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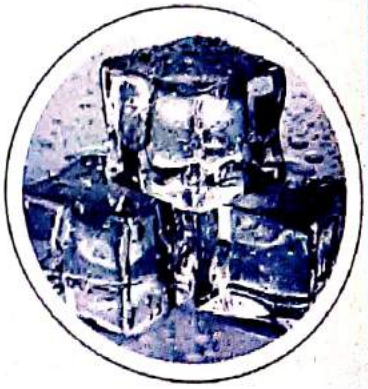
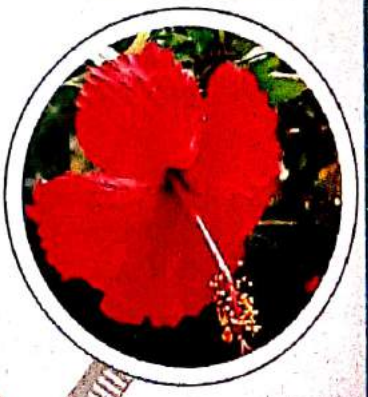




1 Nutrition in Plants

Use **Cordova Smart Class Software** on the **smart board** in class to know the modes of nutrition in plants. Also, to understand the necessary factors for photosynthesis through virtual lab.

All organisms need to perform certain basic life processes like nutrition, respiration, growth and reproduction for their survival. To perform all life processes, every organism needs energy. The food we eat gives us energy. We already know about the various components of food like proteins, carbohydrates, fats, vitamins and minerals. These are called **nutrients**. The nutrients help organisms to grow, repair damaged parts of their bodies and provide energy to carry out life processes.

Nutrition is the process of taking food by an organism and its digestion, absorption and utilisation by the body.

Like us, plants also need nutrients to survive. In this chapter, we will study nutrition in plants.

MODES OF NUTRITION

There are two modes of nutrition in plants- autotrophic and heterotrophic.

1. Autotrophic Mode of Nutrition

The word '*auto*' means 'self' and '*trophos*' means 'nutrition'. Thus, autotrophic means 'self nutrition'. **The mode of nutrition in which an organism makes its own food from simple substances like carbon dioxide, water and minerals present in the surroundings is called autotrophic nutrition. Organisms having autotrophic mode of nutrition are called autotrophs. All green plants** and some bacteria are autotrophs because they prepare their own food.

2. Heterotrophic Mode of Nutrition

The word '*hetero*' means 'other' and '*trophos*' means 'nutrition'. Thus, heterotrophic means 'nutrition obtained from others'. **The mode of nutrition in which an organism cannot make its own food from the simple substances but obtains ready-made food made by the green plants directly or indirectly is called heterotrophic nutrition. Organisms having heterotrophic mode of nutrition are called heterotrophs. Animals** and **non-green plants** have heterotrophic mode of nutrition and thus they are called heterotrophs.

PHOTOSYNTHESIS

All green plants make their own food by the process of photosynthesis (Fig. 1.1). The term photosynthesis was given by **Charles Reid Barnes** in 1893. '*Photo*' means 'light' and '*synthesis*' means 'to build'. Thus, photosynthesis means 'building up by light'. The leaves of a plant are green because

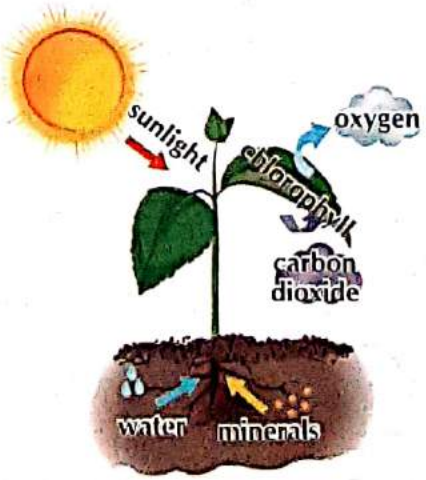


Fig. 1.1 Green plants make their own food.

they contain tiny green coloured bodies called **chloroplasts**. Chloroplasts contain a green pigment called **chlorophyll**. The chlorophyll uses the solar (sunlight) energy to prepare food from carbon dioxide and water.

The process by which green plants make their own food (glucose) from carbon dioxide and water by using solar energy in the presence of chlorophyll is called photosynthesis. Oxygen gas is released during photosynthesis.

$$\underset{\text{Carbon dioxide (from air)}}{6CO_2} + \underset{\text{Water (from soil)}}{6H_2O} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \underset{\text{Glucose (food)}}{C_6H_{12}O_6} + \underset{\text{Oxygen}}{6O_2}$$

The food prepared by the green leaves of a plant is in the form of a simple carbohydrate called **glucose**. Glucose prepared in the leaves is then transported to the different parts of the plant as **sucrose** (a complex carbohydrate) by the **phloem tissue**. Extra glucose gets changed into a complex carbohydrate called **starch**. This starch is stored in the leaves and other parts of the plant.

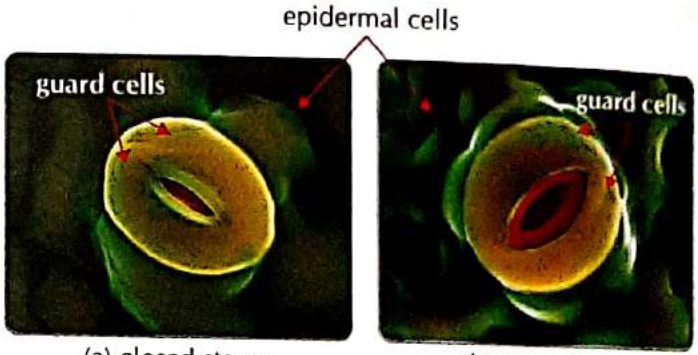
Requirements of Photosynthesis

Plants need water and minerals, carbon dioxide, chlorophyll and sunlight for photosynthesis.

1. **Water and minerals:** Water and minerals are absorbed by the roots of the plants from the soil through the process of **osmosis**. Water and minerals are transported to the leaves and other parts of the plant by **xylem vessels**. Xylem vessels run like pipes throughout the roots, stems, branches and leaves and form a continuous passage for water and minerals to reach the leaves.

The membrane that allows only certain molecules to pass through it is called **semi-permeable membrane**. The movement of water molecules from the region of higher water concentration to the region of lower water concentration through a semi-permeable membrane is called **osmosis**.

2. **Carbon dioxide:** Green plants take carbon dioxide gas from the air for carrying out photosynthesis. Tiny pores called **stomata** (singular: stoma) (Fig. 1.2) are present on the lower surface of the leaves. These pores are surrounded by **guard cells**. The guard cells control the opening and closing of stomata. The carbon dioxide gas enters the leaves of the plant through stomata.



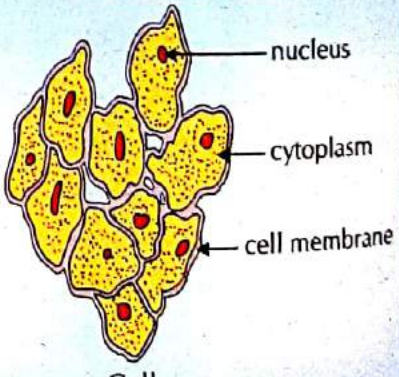
(a) closed stoma (b) open stoma

Fig. 1.2 Stomata

3. **Chlorophyll:** Chlorophyll is a green pigment present in the cell organelle called **chloroplast**. Chlorophyll traps the solar energy. This energy is used to prepare food from carbon dioxide and water during the process of photosynthesis.

Cells

All organisms are made up of **cells**. Cells are very small and can be seen only with the help of microscope. Some organisms are made up of only one cell. All cells have a similar basic structure. Each cell is enclosed by a thin **cell membrane**. Most of the cells have a distinct and centrally placed **nucleus**. The space between the cell membrane and the nucleus is occupied by a jelly-like substance called **cytoplasm**. Tiny structures called cell organelles (e.g., chloroplast) are present in the cytoplasm.



Cell

Besides leaves, photosynthesis also takes place in other green parts of the plant like green stems and green branches. For example, in desert plants like cactus, the leaves are modified into spines to reduce water loss by transpiration. These plants have thick and fleshy green stems that carry out the process of photosynthesis to make their own food.

ACTIVITY 1

*Use **Cordova Smart Class Software** on the **smart board** in class to perform this activity.*

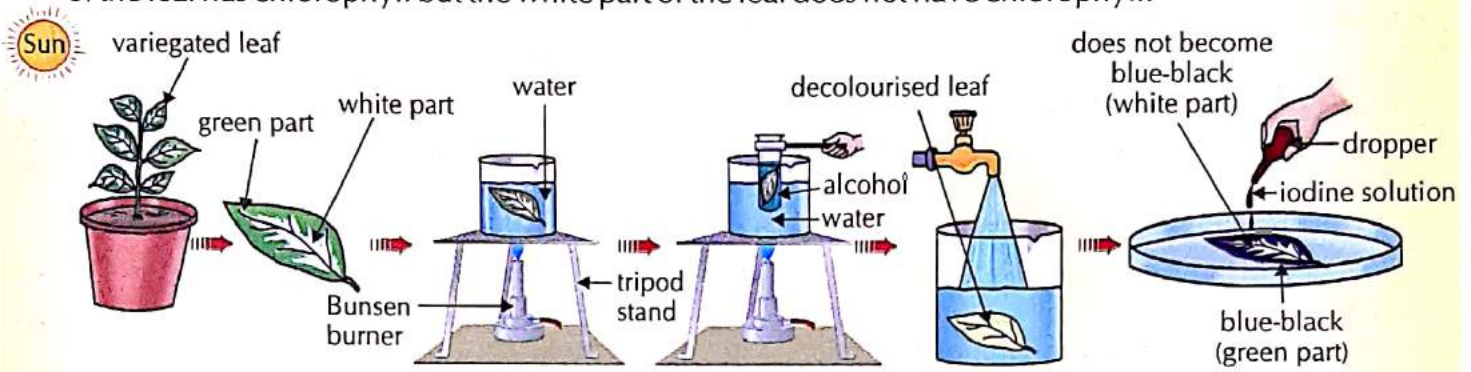
To show that chlorophyll is necessary for photosynthesis

Things needed: A croton plant, a beaker, alcohol, water, a Bunsen burner, iodine solution, a dropper, boiling tube, test tube holder, petri dish, wire gauze and tripod stand

Caution: Do not heat alcohol directly because it catches fire.

Method:

1. Take a croton plant whose leaves are partly green and partly white (variegated leaves). The green part of the leaf has chlorophyll but the white part of the leaf does not have chlorophyll.



(a) Keep the plant in sunlight. (b) Pluck a variegated leaf. (c) Boil it in water. (d) Boil it in alcohol. (e) Wash the leaf in cold water. (f) Add iodine solution to the leaf.

Fig. 1.3 Chlorophyll is necessary for photosynthesis.

2. Keep this plant in the sunlight for a few hours [Fig. 1.3 (a)].
3. Now, pluck a leaf of this plant [Fig. 1.3 (b)] and trace the leaf on a sheet of paper showing green and white patches.
4. Remove the green coloured chlorophyll from the leaf by boiling it first in water and then in alcohol. (Do not heat the test tube containing alcohol directly. Keep it in a beaker filled three-fourths with water.) In this way, you get a decolourised leaf. Wash the leaf with water again [Fig. 1.3 (c), (d) and (e)].
5. Add a few drops of iodine solution over the decolourised leaf and observe [Fig. 1.3 (f)].

