Reproduction in plants

Asexual reproduction in plants

- Production of offspring's by a single parent without the formation and fusion of gametes is called as asexual reproduction.
- Types of asexual reproduction:

a) **Budding:** During this process, a small bulb-like projection comes out from the cell which is called bud. The bud gradually grows and gets separated from the parent plant and forms a new cell and which in turns grows, matures and produces more cells. For example - *Yeast.*

b) **Fission:** It is a process of asexual reproduction in which an individual divides into two (binary fission) or more (multiple fission) new individuals.
For example - *Amoeba.*

c) **Fragmentation:** It is a type of reproduction or the regeneration ability of the organism to replace their lost part. In this process an entire new organism can grow from certain pieces or of parent organisms. For example – *Spirogyra*, liverworts and mosses.

d) **Spore formation:** This is the most common method of asexual reproduction in most of the fungi and bacteria. The spores develop in a structure called **sporangium**. When the spores are released, they keep floating in the air. Since they are tiny and very light, they can cover long distances and remain in the air for a long time. The spores are asexual reproduction bodies. Each spore is surrounded by a hard protective coat and can withstand unfavourable conditions, such as high temperature and drought. Under favourable conditions, it germinates and develops into a new individual. Bread mould (*Rhizopus*) reproduces asexually by spore formation.

e) **Vegetative propagation:** This is a type of reproduction found in higher plants in which a new plant is formed from a vegetative part of the plant such as roots, stems or leaves. All the plants produced by vegetative propagation from one plant are exact copies (clones) of the parent plant.

Natural method of Vegetative Propagation

a) **By roots:** Tuberous roots of sweet potato (*Ipomoea batatas*), *Dahlia* and *Asparagus* become swollen due to food stored in them and in the next season new plants are produced from these roots.

b) **By stems:** The underground and sub aerial stems are especially modified for vegetative propagation.

Underground stems- These are of following types

- ✓ **Tuber** – Potato is an underground stem tuber that is swollen due to food stored in it. It has buds in the depressions called eyes and these buds give rise to new plants. The stored food is used up by the new plant to grow.
- ✓ **Rhizome** – It is an underground stem that bears buds and these buds grow to give rise to new plants. Rhizome is found in ginger and turmeric.
- ✓ **Bulb** – It is short underground stem surrounded by fleshy scale leaves which stores food. It is found in onion. During spring, the stem shoots up from the centre of the scale leaves to form a new plant.

Aerial stems

In grasses, mint, *Chrysanthemum* and strawberry vegetative propagation occurs by sub aerial stem. In these root and aerial branches arise from nodes forming the new plants.

Artificial methods of vegetative propagation

a) **Cutting:** It is the process in which a vegetative portion from plant is taken and is rooted in the soil to form a new plant. For example - Grapes, Sugarcane etc.

b) **Layering:** In the process of layering the lower stem branch of plant is used. Leaves are removed from this stem. Then it is bent close to the ground, pegged and covered with the moist soil in such a way that it's growing tip remains above the soil surface. This pegged down branch is called as layer. After a few days the covered portion of stem develops roots. This stem is then detached from the parent plant and is grown separately into a new individual. e.g. Jasmine

c) **Grafting:** This is a common method used in horticulture to develop new varieties of ornamental plants and fruit trees. Grafting is the process of joining together of two different plants in such a manner that they live as one plant. In this method one part of the plant bearing bud is taken (which is called as scion) and is tied with the stock which is the other part of the plant that is rooted in the soil. After some time the tissues of the stalk and scion join together to form one plant.

d) **Tissue Culture (Micropropagation):**

- In this tissue culture method, a small piece of tissue (called explants) is cut off from the growing tip of the plant.
- The cells of the tissue are separated and kept in a nutrient medium. The cells of the tissue divide rapidly and form an undifferentiated cell mass called 'callus'.
- The callus is transferred into another nutrient medium containing plant hormones.
- The cells of the callus in the nutrient medium divide and differentiate into roots and shoots and form a new plantlet.
- The plantlets so formed can now be grown in pots filled with soil.
- For example: *Asparagus*, *Chrysanthemum,* orchids and many other plants are grown by this method.

Significance of vegetative propagation

(i) Vegetative propagation is a more rapid, easier and cheaper method of multiplication of plants.

(ii) With the help of this method a good quality of variety can be preserved.

(iii) Most of the ornamental plants are propagated through vegetative propagation. For example: Rose, Tulip etc.

(iv) This method is used to propagate plants in which viable seeds are not formed or very few seeds are produced. For example: Orange, pineapple, banana etc.

