Getting to Know Plants

The Root

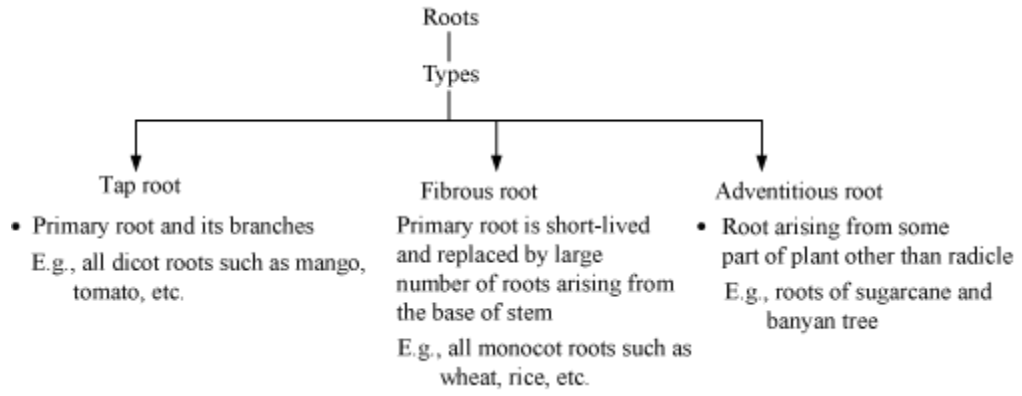
Plants have diverse morphology; still they have the following structures in common:

- Roots
- Stem
- Leaves
- Flowers
- Fruits

What is a root?

It is the underground part of a plant. It performs the function of absorbing water from soil. It also helps in the anchorage of plants to the soil.

Primary root is the direct elongation of radicle, which grows inside the soil. It is the primary root that bears several lateral roots termed as secondary roots, tertiary roots, etc.

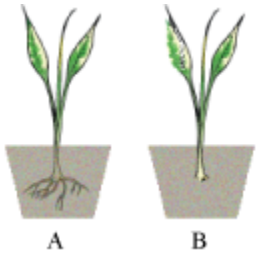


Functions of Root

The two functions of roots can be demonstrated with the help of the following activities.

(i) Absorption

Take two pots and label them as **A** and **B**. Uproot two weeds from your garden. Cut off the roots from one weed. Then, put the weed containing roots in pot **A,** and that without roots in pot **B**. Water the plants regularly for some days.



What do you observe?

You will observe that after 4-5 days, the weed without roots begins to die, while the other weed remains healthy.

Therefore, it can be concluded that roots absorb water from soil. Thus, they are important for the survival of plants.

(ii) Anchorage

Take a bowl and put some wet cotton wool in it. Then put 4-5 gram seeds in that bowl. Sprinkle water everyday to keep the cotton wet.

You will observe that after one week the sprouts develop into young plants.

Now, try to separate these young plants from the cotton wool. **What do you observe?**

You will find it difficult to separate these young plants from the cotton wool. This happens because the roots of these young plants remain attached to the cotton wool.

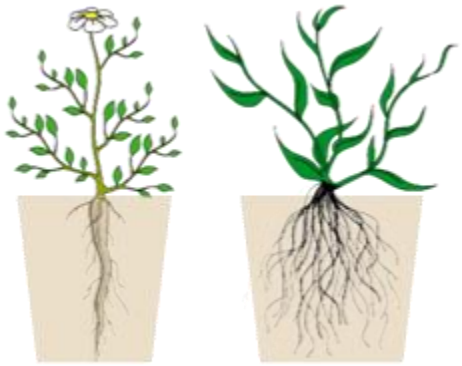
Therefore, on the basis of the above activity, it can be concluded that roots help in holding plants tightly to the soil, thereby performing the function of anchorage.

Do all plants have the same type of roots or do the roots differ in their structure?

There are mainly two types of roots in plants. They are:

(i)Tap root: Tap root consist of a main root, which grows vertically downwards. This main root gives rise to many small branches. They can be observed in the young plantlets of gram.

