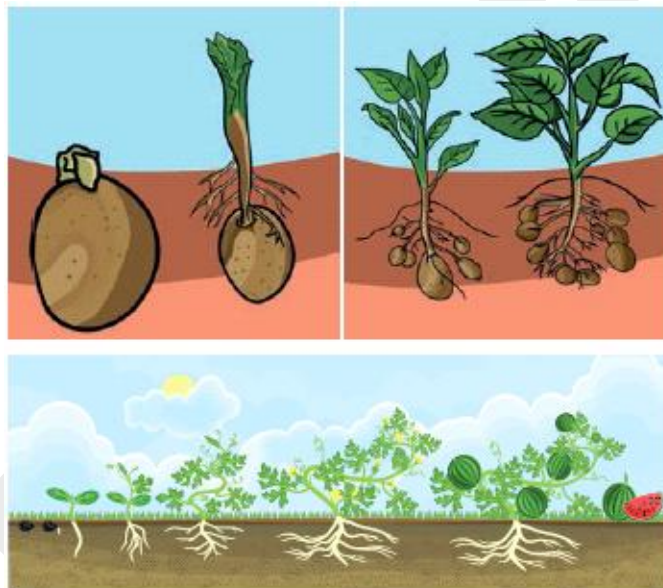


7th Science Lesson 5 Notes in English

5] Reproduction And Modification In Plants

Introduction

- Already we know that flowering plants have root, stem and leaves. They are called vegetative organs.
- Flowers, fruits and seeds in a plant are called reproductive organs. In earlier classes we have seen new plants can be grown from seeds.
- In this lesson, we are going to know about how a flower changes itself into a fruit and the modifications of root, stem and leaves of a plant.



Reproduction

- The process by which plants and animals produce young ones and increase their number is known as 'reproduction'.
- Drumstick tree can be grown from both seeds and stem cuttings. When plants reproduced from seeds we call that process as **sexual reproduction**.
- All other ways of reproduction without seed are called as asexual reproduction.

Sexual reproduction

- Seed is produced from a flower by the process of pollination and fertilization. This is known as sexual reproduction.

- To understand how seeds are formed in a flower, first we need to understand parts of a flower.

Parts of flower

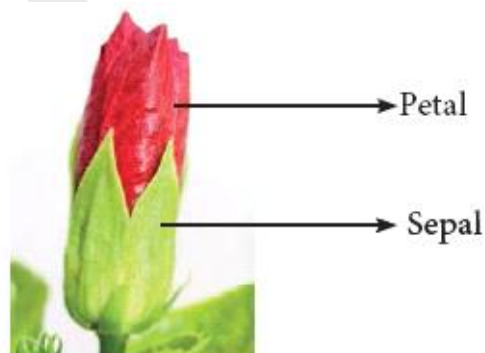
Collect few buds and opened flowers of Hibiscus and Datura. With the help of your teacher, perform the following steps.

- Observe and compare bud and opened flower of Hibiscus and Datura.
- Tabulate the characteristics.

Hibiscus flower	
Bud	Opened flower
Green colour	Brightly colour
Sepals	Petals
Dissected Hibiscus flower	
Bud	Opened flower
Curled petals	Expanded petals
Small tube with yellow lobes-Anthers	Expanded tube with yellow lobes-Anthers
	

Datura flower	
Bud	Opened flower
Green colour	White colour
Sepals	Petals
Dissected Datura flower	
Bud	Opened flower
Curled petals	Expanded petals
Small yellow lobes-Anthers	Expanded yellow lobes-Anthers
	

- In a bud, we can see a green colour, leaf like structure which cover the whole bud or flower, Each of these green like structure present as an outermost layer is called as sepal. This outer most ring of sepals is known as calyx.



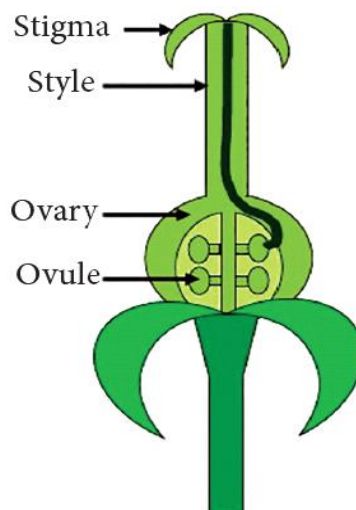
- Petals are the largest part of flowers.
- They are often attractive, brightly coloured, sometimes sweet scented and attract the insects.
- This ring of petals together is called corolla.
- Inner to this corolla, in Hibiscus, we can observe a long tube on which many stamens are arranged.