Flower

The flower is the most beautiful and conspicuous part of a plant. Flower is a specialized shoot in which

The leaves are modified into floral structures.

Parts of a Flower

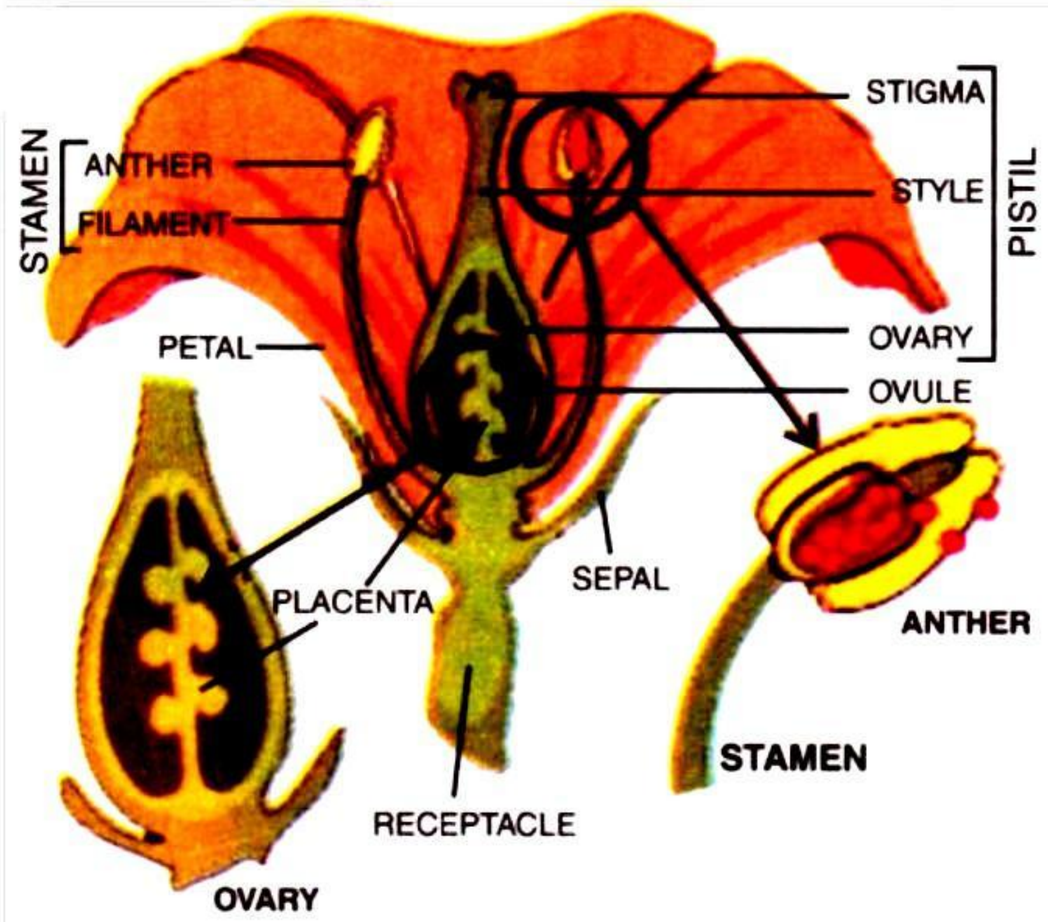
First of all, there is the stalk (pedicel) which supports the flower. Some flowers may be without stalk
(sessile). The tip of the flower stalk may be expanded to form a cup-shaped receptacle (or thalamus).
The floral parts are borne on the thalamus in four whorls.

(i) First whorl – green sepals (collectively called calyx).

(ii) Second whorl –large brightly coloured petals (collectively called corolla).

(iii) Third whorl (Male parts) (♂ = symbol for male) –long thread-like processes somewhat projecting out and each usually ending in a bilobed tip. These are stamens (collectively named androecium). Each stamen consists of threadlike filament and bilobed anther.

(iv) Foruth whorl (female parts ♀ = symbol for female) (centrally located pistil that may be formed of a single female unit (carpel or of several fused carpels (collectively called gynoecium) Each carpel consists of a basal ovary, a middle style and an uppermost stigma.



Generalized arrangement of parts of a bisexual flower

Sexuality in Flowers

Male, female and bisexual flowers, the anthers of the stamens produce pollen which forms the male cells
or the male gametes. The ovary of the carpel bears the ovule which encloses the egg cell or the female gamete.
The stamens and the carpels are the male and female parts of the flower respectively.

A flower which contains both stamens and carpels is called bisexual and hermaphrodite. Such flowers
are also said to be the perfect flowers.

