1

How Do Plants Live

NOTE FOR THE TEACHERS

- Discuss the interdependence of all living things.
- A brief introduction of food chain.
- Take children to the school garden. You can show them the process of decomposition in the manure pit with growth of organisms like mushrooms and moulds. Growth of organisms on moist tree bark and green scum in stagnant water can also be observed and explained.
- Find out plants with deficiency symptoms like yellowing leaves, stunted growth, leaf curls and discuss the importance of minerals for plant growth.

Key Learning Points

- Different modes of nutrition in plants.
- Autotrophic nutrition—the process of photosynthesis.
- Heterotrophic nutrition
- Special mode of nutrition
- Importance of mineral nutrition in plants.

Our earth is the home to millions of different kinds of living things. Living things share certain common characteristics, which enable them to survive. These are called the "Life Processes". Nutrition, respiration, circulation and excretion are important life processes for all of us. We shall study about the life process, nutrition in this chapter. Nutrition is the act of providing nutrients to the body cells of living organisms so that they can carry out activities to keep themselves alive. You have learnt about the importance of food for all living organisms and their nutritive value in Class VI.

Green plants are the most important part of food chain. They can make their own food from basic substances, water and minerals found in the soil and carbon dioxide from atmosphere, in the presence of sunlight. This process is called Photosynthesis (photo=light; synthesis=putting together). All green plants convert solar energy from the sun into chemical energy of food. Animals cannot make their own food. They have to eat plants or other animals that have eaten plants in order to survive. It is for this reason that movement from one place to another in search for food and shelter is essential part of animal life.

TYPES OF NUTRITION

The mode of nutrition of living organisms may be classified into following types:

Nutrition

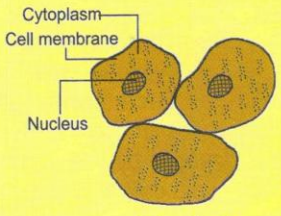
Autotrophic	Heterotrophic
The mode of nutrition in which green plants prepare their own food and nourish themselves. Green plants, all algae and some bacteria belong to this category.	The mode of nutrition in which all non-green plants and animals draw their food from different sources. These sources may be plants or animals that eat plants.

Nutrients

Components of food that are chemical substances and provide nourishment to the body. Nutrients provide us energy; promote growth; repair worn out tissues and protect our body from various diseases.

Cell

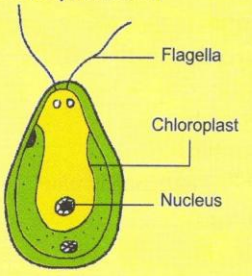
A cell is a mass of protoplasm having a distinct nucleus surrounded by a jelly-like cytoplasm and bounded by a cell membrane. Cells are building blocks of life and can be compared with bricks in a building. Cell can be seen with the help of a microscope. Plants and animals are made up of different kinds of cells.



Animal cell

Algae

Simple plants that grow in water. They may range from single-celled, e.g., Chlamydomonas to tall sea weeds. They contain the green pigment, chlorophyll, so they can photosynthesise.



Algae *(Chlamydomonas)*

Conducting Tissues

They are called vascular tissues and are placed as double pipe-line throughout the plant body. These are of two types – xylem, for carrying water and minerals from roots to leaves and phloem, for carrying dissolved food from leaves to storage organ of plant.

AUTOTROPHIC NUTRITION

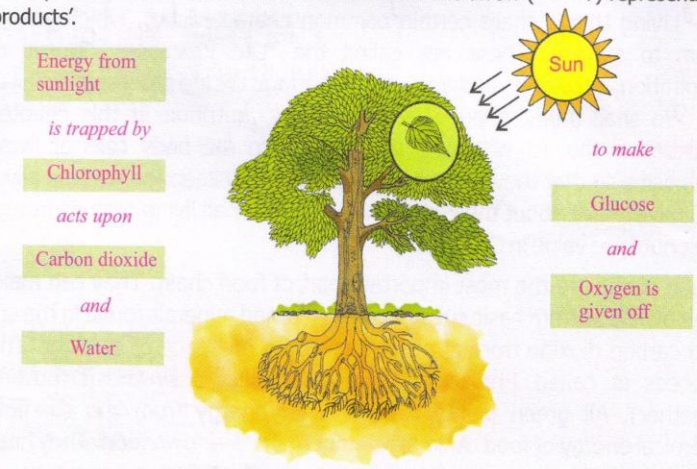
Organisms which make or synthesise their own food from simple ra materials are called autotrophs. As they can prepare their food from ra inorganic materials(carbon dioxide and water), they are also known a producers. Autotrophs range from simplest green plants like algae t complex forms like the large branched trees. The mode of nutrition b green plants is called autotrophic (auto=self; trophos=nourishmen nutrition.

