

11 Main biological processes in plants



Plants are considered as the main living component that contributes much for the proper existence and security of environment.

Plants carry out a number of biological processes for their existence. Let us study about such biological processes taken place inside plants.

11.1 Photosynthesis

Plants are autotrophic; which means they can produce their own food. Hence, plants contribute for the existence of themselves as well as animals.

Observe Figure 11.1 to study about photosynthesis, that is the biological process carried out by the plants to produce food.

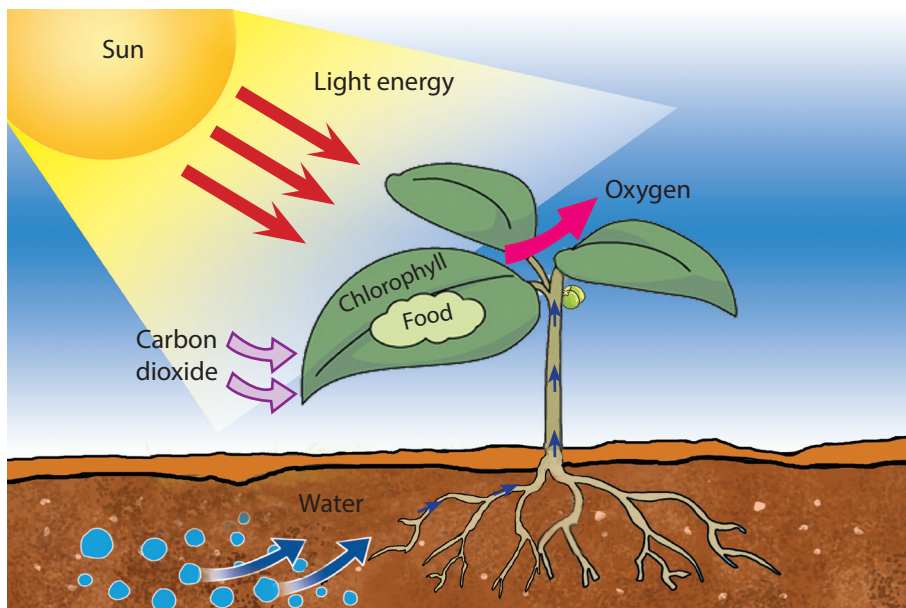


Figure 11.1 ▲ The essential factors and the products of photosynthesis

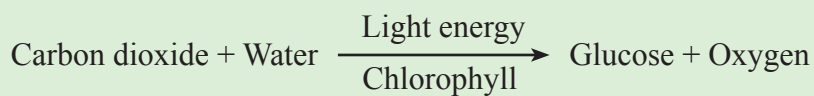
Leaf is the main organ, which produce food. The factors necessary for photosynthesis and the method of obtaining these factors are given below.

- Carbon dioxide :- Enters into the leaf through stomata from atmosphere
- Water :- The root hairs absorb water from soil. Then, it is transported to the leaf through the xylem.
- Chlorophyll :- A green colour pigment which is found within the chloroplast in cells. They absorb light.
- Light energy :- Chloroplast absorb the light energy from the sunlight fallen on the surface of the leaf.

Food is produced in an organ called chloroplasts, which can be found in plant cells.

Photosynthesis is the process of producing food in chlorophyll containing cells, using CO₂ and water by absorbing light energy from the sunlight. The products of photosynthesis are glucose and oxygen.

The reaction of photosynthesis can be given as the following word equation.



Glucose, produced in leaves is converted into starch in the leaves. Later this starch is converted to sucrose and transported to the necessary places of the plant (growing parts and storage organs).

Let us do Activity 11.1 to test whether photosynthesis has taken place in leaves. If the leaves contain starch and thus we can come to a conclusion that photosynthesis has taken place in leaves.



Activity 11.1

You will need:- A beaker, watch glass, tripod, bunsen burner, some leaves that are exposed to the sun light well (sun flower/chilli/drumstick), alcohol, boiling tube, iodine solution, forceps

Method :-

- Dip the leaves in hot water and boil.
- Then put them into a boiling tube with alcohol and boil them in a water bath as shown in Figure 11.2 b until the leaves become colourless.