(ii)Fibrous root: Fibrous root arises in clusters from the base of the stem. They do not have a main root. They can be easily observed in the weeds uprooted for the above activity.



It is important to note that plants with tap roots will always have leaves with reticulate venation, while plants with fibrous roots will always have leaves with parallel venation.

Using this information, one can predict the type of roots a plant has by looking at its leaves.

Some Interesting Facts:

- **Did you know that the deepest roots are those of a wild fig tree in South Africa? They reach a depth of about 400 feet!**

- **The tallest living tree is a Mendocino tree, a coast redwood found in California. It is more than 367 feet and 6 inches tall!**

Modification of Root

- Roots of some plants modify their structure, shape, etc.
- These modifications are performing functions, other than absorption and conduction of water and minerals.
- Modified roots may perform functions such as support, respiration, and storage.
- **For storage of food** – Food can be stored in the roots by certain plants such as carrot, sweet potato, turnip, etc. These roots are eaten also.
- **For additional support** – In certain plants such as banyan tree, screw pine, etc., roots grow vertically downwards from the branches and penetrate into the soil. Such roots are called prop roots and they give additional support to the plant.
- **For respiration** – In certain plants that grow in saline areas, roots grow vertically upwards and come out of the water in the form of conical spines. Such roots are called pneumatophores.
    - Herbs, Shrubs and Trees

- You must have seen a garden with a large number of plants. **Do all the plants have the same characteristics or are they different from each other?**

- You must have observed that while some plants are very small, others are tall. Also, some have soft stems, while others have very thick and strong stems. Based on their characteristics, plants are classified into different categories. Let us learn out about them.
- **(i)Herbs:** These are plants having green and tender stems. They are generally short and do not have many branches. For example, tomato, potato etc.
- **(ii)Shrubs**: These are plants having hard stems, which are not very thick. Their stems branch near the base. For example, lemon, rose etc.
- **(iii)Trees**: These are plants having hard, thick, and brown stems. Their stems branch in the upper part. For example, mango, *neem* etc.

Explore a garden

Go to a garden. Compare your height with that of different plants. Also, observe the colour, thickness, and hardness of their stems.

Classification of Plants Depending Upon the Time Required In Completing their Life Cycles

Depending upon the time taken to complete the life cycle, plants can be annuals, biennials, and perennials.

Annuals

They complete their life cycle in one growing season.

When the seeds are produced, no stem, roots, or leaves remain. Only seeds remain that fall on the ground to give rise to new plants.

e.g., paddy, wheat, maize, etc.

Biennials

They complete their life cycle in two years. In the first year, they concentrate on making and storing food; and in the next year, they flower to produce seeds.

e.g., cabbage, turnip, etc.

Perennials

They complete their life cycles in several years. After many years, they fruit and produce seeds. They just keep on growing.

e.g., mango

Some Interesting Facts:

- **Some plants such as *Petunia*, marigold etc. live for a year or less than that. They flower and produce seeds once in their lifetime.**
- **Some plants such as water lily, *Geranium* etc. last longer and keep flowering for many years.**

- The Stem
- **What is a stem?** It is the main supporting stalk of a plant. It connects the roots to the other parts of
- a plant such as leaves and flowers.
- **What is the importance of stems in a plant body? What are its functions?**
- **Functions of stem**
- 
- • It supports flowers, leaves, and fruits.
- • It elevates the leaves so that they get proper sunlight for manufacturing their food.
- • It transports water, minerals, and food to the roots and the other parts of the plant. The various narrow tubes present in the stem help it in performing the function of transportation.
- Let us perform an activity to demonstrate the functions of stem.

Therefore, on the basis of the above activity, it can be concluded that stems conduct water from the roots to the other parts of the plant.

Some interesting facts:

- The stems of some plants such as sugarcane, bamboo, cinnamon, etc. are economically important.
- Chicle is the main ingredient of chewing gum. It is obtained from the trunks of the *Chicle* tree.
- Quinine, which is used to cure malaria, is obtained from the bark of *Cinchona* tree**.**

Modifications of Stem

Underground modifications in stem are as follows:

Underground stems are used for storage of food in potato, ginger, turmeric, etc. These structures also act as organs of perennation to help the plants survive in unfavourable conditions.