Observation: You find that the white patches of the leaf do not turn blue-black, i.e., starch is not formed in the white parts of the leaf. The portion of leaf which was earlier green, turn blue-black, i.e., starch is formed only in the green parts of the leaf.

Conclusion: We conclude that chlorophyll is necessary for photosynthesis.

You might have observed slimy green patches in stagnant water bodies like ponds. These patches are formed due to the growth of algae. Algae are the simplest of plants. They contain chlorophyll and thus, are green in colour. They can prepare their own food by photosynthesis.

The leaves of some plants, like croton, have chlorophyll, but they appear dark red in colour (Fig. 1.4). This is because the red pigment present in them hides the green colour of the chlorophyll. Such leaves can also make food by the usual process of photosynthesis.

Fig. 1.4 Leaves of various colours

Multiple Choice Questions (MCQs)

Tick (✓) the correct options:

1. Green plants are called _____.
   (a) heterotrophs ◯ (b) autotrophs ◯
   (c) hydrotrophs ◯ (d) saprophytes ◯
2. Which of the following gases is released during photosynthesis?
   (a) nitrogen ◯ (b) oxygen ◯
   (c) carbon dioxide ◯ (d) hydrogen ◯

4. **Sunlight:** Green plants prepare food in the presence of sunlight. Chlorophyll present in the green leaves traps the solar energy. The solar energy is converted into chemical energy by the process of photosynthesis. The chemical energy is stored in the form of carbohydrate (food) in plants.

   Leaves of plants grow in different patterns so as to absorb maximum sunlight.

ACTIVITY 2

*Use **Cordova Smart Class Software** on the **smart board** in class to perform this activity*

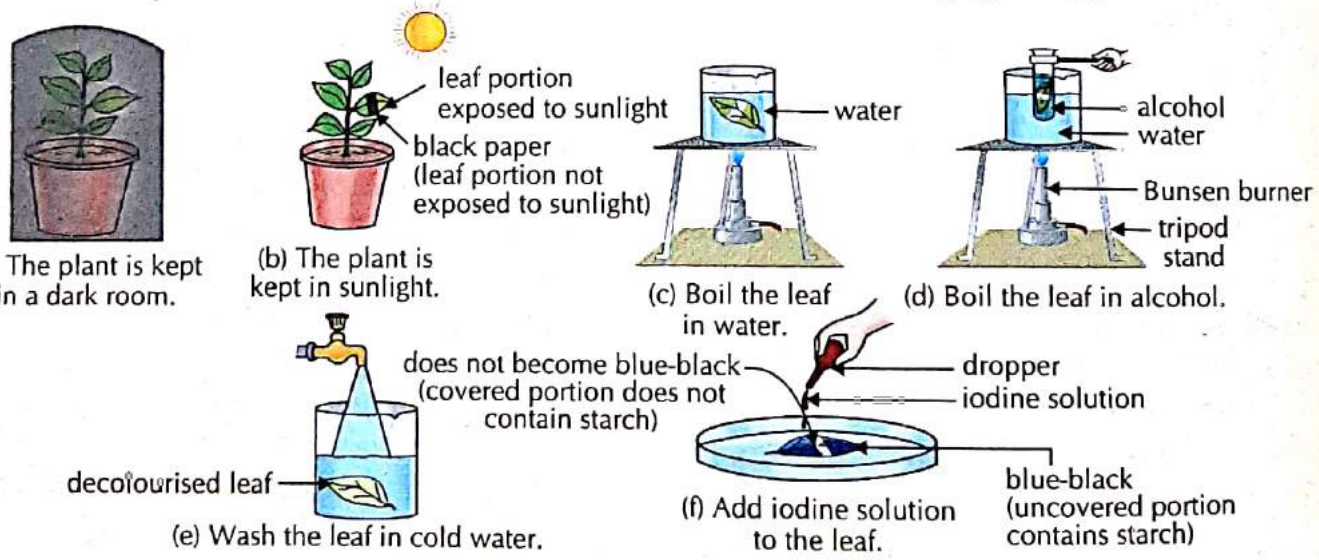
To show that sunlight is necessary for photosynthesis

Things needed: A potted plant, a beaker, a Bunsen burner, alcohol, iodine solution, a dropper, boiling tube, test tube holder, petri dish, a thick black paper, wire gauze and tripod stand

Caution: Do not heat alcohol directly because it catches fire.

Method:

1. Take a healthy potted plant and keep it in a dark room for 2-3 days to destarch the leaves [Fig. 1.5 (a)].
2. Cover one of its leaves partly with a strip of black paper and keep the plant in sunlight for a few hours [Fig. 1.5 (b)].
3. Pluck this covered leaf and remove the black strip.
4. Remove the green coloured chlorophyll from the leaf by boiling it first in water and then in alcohol. In this way, you get a decolourised leaf. Wash the leaf with water again [Fig. 1.5 (c), (d) and (e)].
5. Add a few drops of iodine solution over the colourless leaf and observe [Fig. 1.5 (f)].



(a) The plant is kept in a dark room. (b) The plant is kept in sunlight. (c) Boil the leaf in water. (d) Boil the leaf in alcohol. (e) Wash the leaf in cold water. (f) Add iodine solution to the leaf.

Fig. 1.5 Sunlight is necessary for photosynthesis.

Observation: You find that the part of the leaf covered with a strip of black paper does not turn blue-black on adding iodine solution while the other parts turn blue-black.

Discussion: The covered part of the leaf could not get sunlight, hence no starch is formed in this part.

Conclusion: This shows that sunlight is needed for making starch, i.e., sunlight is necessary for photosynthesis.

Aquatic plants like *Hydrilla*, water lily and *Vallisneria* take in carbon dioxide dissolved in water to prepare their food and give out oxygen during this process.

Importance of Photosynthesis

We cannot imagine the earth in the absence of the process of photosynthesis due to the reasons given below:

1. Photosynthesis enables the green plants to make their own food. In the absence of photosynthesis, there would be no plants.
2. The survival of all animals in the world directly or indirectly depends upon the food made by plants.
3. Oxygen, which is essential for the survival of all organisms, is produced during photosynthesis. Carbon dioxide is used by plants during photosynthesis. So, we can say that photosynthesis maintains the balance between oxygen and carbon dioxide in the atmosphere.

So, in the absence of photosynthesis, life on the earth would be impossible.

PLANTS ALSO SYNTHESISE PROTEINS AND FATS

We have just learnt that plants synthesise carbohydrates through the process of photosynthesis. Carbohydrates are made up of carbon, hydrogen and oxygen. Plants can also synthesise other components of food such as proteins and fats. Proteins contain nitrogen. From where do the plants obtain nitrogen?

Plants cannot use the nitrogen present in the atmosphere. **They need nitrogen in a soluble form.** Soil contains certain bacteria, called ***Rhizobium*** that can take atmospheric nitrogen and convert it into water-soluble nitrogen components (like nitrates) and release it into the soil. These nitrates are absorbed by the plants along with water. Plants also absorb nitrogen from fertilisers, as they are rich in nitrogen.

Some plants, like sunflower and mustard, convert simple carbohydrate 'glucose' (synthesised during photosynthesis) into oils and store them in their seeds.

Plants also synthesise vitamins. Vitamins are found in vegetables, fruits and cereals.

HETEROTROPHIC MODE OF NUTRITION

There are some plants that do not have chlorophyll. They cannot make their own food. Like humans and animals, such non-green plants depend on the food produced by other green plants. This is called **heterotrophic mode of nutrition.** Let us study in detail how these heterotrophic plants get nutrition.

1. Saprotrophic Nutrition

Some non-green plants get nutrients from dead and decaying organic matter of plants and animals. Such plants are usually white in colour and have no leaves.

The mode of nutrition in which the non-green plants obtain their nutrients from dead and decaying organic matter of plants and animals is called saprotrophic nutrition. Plants that have saprotrophic mode of nutrition are called saprophytes. For example, Indian pipe and coral root (Fig. 1.6)

(a) Indian pipe (b) coral root

Fig. 1.6 Some saprophytic plants

The roots of saprophytes contain organisms called **fungi.** The fungi (like mushrooms) secrete digestive juices on the dead and decaying matter and convert it into a liquid that is used as nutrient by the non-green plants. Fungi (like moulds, mushrooms and

yeast) and bacteria are **saprotrophs.** Fungi were earlier considered to be plants but due to the presence of some characteristics different from plants, they are no longer considered plants. They form an entirely different category of organisms and are considered as a separate kingdom.

Multiple Choice Questions (MCQs)

Tick (✓) the correct options:

1. The chlorophyll traps the solar energy and converts it into _____ energy.
   (a) mechanical ◯ (b) chemical ◯
   (c) magnetic ◯ (d) electrical ◯
2. Which of the following is a saprophyte?
   (a) rose ◯ (b) coral root ◯
   (c) *neem* ◯ (d) all of these ◯

2. Parasitic Nutrition

Cuscuta (*amarbel*) is a non-green plant. It does not have chlorophyll. It cannot make its own food. Its long, yellowish, thread-like stems twine around the stem and branches of the tree on which it climbs. It has a special structure called **haustorium** (plural: haustoria) that pierces into the plant's body on which it climbs for absorption of ready-made food.

The mode of nutrition in which some plants live in or on the body of other organisms and get their ready-made food from them is called parasitic nutrition. The plant (like *Cuscuta*) that obtains the ready-made food is called a **parasite** and the organism from whose body the food is obtained is called the **host**. Parasites may be totally or partially dependent upon the host. *Cuscuta* is a **total parasite** (Fig. 1.7).

Fig. 1.7 *Cuscuta* (total parasite)

A few fungi and bacteria are also total parasites.

Some plants, like mistletoe, are **partial parasites**. Mistletoe plant has green leaves. These green leaves make their own food. But this plant receives water and minerals from the host plant (on which it grows) to make its own food (Fig. 1.8).

Fig. 1.8 Mistletoe (partial parasite)

Think! Mosquitoes, bed bugs, lice and leeches suck our blood. Are they also parasites?

3. Symbiosis

Lichens are the most amazing form of life. A lichen is actually composed of two distinct organisms—**algae** and **fungi**. They live and work together.

The algae contain chlorophyll and make their own food. The fungi share the food made by the algae. The fungi, in return, provide protection, water and minerals to algae.

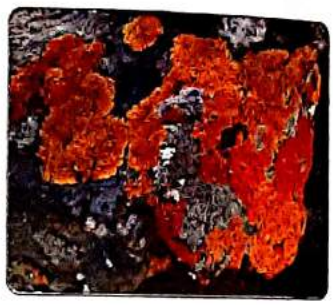


Fig. 1.9 Lichens

The mutual association in which two different types of organisms live and work together for their mutual benefit is called symbiosis. Lichens show symbiotic relationship or symbiosis (Fig. 1.9).

Rhizobium bacteria live in the root nodules of leguminous plants (like pea and gram) and provide them nitrogen in a soluble form (Fig. 1.10). In return, the plants provide food and shelter to the *Rhizobium* bacteria. So, both organisms benefit each other.

