MORPHOLOGY OF FLOWERING PLANTS FLOWER

FLOWER

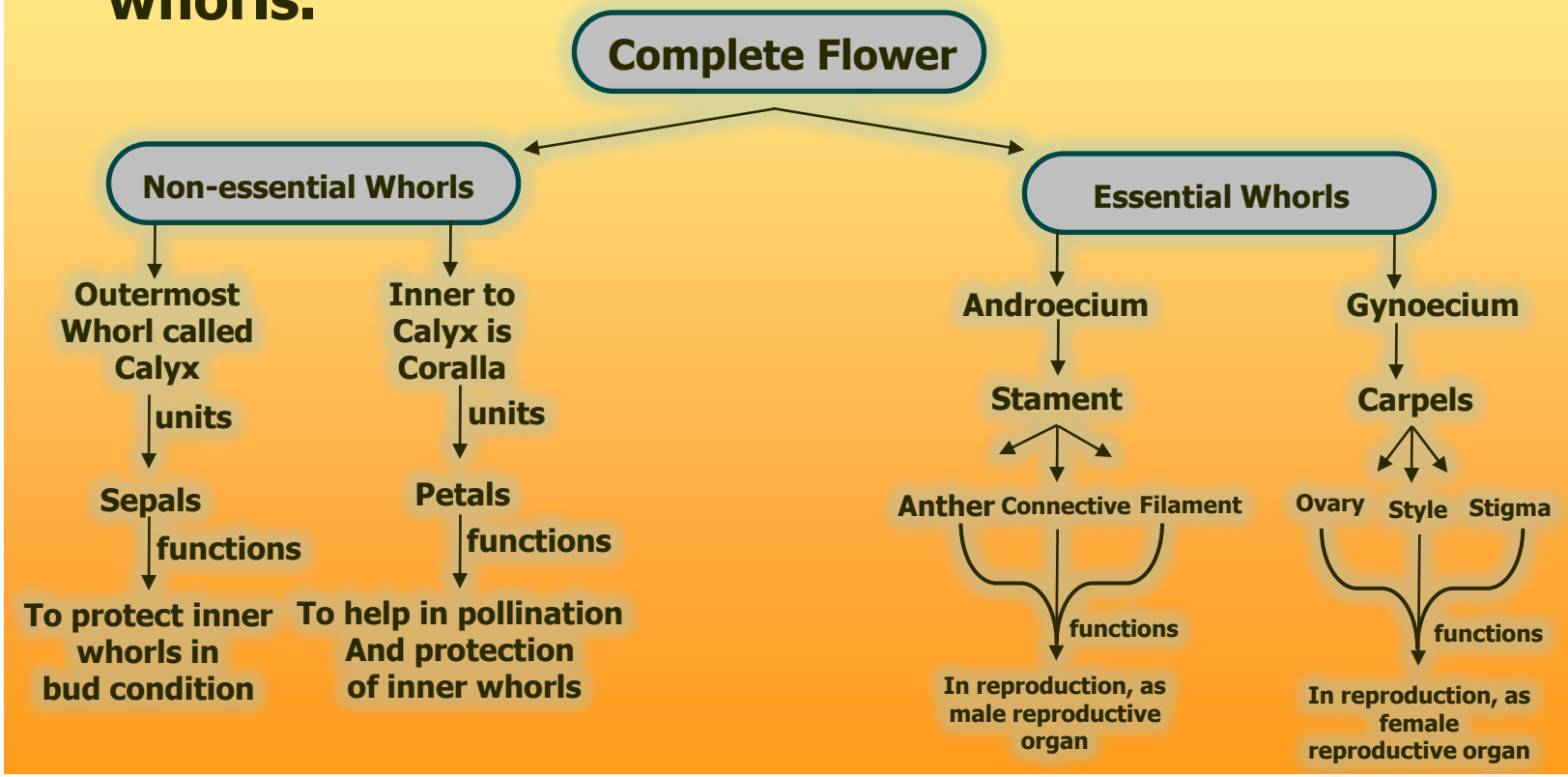
❑ Flower

- A flower is a modified shoot, which acts as reproductive unit in the angiosperms.
- A typical flower has four different kinds of whorl arranged successfully on the swollen end of the stalk or pedicel, called thalamus or receptacle, i.e., calyx, corolla, androecium and gynoecium.
- The outermost whorl of floral parts is composed of sepals, collectively called the calyx, the next inner whorl composed of petals collectively called as corolla. Sepals and petals are the sterile parts of flower.
- The fertile parts are the androecium, arises just inside the corolla and the pistil or gynoecium in the centre of the flower.