- **Rhizome –** Thick, branched underground stem containing nodes and internodes Rhizomes also have buds from which new stems and leaves develop. e.g. – ginger and turmeric
- **Tuber –** Food storing, roughly spherical stem

  It bears eyes, which are the dormant buds present on surface. For example, tubers are found commonly in potato. If potato tubers (containing a bud) are planted, then a new potato plant will develop.
- **Bulb –** In this modification, the stem is highly condensed to form a disc. A terminal bud is present on the upper end of the disc, which has numerous scale leaves. The inner scale leaves are fleshy and store food while the outer scale leaves are dry.

Aerial modifications in stem are as follows:

- **Tendrils** – Develop from axillary bud and are spirally coiled to help the plant to climb (E.g. Present in gourds and in grapevines)

- **Thorns** – Pointed, straight, and woody modifications of axillary buds, which arise to provide protection to plant from animals present in *Citrus, Bougainvillea*

- **Photosynthetic stems** – Modification of stems into flattened and fleshy structures shown by plants of arid regions to carry out photosynthesis (shown by *Opuntia*)

- Underground stems of strawberry and grass spread to new niches to give rise to new plants when older ones die.

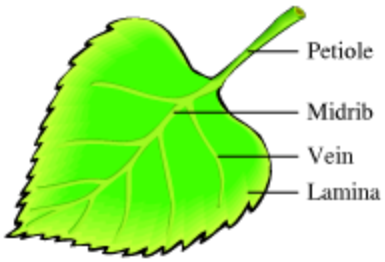
    - Climbers and Creepers
    - You must have seen some plants that cannot stand upright and spread on the ground and some other plants that take support of other plants or walls to climb. **Do you know what these plants are called?** Let us explore.
    - **Creepers**
    - The stems of these plants are very weak and cannot stand upright. Hence, they spread on the ground. The examples of creeper are *Bougainvillea,* Begnonia etc.
    - 
    - **Climbers**
    - These plants take support from neighbouring structures such as trees, walls etc. to climb up. The examples of climbers are money plant, jasmine etc.

The Leaf - Structure and Modifications

What are leaves?

Leaves are those parts of plants that perform the functions of photosynthesis and transpiration. In plants, leaves are found above the ground.

Let us learn about the various parts of a leaf.



Parts of a leaf

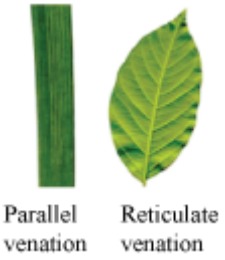
- A leaf is attached to the stem with the help of a petiole.
- The green broad part of a leaf is known as lamina.

- Veins are lines present on the lamina of a leaf. The thick middle vein is known as the midrib.

  The arrangement of veins on the lamina is known as venation. It can be of two types:

- **Parallel venation**: In this type of venation, the veins are parallel to each other. It is commonly found in grasses.

- **Reticulate venation**: In this type of venation, the veins are arranged in the form of a net-like structure around the midrib. It can be easily observed in the leaves of a rose plant.



Types of leaves

- **Simple** – When lamina is entire or when incised, the incisions do not touch the midrib.

- **Compound** – When incisions reach the midrib and break it into number of leaflets (bud is not present in the axil of leaflets)

  Leaves have various shapes. Some of them can be needle shaped (such as in pine trees), or heart-shaped (peepal), or oblong (banana), or circular (lotus). They also vary from each other in the pattern of their margins. Some of them have

complete margin (peepal), some have wavy margin (mango), some have toothed or serrate margin (rose), and some others have spinous margins (prickly poppy).

Modifications of Leaves

Leaves are modified to perform functions other than photosynthesis.