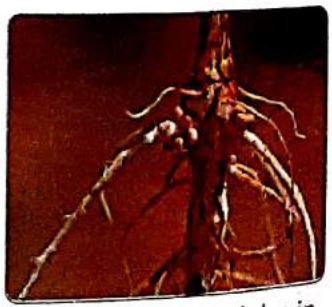


Fig. 1.10 Root nodules in leguminous plants

SPECIAL MODE OF NUTRITION

A few plants feed on insects for fulfilling their nitrogen requirement. Such **insect-eating plants are called insectivorous plants.** Pitcher plant, *Utricularia*, venus flytrap and *Drosera* are some insectivorous plants. They are generally green plants. Therefore, they can prepare their own food. But for preparing proteins, they cannot get nitrogen from the surroundings. The insects on which they feed, fulfil their nitrogen requirement.

In a **pitcher plant,** the leaf lamina is modified to form a pitcher-like structure. The apex of the leaf is modified into a lid that can open and close the mouth of the pitcher (Fig. 1.11). Inside the pitcher, there are hair that are directed downwards.

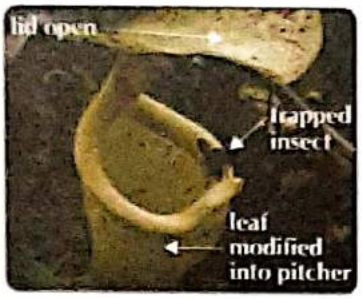


Fig. 1.11 Pitcher plant

When an insect lands in the pitcher, the lid closes and the trapped insect gets entangled in the hair. The insect is digested by the digestive juices secreted in the pitcher.

REPLENISHMENT OF NUTRIENTS IN THE SOIL

Plants absorb the mineral nutrients, especially nitrogen from the soil. Therefore, there is a depletion of nitrogen in the soil over a period of time. Manure and fertilisers are used to replenish the nutrients in the soil. These contain plant nutrients such as nitrogen, potassium and phosphorus needed by plants for their healthy growth. These nutrients need to be added from time to time to enrich the soil.

Rhizobium bacteria, living in the root nodules of leguminous plants, enrich the soil with nitrogen. This is a natural way of replenishing the soil with nitrogen.

Science In Life

Farmers grow leguminous crops in alternation with other crop plants to maintain the fertility of soil.

EXERCISES

*Use **Cordova Smart Class Software** on the **smart board** in class to do these exercises.*

A. Tick (✓) the correct options:

1. *Rhizobium* bacteria live in the root nodules of _____ plant.
   (a) wheat ◯ (b) rice ◯ (c) barley ◯ (d) pea ◯
2. Plants store food as _____.
   (a) cellulose ◯ (b) sugar ◯ (c) glucose ◯ (d) starch ◯
3. Which of the following is an insectivorous plant?
   (a) *Cuscuta* ◯ (b) *Drosera* ◯ (c) mistletoe ◯ (d) lichen ◯
4. The mode of nutrition shown by Mistletoe is _____.
   (a) parasitic ◯ (b) symbiotic ◯ (c) saprophytic ◯ (d) autotrophic ◯
5. The membrane that allows only certain molecules to pass through it is called _____ membrane.
   (a) semi-permeable ◯ (b) completely permeable ◯
   (c) partially-permeable ◯ (d) osmotic ◯
6. We keep healthy potted plant in a dark room for some days to _____ the leaves.
   (a) decolourise ◯ (b) defragment ◯ (c) destarch ◯ (d) deprotein ◯
7. The portion of leaf that is not exposed to sunlight, will not make _____.
   (a) fats ◯ (b) protein ◯ (c) glucose ◯ (d) starch ◯

B. Fill in the blanks:

1. *Rhizobium* bacteria provide _____ to the leguminous plants.
2. Green plants make their food by the process of _____.
3. Stomata are surrounded by _____ cells.
4. *Cuscuta* has a special structure called _____.
5. The roots of saprophytes contain organisms called _____.

C. Very Short Answer Questions:

1. Name any two heterotrophic plants.
2. Name any two insectivorous plants.
3. Name the pores through which leaves exchange gases.
4. Name one plant in which photosynthesis occurs in a part other than leaves. Also, name the part of the plant.
5. What are the two main modes of nutrition in plants?
6. Name the green pigment present in the leaves.
7. In which form, do plants need nitrogen?

D. Short Answer Type-I Questions:

1. What are autotrophs?
2. Why is *Cuscuta* called parasite?
3. What is nutrition?
4. Why do some plants feed on insects?
5. Define photosynthesis.

E. Short Answer Type-II Questions:

1. How can you test the presence of starch in a leaf? What do you conclude when white patches do not turn blue-black on adding iodine solution?
2. What is saprotrophic mode of nutrition? Give one example.
3. How does the pitcher plant trap its food?
4. Algae and fungi live together in lichens.
   (a) What is this association called? (b) What value do we learn from this association in nature?
5. Discuss the importance of photosynthesis.

F. Long Answer Questions:

1. Write an experiment to show that sunlight is necessary for photosynthesis.
2. How do *Rhizobium* bacteria and leguminous plants help each other in survival?

G. HOTS (Higher Order Thinking Skills) Questions:

1. What will happen if plant leaves are devoid of stomata?
2. What will happen if all the plants disappear from the earth?

H. Practical Skill Based Question:

How can we obtain a decolourised leaf?

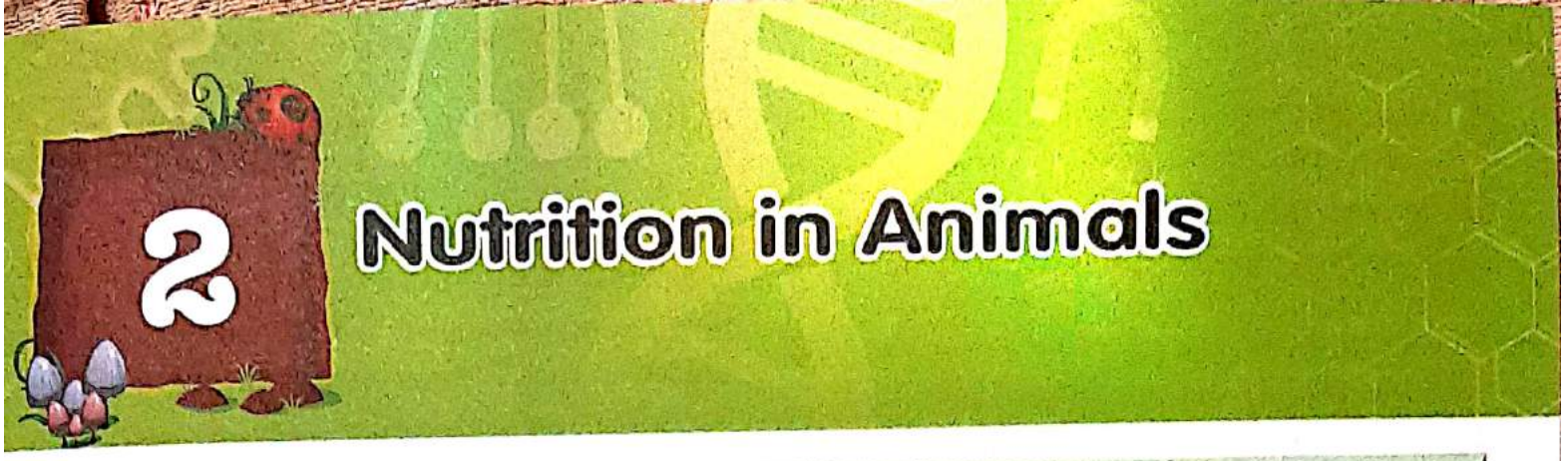
ACTIVITY

Home Assignment/Group Activity/Project: Compare a small green plant, like tomato or *tulsi*, with a pitcher plant and a dodder plant. Observe carefully and note the features (root, stem, leaves, habitat) of each plant in your notebook.

Field Visit

1. Visit a field and uproot a leguminous plant. Closely observe its roots. Make its diagram in your notebook.
2. Visit a greenhouse. Observe how plants are grown there. How is light, water and carbon dioxide regulated there?

Group Discussion: Discuss in the class: 'Modes of nutrition in plants seen around the school'



2 Nutrition in Animals

Use **Cordova Smart Class Software** on the **smart board** in class to understand the process of nutrition in humans, *Amoeba* and ruminants. Also, to explore the human digestive system in detail.

In the previous chapter, we have learnt that green plants can make their own food by the process of photosynthesis. Unlike green plants, animals cannot prepare their own food, they depend on plants for their food directly or indirectly.

We know that all organisms including humans need food for growth, for repairing damaged parts of their bodies and for obtaining energy to carry out life processes. **Animal nutrition is a process of taking food by an organism and its digestion, absorption and utilisation in the body.**

DIFFERENT STEPS IN THE PROCESS OF NUTRITION

There are five main steps in the process of nutrition in animals. These are— **ingestion, digestion, absorption, assimilation** and **egestion.**

1. Ingestion

The process by which the food is taken inside the body of an organism is called ingestion. When we put food into our mouth with hands, we are ingesting the food. However, different animals ingest food in different ways and have special organs for this purpose.

2. Digestion

The food of most animals consists of complex, insoluble substances that cannot be absorbed by their body. **The breakdown of complex, insoluble food substances into simple, soluble food substances with the help of digestive juices prepared by the body is called digestion.**

3. Absorption

The process in which the simple, soluble digested food substances are absorbed into the blood is called absorption.

4. Assimilation

The simple, soluble absorbed food substances are transported to the different parts of the body where they are utilised for energy, growth and repair. This process is called assimilation.

5. Egestion

A part of the food that we eat, remains undigested and unabsorbed. It cannot be utilised by the body. **The process in which the undigested food is removed from the body is called egestion.**

MODES OF PROCURING FOOD

The mode of procuring food into the body varies in different organisms. Each organism has some special structure to procure food.

1. **Human beings:** Human beings use their hands to take food into their mouth.
2. **Ruminants:** Ruminating animals, such as cow and horse, pick up food directly by their mouth.
3. ***Paramecium:*** *Paramecium* (unicellular organism) has fine hair-like structures called **cilia** all over its body (Fig. 2.1). The constant movement of

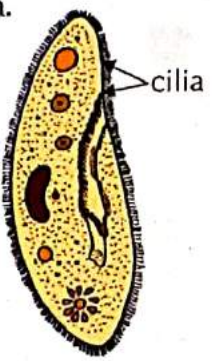


Fig. 2.1 *Paramecium* uses its cilia to take its food.

cilia pushes the food particles along with the water current into its body.

4. **Insects:** The mouth parts of insects such as butterflies, houseflies, mosquitoes and bees are modified to form a feeding tube (called **proboscis**) to suck liquid food. It is similar to the way we sip drinks with a straw (Fig. 2.2).

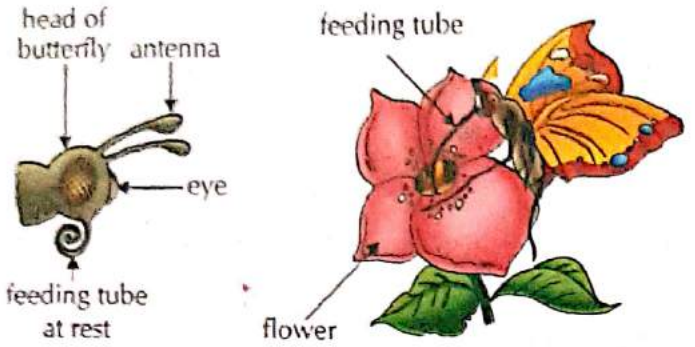


Fig. 2.2 An insect uses its feeding tube to obtain food.