Androecium is the collective term used for the male reproductive organs, the units of which are stamens and each stamen has an anther (pollen grain forming part), connective (cementing tissue ligases two adjacent anther sacs) and a stalk called filament (links the anther to thalamus). Gynoecium or pistil is also a collective term used for female reproductive organs, the units of which are called carpels and each carpel has, a swollen ovary (bears ovules), a long stalk arising at the tip of ovary, called style and a pollen receptive terminal portion on the style, called stigma.

- *Wolfia* (duck weed), a floating aquatic plant has smallest flower (1 mm), whereas *Rafflesia arnoldi* (total root parasite) has largest flower. Lotus (*Nelumbo nucifera*) is the national flower of India.

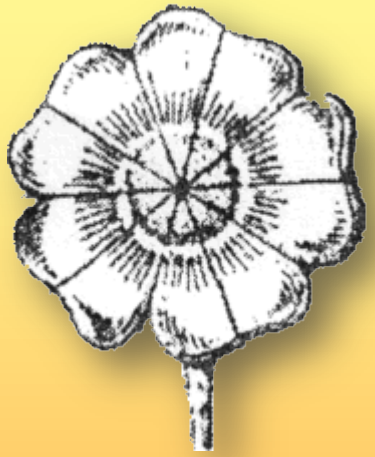
- **Androecium and gynoecium are called essential floral whorls because they directly take part in reproduction, whereas calyx and corolla take part in reproduction indirectly, so they are called non-essential or accessory whorls.**



- **Various terms important for description of a flower are as follows:**

Actinomorphic Flower

- **When the flower is radially symmetrical (divisible into two or more equal halves by and radial plane), it is termed as actinomorphic. Example- mustard (Cruciferae), onion (Liliaceae), brinjal (Solanaceae).**



Actinomorphic

Zygomorphic Flower

- **When the flower is bilaterally symmetrical, i.e., divisible into only two equal halves by a single vertical plane, it is termed as zygomorphic. Example- *Adhatoda*, pea, larkspur, *Ocimum*.**

Zygomorphic

Asymmetric Flower

- Flower, which can not be divided into two equal halves by any vertical division, is called asymmetric flowers. Example- *Canna*.

Hermaphrodite or Intersexual or Bisexual or Monoecious Flower

- A flower is called bisexual when it contains both male and female reproductive organs. Example- China rose, mustard, *Papaver*, pea, cotton, *Datura* etc.

Unisexual or Dioecious Flower

- A flower is called unisexual, when it has only one essential floral whorl, either androecium (staminate or pistalloide) or gynoecium (pistillate or staminode). Example- *Morus alba*, Papaya, *Cucurbita*.

Complete and Incomplete Flower

- A flower is called complete, when it contains all floral whorls, i.e., calyx, corolla, androecium and gynoecium, e.g., Solanum, mustard, while flower with absence of any one of these four whorls, is called incomplete flower. Example- *Cucurbita*.

Regular and Irregular Flower

- When the flower of a plant have same size, shape, colour and arrangement of various floral whorls/organs, then the flower is called regular and if any flower of a plant shows dissimilarity in any of it's part of trait, then the flower is called irregular.

Cyclic and Acyclic Flower

- When the floral parts of a flower are arranged in a whorl, the flower is called cyclic. Example- Solanum and if the floral parts of a flower are arranged spirally and not in whorls, the flower is called acyclic. Example- *Ranunculus, Opuntia, Nymphaea*.