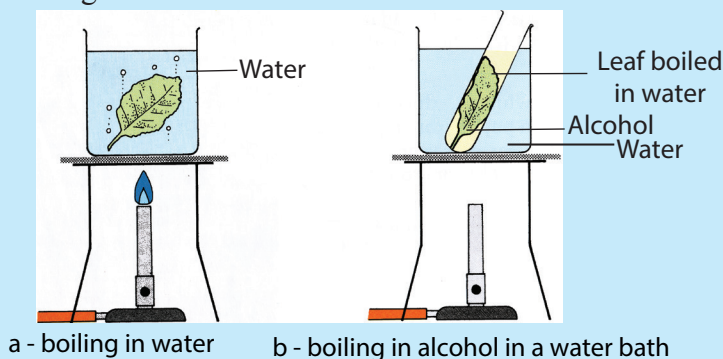
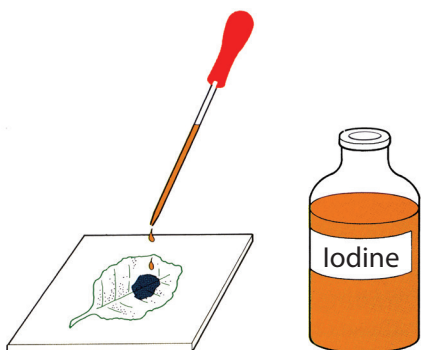


Figure 11.2 ▲ Preparing the leaves for the test

- Take the leaves away and wash well. Keep them on the watch glass and put some iodine drops on to the leaves.
- Note the observations.



You will observe that the leaves turn into dark blue colour when iodine is added. Iodine is an indicator that turns to dark blue in the presence of starch. So, this experiment demonstrates that when necessary conditions are supplied the leaves perform photosynthesis and produce starch.

Let us do Activity 11.2 to study that oxygen is produced during photosynthesis.



Activity 11.2

You will need:- A funnel, some aquatic plants, water, a trough, boiling tube, a glowing splinter

Method :-

- Fill the jar with water and keep some *Hydrilla* plants in it. Place the funnel as shown in Figure 11.4. Close the free end of the funnel with the boiling tube filled with water.
- Expose the set-up to sunlight.
- Note your observations.
- Take the boiling tube out very carefully and insert a glowing splinter into the boiling tube.
- Observe what happens.

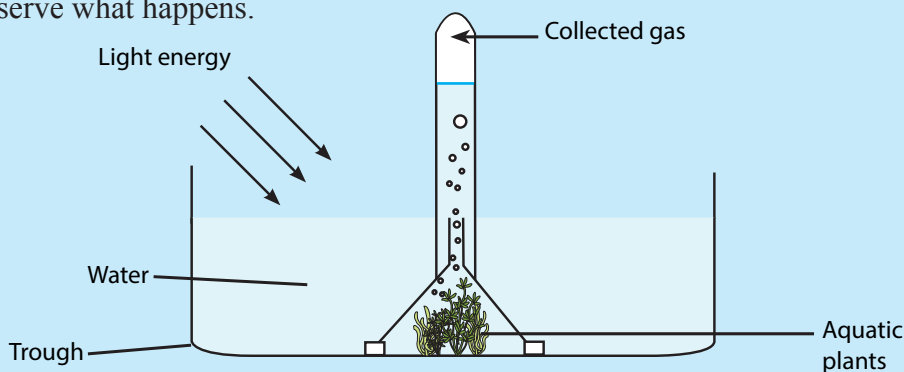


Figure 11.4

You will observe that air bubbles released from the plants and get collected in the upper part of the test tube. You must take the test tube out very carefully and insert the glowing splinter. You will see the glowing splinter reignite and bursting into flame. The reason is presence of oxygen inside the test tube. So, you can come to conclusion that oxygen is produced during photosynthesis.

Have you seen air bubbles coming out from a fish tank during the day time? The air bubbles are oxygen, a product of photosynthesis. Now you can understand the importance of growing aquatic plants in fish tanks.