Multiple Choice Questions (MCQs)

Tick (✓) the correct options:

1. The process of nutrition in animals has _____ main steps.
   (a) three ◯ (b) four ◯
   (c) five ◯ (d) six ◯
2. The process by which the food is taken inside the body is called _____.
   (a) assimilation ◯ (b) absorption ◯
   (c) digestion ◯ (d) ingestion ◯

DO YOU KNOW?

A starfish feeds on animals that are covered with hard shells of calcium carbonate. After opening the shell, the starfish takes out its stomach through the mouth to eat the soft animals. Then, the stomach goes back into the body and food is digested slowly.

starfish

NUTRITION IN HUMANS

We take in food through the mouth, digest and utilise it. The undigested parts of the food are expelled from the body. The food passes through a long muscular canal called **alimentary canal** or **digestive tract**. The alimentary canal begins at the buccal cavity and ends at the anus.

The alimentary canal consists of following organs:

1. Buccal cavity or oral cavity
2. Oesophagus or foodpipe
3. Stomach
4. Small intestine
5. Large intestine ending at the rectum
6. Anus

The inner walls of **stomach, small intestine** and various glands such as **salivary glands, liver** and **pancreas** secrete digestive juices. These digestive juices change the complex, insoluble food substances into simple, soluble food substances. **The digestive tract and the associated glands together constitute the digestive system** (Fig. 2.3).

Ingestion

We have learnt that **the process of taking food into the body is called ingestion.** Human beings have mouth for the ingestion of food. The food is taken into the body through the mouth with the help of hands.

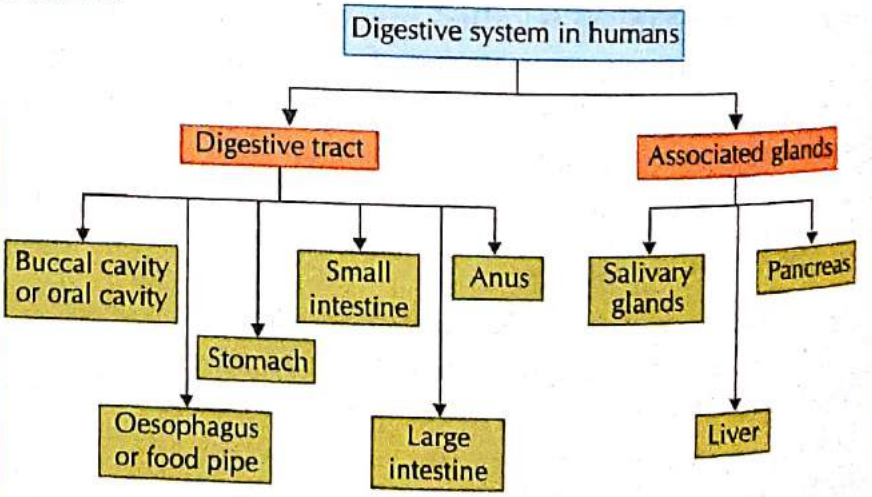


Fig. 2.3 Human digestive system

Digestion

1. Buccal Cavity or Oral Cavity

From the mouth, the food goes into the buccal cavity or oral cavity. The buccal cavity contains teeth, tongue and salivary glands. Let us study in detail about each of them.

(a) **Teeth:** The teeth break the food into small pieces, chew and grind it. Chewing mixes the small pieces of food with saliva. This process is called **mastication.** The digestion of food inside the buccal cavity is called **mechanical digestion.** Each tooth is present in a separate socket in the gums. **The white substance that covers the teeth is called enamel.** It is the hardest substance in the human body.

Our teeth are of different shapes and carry out different functions. On the basis of their structure and functions, teeth are of four types.

(i) **Incisors (cutting teeth):** These are four flat and blade-like teeth present in the front part of each jaw. These teeth are used to **bite and cut the food** into small pieces.

(ii) **Canines (tearing teeth):** These are present on the either side of the incisors. These are two in number in each jaw. These are sharp and pointed and help in **tearing the food.**

(iii) **Premolars (grinding teeth):** There are two premolars next to each canine (four in number in each jaw). These have broad and flat grinding surfaces. They **grind the food** and break it into small pieces.

(iv) **Molars (grinding teeth):** The remaining teeth in the jaws are three molars on either side of premolars (six in number in each jaw). These teeth also have broad and flat grinding surfaces. They are larger than the premolars. These teeth are also used to **crush** and **grind the food.**

Temporary and permanent set of teeth: In human beings, the teeth grow twice. The temporary set of teeth grow when the child is in the age group of 6 months to 8 years. This set of teeth is called **milk teeth.** These teeth are smaller and weaker. These are 20 in number: 10 in the upper jaw (4 incisors, 2 canines and 4 molars) and 10 in the lower jaw. Teeth grow again after the milk teeth fall out. The second set of teeth is called **permanent teeth.** These teeth remain till old age. Permanent teeth cannot be replaced by new natural teeth. These are 32 in number: 16 in the upper jaw (4 incisors, 2 canines, 4 premolars and 6 molars) and 16 in the lower jaw (Fig. 2.4).

(b) **Tongue:** The tongue is a fleshy muscular organ

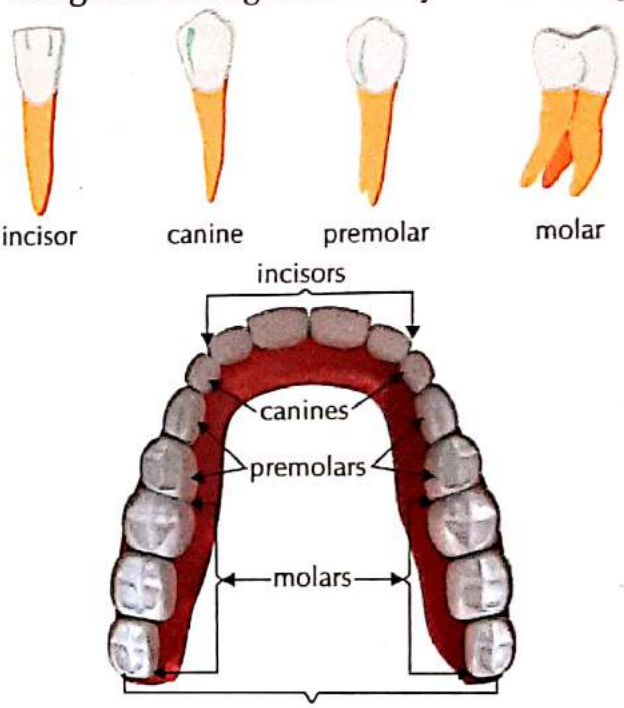


Fig. 2.4 A permanent set of teeth of humans

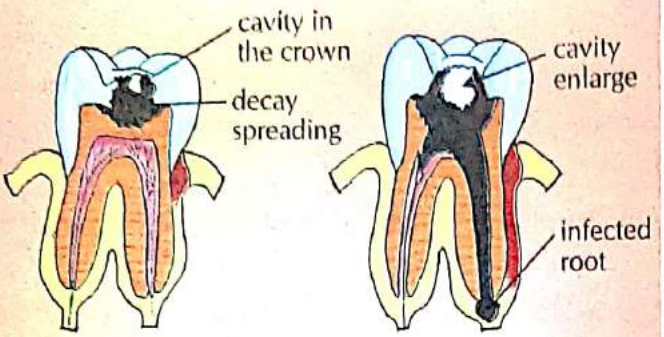
TOOTH DECAY

When we eat food, small bits of it get stuck between our teeth. Sometimes, these bits of food stay between our teeth if we do not brush our teeth carefully. The bacteria present in our mouth react with the leftover food and the saliva, and form a thin sticky layer called plaque on the surface of teeth. This **plaque**, if not removed by brushing, forms acids with sugar present in the food. These acids affect the

tooth enamel. It causes holes or cavities in the enamel. This is called **tooth decay.**

As a result, the nerves and the blood vessels in the pulp get exposed. When any cold or hot thing comes in contact with these exposed nerves, we feel pain.

Tooth decay causes holes or cavities in the teeth, foul smell, loss of teeth and toothache.



(a) tooth decay spreads to the pulp; severe toothache

(b) bacteria reach the base of the tooth causing unbearable pain; tooth may have to be removed

Tooth decay

We can prevent tooth decay by the following ways:

(i) We should avoid eating too many sweets, ice creams and chocolates.

(ii) We must brush our teeth at least twice a day— in the morning and at night, before going to the bed.

(iii) We must floss our teeth every day. A **dental floss** is a special strong thread that is moved back and forth through the spaces between our teeth to remove the food stuck between our teeth that cannot be removed by brushing.

attached at the back to the floor of the buccal cavity. It is free at the front and can be moved in all directions. The tongue helps in mixing saliva with food, pushing and swallowing the food into the food pipe and getting the different tastes of food. It has several taste buds that can distinguish four types of tastes in food— **salty, sour, bitter** and **sweet** (Fig. 2.5). The tongue also helps us speak.

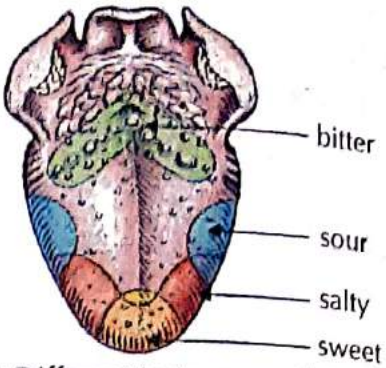


Fig. 2.5 Different taste areas of the tongue

(c) **Salivary glands:** The salivary glands produce **saliva.** The saliva contains an enzyme (a substance that helps chemical change happen more quickly) called **amylase.** Amylase converts the starch present in the food into sugars. Saliva also makes the food wet and slimy so that it can be easily swallowed.

ACTIVITY 1 *Use Cordova Smart Class Software on the smart board in class to perform this activity.*

To test the action of saliva on starch

Things needed: Two test tubes, a boiled potato, iodine solution and a dropper

Method:

1. Take two test tubes and label them 'A' and 'B'. In test tube 'A', put a few pieces of boiled potato. In test tube 'B', put a few pieces of boiled potato after chewing them for 3 to 5 minutes.
2. Put 2-3 drops of iodine solution in each test tube.

Observation: You observe the following:

1. In test tube 'A', the pieces of boiled potato turn blue-black [Fig. 2.6 (a)].
2. In test tube 'B', the pieces of boiled and chewed potato do not show any change in colour [Fig. 2.6 (b)].

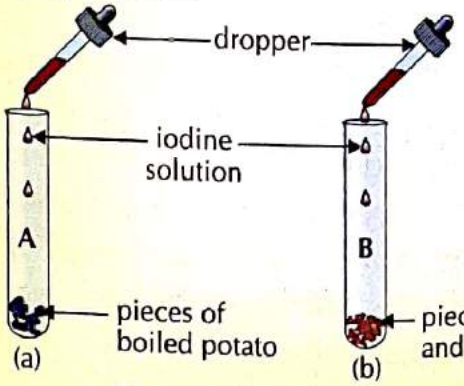


Fig. 2.6 Effect of saliva on starch

Discussion: The boiled potato in the test tube 'A' contains starch that turns blue-black when it comes in contact with iodine solution.

The boiled and chewed potato pieces in the test tube 'B' are acted upon by the saliva. The amylase present in saliva converts the starch in the boiled potato into sugar that does not give blue-black colour with iodine solution.