- But in *Datura*, we can see only five stalked structures, stamens. This ring or whorl of a flower is called androecium.
- Each stamen consists of two parts – a stalk called filament and a lobe called anther.
- If you touch these lobes in a mature flower, we can get a powdery substance called pollen grains, male reproductive part.



Androecium -Male part of the flower

- Inner to this androecium whorl, we can find a female reproductive part of the flower, called Gynoecium.
- You will find this part with a swollen bottom part. This is the ovary. Seeds are produced in this part.
- On top of the ovary there is a slender tube like structure called style. The top most sticky tip of the style is stigma.
- Pollen grains are received by the stigma. This is the fourth whorl of a flower.

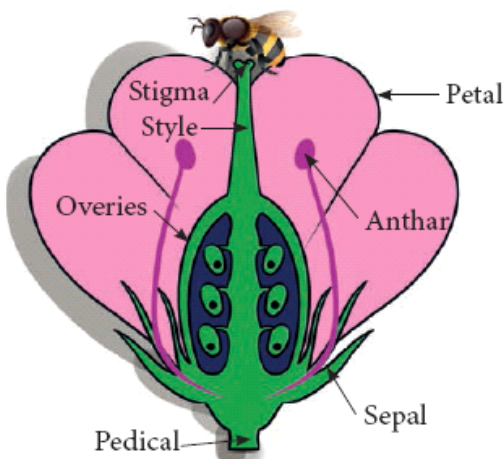


Gynoecium – Female reproductive part

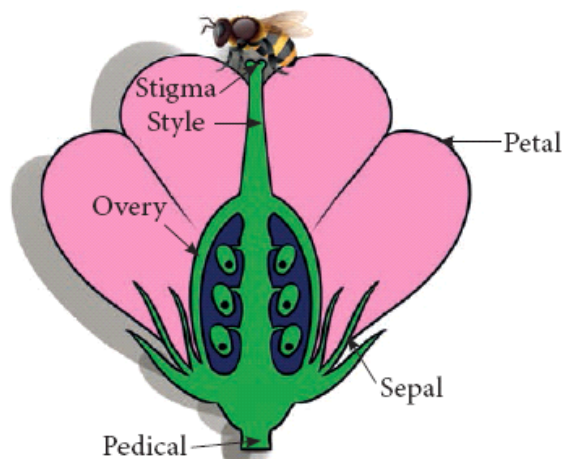
Types of flowers

Now we shall learn some important terms to understand flowers and their role in reproduction.

- If all the four whorls- calyx, corolla, stamens and pistil are present, then it is called as complete flower.
- Complete flowers are bisexual flowers.
- If any of these four whorls is missing, then it is called as an incomplete flower.
- Incomplete flowers are unisexual flowers.
- There are two types of unisexual flowers, male flower and female flower
- The one with androecium and without gynoecium is called as male flowers and the one with gynoecium and without androecium is known as female flowers.
- These are called unisexual flowers.



Bisexual Flower



Unisexual Flower

Flower to fruit

- To understand how a flower develops into fruit, let us perform an experiment on pumpkin plant.
- We know from our earlier explorations that flowers of pumpkin are unisexual- that is some of the flowers are male while many are female flowers.
- We can easily identify the male and female flower buds of pumpkin, even before they bloom.
- Once flower buds appear, immediately identify ten female flower buds. Tie a plastic bag around each bud so that no outside material can enter.

- Ensure to make small holes with a pin to allow air flow. Wait for two to three days to bloom.
- Choose three to four male flowers. Pluck the stamens of these flowers and dust the pollen grains in a sheet of paper and collect it.
- Open five out of ten bags containing female flowers. Brush the collected pollen grains on the stigma with a soft paint brush.

**Female****Male**

- Take care not to damage the stigma.
- After few days we can see that flower in all bags that were not opened at all would wilt without forming a fruit, while most of the flowers to which pollens have been applied for fruits.
- The process by which pollen grains reach stigma is called as pollination.
- The flower that receives pollen grains is called pollinated flower while the one that did not receive pollen grains is called as unpollinated flower.