Figure 11.5 Releasing oxygen gas from submerged aquatic plants

Photosynthesis is very important for the existence of the living world. Let us engage in Assignment 11.1 to study the importance of photosynthesis.



Assignment 11.1

Collect and compile a report on the global importance of photosynthesis to display on your wall paper.

Figure 11.6 showed the discription of the global importance of photosynthesis.

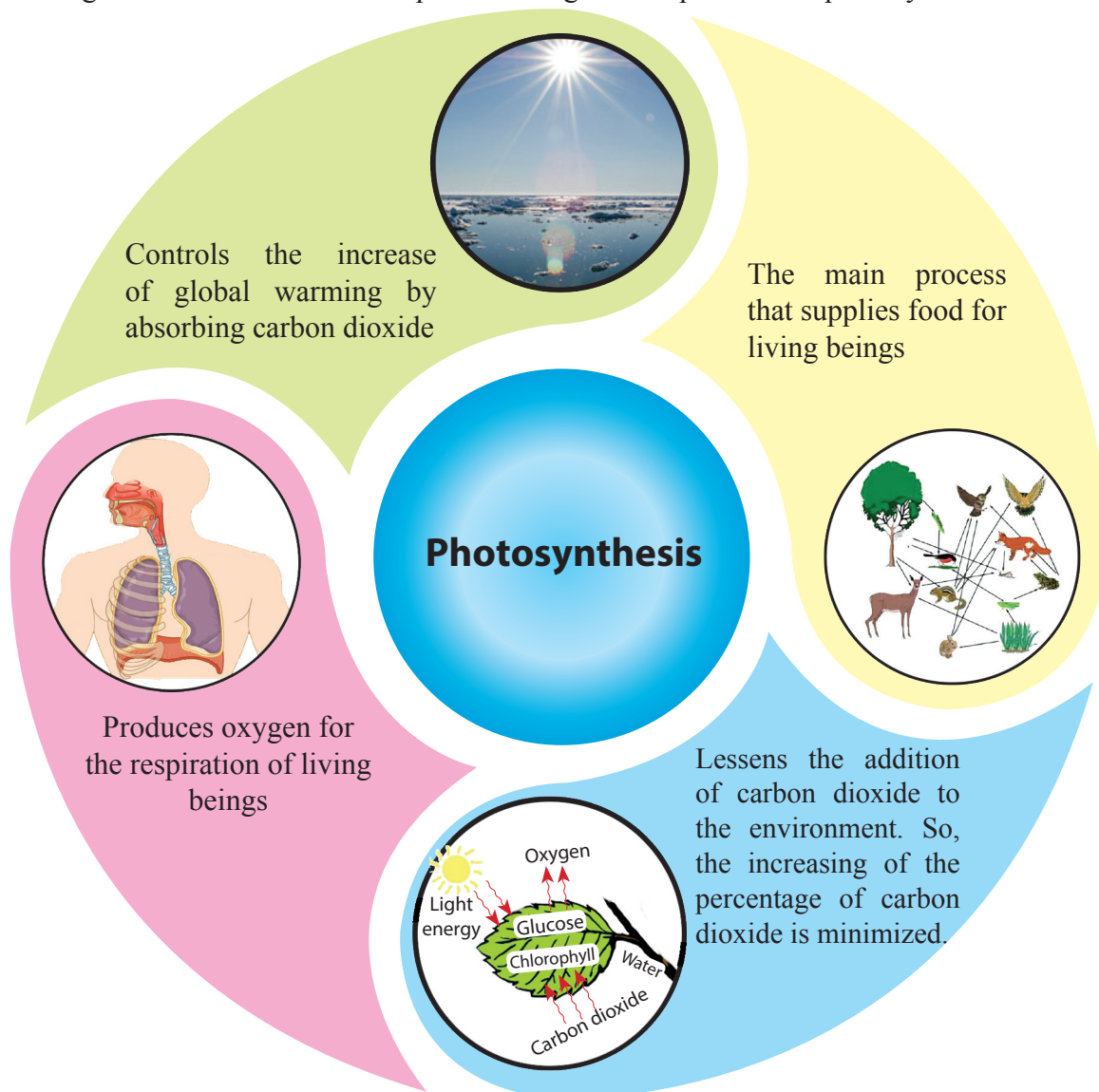


Figure 11.6 ▲ Global importance of photosynthesis

Have you ever thought about the way plants intake the raw materials for photosynthesis and how its products are sent to the different parts of the plant? You will understand how it happens with further studies.