2. Pharynx and Oesophagus

The chewed food is pushed into a long and narrow muscular tube called the **foodpipe** or **oesophagus** through another short muscular tube called the **pharynx**.

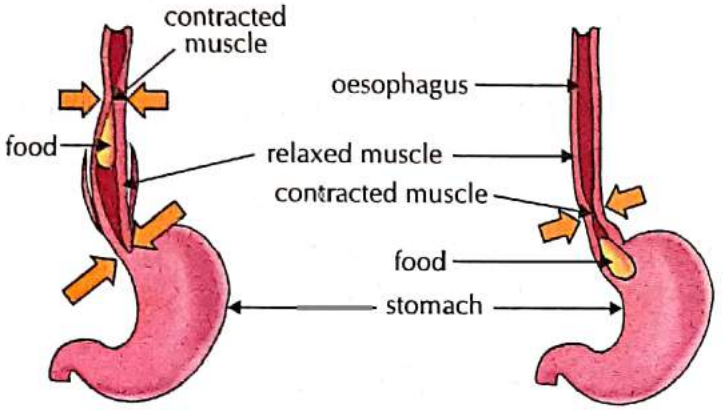


Fig. 2.7 Movement of food in the oesophagus

When the slightly digested food enters the food pipe, the walls of the oesophagus start contracting and expanding to push the food down into the stomach (Fig. 2.7). **The pushing down of food by the walls of the oesophagus in a wave-like manner is called peristalsis.** Digestion of food does not take place in the oesophagus.

3. Stomach

From oesophagus, the food goes into the stomach.

The stomach is a J-shaped, thick-walled organ on the left side of the abdomen. It is the widest part of the alimentary canal. The inner wall of the stomach contains **gastric glands**. These glands secrete gastric or digestive juice that contains three substances–**hydrochloric acid, mucus** and **pepsin**.

(a) Hydrochloric acid kills many harmful bacteria that enter with the food. It provides an acidic medium in the stomach and helps the digestive juices to act.

(b) The mucus protects the inner lining of the stomach from the action of enzymes and acid.

(c) In the acidic medium, pepsin digests the proteins in the food to form simple, soluble substances called **peptones**.

$$\text{proteins} \xrightarrow[\text{in the stomach}]{\text{pepsin (acidic medium)}} \text{peptones}$$

Consequently, the food gets converted into a partially digested, semi-solid food called **chyme**. The chyme leaves the stomach and enters the small intestine.

DO YOU KNOW?

You must not eat hurriedly or talk or laugh loudly while eating as it may cause hiccups or a choking sensation. This happens when food particles enter the windpipe instead of entering the oesophagus. The windpipe carries air from the nostrils to the lungs. It runs adjacent to the oesophagus. But inside the throat, air and food pass through a common passage. We cannot breathe and swallow at the same time. When food is swallowed, a flap-like valve, called the **epiglottis**, closes the passage of the windpipe and allows the food to enter into the oesophagus. If, by chance, food particles enter the windpipe, it gets choked and results in cough or hiccups.

Know More

The working of stomach was discovered by a strange accident. A man named Alexis St. Martin was accidentally hit by a shotgun in 1822. The bullet seriously damaged his abdomen and made a hole in his stomach. He was brought to an American doctor, William Beaumont. Martin survived but the doctor could not close the hole properly and left it bandaged.

Dr Beaumont took it as a great opportunity to see the inside of the stomach through the hole and observe the digestive processes. He began to perform experiments on digestion using Martin's stomach without giving any discomfort to him and made some wonderful observations.

He found that the stomach churns the food. The wall of stomach secretes certain gastric juices that help in the digestion of food. He mixed the gastric juices from the stomach with the food. He observed that the food mixed with the gastric juices of the stomach gets dissolved and digested.

This led to an important discovery that the stomach secretes digestive juices that digest the food into nutrients. These nutrients are used by the body.

DO YOU KNOW?

Sometimes, we vomit the food. This happens when our stomach rejects the food we have eaten. The anti-peristaltic movements of the stomach wall and the oesophagus push the food up to the oesophagus.

4. Small Intestine

The small intestine is the longest part of the alimentary canal. It is about 7.5 metres long and arranged in the form of a coil (Fig. 2.8). The small intestine receives secretions from two glands, liver and pancreas, through a common duct. The wall of the small intestine also secretes digestive juices called **intestinal juices**.

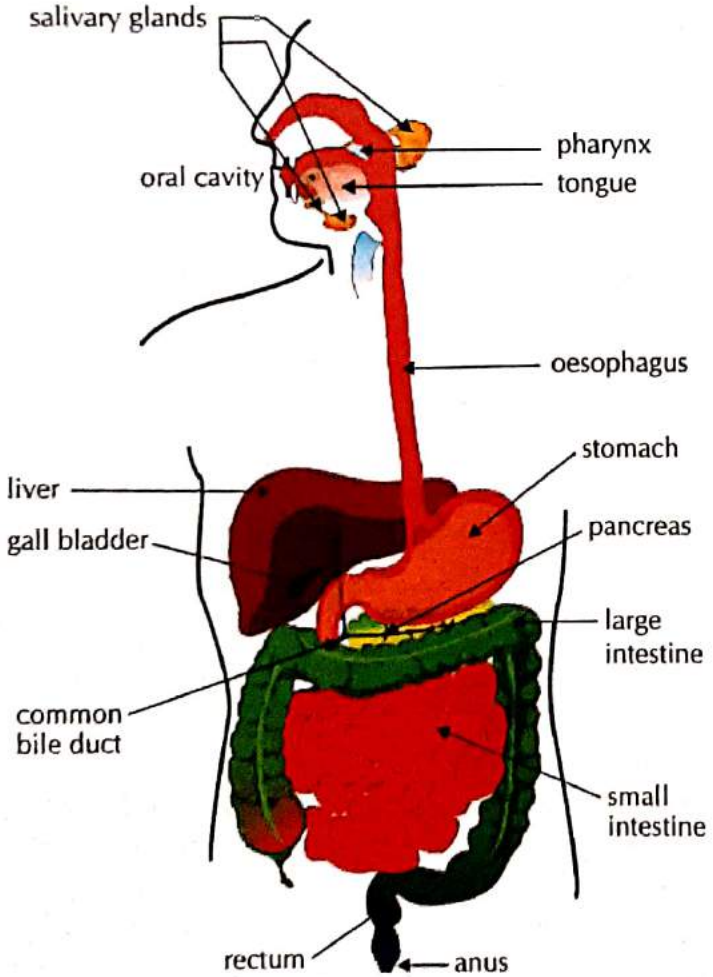


Fig. 2.8 Human digestive system

Here, the partially digested food gets mixed with pancreatic juice, bile juice and intestinal juices. The process of digestion completes in the small intestine.

(a) **Liver:** The liver is a reddish-brown gland situated in the upper part of the abdomen on the right side. It is the **largest gland in the body**. It secretes **bile juice** that is stored in a sac called the **gall bladder** (located near the liver). Bile juice helps in the digestion of fats. Fats are present as big droplets in the food because of which they cannot be digested easily. Bile juice breaks these big droplets of fat into small droplets and makes their digestion and absorption easier.

(b) **Pancreas:** The pancreas is a large cream-coloured gland located just below the stomach. It secretes pancreatic juice and releases it into the intestine. The **pancreatic juice** acts on carbohydrates and proteins and changes them into simpler forms.

(c) **Intestinal juices:** The partially-digested food now reaches the lower part of the small intestine. The process of digestion that starts in the mouth, is completed in the small intestine. The enzymes in the intestinal juices act upon the partially-digested food and convert it into simple, soluble substances.

As a result,

(i) The carbohydrates get broken into **glucose**.

(ii) The fats get broken into **fatty acids** and **glycerol**.

(iii) The proteins get broken into **amino acids**.

Carbohydrates (partially digested) $\xrightarrow{\text{Intestinal juice in small intestine}}$ Glucose

Fats (small droplets) —Intestinal juice in small intestine→ Fatty acids and glycerol

Proteins (partially digested) —Intestinal juice in small intestine→ Amino acids

DO YOU KNOW?

Fats in goat's milk are much simpler than those in cow's milk. Therefore, goat's milk is much easier to digest than cow's milk.

There is no need for the minerals and vitamins present in the food to be broken down into simpler substances as cells are able to absorb them as they are.

Absorption in the Small Intestine

The process of absorption occurs in the small intestine. The inner wall of the small intestine has millions of finger-like projections or folds called **villi** (singular : villus). Each villus has a network of thin and small blood vessels called **capillaries** close to its surface (Fig. 2.9).

These villi give the inner walls of the small intestine a very large surface area for the absorption of digested food. The surface of villi absorbs the digested food materials and passes them to the fine blood capillaries. The absorbed food is carried to all the cells of the body by blood. This food is utilised by the cells to release energy.

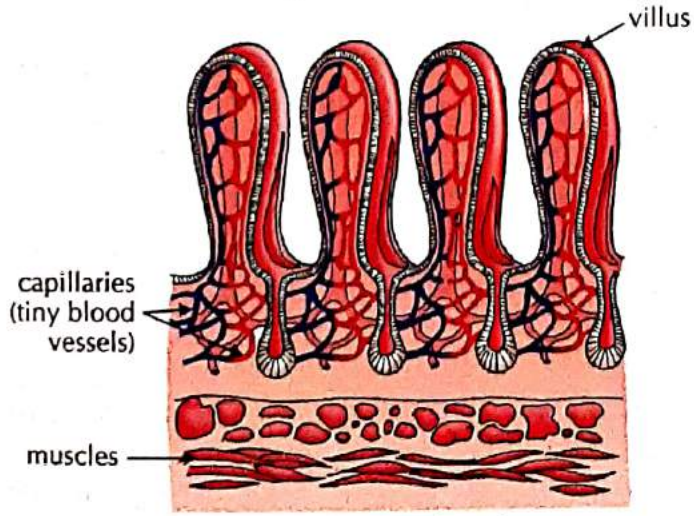


Fig. 2.9 Villi as seen under the microscope

Assimilation of Food

Blood carries the absorbed digested food from the small intestine to different organs of the body. The digested food is used to build complex substances, such as proteins, required for the growth and repair of body tissues. This is the final stage in the process of digestion and is known as **assimilation.**

In cells, glucose breaks down with the help of oxygen into carbon dioxide and water, and energy is released. Amino acids are used for building and repairing of body parts such as worn out cells and tissues. Fatty acids and glycerol act as energy reserves and are stored under the skin for further use.

DO YOU KNOW?

Sometimes, an infection, food poisoning or indigestion results in **diarrhoea.** Diarrhoea is an infection of the intestine and involves passage of watery stool very frequently. This leads to the loss of water and useful salts from the body and can cause dehydration. It can be fatal under severe conditions. It can be avoided by giving the patient plenty of boiled and cooled water with sugar and a pinch of salt dissolved in it. This is called **Oral Rehydration Solution (ORS).**

Egestion of Undigested Food

The food that remains undigested and unabsorbed passes from the small intestine into the **large intestine**. Large intestine is wider and shorter than the small intestine. It is about 1.5 metres in length. Large intestine has two parts—colon (upper part) and rectum (lower part). Colon absorbs water and some salts from the undigested food. Due to this, the undigested food becomes dry and almost semi-solid. This is known as **faeces** and is stored in the **rectum.** Faeces is removed from the body through **anus.** This process is called **egestion.**

DO YOU KNOW?