- **Achlamydous, monochalamydous and dichlamydous flowers: In achlamydous flowers, the accessory floral whorls (calyx and corolla) are absent. Example- Piper sp. (Piperaceae) and when a flower contains only one accessory whorl (either calyx or corolla) or perianth (a collective term given to a group of undifferentiate calyx and corolla), it is called monochalamydous. Example- *Polygonum* (Polygonaceae), onion (Liliaceae), while the condition dichlamydous is used when both the accessory whorls (calyx and corolla) are present. Example- in most of the flowers.**
- **Isomerous and heteromerous flowers -When the parts of a floral whorl are found in a particular basic number or its multiple the situation is called isomary and the flower is isomerous. An isomerous flower may be dimerous (2 or multiple of 2). Example- poppy or trimerous (3 or multiple of it), Example- *Argemone* or tetramerous (4 or multiple of 4), Example- *Solanum*. A flower is called heteromerous when different parts of different floral whorls have different basic number of its multiple.**

- **Hypogynous, perigynous and epigynous flowers : A flower is called hypogynous when the innermost floral whorl (gynoecium) occupies the highest position (superior) viz, androecium. Corolla and calyx are successively arised below it (inferior), Example- rose, peach, *Prunus*. In an epigynous flower, the innermost whorl, i.e., gynoecium is covered by the elongated margins of thalamus, thus, their position is inferior in regard to other floral whorls which arise above the ovary and thus superior, Example- sunflower, *Cucurbita*, Coriander.**
- **Bracteate and ebracteate flowers - Bract is a small leaf like structure whose axil bears a pedicel (flower stalk). A flower containing bract is called bracteate, Example- *Adhatoda* and without bract it is called ebracteate, Example- *Solanum*.**

❑ Androecium

- **Androecium represents a group of stamens or male reproductive organs. Each stamen consists of a long filament, anther and connective.**

- **Diplostemonous condition - It is opposite condition of diplostemonous. Here, also occurs two whorls of stamens, in which the outer whorl occurs opposite to petals and the inner whorl is alternate with petals, Example- *Stellaria*, *Geranium*.**
- **Epipetalous condition - This condition arises when stamens are fused with petals (units of corolla which form second whorl of flower), Example- Solanaceae and Compositae families.**
- **Epiphyllous or epitepalous condition - In this, stamens become fused with tepals (units of perianth), Example- some members of Liliaceae as Asphodelus, Asparagus etc.**
- **Gynandrous condition - The situation arises when stamens are fused with the carpel (unit of gynoecium) throughout their whole length or by their anthers only, Example- Ascelpiadaceae.**
- **Polyandrous condition - In this condition, stamens are free (they are not attached with itself or with other floral parts), Example- mustard, Papaver, lily, radish etc.**
- **Adelphous Condition - In this situation , filaments of anthers become fused but anthers remain free.**

This situation may be of the following types :

1. Monadelphous : When all filaments become fused and form a group, while anthers remain free, Example- Malvaceae (China rose), Achyranthes etc.
2. Diadelphous : When two separate bundles of united filaments (anthers are free) are formed, Example- Papilionaceae (pea).
3. Polyadelphous : This condition arises when more than two separate bundles of filaments are formed (all anthers remain free), Example- castor (Ricinus), lemon (Citrus).

- Synandrous condition : It is slightly different condition, in which stamens are united throughout their whole length, Example- Cucurbitaceae (Cucurbita).
- Syngenesious or synantherous condition : Here, opposite condition of Monadelphous is seen, that is all anthers are united but their filaments remain free, Example- Compositae (sunflower).

- **Didynamous - Here, total number of stamens are four. Out of which, two stamens are with shorter filaments, whilerest two contain larger filaments, Example- *Ocimum, Salvia*.**
- **Tetradynamous - Here, total number of stamens are six. Out of which, four stamens of inner side have long filaments than the two stamens of outer side, Example- Cruciferae.**
- **Extrorse - When the anthers are opened towards the periphery side of a flower, then anthers are called extrorse. This process helpful in cross pollination, Example- poppy, *Argemone*.**
- **Introrse - When the anthers are opened towards the centre of a flower, the anthers are called introrse. This situation is quite common in bisexual flowers and helpful in cross pollination, Example- *Citrus*, *Dianthus*.**
- **Basifixed - Here filament adheres to the basal part of anther, Example- Cassia, Mustard.**
- **Adnate - In this, filament runs through the connective, Example- *Michelia*, *Ranunculus*.**