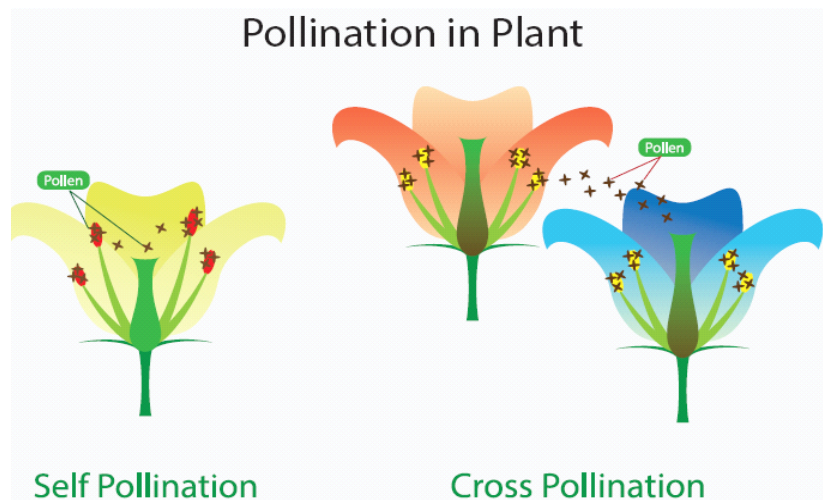
Pollination

- In the above experiment we transferred the pollen grains from male flower to the female flower.
- This is called as an artificial pollination. However in nature there are many ways in which pollen grain reach the stigma of the flower and are called as natural pollination.
- In some plants like grasses, pollen grains are light. Stamens shed pollen grains, and are carried by wind to other flower.
- Insects, birds are also other agents of pollination. Bees, butterflies and variety of birds hover around flowers.
- **They help to carry pollen from one flower to another. Pollen grains stick to their legs, wings or abdomen when they move from one flower to another.**

- This is called as Cross pollination when you shake stamens, pollen grains fallout.
- Thus when a wind shakes the flower or when a butterfly agitates the flower, pollen grains could fall onto the stigma of same flower.
- Some plants that have both the male and female parts within a single flowers(bisexual) pollinate by this means. This is called as Self pollination.
- Beans (Fabaceae), tomatoes (Solanaceae) are commonly self-pollinate.
- Even though, for example tomato, self pollinate, they need the help of the insects to create vibrations within the flowers that will effectively loosen the pollen.
- Paddy is mostly self pollinating using just gentle wind as the pollinating agent. The agents that are helping in pollination are called pollinators.
- In many plants, pollens have to come from some other flowers.
- This is obvious in case of plants which have distinct male and female flowers like pumpkin.
- In some flowers the gynoecium matures first before the androecium shed pollens.
- Plants such as apples, plums, strawberries, pumpkins use insects for cross-pollination.

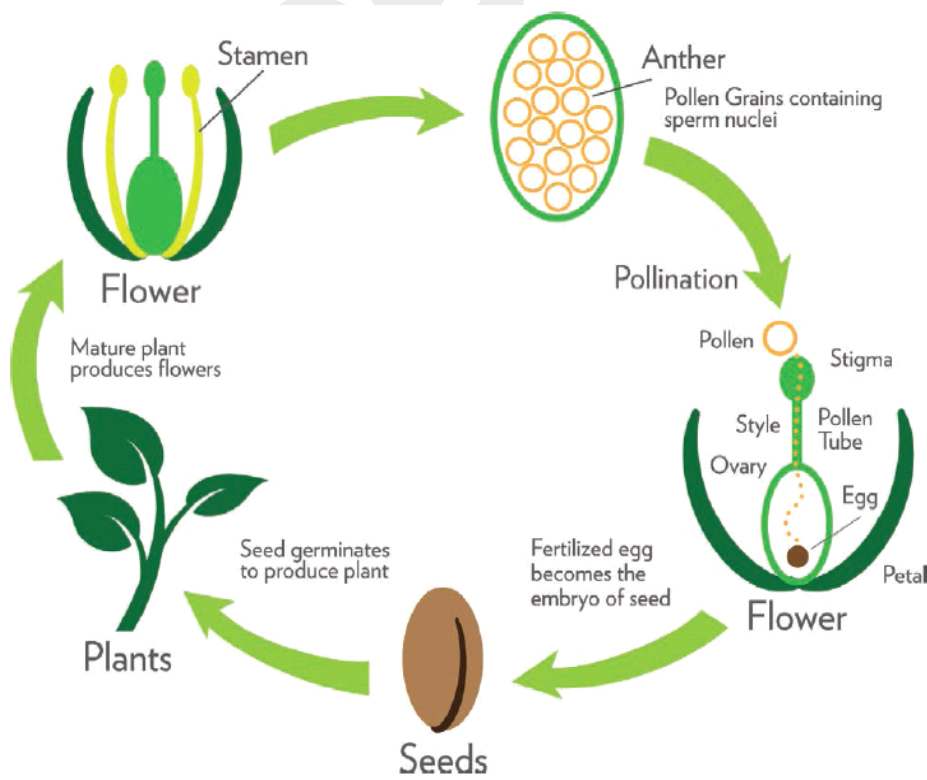
Differences between Self / Cross Pollination