- **Leaf tendrils** are used for support and climbing (eg. Peas) – It is actually a thin, wired, and coiled structure that supports the plant as it climbs up.
- **Leaf spines** are the thorny structures into which leaves are modified for reducing water loss and defence.
- In insectivorous plants, leaves are modified to trap insects as in pitcher plant.
- **Fleshy leaves**- Leaves are modified for storage of food in onion and garlic.

Insectivorous Plants

Some of the insectivorous plants are described below:

- **Pitcher plant –** The leaf is modified into pitcher. The leaf has a lid, which is an extension of the leaf apex, and the petiole of the leaf coils to form a tendril-like structure. Once the insect enters the pitcher, the lid closes and the insect is trapped inside the pitcher. Plant then releases digestive juices to digest the insect.
- **Bladderwort –** The leaf is highly segmented. Some of the segments modify and form tiny bladder-like structures in which insects are trapped.
- **Venus flytrap –** The edges of the leaves in this plant have long pointed hair. The leaf blade is divided into two parts and the midrib acts as a hinge. When the insect comes in contact with the leaf, it suddenly closes. Then digestive juices are secreted to digest the insect.

Vegetative Propagation Through Leaves

Usually plants propagate through seeds. These seeds are found inside fruits and are responsible for giving rise to new plants. However, in some plants, parts other than seeds can also give rise to new plants. These vegetative parts of the plants include

stem, roots, and leaves, and such type of reproduction is called vegetative propagation. A well known example of vegetative propagation through leaves is *Bryophyllum* plant. In this plant, new buds are formed along the margins of its leaves, These buds later on fall in the moist soil, and each bud gives rise to whole new *Bryophyllum* plant.

Functions of Leaf- Photosynthesis and Transpiration

Functions of a leaf

Leaves perform two main functions: photosynthesis and transpiration. Let us learn about these functions in detail.

Photosynthesis

Photosynthesis is a process in which the chlorophyll-containing cells synthesize food using carbon dioxide, water, and solar energy.

Do you know what is formed as a result of photosynthesis? Let us explore by performing a simple activity.

Take a leaf from a healthy plant and put it in a test tube. Add some alcohol to it. Now, place this test tube in a beaker half-filled with water. Heat the beaker till the contents of the test tube turn green in colour. Then, take out the leaf and wash it with water. Put the leaf in a petri plate and add some drops of iodine solution to it.

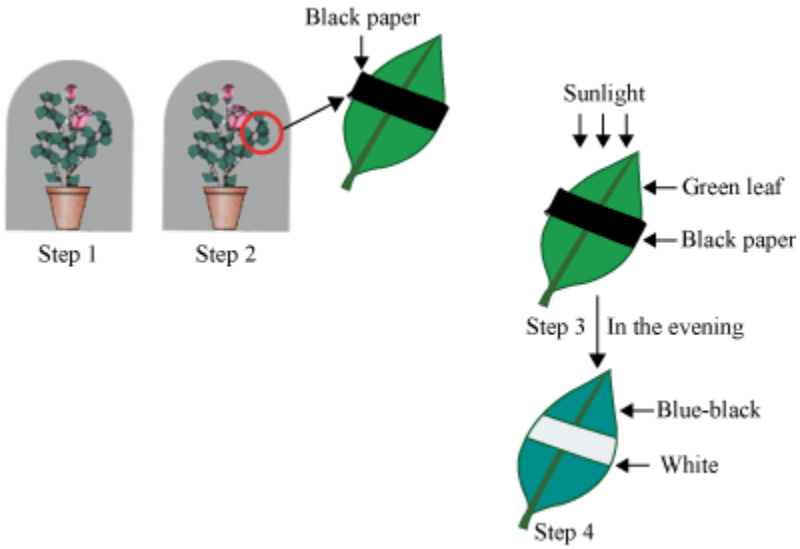
What do you observe?

You will observe that the leaf turns blue-black in colour, indicating the presence of starch. Thus, on the basis of the experiment conducted, we can say that plants make food in the form of starch during the process of photosynthesis.

But why do plants need sunlight? Let us find out.