Leaves–The Plants' Food Factories

Green leaves are the kitchen of the plant, as in the cells of these leave there are tiny structures, the chloroplasts (chloros=green) where food made by the process of photosynthesis. The chloroplasts contain a gree pigment, chlorophyll that makes the leaf look green. Chlorophyll absorb the solar energy and converts it into chemical energy.

$$\underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O} \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Oxygen}}{O_2}$$

The equation need not be balanced at this level. The arrow (⟶) represents 'products'.

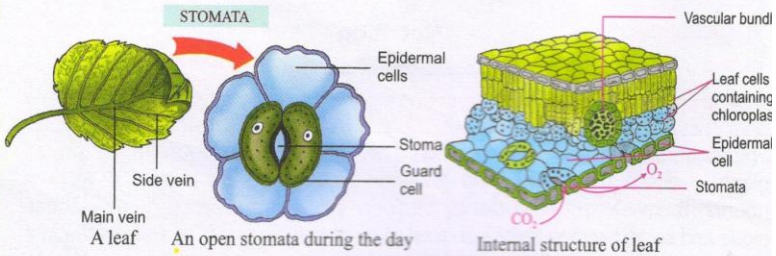


Process of photosynthesis

This chemical energy is stored in the food that is prepared. For photosynthesis, the leaves need water from th soil and carbon dioxide from the air. Water and minerals are absorbed from the soil by the roots, carried to th stem and finally to the leaves through water conducting tissues called xylem vessels. These vessels are presen throughout the plant body as series of water pipes from roots to leaves. Small aerating pores present in the leaf called stomata allow carbon dioxide to pass in and oxygen to be released out into the atmosphere.

Stomata

Mostly present on the underside of the leaf, these are minute openings. Each stomatal apparatus has an opening, the stoma bounded by two bean-shaped guard cells and several epidermal cells.



A leaf adapted to perform photosynthesis

Can we imagine an earth without green plants and no photosynthesis? In the absence of photosynthesis, there would be no living organisms and the earth would be a barren place. Thus, photosynthesis is important in the following ways —

- It is the ultimate source of food and energy for all living organisms.
- Oxygen, released into the atmosphere is a life supporting gas.
- The process helps in maintaining balance between oxygen and carbon dioxide in the atmosphere.

All green plants prepare food as glucose, a type of carbohydrate. They store food as starch, a complex insoluble form of carbohydrate. These are stored in different storage organs like root, stem, leaf, fruit and seed.

Food stored in different storage organ of plants

ACTIVITY - 1

Aim: To test for the presence of starch in leaf.

Materials Required: Green leaf, beaker, tripod stand, burner, test tube, alcohol, iodine solution, tap water and petri dish.

Procedure: Pluck a healthy green leaf of a plant which was kept in sunlight. Boil it in water contained in a beaker for about two minutes. This will make the leaf soft and stop any further chemical changes in it. Put the leaf in a test tube containing alcohol. Place the test tube in a beaker of boiling water. The alcohol will bleach the leaf and make it free from chlorophyll. Wash the leaf in water. Place it in a petri dish and add a few drops of iodine solution.

Your Wisdom

Coleus and Croton leaves

How do colourful leaves of coleus and croton perform photosynthesis?

INSIGHT

Less than 1% of the water absorbed by the roots is utilised in photosynthesis.