Self Pollination	Cross Pollination
Pollen grains are transferred from the anther to the stigma of the same flower or to another flower of the same plant.	Pollen grains are transferred from the anther of one flower to the stigma of another flower of the same kind or different plant.
Plants do not need to produce pollen grains in a large quantity for self pollination	Plants need to produce pollen grains in larger quantities to increase the chance of pollination.
It does not produce changes in the characteristics of new plants.	Cross pollination does introduce variations in characteristics of new plants.



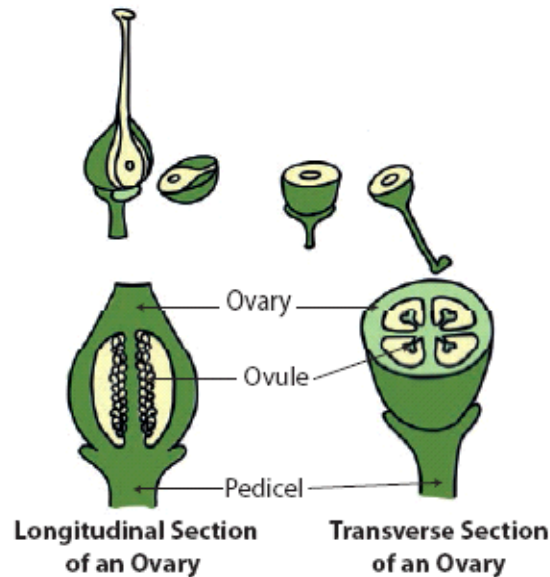
Fertilization

- Substances produced on the stigma causes the pollen grain to germinate.
- During the germination a tube develops from the pollen grain that carries male gametes that ultimately reaches female gamete inside the ovary through the style.
- Male gamete fuses with the female gamete to form zygote. This process is known as fertilization.



Life cycle of a plant

- Inside the ovary, small rounded structures, ovules are present. In these ovules, female gamete is present.
- To know more about this, we should cut ovary of a flower in longitudinal and transverse ways.



- Cut an ovary of a flower both vertically and horizontally. Observe the ovules.
- Collect some fruits – Tomato, Brinjal, Lady's finger (vegetable), mango, peas and custard apple and observe.
- Compare mango, custard apple and peas.
- All these are single fruits but custard apple has many small parts in it, each with a seed.
- Mango has a single seed and pea has many seeds.
- A green part above fruits of brinjal and lady's finger are sepals of a flower. In some, after fertilization, sepal will not fall from fruit and remain or persist with fruit.

Custard apple:

- It is made up of many fruits, aggregated together. Each fruit part is thin, membranous with some granule like, which is edible.

Mango:

- Outer skin and middle pulpy are edible and sweet. Inner most is with single seed.

Pea:

- Fruit is not fleshy, but forms a covering pouch for many seeds.

- In all above fruits, ovary, a lower most swollen part of pistil develops into a fleshy fruit. Ovules present inside the ovary gets transformed into a seed.
- **Hence, now with these observations, shall we list the changes taken place in a flower after fertilization.** These are collectively said to be post fertilization changes and are:
 1. Calyx sometimes persist with fruit
 2. Petals wither / fall off
 3. Androecium fall off.
 4. Pistil remains and develops into a fruit.
 5. Style and stigma fall off
 6. Ovary enlarges to store food materials and develops into a fruit.
 7. Ovules present inside the ovary develops into seeds.