11.2 Transportation

Plants in taking the raw materials for different biological processes and taking the products of these processes to the appropriate places of the plant is known as **transportation**. Some examples are given below.

- Transportation of atmospheric air through the stomata to the cells of the leaf.
- Transportation of water and minerals from soil to the leaves through root hairs.
- Transportation of food produced by photosynthesis from leaves to the other parts of the plant.

There should be a mechanism within the plants for transportation. Let us do Activity 11.3 to study about it.

11.2.1 Diffusion



Activity 11.3

You will need :- Condis, water, a beaker

Method:-

- Fill the beaker with water.
- Put some condis into it.
- Observe how the particles spread throughout water.



Figure 11.7 ▲ How condis particles spread throughout water

Spreading of condis in water can be described using Figure 11.8

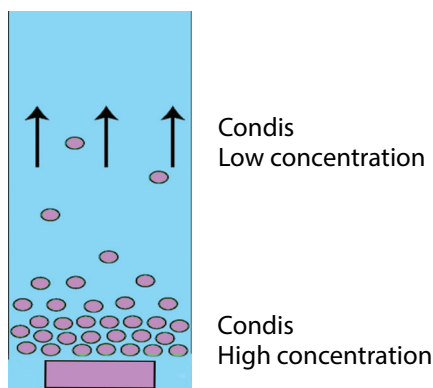


Figure 11.8 ▲ Spreading of condis particles in water

When the cube of condensation is put into water more particles of condensation can be seen around the cube. That is the concentration of condensation particles is high around the cube, which means there are more condensation particles within a unit volume. There is less amount of condensation particles in the upper part of the water beaker. Condensation particles move randomly from a region of higher concentration to a region of lower concentration. This movement of particles occurs not only in the liquid but also in the gas medium.

When skin of an orange is peeled off the smell can be felt for a person who is even a little far away. That is because the orange skin contains volatile materials. These volatile materials randomly move through the air from the higher concentrated area to the lower concentrated area. Spreading the smell of joss sticks and the smell of perfumes is also done according to the above method.

The process in which there is a movement of a substance from an area of higher concentration of that substance to an area of lower concentration is called diffusion.

Diffusion is a main process in plants that helps for the transportation of substances.

Following are some instances where diffusion takes place.

- Diffusion of carbon dioxide from atmosphere to the plant leaves through stomata for photosynthesis.
- Diffusion of oxygen through stomata to the leaves for respiration.
- Oxygen, a product of photosynthesis diffusing out of the stomata to the atmosphere.
- The products of respiration, carbon dioxide and water vapour diffusing from stomata to the atmosphere.

11.2.2 Osmosis



Assignment 11.2

Uproot a balsam plant carefully without breaking its roots. Wash soil in the roots. Put some water into a container and dissolve some red ink in it. Now, dip the plant in the water you prepared with ink. Observe after few hours.

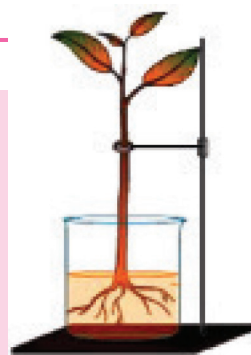


Figure 11.9 ▲ Ink solution goes up through the stem

You will see that roots absorb the red ink solution and it goes up to the stem. There is a mechanism that water particles and ink particles travel through the root cells and enter the xylem tissue.

Thus there is a mechanism that water particles travel from cell to cell. To study about this mechanism let us do Activity 11.4.