A flower which has only one of these parts, that is, having only the stamens or only the carpels is called
unisexual or imperfect flower, e.g. papaya, palm. A unisexual flower which contains only the stamens is
called the male or staminate flower. A flower which contains only the carpels is called the female or the
pistillate flower.

Pollination

The stamens of a flower are the male organs. The anthers of the stamens produce a powdery material called pollen which consists of particles called pollen which consists of particles called pollen grains. Each pollen grain contains nuclei that participate in reproduction. For initiating

this process of formation of fruits and seeds the first vital step is that the pollen grains must reach the stigma. It may happen in several ways.

Pollination is the process of transference of pollen grains from the anther to the stigma. Pollination must occur between plants of the same species. May different kinds of flowering plants may be growing in the same vicinity. For example, an orchard may have trees of mango, guava, litchi, etc., and even some wild treeslike neem, jamun or sheesham may also be growing in the neighbourhood. Similarly, various crops may be growing in neighbouring agricultural fields- wheat, mustard, pulses, vegetables and so on. The wind may blow away the pollen from all such plants together and thus the flowers of a particular plant may receive all kinds of pollen of its own kind as well as of others, similarly, insects like bees and butterflies generally do not discriminate between plants and collect nectar from all kinds of flowers. In the process, the insects are carrying different types of pollen on their bodies.

Kinds of pollination, there are two kinds of pollination : self-pollination and cross pollination.

Self Pollination :

Self-pollination is the transfer of pollen from the anther to the stigma of the same flower, or to the stigma of another flower of the same plant.

When can self-pollination occur ?

Self-pollination can occur in bisexual flowers, i.e.in flowers having both male and female organs, or it can also occur in such unisexual flowers where both male and female flowers are borne on the same plant.

A. Advantages of self-pollination

1. It is much surer in such bisexual flowers where stamens and carpels mature at the same time.
2. Parental characters are preserved indefinitely.
3. There is no wastage of pollen grains.
4. The flowers need not be large and showy.
5. Scent and nectar need not be produced by flowers.

B. Disadvantages of self-pollination

1. Continued self-pollination, generation after generation, any lead to weakening of the variety or the species. The seeds produced through it are poor in quality and give rise to les vigorous offspring.
2. The weaker or defective characters of the variety or breed cannot be eliminated.
3. It does not yield new varieties, the genetic trait of the same plant with no change and without any intermixing are passed on to the next generation. Thus there is little chance for improvement in the next generation.

Cross-Pollination

Cross-pollination is the transfer of pollen from the anthers of flowers of one plant to the stigma of a
flower of another plant. This too has advantages and disadvantages.

A. Advantages of cross-pollination

1. The offspring are healthier.
2. The seeds produced are abundant and viable.

3. New varieties may be produced by cross-pollinating two different varieties of the same species or even two species.

B. Disadvantages of cross-pollination

1. The pollination is not always certain because some pollinating agent is always needed which may or may not be available at the proper time.
2. The pollen has to be produced in large quantity to ensure chances of pollination which means a lot of wastage of pollen.
3. The process is uneconomical for the plant because the flowers have to be large, coloured, scented and have to produce nectar for attracting pollinating agents.

Self-pollination	Cross-pollination
1. It is the transfer of pollen grains from the anthers to the stigma of the same flower (autogamy).	1. It is the transfer of pollen grains from the anthers of one flower to the stigma of another flower of a different plant of the same species. (allogamy).
2. No external agency or agent is required.	2. An external agent (wind, water, insects) is always required.
3. Male and female parts mature at the same time.	3. Anthers and stigma mature at different times.
4. It can occur even when flower is closed.	4. It can occur when flower is open.
5. It preserves parental characters	5. It does not preserve parental characters.
6. New variations are impossible, hence young ones cannot adapt changed environmental conditions.	6. Offsprings are healthier to adopt environmental changes.
7. New varieties are not possible	7. New varieties can be produced.

Agents Of Cross Pollination

The two commonest agencies of cross-pollination are insects and wind. Some flowers are also pollinated by certain animals and birds, like squirrels, bats, etc., or even by water in the case of some aquatic plants.

Each category has some special features to promote chances of pollination.

