such plants can be preserved by tissue culture and those varieties can be protected.

   These are the uses of tissue culture and biotecnology in the case of plants. Next year, we will study the use of this technique in the medical field and for conservation of animals.

Use your brain power !

1. Which other industries can be developed as an extension of the of plant nursery business?
2. To which places do people choose to go on vacation in order to relax when they are tired of crowds and a stressful life?

   What is inter-relationship between the two questions above?

Agritourism

If sufficient land is available, the emerging field of 'agri-tourism would be a good business. Plantlets of flowering, medicinal, ornamental, vegetable plants and fruit trees can be produced on a large scale by the tissue culture technique. And, by growing some of the plants fully a self-sufficient agritourism centre can be developed.

17.9 Some of the fruit trees in the agritourism centre

- Mango, chikoo (sapota), guava, coconut, custard apple and some other regional fruit trees.
- Shade giving local or exotic attractive plants.
- Ornamental and flowering plants.
- Butterfly garden.
- Medicinal plant garden.
- Organic vegetables and fruits.

People visit places with such attractions in large numbers. Selling plantlets / seedlings, fruits, vegetables at such place can be quite profitable.

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Agro-complementary occupations :

Observe and discuss.

A. Animal husbandry

Visit a modern cowshed nearby and record the following points -

The number of cattle, their variety, total milk production, cleanliness in cattle-shed, arrangements for health care of cattle.

In India, animal husbandry is practised for milk production and for using the catttle as help in farming operations. Ex. Cows and buffaloes are raised for milk and bulls and male buffaloes for pulling the heavy loads.

Local Indian varieties of cows like sahiwal, sindhi, gir, lal kandhari, devni, khillari, dangi, etc. and exotic varieties like jersey, brown Swiss, Holstein, etc. are kept for their milk. Proper care of cattle is necessary for a clean and high yield of milk.

1. A balanced diet i.e. which includes all constitents of food should be given to cattle. It must include fibre-rich coarse food, fodder, and sufficient water.
2. The cattle-shed should be clean and dry with proper ventilation and a roof.
3. Cattle should be regularly vaccinated.

Find out

1. What is meant by 'white revolution? Who was its pioneer? What benefits did it bring?
2. Collect more information about animal husbandry.
3. Find out from the internet the average daily milk yield from local and exotic varieties of cows.

17.10 Animal husbandry

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B. Poultry farming

Rearing of egg and meat yielding chickens is called poultry farming.

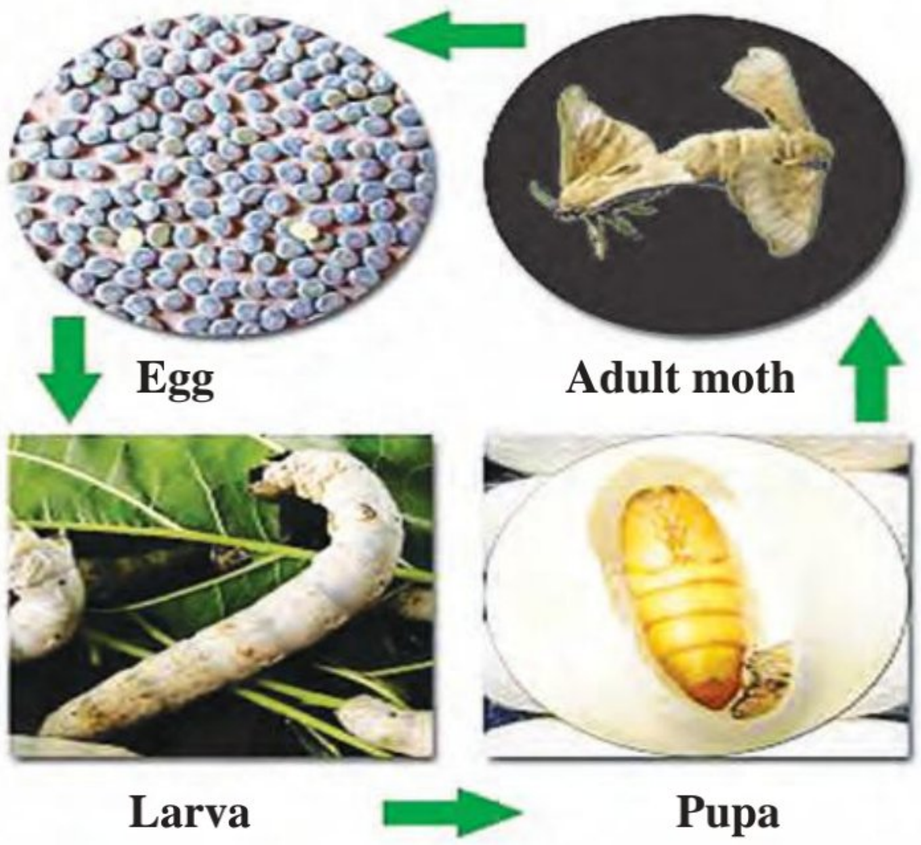
The objectives behind development of new hybrid varieties from a cross between Indian varieties like Aseel and exotic varieties like leghorn are as follows : to produce good quality chickens in large numbers, to develop the ability to withstand high temperature, to use by-products of agriculture as poultry feed, etc.