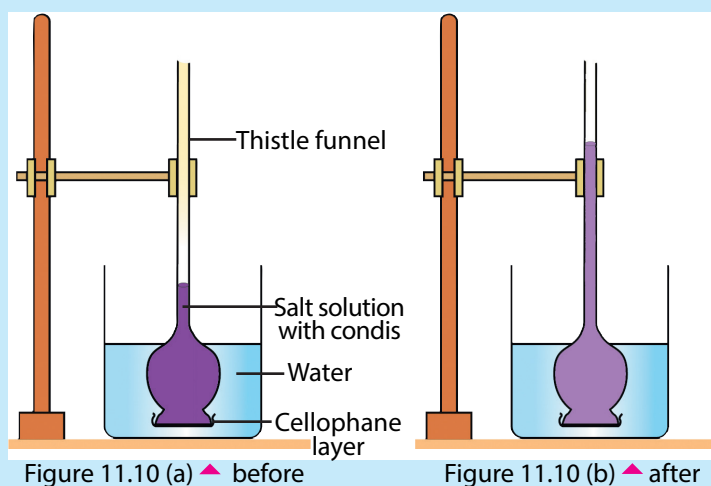


Activity 11.4

You will need:- A thistle funnel, a piece of colourless cellophane, 500 ml beaker, rubber bands threads, salt solution, water, condensation solution

Method :-

- Fill the beaker with water.
- Cover the mouth of the funnel with the piece of cellophane.
- Place the funnel in the beaker and put condensation solution and salt solution into the funnel.
- Mark the starting level in the thistle funnel.
- Note your observations after a few minutes.



After few minutes you will observe that the level of the liquid in the funnel rises up and the colour of the condensation is faded.

The reason for the rising up the level of liquid can be explained as below.

The concentration of water molecules is higher in the beaker compared to the solution in the thistle funnel. So, water molecules tend to move from area of higher concentration (beaker) into those of its lower concentration (thistle funnel) across the cellophane. Cellophane allows only the water molecules to pass across and prevents salt and condensation molecules from passing across it. Such membranes are called **semipermeable membranes**.

A semipermeable membrane allows only some selected molecules to pass across it. You can do the same experiment using an egg membrane instead of the cellophane. Egg membrane is also considered as a semipermeable membrane.

Diffusion of water molecules through a semipermeable membrane from an area of higher water potential to an area of lower water potential is known as osmosis.

To study about the osmosis let us do Assignment 11.3.



Assignment 11.3

- Take a petiole of a papaw leaf (with a closed end) and fill it with a salt solution. Place it in a water container as in Figure 11.11.
- Observe what happens.



Figure 11.11 ▲

Many minerals are dissolved in soil water. The root hairs of plants absorb these water particles by osmosis. From root hair up to the xylem water particles move from cell to cell by osmosis. The cell membrane inside the cell wall act as a semipermeable membrane.

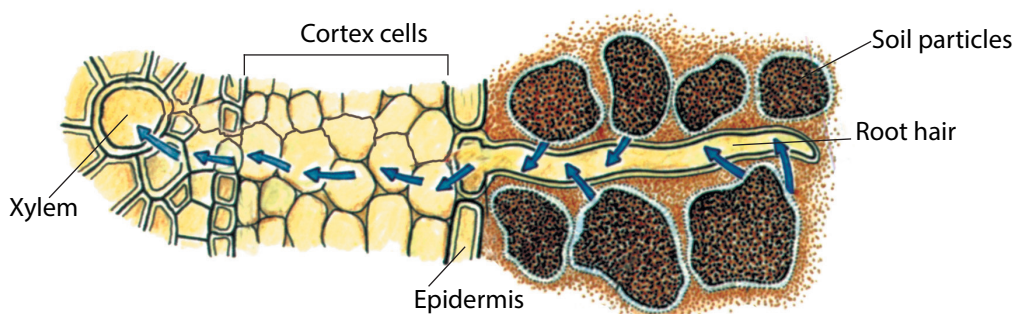


Figure 11.12 ▲ Transportation of water absorbed by the root hairs to the xylem

Root hairs absorb water by osmosis. Energy is not needed for this. But energy is needed to absorb minerals. Food produced in leaves are also transported to the other parts of the plant through the phloem tissues. These photosynthetic products are transported as a unit along the phloem tissues and that process is known as **mass flow**.

Some methods of transportation in plants are given below.