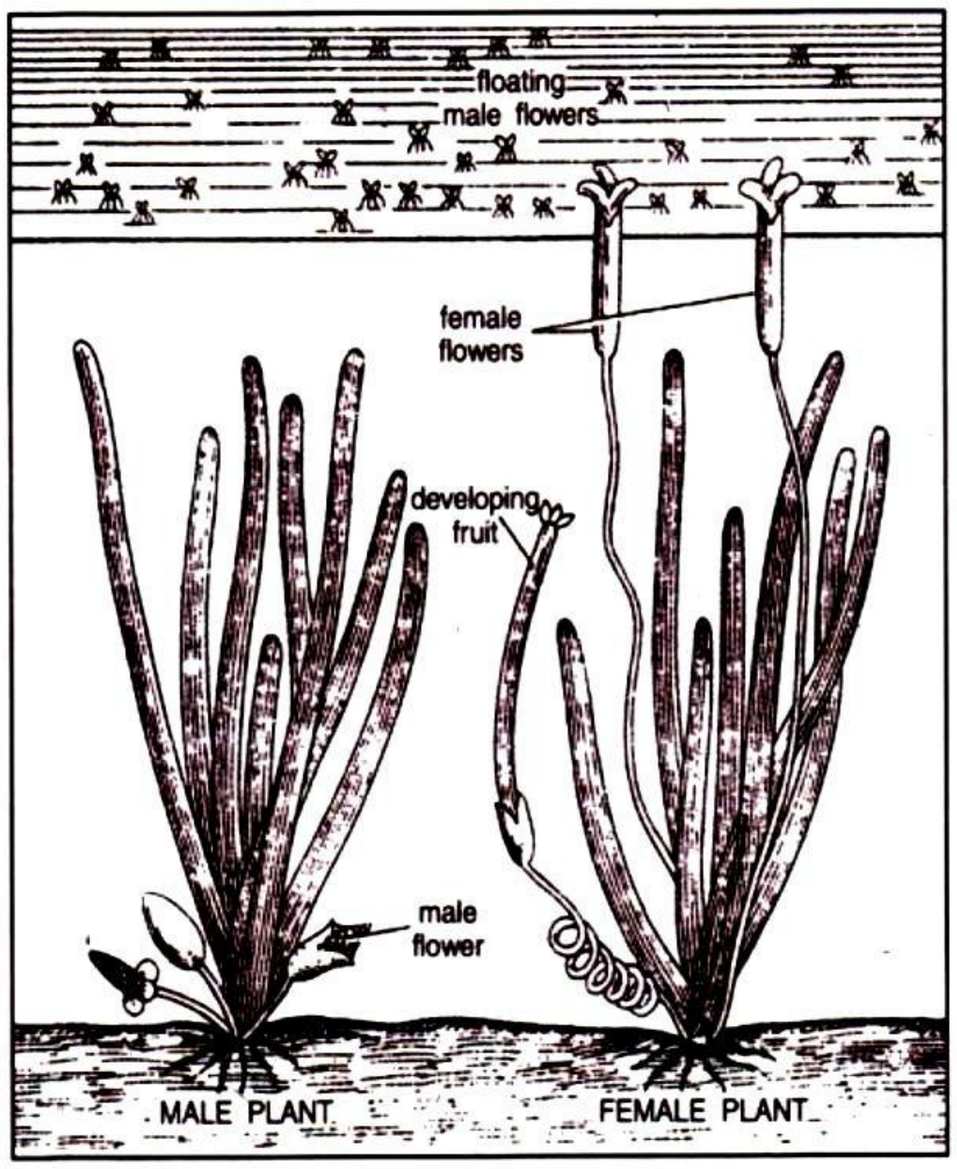
Insect-pollinated (or **entomophilous;** *entomon :* insect, *phile* : affinity) flowers usually have the following characteristics :

1. The flowers are *large.*
2. They are usually ***brightly coloured*** to attract insects.
3. They usually emit *scent* for attracting insects.
4. They produce *nectar* which is food for the insects.
5. The pollen grains are *sticky* or spiny to enable them to be carried by the insects easily.
6. The stigma is *sticky* and does not generally hang out from the flower.
7. The flowers tend to be in *clusters* to make them conspicuous, specially in the cases where individual

flowers are small, e.g. Dahlia.

Wind-pollinated (or **anemophilous,** *anemo:* wind; *phile :* affinity) flowers usually possess the following special features. *(Example:Maize).*

1. The flowers are *small.*
2. They are usually *not brightly coloured* and often dull green.
3. They do not produce scent or nectar.
4. The stamens are long and hang out of the flower to be exposed to wind.
5. The anthers are large and loosely attached to the filaments so that the slightest wind may move them (versatile).
6. Pollen is produced in *very large quantities.*
7. Pollen grains are light, dry and smooth so that they can easily be carried away by wind.
8. The stigmas are feathery and hang out of the flower to trap the pollen grains.