Your Wisdom

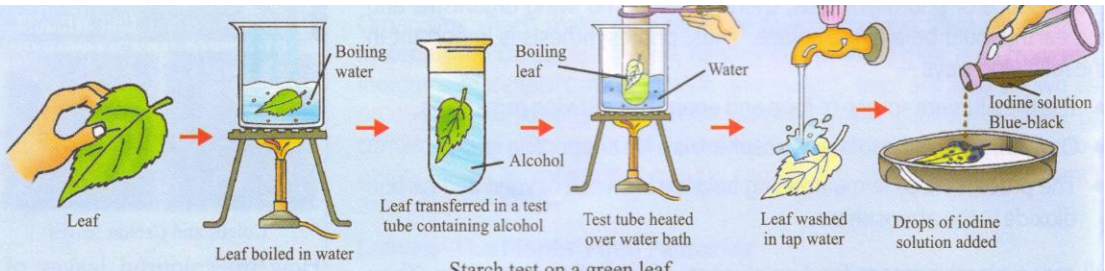
Why is it advisable not to sleep under trees during night?

INSIGHT

Cactus is an unusual plant adapted to grow in extremely hot and dry environment. Their stems have developed into green fleshy structures.

They act as reservoir for water and become photosynthetic. The leaves are modified into spines to prevent loss of water through transpiration.

A cactus plant



Starch test on a green leaf

Observation: The leaf turns blue-black.

Conclusion: The leaf changes into blue-black colour due to presence of starch in it.

ACTIVITY - 2

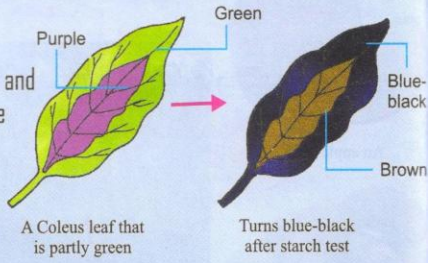
Aim: To show that chlorophyll is necessary for photosynthesis.

Materials Required: Coleus leaf and materials used in Activity-I.

Procedure: Take a coleus plant with variegated leaves having some green and some purple areas. Pluck one leaf. Make its outline on paper and mark on the outline, the green and non-green area. Test the leaf for starch as in Activity-I. Compare the blue part of the leaf with your sketch.

Observation: Only the part that was green turns bluish-black whereas the other non-green part does not.

Conclusion: This shows that starch is formed only in the green areas of the leaf. The other non-green area does not show the starch test. Thus only green parts of leaf can prepare food.



Chlorophyll is necessary for photosynthesis

ACTIVITY - 3

Aim: To show that sunlight is necessary for photosynthesis.

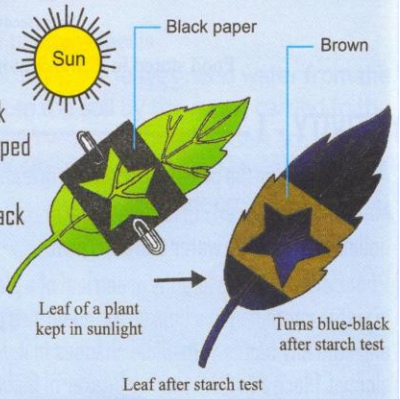
Materials Required: A potted plant, black paper and materials for starch test as in Activity-I.

Procedure: Take a potted plant. Destarch the leaves by keeping the plant in a dark room for two days. Cover one of its leaves with black paper on which a star-shaped design is cut.

Place the plant in sun. After a few hours, test the leaf which is covered with black paper for the presence of starch as in Activity-I.

Observation: Only the part of the leaf, which could get light through the cut out design as well as those that were left uncovered by the paper turns blue-black.

Conclusion: This shows the presence of starch in parts of leaf exposed to sunlight. Thus sunlight is necessary for photosynthesis.



Sunlight is necessary for photosynthesis

ACTIVITY - 4

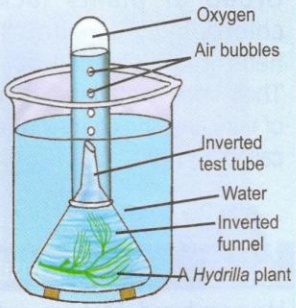
Aim : To show that oxygen is evolved during photosynthesis.

Materials Required : Beaker, *Hydrilla*, funnel, test tube and water.

Procedure : Take some *Hydrilla* plant and put them in a beaker filled upto three-fourth with water. Cover the plant with a short-stemmed funnel. Keep supports to raise the level of funnel. Invert a test tube full of water over the stem of the funnel. Ensure that the level of water in the beaker is above the level of stem of the inverted funnel. Place the apparatus in the sun for a few hours.