- Diffusion
- Osmosis
- Mass flow

11.3 Transpiration

Let us engage in Activity 11.5 to identify another important biological process that takes place in the plants.



Activity 11.5

You will need:- A potted plant, transparent polythene bag, rubber bands

Method :-

- Cover a branch of the plant with the polythene bag.
- Observe after about one hour.



Figure 11.13 ▲

You will notice that there are droplets in the polythene bag. When some anhydrous copper sulphate crystals are put on the droplets the crystals turn from white to blue. So, that you can come to a conclusion that the droplets were water droplets.

These water droplets mainly come out from the leaves.

The process of giving off of water vapour by evaporation through the aerial parts of a plant is termed as transpiration. Mainly this happens through the stomata in leaves.

Engage in Activity 11.6 to show that plants absorb water to fill the gap of water due to transpiration.



Activity 11.6

You will need:- A leafy shoot (you should cut this under water), coconut oil, rubber cork, grease/paraffin, "U" tube, water

Method :-

- Fill the "U" tube with water.
- Cut a leafy shoot under water.
- Fix it to the rubber cork and fix the cork to the one arm of the "U" tube. Seal it using grease.
- Put some coconut oil to the other arm of the "U" tube and mark the level of water.
- After an hour observe the water level in the arm with coconut oil.

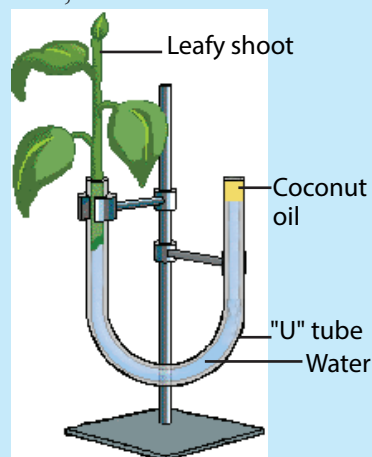


Figure 11.14 ▲

You will observe that the water level in the free arm of the "U" tube decreases. The shoot loses water through transpiration. Therefore, it absorbs the same amount of water from the "U" tube. This is the reason for the decreasing of water level in the free arm of the "U" tube.

Due to transpiration the speed of the transportation within the plants increases. Other than this there are some other functions of transpiration.

- The transpiration pull is responsible for the continuous ascent of water and nutrients from the roots to the top most parts of the plants.
- As the water is evaporated, transpiration helps the plant in cooling.
- Maintains the water cycle by evaporating water.

Therefore, transpiration is a process, favourable not only for the plants but also for the environment.

Severe heat, strong wind, strong light increase the rate of transpiration. Transpiration during dry condition may affect the plant to dry. There are many adaptations of plants that live in such weather conditions to conserve water. Recall what you have

studied in chapter 3.

Some adaptations are given below.

- | | |
|----------------------------------------|------------------------------------------------------------------------------|
| • Thick epidermis in aerial parts | e.g. - Temple trees |
| • Leaves reduced to spines | e.g. - Cactus |
| • Leaves turned to scale leaves | e.g. - 'Kasa'/'Savukku' |
| • Reducing the size of leaves | e.g. - 'Navahandi'/'Kally' |
| • Hairs on epidermis | e.g. - Sun flower, Pumpkin |
| • Sunk stomata | e.g. - Oleander |
| • Leaves falling during the dry season | e.g. - Rubber, Teak |
| • Fleshy leaves | e.g. - <i>Aloe</i> |
| • Rolled leaves during dry seasons | e.g. - 'Maha ravana reula'/'Ravanan meesai'
- 'Bim thamburu' / 'Vatralai' |

11.4 Guttation



Figure 11.15 ▲

When the humidity is high at nights the margins and tips of leaves in some plants such as anthurium, acacia ooze liquid drops. Think for a while the reason for these droplets.

At night the percentage of water vapour in the atmosphere is high and transpiration occurs very rarely. Therefore, the margins and the tips of leaves in small plants secrete water in the liquid form. They are exuded from the hydathodes.

The process of water being exuded in the liquid form from hydathodes of the leaves is known as **guttation**.