Asexual reproduction

- Earlier we saw that plants reproduce not only from seeds but by other processes as well.
- The production of new plants without the involvement of pollination and fertilization is known as asexual reproduction. Let us know the types of asexual reproduction.

Vegetative Propagation

- In potato, shoot arise from eyes. Sugarcane, yam is also grown like this.
- Vegetative parts of the plants such as root stem and leaves can help to propagate the plant.



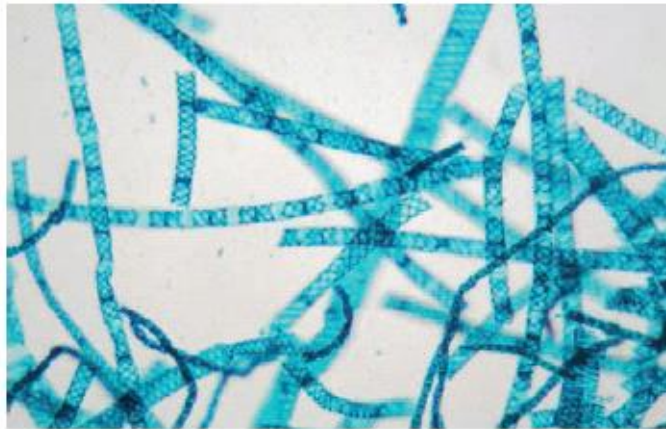
Budding

- When we go to a bakery we see so many types of cakes and breads. These are very soft in nature.

- This is due to the presence of Yeast.
- Single yeast undergoes asymmetric division. It produces a small protuberance which gradually grows and detaches from the parent cell.
- This process is called budding.

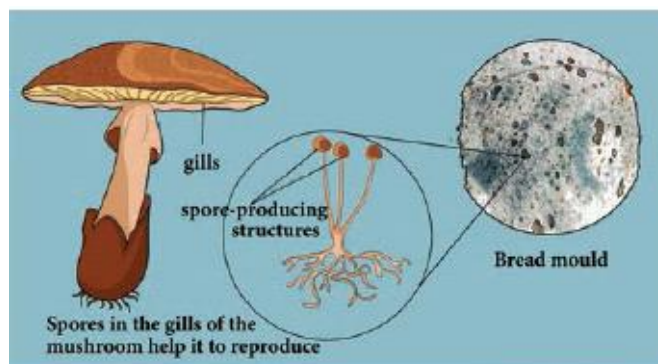
Fragmentation

- In a pond we see so many algae. Spirogyra is a filamentous alga, when it matures, the filament divides into pieces.
- Each fragment or piece of a filament will grow into a new filament or individual.
- Likewise Spirogyra produces so many young ones and this process is known as fragmentation.



Spore Formation

- Scarcity of water, high temperature, nutrient deficiency in soil etc., is unfavorable conditions.
- During these conditions non-flowering plants like Algae, Fungi, Moss and Ferns produce spores.
- They germinate into a new plant when favourable conditions return.



Modifications of plant parts

- Carefully remove a fresh carrot plant from the soil. Observe it. Look at the part we usually consume as 'carrot vegetable'.
- However it is not a unripe fruit, but the tap root of the carrot plant. We can see that the tap root of the carrot is swollen.
- In the case of the carrot plant, the tap root has different characteristics than the usual plants. Normally, each plant organ originally evolved to meet certain needs of the plant.
- For example, roots evolved primarily to anchor the plant and also absorb water and mineral nutrients from soil. Leaves were adapted to optimize photosynthesis.
- Stems evolved to reach out to sunlight and also served to conduct water from roots to leaves.
- However in certain plant species, specific parts have evolved further in unusual and surprising ways to meet certain other specific needs, In some plants root, stem, and leaves change their shape and structure to perform special functions like storage of food, mechanical support, protection and other vital functions.
- This is known as modification.
- What appear as the 'leaf' of acacti is actually their stem and what appear as 'spine' on them is actually leaf.
- Its leaves are modified into spines, an adaptation to reduce transpiration. Photosynthesis is performed by the stem part of the plant.