Take a healthy, green potted plant and keep it in a dark room for one-two days (this is done to ensure that the leaves do not contain any reserve food).

Now, take a leaf from this plant (do not pluck it) and cover a portion of it with two uniform pieces of black paper on both sides. You can fix the paper using two paper clips.



Now, expose this plant to bright sunlight for a few hours (say from morning to evening). Wait till evening and then pluck the covered leaf. Decolourise it by washing it in alcohol. Then, put this leaf in an iodine solution.

What do you observe?

The blue-black colour appears only in the exposed portions of the leaf. This indicates the presence of starch in the leaf.

Therefore, on the basis of the two activities performed above, we can conclude that during photosynthesis, plants make carbohydrates using carbon dioxide, water, and sunlight. These carbohydrates later get converted into starch, which acts as a food reserve.

Now let us study about the second function performed by a leaf i.e., the function of transpiration.

Transpiration

The evaporation of water from a plant's surface, mainly through leaves, is known as transpiration.

Let us observe the process of transpiration by performing an activity.

Take a potted-plant and keep it in a polythene bag. Tie the mouth of the bag and keep it in sunlight.

You will observe that after 4-5 hours, the inner surface of the bag develops some water droplets.

Thus, it can be concluded from the above activity that leaves lose water in the form of vapour. These water vapours diffuse out of leaves' surface through small pores called **stomata**.

Some Interesting Facts:

- Did you know that up to 99% of the water absorbed by roots is lost via transpiration!
- A corn plant transpires over 200 litres of water in one growing season!

Is losing water an advantage? Is there any particular use of transpiration?

- The loss of water through transpiration helps in keeping plants cool. It especially helps them survive in hot weather conditions.
- Transpiration also helps in maintaining the concentration of cell sap inside the plant cells. If the excess water is not evaporated out through transpiration, the cell sap of the root hairs will become dilute. This will prevent the absorption of water from the soil through osmosis.

Factors Affecting Transpiration

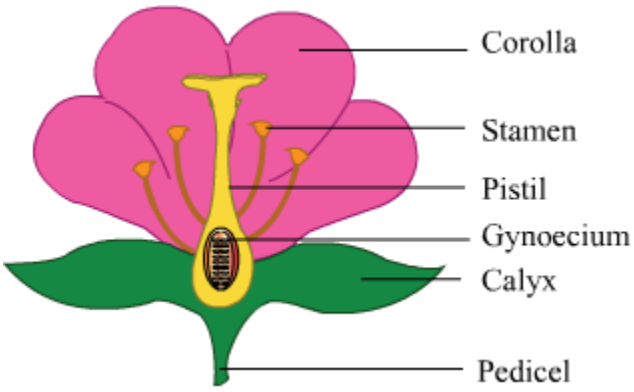
Transpiration process is affected by a number of atmospheric factors. Let us know about them as well.

- **Sunlight**: The stomata remain open during the daytime, and close at the night time. This the rate of transpiration is much higher during daytime than at night.
- **Temperature**: More is the temperature, faster is the transpiration.
- **Wind**: More is the air velocity, faster is the transpiration.
- **Humidity**: High humidity corresponds to higher amount of water molecules in the air. The humid air cannot hold more water molecules, and thus the rate of transpiration decreases.
    - Different Parts of a Flower and Their Functions
    - You must have seen flowers growing on a plant. **But do you know that there are some plants that do not bear flowers?**
    - Plants that have flowers and produce seeds and fruits are called **flowering** plants such as apple, mango, tomato etc. while the plants that do not produce flowers, seeds, fruits are called **non-flowering** plants such as ferns, mosses etc.

      What are flowers and what are their functions in plants? Let us explore the answers to these questions.
    - Flowers are the brightly coloured parts of a plant. They are involved in the formation of fruits.
    - **What are the different parts of a flower?**

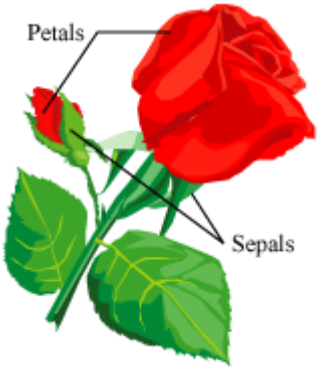
Parts of a flower

A flower usually consists of four main parts:



1. Calyx- The leaf-like structure at the base of the flower that protects the flower in the bud stage is called calyx. Individually it is known as sepals.