Observation : Bubbles of oxygen gas is seen rising from the stem of the funnel.

Conclusion : These bubbles are produced by *Hydrilla* as end product of photosynthesis. This gas can be tested for oxygen.



Oxygen is evolved during photosynthesis

Let us Revise

1. How do plants and animals depend on each other ?
2. In which form of carbohydrate do green plants make food ?
3. Why can't leaves kept in a dark room prepare food ?
4. Explain:
   (i) Plants do not take in carbon dioxide at night.
   (ii) Veins in a leaf have double pipeline.

HETEROTROPHIC NUTRITION

Organisms that are not capable of synthesizing their food, and are dependent on other organisms for their food requirement are called heterotrophs (heteros=other). As these organisms depend on others for food (plants and animals) they are also called consumers. All animals, including human beings belong to this category. The mode of nutrition in non-green plants and animals is known as heterotrophic nutrition. Heterotrophic plants do not contain chlorophyll. Yeast, mushrooms and moulds are some examples of non-green plants. Can you name others?

Heterotrophic Nutrition in Non-Green Plants —

Heterotrophic nutrition in non-green plants are of the following three types:

Heterotrophic Nutrition in Plants

Saprotrophic	Parasitic	Symbiotic
Mode of nutrition in which organisms depend on dead and decaying matter. eg, yeast, moulds, mushroom	Mode of nutrition in which organisms depend on other living organisms. eg, Cuscuta	Mode of nutrition in which two living organisms live together for mutual benefit. eg, *Rhizobium*, lichen

1. Saprotrophic Nutrition

Organisms which feed on dead and decaying organic matter are called saprotrophs. Other terms used for saprotrophs with the same meaning are saprophytes and saprobionts. Saprotrophs secrete digestive juices on the dead and organic matter. It is then digested and converted into simple soluble forms. The soluble end products of

Fungi
Group of plants lacking chlorophyll, so they lead heterotrophic mode of life. Their body is made up of mass of very fine and cottony threads called hyphae.

digestion are then absorbed by the saprotrophs. The mode of nutrition which organisms take in nutrients from dead and decaying organic matter called saprotrophic nutrition. Saprotrophs are also called decomposers. Common examples of saprotrophs are fungi like mould, yeast, mushroom and many bacteria. Fungi are more commonly seen growing during rainy season. They grow on plant and animal organic matter like clothes, pickle, jam, bread, leather, wood and paper.


Mushroom—a fungus


Your Wisdom
How are bread, bhaturas and idlis made fluffy?

ACTIVITY - 5

Aim : To observe the growth of bread mould.
Materials Required : A slice of bread, plastic bag, oven and refrigerator.
Procedure : Cut a slice of bread into three pieces. To the first piece, sprinkle water, keep it in a plastic bag and seal it. Leave the second piece in an oven to dry. When it is completely dry put it in the second plastic bag and seal it.
Put these two plastic bags in a warm room. Now keep the third piece of bread in a refrigerator after putting it in the third plastic bag.
After a week, examine the bread pieces without opening the bag.

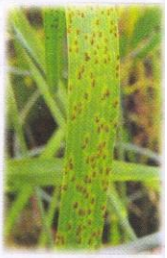

Bread mould

Observation : A white cottony growth of the mould can be seen in the first plastic bag. There will be no growth of the fungus in the other two bags.
Conclusion : The bread is a favourable organic nutrient for the growth of the mould. The first plastic bag has all favourable conditions for its growth i.e. warmth and humidity. There will be no growth of fungus in the other two bags. One of the conditions i.e. moisture is not favourable in the second bag. The third bag does not get favourable temperature condition for the fungal growth.


INSIGHT
Parasitic fungi, attack several crops, cultivated plants, ornamental and many wild plants, often causing serious diseases in them. Rusts and smuts are common examples. They are known as plant pathogens.