Some organisms live in the digestive system of other animals, for example, tapeworm lives in the human intestine.

Science In Life

We should include roughage in our diet as it helps the food move through the digestive system, in bowel movements and prevents constipation.

Multiple Choice Questions (MCQs)

Tick (✓) the correct options:

1. Bile juice helps in the digestion of _____.
   (a) carbohydrates ◯ (b) proteins ◯
   (c) fats ◯ (d) minerals ◯
2. The carbohydrates get broken down into _____.
   (a) glucose ◯ (b) starch ◯
   (c) fats ◯ (d) sucrose ◯

Know More

Constipation and **stomach ulcers** are digestive disorders.

In constipation, the person suffers from difficult bowel movements characterised by dry and hardened faeces.

We suffer from constipation when we do not take sufficient amount of liquid or roughage in our diet.

A person with stomach ulcers develops a painful wound on the wall of the stomach. Eating food too quickly or not chewing it properly leads to excessive production of hydrochloric acid in the stomach. If this condition persists for a long period of time, the excessive hydrochloric acid destroys the inner lining of the stomach.

NUTRITION IN AMOEBA

Amoeba is a microscopic, single-celled organism found in ponds, pools and ditches. It constantly changes its shape by pushing out one or more finger-like projections called **pseudopodia** or **false feet** that are meant for locomotion and capturing of food. All the processes of nutrition are performed by the single cell of *Amoeba*.

1. Ingestion

Amoeba eats tiny microscopic plants and animals as food, that float on water in which it lives. When an *Amoeba* finds a suitable organism, it pushes out two pseudopodia around the organism. Gradually, the tips of the pseudopodia fuse with each other.

As a result, the food is engulfed along with a little surrounding water to form a **food vacuole** inside it [Fig. 2.10 (a)].

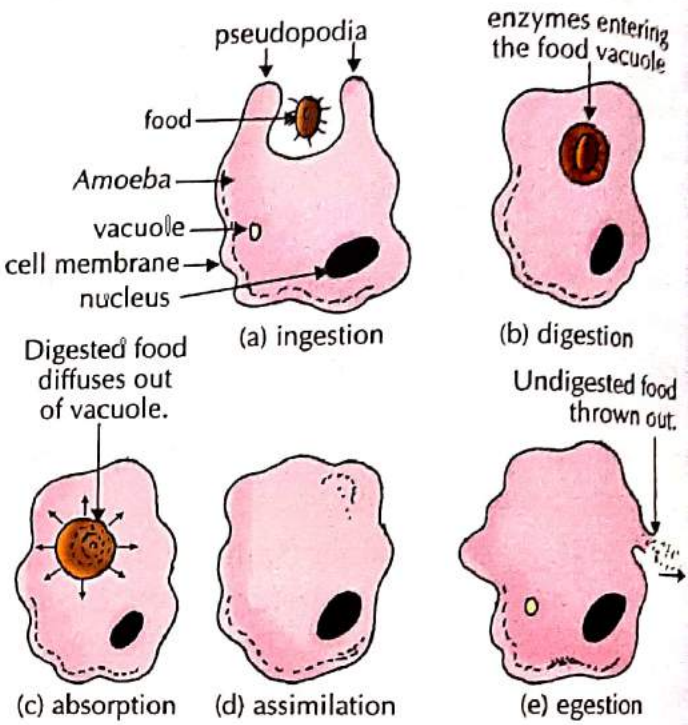


Fig. 2.10 Different stages of nutrition in *Amoeba*

2. Digestion

The enzymes from the surrounding cytoplasm enter the food vacuole and breakdown the food into simple, soluble substances [Fig. 2.10 (b)].

3. Absorption

The digested food present in the food vacuole is absorbed directly into the cytoplasm [Fig. 2.10 (c)].

4. Assimilation

The digested food absorbed by the cytoplasm is stored or utilised for its growth, development, multiplication and release of energy [Fig. 2.10 (d)].

5. Egestion

The undigested food gets collected inside the vacuole. The cell membrane ruptures at any place and the undigested food is thrown outside the body by the vacuole [Fig. 2.10 (e)].

NUTRITION IN RUMINANTS

Certain grass-eating animals, such as cows, buffaloes, deer and sheep, quickly chew the food, mix it with saliva and swallow. Do you know why? Carnivores eat these grass-eating animals as their food. To avoid being caught by carnivores, grass-eating animals quickly eat their food. They then move to a safer place and bring the food back into the mouth in small lumps and chew it. This process of chewing food is called **rumination** and these animals are called **ruminants.**

In ruminants, the stomach is divided into four chambers **rumen, reticulum, omasum** and **abomasum.** This type of stomach is called **compound stomach** (Fig. 2.11).

The food that is swallowed goes into the first and the largest chamber, the **rumen.** Here, it is partially digested and is called **cud.** The bacteria present in the rumen help in the digestion of cellulose (Grass is rich in cellulose). The partially digested food goes to the second chamber or the **reticulum** from where it is returned to the mouth for thorough chewing. After thorough chewing and mixing with the saliva, the rechewed food is swallowed again. It now, bypasses the first two chambers and enters the third and the smallest chamber, the **omasum.** Here, it is broken down into smaller pieces.

The food enters the fourth chamber or the **abomasum.** Here, a kind of gastric juice is secreted. It contains an enzyme and hydrochloric acid. The process of digestion completes here. The digested food now passes into the small intestine. Here, the absorption of the food takes place. The undigested food passes through the large intestine and is removed from the body (Fig. 2.12).

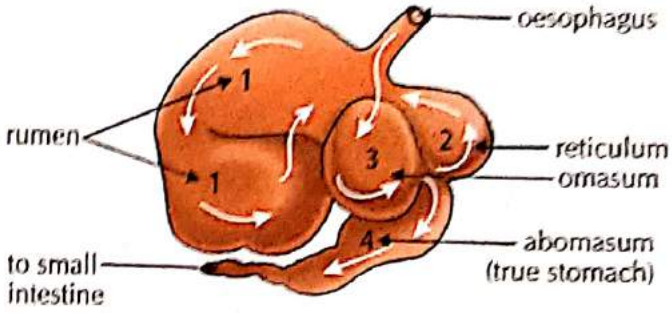


Fig. 2.11 Stomach of a ruminant (cow)

Some animals, like horses and rabbits have a large sac-like structure between oesophagus and small intestine. It is called **caecum.** Cellulose is digested in the caecum by the action of certain bacteria. Many animals including humans cannot digest cellulose.

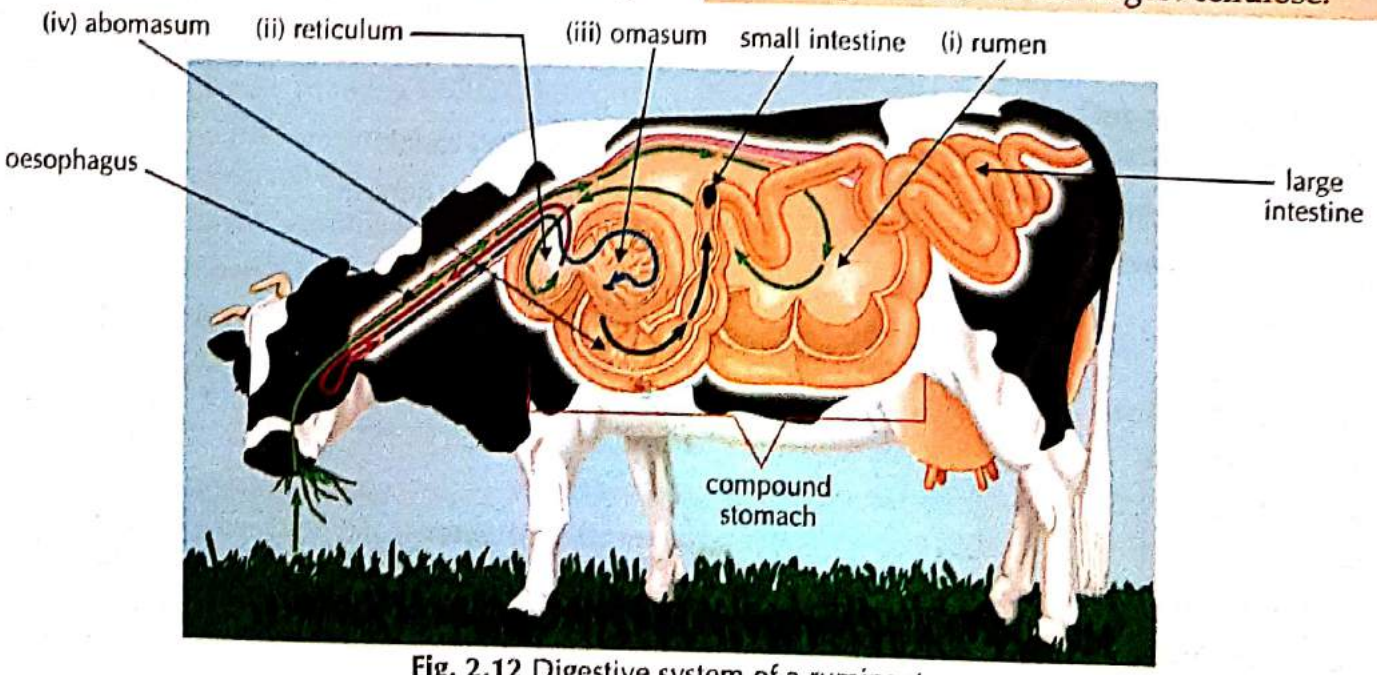


Fig. 2.12 Digestive system of a ruminant

EXERCISES

*Use **Cordova Smart Class Software** on the **smart board** in class to do these exercises.*

A. Tick (✓) the correct options:

1. Which of the following is not a type of teeth?
   (a) incisor ◯ (b) canine ◯ (c) anus ◯ (d) molar ◯
2. The process of absorption occurs in _____.
   (a) small intestine ◯ (b) large intestine ◯ (c) stomach ◯ (d) pancreas ◯
3. Bile juice is stored in _____.
   (a) pancreas ◯ (b) gall bladder ◯ (c) liver ◯ (d) stomach ◯
4. Compound stomach is found in _____.
   (a) humans ◯ (b) *Amoeba* ◯ (c) ruminants ◯ (d) rat ◯
5. Permanent teeth are _____ in number.
   (a) 32 ◯ (b) 34 ◯ (c) 20 ◯ (d) 22 ◯
6. When a few drops of iodine solution are added to a boiled potato, it turns _____.
   (a) green ◯ (b) yellow ◯ (c) blue ◯ (d) blue-black ◯
7. Food poisoning or indigestion results in _____.
   (a) constipation ◯ (b) stomach ulcers ◯ (c) diarrhoea ◯ (d) skin disease ◯
8. Proboscis is present in _____.
   (a) insects ◯ (b) humans ◯ (c) ruminants ◯ (d) bacteria ◯

B. Fill in the blanks:

1. The mucus protects the inner lining of the _____.
2. The inner wall of the small intestine has folds called _____.
3. The saliva contains an enzyme, _____, that breaks down the starch.
4. The process in which the undigested food is removed from the body is called _____.
5. The tongue pushes the chewed food into a short muscular tube called the _____.
6. The proteins get broken into _____.
7. The _____ is the longest part of the alimentary canal.
8. Constipation and stomach ulcers are _____ disorders.