Guttation occurs from the tips of the plants such as 'habarala'/'nersshembu', anthurium, grass etc. and from the margins of the plants such as potato, tomato etc. The water in the droplets, secreted from guttation gets evaporated during the day time. But the salt get left behind and can burn the tips of the leaves. You would have seen such burns in the plants such as 'habarala'.

The differences between transpiration and guttation are shown in Table 11.1

Table 11.1

Transpiration	Guttation
1. Water released in the form of water.	Water released in the form of drops/liquid.
2. Occurs mainly through stomata.	Occurs through hydathodes
3. Only water is released.	Water and salts are released
4. Occurs during both day time and night time.	Mostly occurs during night.
5. When humidity in the atmosphere is increased, rate of transpiration is decreased.	When humidity in the atmosphere is high, it increases the guttation.

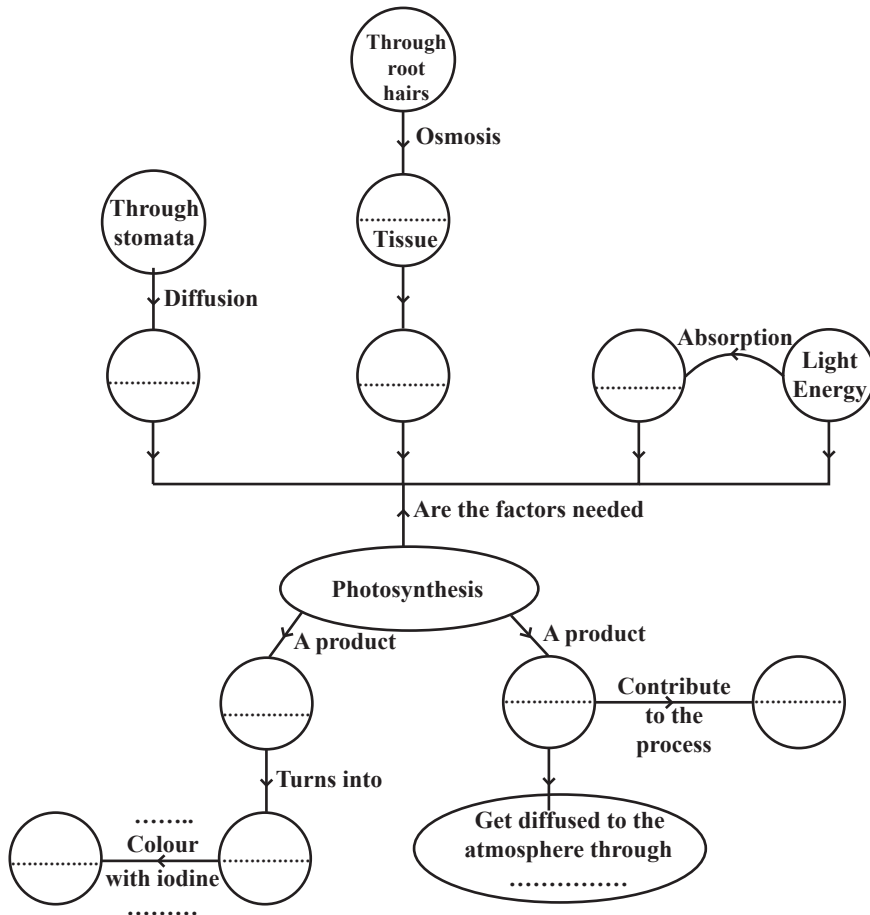


Summary

- Plants are considered as the main living component that contributes much for the proper existence and security of environment.
- Plants ensure their existence by the biological processes.
- Some biological processes carried out by the plants are photosynthesis, transportation and transpiration.
- It is important to transport water, a raw material of photosynthesis to the leaves and also starch, a product of photosynthesis to the necessary parts of the plant.
- The mechanisms such as diffusion, osmosis, help for the plant to absorb water from soil by the root hairs.
- Mass flow is the mechanism used to transport produced food along the phloem.
- Transpiration and guttation are important for the efficiency of transportation within the plants.
- The plants in xeric environments show many adaptations to minimize transpiration.
- The existence of plants ensures the conservation of environment.