Rhode Island Red, New Hampshire, Plymouth Rock, Black Rock are varieties of chicken reared for eggs as well as meat.

Layers	Broilers
Chickens raised for eggs.	Chickens raised for meat.
Leghorn, Minorca, Ancona, Lehman	Brahma, Long, Cochin, Aseel

E. Sericulture

Silkworms (moths) are reared for production of silk. *Bombyx mori* is the most commonly used variety for this purpose. The life cycle of the silk moth consists of four stages, namely egg, larva, pupa and adult. Thousands of eggs deposited by female moths are incubated artificially to shorten the incubation period. Larvae hatching out of eggs are released on mulberry plants. Larvae are nourished by feeding on mulberry leaves. After feeding for 3 – 4 days, larvae move to branches of mulberry plant. The silk thread is formed from the secretion of their salivary glands. Larvae spin this thread around themselves to form a cocoon. The cocoon may be spherical in shape.



17.10 Life cycle of the silk moth

Ten days before the pupa turns into an adult, all the cocoons are transferred into boiling water. due to the boiling water, the pupa dies in the cocoon and silk fibres become loose. These fibres are unwound, processed and reeled. Various kinds of fabric is woven from silk threads.

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Use your brain power !

Why are the cocoons transferred to boiling water before the pupa develops into an adult?

Exercises

1. Each of the following statements is wrong. Rewrite them correctly by changing either one or two words.

a. Simple squamous epithelium is present in respiratory tract.
b. Glandular epithelium is present in kidneys.
c. Chlorenchyma helps the plant to float in water.
d. Striated muscles are also called involuntary muscles.
e. Chloroplast is present in permanent tissue.

2. Identify the odd word and explain why it is odd.

a. Xylem, phloem, permanent tissue, meristematic tissue.
b. Epithelium, Muscle fibre, nerve fibre, epidermis.
c. Cartilage, bone, tendon, cardiac muscle.

3. Write the names of the following tissues.

a. Tissue lining inner surface of mouth.
b. Tissue joining muscles and bones.
c. Tissue responsible for increasing height of plants.
d. Tissue responsible for increasing girth of stem.

4. Write the differences.

Simple tissue and complex tissues in plants.

5. Write short notes.

a. Meristematic tissue.
b. Xylem
c. Striated muscles.
d. Agro-complementary business.
e. Genetic engineering
f. Sericulture

6. Explain the meaning of biotechnology and its impact on agricultural management with suitable examples.

7. Which two main techniques are used in biotechnology? Why?

8. Discuss 'Agritourism' in the class and write a project on an agro-tourism centre nearby. Present it in the class in groups.

9. Define the term tissue and explain the concept of tissue culture.

10. 'Rearing of sheep is a livestock'. Justify this statement.

Activity :

1. Obtain information about the diversity of butterflies. Collect detailed information about what would have to be done to establish a butterfly garden in your school.
2. Visit an apiculture centre and gather information about it.

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