C. Match the following:

Column A	Column B
1. Liver	(a) cilia
2. Large intestine	(b) pseudopodia
3. *Paramecium*	(c) bile juice secretion
4. *Amoeba*	(d) tearing teeth
5. Canines	(e) absorption of water

D. Very Short Answer Questions:

1. Name two different tastes that can be detected by our tongue.

2. Name the cutting teeth.
3. What is the pushing down of food by the walls of oesophagus called?
4. Give the name of largest gland of our body.
5. Name the widest part of the alimentary canal.
6. Name the hardest substance in the human body.
7. What do salivary glands secrete?
8. Where are gastric glands present?

E. Short Answer Type-I Questions:

1. What is the function of saliva?
2. What is mechanical digestion?
3. What is chyme?
4. What happens to the undigested food in the body?
5. What do you understand by the term assimilation?
6. Where is liver located? Give its function.

F. Short Answer Type-II Questions:

1. Why cannot we breathe and swallow at the same time?
2. In what substances carbohydrates, proteins and fats get converted into after digestion?
3. What are the functions performed by tongue?
4. Which part of the alimentary canal is involved in (a) chewing of food (b) killing of bacteria (c) absorption of food (d) formation of faeces?
5. Different types of teeth in our jaws have different functions, but they all work together to chew the food.
   (a) Discuss the functions of each type of tooth.
   (b) What do we learn from our teeth that have different functions?

G. Long Answer Questions:

1. Briefly describe nutrition in *Amoeba* with the help of labelled diagrams.
2. Describe the process of digestion in ruminants.
3. What are liver and pancreas? Write their functions in detail.

H. HOTS (Higher Order Thinking Skills) Questions:

1. The bacteria present on uncleaned teeth convert the sugar in food into a substance 'X' that causes tooth decay. Name the substance 'X'. Which part of the teeth does it affect?
2. How is ruminant's stomach different from humans?

I. Practical Skill Based Question:

What do you observe when iodine is added in (a) pieces of boiled potato and (b) boiled and chewed potato? Give reason.

ACTIVITY

Home Assignment/Group Activity/Project: Collect following information and compile.
(a) Importance of vitamins in diet (b) Which fruits or vegetables should we eat regularly to get vitamins?
Field Visit: Visit a doctor and find out, under what conditions a patient requires a drip of glucose.
Group Discussion: Discuss in the class: 'The process of digestion in human beings'

3 Fibre to Fabric

Use **Cordova Smart Class Software** on the **smart board** in class to observe various types of fibres and the processing of animal fibres to fabric.

Fibres are long, strong and flexible thread-like structures that are used to make fabrics (clothing materials). **Natural fibres** are obtained from plants and animals. Cotton and jute are obtained from plants whereas wool and silk fibres are obtained from animals. Nylon, terylene and rayon are some **human-made** or **synthetic fibres** that are made by different chemicals.

ANIMAL FIBRES

Wool and silk are animal fibres. They are made up of proteins. We get wool from fur (hair) of sheep, angora goat, yak, rabbit, camel, llama and alpaca (Llama and alpaca are found in South America.) (Fig. 3.1). The body of these animals is covered by a thick coat of hair called **fleece**. The fleece is formed by two types of fibres of the hairy skin of sheep which are (i) soft under hair close to skin and (ii) coarse beard hair. The fine hair are used for making wool. Silk is obtained from cocoons of silkworms.

(a) llama

(b) alpaca

(c) yak

(d) angora goat

Fig. 3.1 Some wool-yielding animals

Yak wool is common in Tibet and Ladakh. Mohair is obtained from Angora goats, found in hilly regions like Jammu and Kashmir. Pashmina shawls are made from the soft under fur of Kashmiri goat.

WOOL

Wool is present as a thick coat of hair on the body of the wool-yielding animals. Air gets trapped in the spaces between the wool fibres. Since, air is a bad conductor of heat, it does not allow the body heat to escape and keeps the body warm. That is why, we wear woollen clothes in winters.

REARING AND BREEDING OF SHEEP

Rearing of sheep means to look after the sheep by giving them food, shelter and health care.

In India, sheep are mainly reared in the hilly regions of Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Uttarakhand, Arunachal Pradesh and Sikkim or the plains of Haryana, Punjab, Rajasthan and Gujarat.

The person who looks after the sheep is called a shepherd. Sheep are herbivores and mainly eat grass and leaves. So, shepherds take the herds of sheep to open grasslands for grazing. Apart from grazing grass, the sheep are also fed a mixture of pulses, corn, *jowar* and oil cakes (material left after taking out oil from seeds). In winters, sheep are kept indoors and fed on leaves, grains and dry fodder.

In animals, breeding is done to get animals with desired characteristics. The two individuals having desirable characteristics are selected as parents. These are then crossbred (made to reproduce) to get the new breed of animals having desirable characteristics of both the parents. This is called **selective breeding.** With this process, certain high yield breeds of sheep have been produced. They have thick coat of hair on their bodies that yields good quality wool in large quantities.

The names of some of the breeds of sheep in our country reared for obtaining wool, the quality of wool obtained and the names of states where these sheep are found, are given in Table 3.1.

Table 3.1 Some Indian breeds of sheep

S. No.	Name of breed	Quality of wool	State where found
1.	Lohi	Good quality wool	Rajasthan, Punjab
2.	Rampur bushair	Brown fleece	Uttar Pradesh, Himachal Pradesh
3.	Nali	Carpet wool	Rajasthan, Haryana
4.	Bakharwal	For woollen shawls	Jammu and Kashmir
5.	Marwari	Coarse wool	Gujarat
6.	Patanwadi	For hosiery	Gujarat

PROCESSING FIBRES INTO WOOL

Once the reared sheep have developed a thick coat of hair, it is shaved off for getting wool. We get wool from the sheep by a long process that involves various steps. Let us study each step one by one.

Step 1: Shearing

The fleece (coat of wool) of sheep along with a thin layer of skin is peeled from the body of sheep. It is done manually with a large razor or with an electrically driven shearing machine. **The process of removing hair from the body of sheep is called shearing** (Fig. 3.2). Shearing does not hurt the sheep because the uppermost layer of the skin of sheep is dead. Sheep are sheared in early summer so that they do not feel the heat. The hair of sheep grow again before the onset of winters and protect them from cold weather.

Fig. 3.2 Shearing

Science Update

Scientists have developed a new technique for shearing of sheep that is used in some sheep sheds nowadays. This technique is called **bioclipping.** In this technique, the sheep is injected with special hormones so that their fleece can be easily peeled off without using shears.

Step 2: Scouring

The fleece of sheep contains dust, dirt, sweat, vegetable matter, grease, etc. It is thoroughly cleaned by washing with soap (or detergent) and a lot of water in a tank [Fig. 3.3 (a)].

The process of washing the fleece of sheep to remove dust, dirt, sweat, grease, etc., is called scouring. Nowadays, scouring is done by machines [Fig. 3.3 (b)].

Fig. 3.3 (a) Scouring in tank

Fig. 3.3 (b) Scouring by machine

Step 3: Sorting

After scouring, the wool is separated or sorted into various categories on the basis of its quality. Only fleece of long fine quality is sent to the factory for further processes. **The process of separating the long fine quality fleece from the remaining inferior quality or broken pieces is called sorting.**

Step 4: Combing

The fleece is combed to remove the **burrs** (tiny knots). The fewer the burrs, the better is the wool. **The process of removing the burrs from the fleece is called combing.** The fibres are straightened in this step.

Step 5: Dyeing

The natural fleece of sheep is black, brown or white in colour. The fibres obtained after combing are dyed in various colours.

Step 6: Spinning

The straightened fibres are spun or twisted together to make yarn. The wool yarn is either knitted or woven. The longer fibres are knitted into wool for sweaters and the shorter fibres are woven into woollen cloth.

Multiple Choice Questions (MCQs)

Tick (✓) the correct options:

1. Which of the following is not a wool-yielding animal?
   (a) sheep ◯ (b) angora goat ◯
   (c) yak ◯ (d) cow ◯
2. Which of the following is the next process after scouring?
   (a) shearing ◯ (b) sorting ◯
   (c) spinning ◯ (d) combing ◯

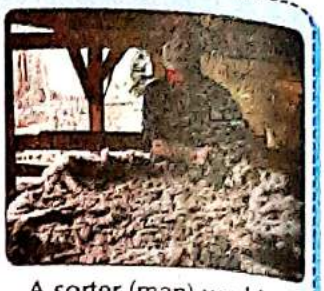
SILK

Silk is a fine, strong, soft and shiny fibre obtained from silkworms. It is separated from the **cocoons** of silkworms. It is made up of protein and is the strongest natural fibre. Since it is an animal protein, on burning, it gives the smell of burning hair. Silk is a costly fibre because of its natural shining appearance. Silk fibres are converted into silk yarn that is used for making silk cloth. This silk cloth is then used for making sari and other dresses.

The rearing of silkworms for obtaining silk is called sericulture. China leads the world in silk production. Other silk producing countries are **India** and **Japan**.

DO YOU KNOW?

Wool industry is an important source of livelihood for many people in our country. The people who do the job of sorting (separating) the fleece of sheep into fibres of different qualities are called 'sorters'.



A sorter (man) working in wool industry

The job of sorters is very risky because sometimes they get infected by the bacteria called ***'Bacillus anthracis'*** that cause a deadly blood disease called Sorter's disease. This is called occupational disease because the person catches this disease while working in the industry due to the nature of his work.

Before we discuss the process of obtaining silk, let us study the life cycle of silk moth.

Life Cycle of Silk Moth

1. The female silk moth lays pale yellow eggs on the leaves of a tree (such as mulberry tree) [Fig. 3.4 (a)].
2. The worm-like larvae called '**caterpillars**' or '**silkworms**' [Fig. 3.4 (b)] hatch out from eggs in about two weeks. The silkworms feed on the leaves of mulberry tree and grow bigger in size. During the larval stage, the silkworms shed their skin four times while they grow. Silk is formed in liquid form in the two glands in the silkworm's head.
3. Now, the silkworm is ready to enter the next stage of its development called **pupa** [Fig. 3.4 (c)]. Each silkworm begins spinning a **cocoon** by moving its head in the same pattern as that of number eight (8). During these movements of head, the silkworm secretes silk in liquid form through the tiny opening in its head. Liquid silk solidifies on contact with the air and becomes silk fibre. Within 2-3 days, the silkworm covers itself completely with silk fibres. **The silky covering spun by the**