2. Parasitic Nutrition

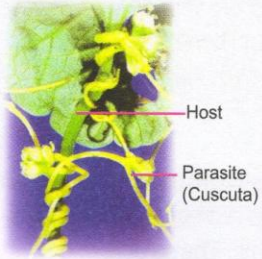
Parasitic organisms live on or inside other living organisms called hosts and derive their food from them. The mode of nutrition in which organisms take in food from other living organisms is called parasitic nutrition. In parasitic association, the parasite is always benefitted whereas the host is harmed.
Parasitic plants are of two types:


Rust on wheat leaf

Parasitic Plants

Total Parasites
These plants cannot make their food and derive all of it from the host on which they are totally dependent throughout their life., e.g., Cuscuta (*Amarbel*) - a total stem parasite; Rafflesia - a total root parasite

Partial Parasites
They have green leaves and therefore can make food for themselves. However, they get water and minerals they need for making food from the host plant. e.g., Mistletoe - a partial stem parasite; Sandalwood - a partial root parasite



Cuscuta on host plant

3. Symbiotic Nutrition

Two organisms living in close association with each other, being of mutual benefit are called symbionts (syn=together; bios=life) and the condition of living together is called symbiosis. The mode of nutrition in which a close relationship between two organisms of different species is established and they live together for their mutual benefit is called symbiotic nutrition.

Lichens

Lichen is an example of such an association of two organisms – algae (autotrophs) and fungi (saprophyte). The fungus holds the algal cells in its mat of web-like hyphae and supplies them with water and minerals. Algae, on the other hand, prepares food and supplies it to the fungi.

Rhizobium, the bacterium living in association with root nodules of leguminous plants is another example. It derives its nutrition from the roots and in turn converts atmospheric nitrogen into nitrogenous compounds. These compounds are used by the plants for synthesizing proteins. In this way the soil is replenished with nitrogen naturally.

SYNTHESIS OF OTHER ORGANIC COMPOUNDS

During photosynthesis green plants synthesise carbohydrates. These are organic compounds containing carbon, hydrogen and oxygen. Plants also synthesise other organic compounds, like proteins. Proteins help to make new cells and are required for growth of body by all living organisms. They are complex organic molecules containing nitrogen apart from carbon, hydrogen and oxygen. From where do plants obtain nitrogen? Though, nitrogen is present in the atmosphere in abundance, about 78% by volume, its form is inert and cannot be used by any organism directly. Plants derive nitrogen from the soil in the form of nitrogenous compounds. The conversion of free nitrogen of the atmosphere into nitrogenous compounds to make it available for plants is called nitrogen fixation.

Nitrogenous compounds are made available to plants for synthesizing proteins. Different methods that help in converting atmospheric nitrogen into usable forms are—

- Electrical discharge during lightning process fix some amount of nitrogen in the soil.
- A number of free living bacteria and symbiotic bacteria take part in fixing the atmospheric nitrogen. *Azobacter* is one such example of free living bacteria. *Rhizobium*, living in root nodules of leguminous plants fix atmospheric nitrogen in the form of nitrates.
- Farmers replenish nitrogen in the soil by adding fertilizers to the soil that contain nitrogen compounds. These fertilizers are water soluble. They are absorbed by the plants through the roots.

Root nodules of pea plant

SPECIAL MODE OF NUTRITION

A special category of plants are insectivorous plants. These plants are also called carnivorous plants as they capture animals of different kinds, particularly insects. These are usually green and can make their own food. In this way, they supplement their normal autotrophic nutrition with a form of heterotrophic nutrition. Such plants

typically live in nitrogen deficient soil. They trap insects using specialised leaves or parts of leaves, diges prey and absorb the nitrogenous products from their body. Hence, their nitrogen demand is fulfilled external source rather than the soil.

The hollow leaves of Pitcher plant are filled with a fluid. Insects come to drink it, but the lid closes, the insects are drowned and eaten by the pitcher plant.

The leaves of Venus-flytrap is like a trap. It can close suddenly when an insect sits on them.

The leaves of Sundew secre kind of fluid that glitters in sun like dew drops. When insect sits on the leaf, it ge entangled in the sticky flui

Pitcher plant

Venus flytrap

Sundew plant

Some insectivorous plants

MINERAL NUTRITION

Plants need a wide variety of mineral elements for carrying out life functions. These are absorbed from th by the root system, carried to the stems, branches and leaves. The mineral sources are air, soil and Mineral salts get dissolved in water and are taken up. Plants use minerals in a number of ways. They be constituents of protoplasm and cell wall, e.g., Nitrogen and Sulphur in proteins; Magnesium in chlorophy Calcium in cell wall.