Vallisneria spiralis showing male and female plants; note the free floating male flowers.

Water-pollinated (or **hydrophilous,** *hydro :* water, *phile* : affinity) flowers are found only in aquatic plants such as *Vallisneria* (Fig.). They have the following characteristics :

1. Pollen grains are produced in *large numbers.*
2. In some plants the pollen grains have a specific gravity almost equal to that of water so that they *remain*
   floating below the surface of water.
3. In some special cases male flowers are such that they float on the surface of water till they meet female
   flowers (Fig.) *e.g. Vallisneria.*

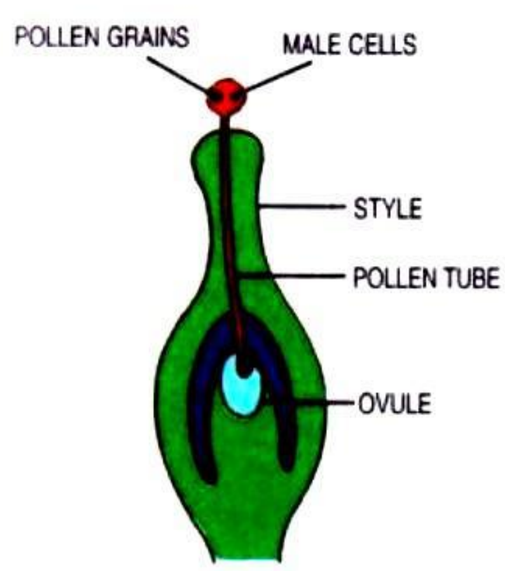
Some flowers are pollinated by birds (ornithophily, *ornitho:* bird), e.g. Bignonia, Canna; Elephophily is the pollination affected by elephants. Elephophily is found in Rafflesia whose flowers are very large. The pollen grains of one flower get attached to the feet of elephants and may be carried to the stigma of another flower when the latter gets trampled.

Fertilization (Fusion of male and female sex cells)

After reaching the stigma of the flower of the same kind of plant, the pollen grain begins to grow out of a tube into the stigma. This tube is called the pollen tube.

The pollen tube lengthens through the style and enters the ovule. There, it releases its male cells which fuse with the female cells to produce a zygote. The fusion of sex cells is called *fertilisation.*

The ovule containing the fertilised cell develops into a seed. The covering of the ovule gives rise to the seed coat and the ovary turns into a fruit containing the seeds.



Pollen tube entering the ovule

The Fruit

For the common man, fruit is something sweet and fleshy, but for a science student, fruit is the ripened ovary. Thus tomato, pea and pumpkin are all fruits and not just vegetables. The term vegetable is not a scientific term, whereas, the fruit is.

A vegetable can be any part of a plant – root, stem, leaf or fruit, which can be cooked and eaten.

The wall of the ovary may be fleshy as in papaya and tomato, or dry as in pea, gram, maize, etc. Thus, a fruit may be *a fleshy fruit* or a *dry fruit.*

The so-called "dry fruits", such as almond, cashew nut, walnut, pistachio, raisins, *etc.* are actually *dried fruits* and not dry, fruits. Also, all dried fruits are fleshy fruits.

Apple and pear are different kinds of fruits. In these fruits, the base of the flower (and not the ovary) becomes the main fleshy part of the fruit which we eat, while the ovary remains a small central part containing seeds. Such fruits are called the "false fruits".

Dispersal of Seeds

Seeds must come out of the fruits to produce new plants. In fleshy fruits, seeds come out only when the fruit wall decays or when animals or men eat the fleshy part and throw away the seeds. Most dry fruits, on the other hand, burst open and release the seeds. Any such method of release of seeds is called seed dispersal

Dispersal of fruits and seeds is brought about by :

1. Man and animals
2. Wind
3. Water

Seed -structure and germination

Plants usually grow by seeds, such as marigold, mango, apple, wheat, gram plants, *etc.* You eat mango and throw out its stone. When a seed is sown, it sprouts and produces a seedling which then grows into a mature plant. This plant again produces flowers, fruits and seeds. Some plants, like wheat and marigold, produce seeds only once in a year and die out, while others continue to produce a seeds for many years such as mango, apple, *etc.*

Types of Seeds

There are two types of seeds, namely, dicotyledonous and monocotyledonous.

1. Some seeds, like those of pea and bean, when opened, show two thick parts known as cotyledons. The seeds with two cotyledons are called dicotyledonous*(di :* two).
2. Some seeds have only one cotyledon, as in maize. Such seeds are called monocotyledonous *(mono :* single/ one).