- **Dorsifixed : Here, filament attaches to the base of an anther, Example- *Citrus*, *Passiflora*.**
- **Versatile : It is also a dorsifixed type attachment but here anther is free to swing over the filament, Example- characteristic feature of grasses, *Eucalyptus*.**

❑ Gynoecium

- **Gynoecium consists of one or more carpels. Each carpel consists of ovary, style and stigma. Ovary contains ovules.**
- **Style may be terminal (i.e., upright, arises on tip of ovary), lateral (i.e., arises from one lateral side of an ovary, Example- mango, strawberry) or gynobasic (i.e., arises directly from centre of ovary or from thalamus, Example- *tulsi -Ocimum*, *Salvia*).**
- **Gynoecium may be either monocarpellary (having single carpel, Example- pea) bicarpellary (having two carpels, Example- *Funaria*), tricarpellary (having three carpels, Example- *Stellaria*), tetracarpellary (having four carpels, Example- Rhamnaceae), pentacarpellary (having five carpels, Example- *Melia*) or multicarpellry (having many carpels, Example- *Papaver*).**

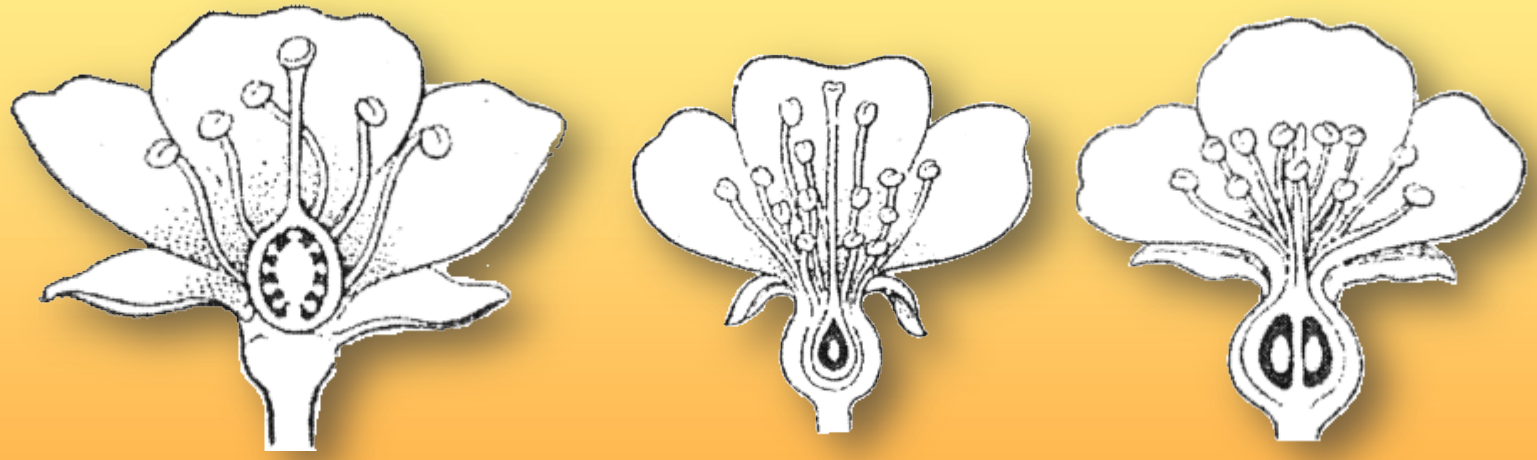
- In mustard (*Brassica campestris*), the carpel is unilocular (one chambered) but a false septum, called replum is present due to which carpel seems to be bicarpellary.
- In Cucurbita (pumpkin), the carpel is unilocular but there are three false placenta, which grow inwardly and meet at the centre and then bend downwardly. This leads a false trichambered or trilocular situation.
- In Apocarpous condition, carpels remain free from each other, Example- *Ranunculus, Aconitum, Clematis* (Magnoliaceae), in contrast, syncarpus is condition, where carpels are fused, Example-, mustard (Cruciferae), China rose (Malvaceae).
- The mode of arrangement or distribution of placentae and ovules within ovary is called placentation.
- Based on the position on thalamus, ovary may be superior, semi-superior or inferior.