The sources of some important plant nutrients are given in the following table:

Source of plant nutrients

Air	Water	Soil
Carbon dioxide Oxygen	Hydrogen Dissolved metals in ionic form	Nitrogen, Potassium, Phospho Sulphur, Calcium, Magnesium, I Manganese, Zinc, Boron, Cop Cobalt, Molybdenum

These mineral nutrients are used by the plants for their growth and development. Their amount ke decreasing in the soil as they are used by plants. In order to compensate for its loss, the farmers use fert and manures. These contain specific nutrients that replenish in the soil. This enrichment of the soil kee plant healthy which leads to a larger crop output. Can you say why farmers practice crop rotation in their fi

Let us Revise

1. Name any two plant parasites.
2. Give two examples of useful fungi. Explain their uses.
3. Why do insectivorous plants catch insects ?
4. How is fungi different from an autotroph ?
5. What is symbiosis ?

Quick Review

- Living beings need nutrition to live and run their life processes.
- Sun is the ultimate source of energy for all living beings.
- Green plants convert the solar energy into chemical energy, i.e., the food that they synthesise during photosynthesis.
- Green plants produce glucose from simple raw materials carbon dioxide, mineral salts, water and sunlight in the presence of chlorophyll. They are called autotrophs and the process is called photosynthesis.
- Oxygen, released as a by-product of photosynthesis is a life supporting gas and used by all living organisms for their survival.
- Nitrogenous compounds are available to plants for protein synthesis through Nitrogen Fixation.
- Nutrition in non-green plants and animals is heterotrophic.
- Heterotrophic plants may be parasites, taking food from the host plant or saprophytes, deriving nutrition from dead and decaying organic matter.
- Living organisms may also live in close association for mutual benefit as in a symbiotic association.
- Some plants adopt a dual mode of nutrition, insectivorous plants are partly autotrophic and partly heterotrophic.
- Plants fulfil their mineral requirement from soil, water and air.

Key Words

Nutrition	: Process of taking in food and its utilisation for life processes.
Photosynthesis	: The special way in which green plants make their own food in the presence of sunlight.
Autotrophs	: Organisms that prepare their own food.
Chloroplast	: Green plastids, containing chlorophyll, abundant in green leaves.
Chlorophyll	: Green pigment present in chloroplast that traps light energy.
Transpiration	: Process by which plants lose water in the form of water vapour.
Bleach	: Process of removing colour.
Iodine	: Chemical used for starch test, turning into dark blue when in contact with starch.
Nodules	: Bead-like warty outgrowth in the roots of leguminous plants.
Saprotrophs	: Organisms feeding on dead and decaying organic matter.

Consumers	: Animals feeding on plants or other plant-eating animals, may be a herbivore carnivore or omnivore.
Symbionts	: Organisms which live together for mutual benefit.
Hypha	: The thread like filamentous structure of which the fungal body is made.

EXERCISES

A. Multiple Choice Questions :

1. Organisms need nutrition to —
   (a) Grow
   (b) Get energy
   (c) Fight against diseases
   (d) All of the above
2. Products of photosynthesis are —
   (a) Protein, oxygen and carbon dioxide
   (b) Carbon dioxide and oxygen
   (c) Carbohydrate and oxygen
   (d) Protein, fat and carbohydrate
3. _____ is used in starch test .
   (a) Safranin
   (b) Blue ink
   (c) Iodine
   (d) Litmus
4. To which of the following category does a pitcher plant belong ?
   (a) Herbivore
   (b) Carnivore
   (c) Insectivore
   (d) Both *b.* and *c.*
5. Parasites —
   (a) Prepare their own food
   (b) Live on other living beings
   (c) Live on dead organisms
   (d) Eat insects
6. Water reaches the leaves from root by _____ .
   (a) Stomata
   (b) Phloem
   (c) Xylem
   (d) All of the above
7. One should not sleep under the trees at night because —
   (a) Plants make food during the night
   (b) Trees also sleep at night
   (c) Carbon dioxide ratio is higher under the trees at night
   (d) One can catch a cold
8. Photosynthesis occurs in the coloured leaves of croton plant as —
   (a) Yellow and red pigment help photosynthesis.
   (b) Chlorophyll is not needed.
   (c) Chlorophyll is embedded below these pigments of yellow and red.
   (d) Less light is required by yellow leaves for photosynthesis.
9. Which of the following is used from the atmosphere during photosynthesis?
   (a) Oxygen
   (b) Hydrogen
   (c) Minerals
   (d) Carbon dioxide