Modification of Root**Roots for storage**

- Look at a radish, turnip, beet root, and carrot.
- They all grow under the soil. As soon as you pluck it from the ground if you wash them gently, you will notice small roots dangling from their surface.
- All these vegetables are in fact roots of the plant. Instead of thin slender roots, in case of such plants, the roots have become a place to store the food produced by them.
- Hence they are thick and swollen. One can notice that the tap root of radish is in the shape of spindle, swollen in the middle and tapering at both ends.
- Such type of modified roots are called spindle shaped root. Example : Radish

- At times, like in the case of turnip, and beet root the tap root can acquire a shape of top that is spherical at the base and tapering shortly towards the apex. They are called as Top shaped root.
- In case of carrot, the shape is conical, broad at the apex and tapering gradually towards the base and such modified roots are called conical shaped root.

Mechanical Support

- Look at a banyan tree. It seems to have many trunks supporting it.
- However many of them are actually roots. As the banyan tree is large and huge, it needs support not to tilt and fall down.
- Many plants require such additional support. Such plants develop roots on their aerial parts to provide mechanical support.
- These roots grow downward and act as supportive organs. There are three types of modified roots for support.

Prop roots:

- Roots are modified to provide mechanical support as seen in Banyan tree. These roots grow vertically from horizontal branches of a tree.

Stilt roots:

- In sugar cane, and maize adventitious roots arise from the nodes in cluster at the base of the stem. These roots are called stilt roots which gives additional support.

Climbing roots:

- In betel and black pepper, nodes or internodes bear roots which help in climbing.

Gaseous Exchange:

- Avicenna is a tree which grows in mangroves or swamps.
- They have roots which are seen above the ground for the purpose of gaseous exchange.
- These roots are erect, peg like structures with numerous pores through which air circulates. These roots are called breathing roots, or pneumatophores.



Avicennia

Roots for other vital function

- Roots may also be performing special function.
- Haustoria or Sucking roots are one such example.
- Cuscuta a parasite plant, climb the trees and other vegetation and use the haustorial roots to penetrate the tissue of the host plant and suck nutrients from them.
- They are usually found in parasitic plants that depend on the host plants for nutrients.



Cuscuta

Modification of stems

- Can you guess what is common between gingers, onion bulb, potatoes.
- All three are stems. Some plants have their stems modified for storing food and for vegetative propagation.

- Modified stem may be aerial, sub aerial or underground stems.

Aerial Modifications

Phylloclade:

- In dry climate, conserving water is a challenge.
- Water evaporates from the surface. If the surface area is larger, evaporation would be more; and if the surface area is smaller, the evaporation will be less.
- Plants with many leaves have more surface area.
- Cactus hence has a thick stem which does most of the food production through photosynthesis and leaves are reduced to small spines with less surface area.



Cactus

Sub – aerial Modifications

- Stem of some plants remains sub – aerial which grow horizontally on the surface of the soil for the purpose of reproduction. There are four types.

Runner:

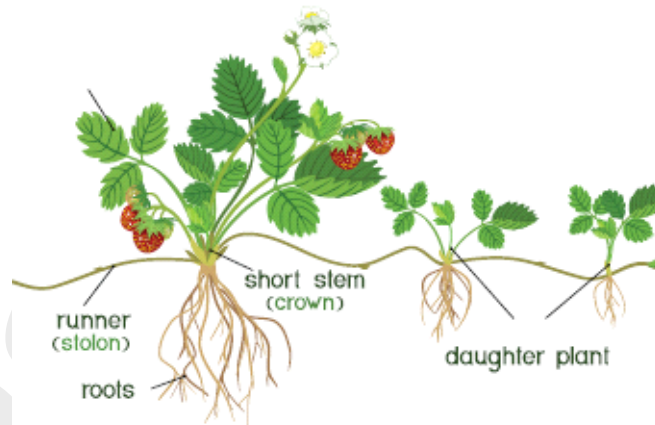
- The stem grows laterally on the surface of the soil, breaks up to produce roots where it touches the ground to give rise to new plants. E.g.: Centella (Vallarai)



Centella

Stolon:

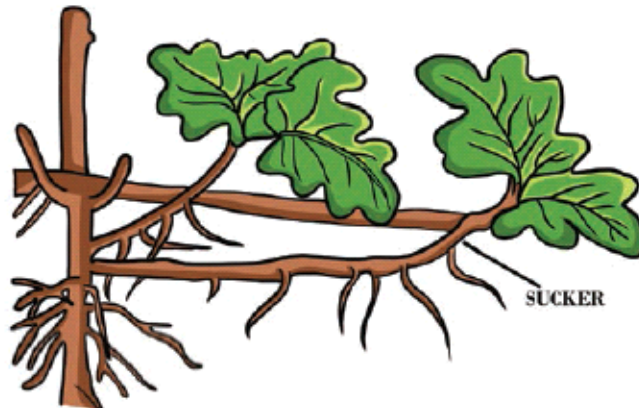
- Stolon is a slender branch of the stem that grows upwards to some distance and then bends towards the ground.
- Upon touching the ground, it gives rise to a new plant. E.g: Wild strawberry.