2. Corolla- This part of the flower is often bright in colour and unusually shaped to attract insects for pollinations. All the petals together are called corolla.



- **Sepals**

  They are the small, leaf-like green structures of a flower. They can be clearly distinguished as separate structures in flowers such as rose, marigold, etc. However, sepals are found to be fused in flowers such as periwinkle, *Hibiscus*, etc.

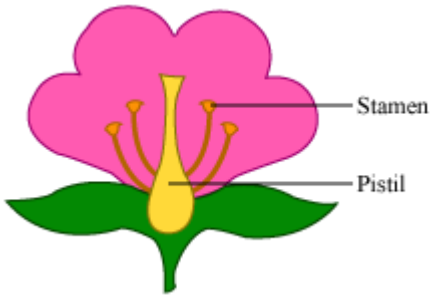
- **Petals**

  They are the brightly coloured, prominent parts of an open flower.

  3. Androecium-This is the male reproductive part composed of stamens and each stamen consists of a filament and an anther.

4. Gynoecium- This is the female reproductive part of the flower composed of carpels and each carpel have 3 parts- stigma, style and ovary.

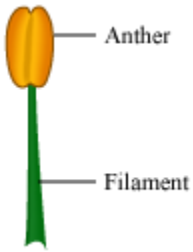
Stamens and pistils are the two reproductive parts of flowers.



- **Stamens**

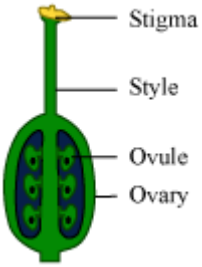
  They are the male reproductive parts of plants. They can vary in number. A stamen is divided into two parts: anther and filament.

  Stamens can be free, such as those present in *Hibiscus*, pea, marigold, etc., or they can be joined to petals, such as those in *Datura*, potato, sunflower, etc. The anther contains a number of pollen grains.



- **Pistils**

  They are the female reproductive parts of plants. They are present in the innermost parts of flowers. They consist of three parts: stigma, style, and ovary.



Ovary is the lowermost, swollen part of the pistil. It contains one or many small, bead-like structures called **ovules**. These ovules are attached to the ovary wall with the help of structures called placenta.

These ovules develop into seeds, and the entire ovary (containing the ovules) develops into a fruit.

On the basis of presence or absence of male and female reproductive parts, flowers are classified into two main groups.

- **Bisexual (hermaphrodite) flowers:** These are the flowers that have both androecium and gynoecium parts. Examples include rose, lily, sunflower, mustard, etc.
- **Unisexual flowers:** These are the flowers that have either androecium or gynoecium part. Examples include coconut, papaya, cucumber, watermelon, etc.

Functions of a Flower

The main function of a flower is aiding in reproduction.
The flower contains the stamen and the pistil that are involved in reproduction.
The pollen grains from the stamen are transferred to the pistil, this process is known as pollination.
Pollination takes place with the help of wind, water, insects, birds and other animals.

Dissecting a flower

Take a fresh flower, for e.g. *Gulmohur*. Observe the prominent parts (sepals and petals) of the flower. Now, remove all the sepals and petals to see the rest of the parts.

Can you count the number of stamens in the flower?

Some interesting facts:

- Did you know that *Wolffia* is the world's smallest flower? Its entire body (including the flower) is less than 1 mm long!
- *Rafflesia arnoldii* is the world's largest flower. It is a parasitic plant. It measures around 3 feet across and weighs up to 15 pounds!

Fruits

After pollination, the ovary changes into the fruit and the ovules present inside the ovary change into seeds. The seeds fall off from the plant and under favourable conditions, germinate into a new plant.