10. Fungi are _____.

a. Parasites
b. Saprophytes
c. Both *a.* and *b.*
d. Symbionts

Fill in the blanks :

1. _____ are chemical substances present in food.
2. Starch gives a blue-black colour with a solution of _____.
3. _____ is the site of photosynthesis in plants.
4. Autotrophs are all _____ plants.
5. _____ is a plant parasite.
6. During photosynthesis, the chlorophyll traps the energy from _____.
7. Plant food is stored in the form of _____.
8. Plants get nitrogen in the form of _____ from soil.
9. _____ depend on dead and decaying organic matter for food.
10. Mode of nutrition in algae is _____.
11. _____ is an example of symbiotic association.
12. A fungus we like to eat is _____.

Alternative Response Type :

True(T)/False(F) Type :

1. Product of photosynthesis is water and light. ☐
2. Bread mould is a saprophyte. ☐
3. Tiny openings present in leaf surface is called stomata. ☐

Right(✓)/Wrong(×) Type :

1. Pitcher plant is a carnivore. ☐
2. During starch test, leaves are boiled in a test tube of alcohol so that they are decolourised. ☐
3. Variegated leaves do not perform photosynthesis. ☐
4. Nitrogen can be taken from the atmosphere by living organisms for making proteins as they occur in excess in the atmosphere. ☐

Yes(Y)/No(N) Type :

1. Can photosynthesis happen in dark ? ☐
2. Is chloroplast found in chlorophyll ? ☐
3. Soil is the only source of minerals to the plants. ☐

Analogy Type :

1. Green plants : Autotroph : : Human beings : _____
2. Symbiotic nutrition : *Rhizobium* : : _____ : Sandalwood

Give two examples of each :

1. Nutrients _____ _____
2. Autotrophs _____ _____
3. Algae _____ _____
4. Harmful fungi _____ _____
5. Insectivorous plants _____ _____
6. Symbionts _____ _____

Classify the following living organisms into parasites, saprophytes and autotrophs :

Yeast, Cuscuta, Mushroom, Algae, Smut, Ringworm, Money plant, Fungi, Ferns, Rust, Rafflesia, Mistletoe, Mould, Pine tree, Bacteria.

G. Very Short Answer Type Questions :

1. Name all the nutrients present in food.
2. Define nutrition.
3. What are the raw materials used in photosynthesis ?
4. What is photosynthesis?
5. Write the word equation for photosynthesis.
6. Write a difference between chlorophyll and chloroplast.
7. What type of relationship is shown by lichens ?
8. How does water reach the leaves for synthesising food ?
9. How are nutrients taken up by the plants ?

H. Short Answer Type Questions :

1. How do green plants make food ?
2. Differentiate between the following:
   - *i.* Autotrophs and Heterotrophs
   - *ii.* Parasites and Saprophytes
   - *iii.* Total and Partial parasites
3. What role do leaves and roots of green plants play during photosynthesis ?
4. What are insectivorous plants and what is their mode of nutrition ?
5. Name the conducting tissues in plant and define their role.
6. Why is nitrogen important to all living organisms ?
7. What are the functions of stomata ?
8. How do saprophytes help in cleaning the environment ?

I. Long Answer Type Questions :

1. Explain the terms nutrient and nutrition.
2. Draw a labelled diagram of stomata and explain its structure.
3. How will you prove that starch is formed during photosynthesis?
4. Explain the types of heterotrophic nutrition in plants.
5. Draw a pitcher plant and describe its modifications to traps insects.
6. Explain symbiotic nutrition in lichens.
7. What are plant nutrients ? How are they replenished in the soil ?

ACTIVITY CORNER

Find Out :

1. Who invented the microscope ? What is the magnification of a compound microscope ?
2. What is crop rotation ?
3. What role does yeast play in breweries ?

Do it Yourself :

1. Study the action of yeast on dough.
2. Observe the changes taking place during the decay of fruits and vegetables.
3. Observe the growth in young seedlings kept separately in dark and lighted room.

Write down the observations in all the above cases in your notepad.