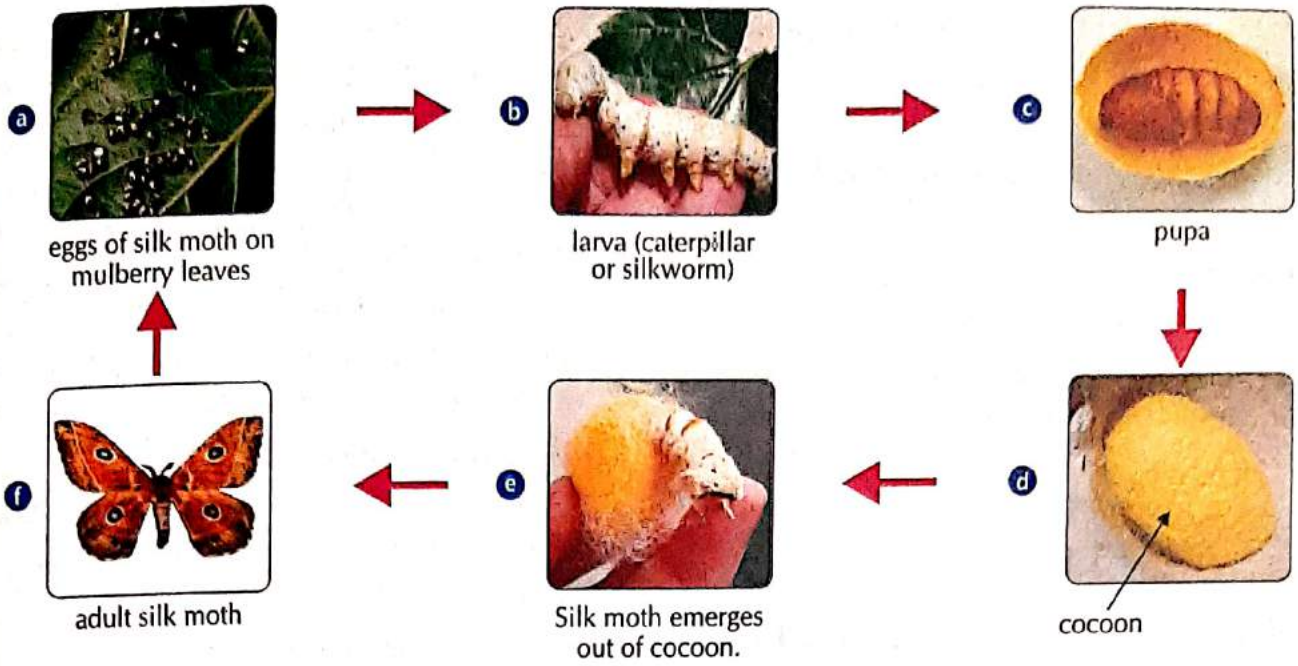


Fig. 3.4 Life cycle of a silk moth

silkworm for its protection is called cocoon [Fig. 3.4 (d)]. The cocoon is made by the silkworm to protect its development as pupa.

4. When the pupa (enclosed in cocoon) develops fully to form an adult silk moth, then the cocoon splits up and a beautiful silk moth comes out [Fig. 3.4 (e) and (f)]. Adult silk moth lives only for a few days.

ACTIVITY 1

Cut out pictures of the stages of life cycle of a silkworm. Paste them on a cardboard. Now, cut them again and jumble them. Now, try to arrange them in cyclic form with correct sequence.

Multiple Choice Questions (MCQs)

Tick (✓) the correct options:

1. What do you call the process of rearing of silkworms for obtaining silk?
   (a) apiculture ◯ (b) pisciculture ◯
   (c) sericulture ◯ (d) none of these ◯
2. Which of the following pattern is followed by silkworm to spin cocoon?
   (a) 'O' ◯ (b) 'C' ◯
   (c) '8' ◯ (d) '6' ◯

REARING OF SILKWORMS

For obtaining silk, silk moths are reared and their cocoons are collected to get silk threads.

Rearing of silkworms means to look after the silkworms by giving them proper food, shelter and health care.

1. In a silk farm, female silk moths are kept in separate linen bags.
2. Each female silk moth lays 200-500 eggs at a time.
3. The eggs are kept in perforated cardboard boxes on bamboo trays under hygienic conditions, suitable temperature and humidity.
4. The eggs are warmed to a suitable temperature in an **incubator** (an electrically warmed box inside which a substance can be kept at a desired temperature) for the larvae to hatch from eggs.
5. A perforated sheet of paper is placed over the hatching box or tray and chopped mulberry leaves are spread over it. When the larvae (silkworms or caterpillars) hatch out of the eggs, they feed on mulberry leaves. They

eat day and night and increase enormously in size.

6. After 25 to 30 days, the silkworms stop eating and move to a tiny chamber of bamboo in the tray to spin cocoons.
7. Small racks or twigs are provided in the trays to which cocoons get attached.
8. During the period of spinning its cocoon, a silkworm is transformed into pupa.

From Cocoon to Silk

The process of obtaining silk involves the following steps (Fig. 3.5):

1. **Boiling:** The cocoons are first boiled in hot water or treated in ovens to kill the pupa inside. If the pupa are not killed and allowed to grow, they will break the cocoon. This will reduce the length of the silk fibre.
2. **Reeling: The process of taking out threads from the cocoon (for use as silk) is called reeling the silk.** Reeling is done in special machines that unwind the threads or fibres of silk from the cocoon.

   The fibres of the cocoon are too fine and delicate to handle. So, many of them (3-10 fine filaments) are reeled together to yield a stronger thread called **raw silk**. The inferior quality silk produced by damaged or waste cocoons is called **spun silk**.
3. **Throwing:** The raw silk is twisted to produce **thrown silk**. The process is called **throwing**. This prevents the silk from splitting into individual fibres.
4. **Dyeing:** Thrown silk is dyed for making coloured fabrics. The dyed silk fibres are then spun into silk threads that are woven into silk cloth by weavers.

The summary of the whole process of obtaining silk from silk moth is given below:

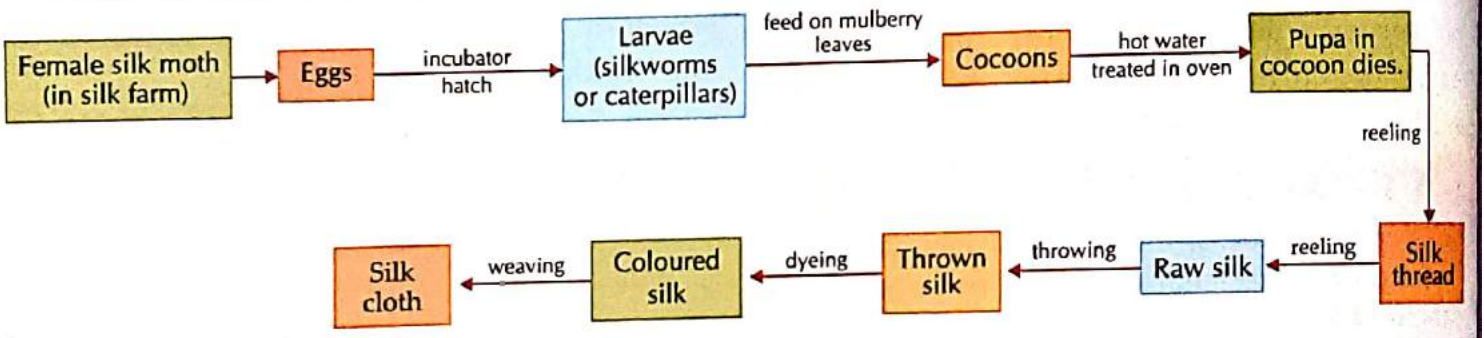


Fig. 3.5 From silk moth to silk cloth

VARIETIES OF NATURAL SILK

The silk yarn (thread) is obtained from the cocoon of the silk moth. There are varieties of silk moths that look very different from one another. The silk yarn (thread) obtained from them is different in texture (coarse, smooth, shiny, etc.).

1. **Mulberry silk moth** is the most common silk moth. The bulk of the world's silk supply comes from the mulberry silk moth. The silk fibre from the cocoon of this moth is soft, lustrous and elastic. It can be dyed in beautiful colours.
2. ***Tassar* silkworms** mainly feed on *Arjun* leaves. They produce tassar silk.
3. **Eri silkworms** feed on Castor leaves. They produce a brick red silk called **Eri silk**.
4. ***Mooga* silkworms** feed on *Som* leaves. They produce a lustrous golden yellow ***mooga* silk**. *Mooga* silkworms are found only in Assam and nowhere else in the world.

EXERCISES

*Use **Cordova Smart Class Software** on the **smart board** in class to do these exercises.*

A. Tick (✓) the correct options:

1. Which of the following is not a natural fibre?
   (a) cotton ◯ (b) rayon ◯ (c) silk ◯ (d) wool ◯
2. Lohi is the breed of _____.
   (a) cow ◯ (b) silk moth ◯ (c) sheep ◯ (d) buffalo ◯
3. How many weeks are required for the eggs of silk moth to hatch?
   (a) one ◯ (b) two ◯ (c) three ◯ (d) four ◯
4. Sheep are sheared in _____ season.
   (a) summer ◯ (b) spring ◯ (c) autumn ◯ (d) winter ◯
5. _____ silkworms mainly feed on *Som* leaves.
   (a) Mulberry ◯ (b) Tassar ◯ (c) Eri ◯ (d) Mooga ◯
6. Which of the following silk is produced when raw silk is twisted?
   (a) spun ◯ (b) coloured ◯ (c) thrown ◯ (d) *mooga* ◯

B. Fill in the blanks:

1. Alpaca is generally found in _____.
2. _____ and _____ fibres are obtained from animals.
3. Silk is obtained from cocoons of _____.
4. Natural fibres are obtained from _____ and _____.
5. The person who looks after the sheep is called a _____.
6. The _____ the burrs, the better is the wool.
7. The eggs are warmed to a suitable temperature in an _____.
8. During the period of spinning of its cocoon, a silkworm is transformed into _____.

C. State whether the following statements are True (T) or False (F). Rewrite the false statements correctly:

1. Silk is obtained from cocoons of silkworms.
2. The process of washing the fleece of sheep to remove dust, dirt, sweat and grease is called shearing.
3. The rearing of silkworms for obtaining silk is called sericulture.
4. The damaged or waste cocoons are used to produce raw silk.

D. Very Short Answer Questions:

1. What is the process of removing the burrs from fleece called?
2. Name any two breeds of sheep found in India.
3. Name the process of removing hair from the body of a sheep.
4. Name the sheep that is found in Gujarat and whose wool is used in hosiery.
5. What is the process of taking out threads from the cocoon called?
6. Which country leads the world in silk production?
7. Name two wool-yielding animals.

E. Short Answer Type-I Questions:

1. What is meant by rearing of sheep?
2. What are fibres?
3. Why does shearing not hurt the sheep?
4. What is meant by scouring?
5. What is cocoon?

F. Short Answer Type-II Questions:

1. What is meant by selective breeding? What is its purpose?
2. What is silk? How do we get silk from cocoon?
3. (a) What are raw silk and spun silk?
   (b) On burning silk, it gives out the smell of burning hair. Give reason.
4. With the help of a flow chart only, describe the life cycle of a silkworm.
5. (a) What is sorter's disease?
   (b) Why is this disease called occupational disease?
6. (a) Why do wool-yielding animals have a thick coat of hair on their bodies?
   (b) Why is shearing done in summers?

G. Long Answer Questions:

1. Write the various steps involved in the production of silk cloth from silk moth.
2. Describe the process of wool production.
3. Discuss various varieties of natural silk.

H. HOTS (Higher Order Thinking Skills) Questions:

1. How is selective breeding advantageous for us?
2. Why are animal activists against the silk production?

ACTIVITY

Home Assignment/Group Activity/Project

1. Collect pictures of some animals from which we get wool and paste them in your scrapbook.
2. Take the maps of India and world. Mark the places on the map where you find animals that provide wool. You can use different colours to mark the location for different animals that give wool.
3. Find out (i) How was silk discovered? (ii) What is silk route?

Field Visit: Visit a textile shop. Collect pieces of clothes of various types. Paste them in your scrapbook and mention the following details for each: (a) The kind of fibre and (b) Origin (plant/animal)

Group Discussion: Discuss with your classmates whether it is fair to rear sheep and chop off their hair for getting wool.