Wild strawberry

Sucker:

- Sucker is a short and weak lateral branch that grows diagonally upwards and directly gives rise to a new shoot. E.g.: Chrysanthemum.



Chrysanthemum

Offset:

- An offset is a short and thick branch that arises from the axil part of a leaf. It has thick internodes. It produces a tuft of leaves and cluster of small roots below. E.g.: Eichhornia.



Eichhornia

Underground modifications

- In aerial and sub aerial modifications, stem has indefinite growth. In underground modified stem, whole stem is buried under the ground and it has definite growth.
- Usually stem grows above the ground, but there are some stems that grow under the ground to store food. These underground stems swell and become thick.
- There are four types of underground stems:
 1. Rhizome;
 2. Corm;

3. Tuber;

4. Bulb

Rhizom:

- It is an underground thick stem with nodes and internodes with scale leaves at the node. It grows horizontally and has an irregular shape.
- Rhizome has buds. If give rise to new stem and leaves. E.g.: Ginger and Turmeric.



Turmeric

Corm:

- This underground stem is round in shape and flat at the top and bottom.
- It is a condensed form of rhizome and bears one or more buds in the axils of scale leaves. Daughter plants arise from their buds. E.g. Colocasia.



Colocasia

Tuber:

- It is an enlarged, spherical underground stem that stores food. It has many dormant buds on its surface known as "Eyes".
- If we plant a part of tuber with the bud, it grows into a new plant. E.g. Potato.



Potato

Bulb:

- It is a condensed stem which is disc like and stores food in the fleshy leaves. The bulb has two types of leaves.
 1. Fleshy Leaves
 2. Scaly Leaves
- The upper part of the stem has a terminal bud and it is covered by many scaly leaves. The inner fleshy leaves store food as seen in Garlic and Onion.

Modifications of Leaf

- Plants have changed themselves to adapt to the environment they grow. One of them is the modification of leaves.
- Leaves of several plants get modified into different form based on the purpose and environment

Spines:

- Leaves are reduced to spines, and the stem is modified into green succulent part to perform photosynthesis. E.g. Opuntia.



Opuntia

Tendrils:

- In climbers, the leaf of plant would be modified into elongated structure to help the plants climb efficiently.

Gloriosa superba – Leaf tips are modified into tendrils.

Pisum sativum (pea) –Terminal leaflets are modified into tendrils.

Phyllode:

- In Acacia auriculiformis, petioles expand to form leaf like structure. They carry out the function of leaf (Photosynthesis)



Pisum sativum



Acacia

Traps:

- Plants that grow in nitrogen deficient places adapt themselves well to get it.
- In Nepenthes, the leaves are modified into a flask like structure, which is used to attract insects and other tiny animals.
- The inner wall of the leaf secretes digestive enzymes that help to digest the insects and extract the nitrogen needed for the plant. E.g.: Nepenthes.



Nepenthes

More to know:

- The sunflower is not a single flower. It is a group of flowers clustered together. A group of flowers arranged together is called inflorescence.
- Tridax procumbent, looks like a single flower, but is an inflorescence. Leaf juice of this plant is used to cure wounds and cuts.
- The world's largest and heaviest seed is the double coconut. **The seed looks like two coconut fused together. It only grows in two islands of the Seychelles. A single seed may be 12 inches long, nearly 3 feet in circumference and weighs about 18 kg.**
- Orchids have the smallest seeds in the plant kingdom. 35 million seeds may weight only about 25 gram.
- A root growing from a location other than the underground, such as from a stem or leaf is called as adventitious root
- Vanda is an epiphytic plant, which grows on trees. The velamen tissue present in the epiphytic root, absorbs moisture, to perform photosynthesis.