Exercise

- 1) The following is a concept map prepared by a grade eight student. Fill the blanks using suitable words.



- 2) Select the correct answer.

1. Following are three statements that a student wrote about transpiration.

- A - Loss of water as vapour to the atmosphere.
- B - Occurs only during night.
- C - Mainly occurs through stomata

Out of these three the correct statement/s are

1. A and B Only 2. A and C Only 3. B and C Only 4. A, B and C

2. The leaves of a plant that grows in a certain area has reduced to scale leaves. An example for such a plant is

1. Cactus 2. 'Nawahandi' 3. 'Kasa' 4. Oleander

3. The biological process demonstrated by the following figure is

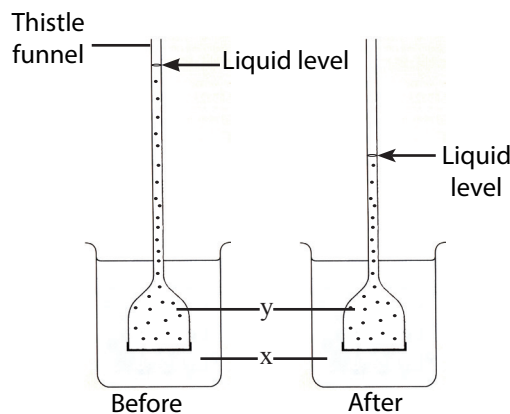


1. Photosynthesis
2. Mass flow
3. Osmosis
4. Transpiration

4. The group of plants that shows the guttation is

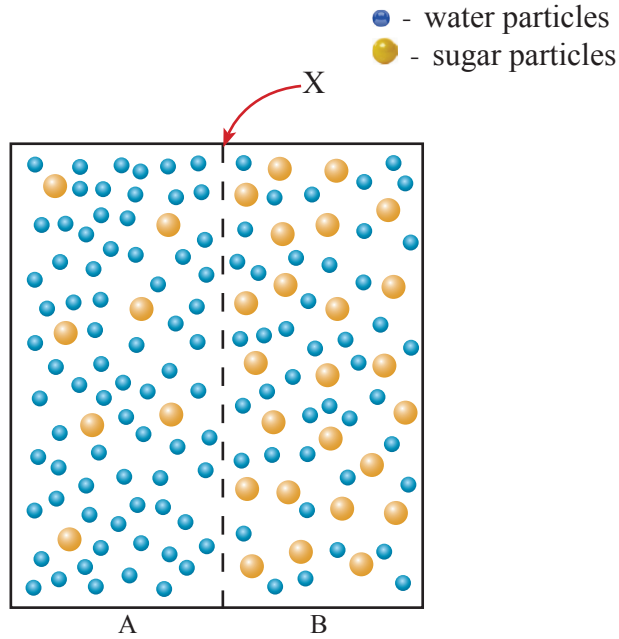
1. Acacia, potato, temple tree 2. Anthurium, tomato, acacia
3. Cactus, temple tree , potato 4. Aloe, oleander, pumpkin

5. It can be observed the levels of liquids in thistle funnel has been changed after few minutes in the set-up. According to the difference of liquid levels in thistle funnel, x and y are respectively.



1. Sugar solution and water 2. Water and sugar solution
3. Water and water 4. Sugar solution and sugar solution

6) Following is a model of a method of transportation of plants.



- What is denoted by X?
- What is the method of transportation in the model?
- What is the direction of net movement?
- What are the other methods of transportation in plants?

Technical Terms

Photosynthesis	- ප්‍රභාසංශ්ලේෂණය	- ஒளித்தொகுப்பு
Transportation	- පරිවහනය	- கொண்டு செல்லல்
Osmosis	- ආසූරිය	- பிரசாரணம்
Diffusion	- විසරණය	- பரவல்
Mass flow	- ස්කන්ධ ප්‍රවාහය	- திணிவுப்பாய்ச்சல்
Transpiration	- උත්ස්වේදනය	- ஆவியுயிர்ப்பு
Guttation	- බන්ද්‍රදය	- கசிவு