Various types of Placentations

Placentation	Description	Examples
Marginal placentation	Monocarpellary, unilocular ovary, ovules arise from the ventral suture	Pea (*Pisum sativum*), Lathyrus (Family - Leguminosae).
Axile placentation	Multicarpellary, syncarpous, multilocular ovary Ovules arise from central axis	*Citrus* (Rutaceae), *Solanum nigrum* (Solanaceae) China rose (Malvaceae), Liliaceae
Parietal placentation	Ovary syncarpous and unilocular. Ovules arise from inner wall of ovary	Mustard, Radish (Brassicaceae), *Cucurbita* (Cucurbitaceae), *Argemone maxicana* (Papaveraceae)
Free central placentation	Ovary unilocular, ovules arise from central axis	*Stellaria, Dianthus* (Caryophyllaceae)
Basal Placentation	Ovary unilocular, ovules directly arise on thalamus from base of ovary	Sunflower (Compositae)m Wheat, Maize (Poaceae), (Ranunculaceae)
Superficial placentation	Ovary multilocular, ovules arise from inner wall of septa	Water lily (Nymphaea)

- **Superior ovary - Here, the ovary occupies the highest (superior) and central position on the thalamus while, the other floral whorls like androecium, petals and sepals are arised successively below it. Flowers containing superior ovary are called hypogynous flowers, Example- Citrus, Rose, Butter cup, Stellaria etc.**
- **Semi-superior or Semi-inferior ovary - This situation arises due to slight growth in the margins of thalamus. It leads to a disc shaped thalamus as is seen in pea or cup shaped thalamus as is seen in rose. Flowers with this type of ovary are called superior flowers. In these flowers, the position of ovary on the thalamus is same with that of other floral whorls (androecium, sepals and petals).**
- **Inferior ovary - In this, the marginal growth of the thalamus has completed and it completely covers the ovary. Here, the position of ovary is inferior (lowermost), while the other whorls of flower like sepals, petals and androecium grow successively above the ovary.**

- **Flowers containing inferior ovary are called, inferior flowers, Example- Coriander, Carrot, Apple, Sunflower, Cucurbita, Guava etc.**



(a) Superior **(b) Semi-inferior** **(c) Inferior**

Position of ovary on thalamus

Points to Remember

- A plant having butterfly shaped flowers with one standard, two wing like alae and two keel shaped petals belong to Fabaceae.
- The example of trimerous , unisexual flower is *Cocos nucifera.*
- Diadelphous stamens are characteristic of Fabaceae.
- Tetradynamous condition is found in *Brassica compestris*.
- Family Brassicaceae has bimerous flowers, six stamens, bicarpellary gynoecium, siliqua type fruit.
- Trimerous flowers ,superior ovary and axile placentation is characteristic of Liliaceae.
- Pentamerous, actinomorphic flowers, bicarpellary ovary with oblique septa and a fruit a capsule or berry are characteristic features of Solanaceae.

Points to Remember

- A flower which can be divided in the halves in only one vertical plane is called Zygomorphic.
- Zygomorphic condition can be represented as +
- Replum is present in the ovary of flower of Mustard.
- Tetradynamous androecium is found in mustard.
- Synandrous condition is the fusion of both filaments and anthers.
- Cyathium is characterised by single female flower surrounded by many male flowers and have involucres of bracts enclosing all the flowers.
- Monothecous anther is characteristic of Malvaceae.
- Gynobasic style is characteristic feature of Lamiaceae.

Points to Remember

- Dry indehiscent single-seeded fruit formed from bicarpellary syncarpous inferior ovary is Cypsella.
- The order of opening of floral parts from the periphery towards the centre is called centripetal.
- In a monoecious plant male and female sex organs are on same individual.
- Jaculators are present in *Ruellia*.
- Glumes represent bracts.
- Smallest flower is *Wolffia*.

Thank You…