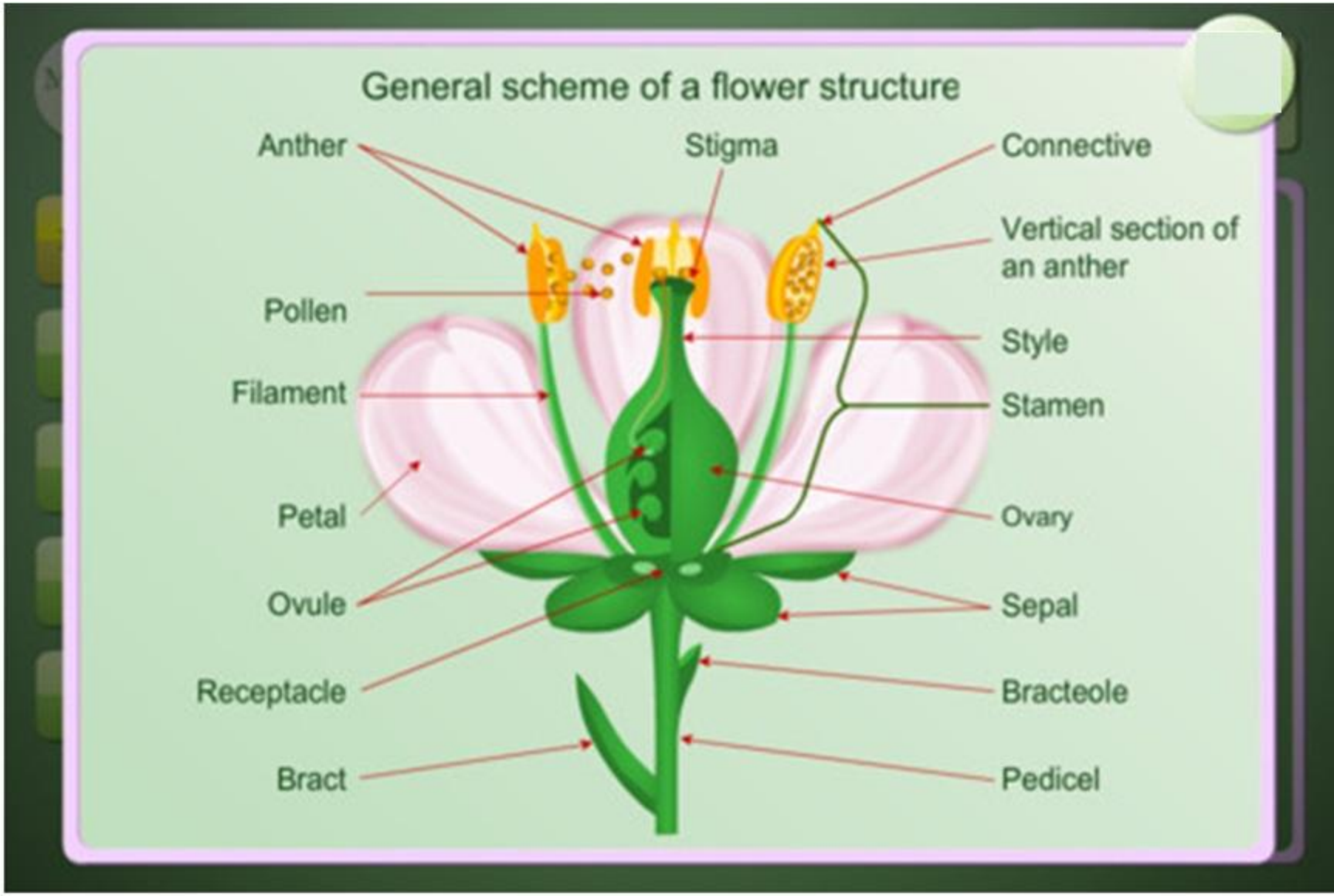
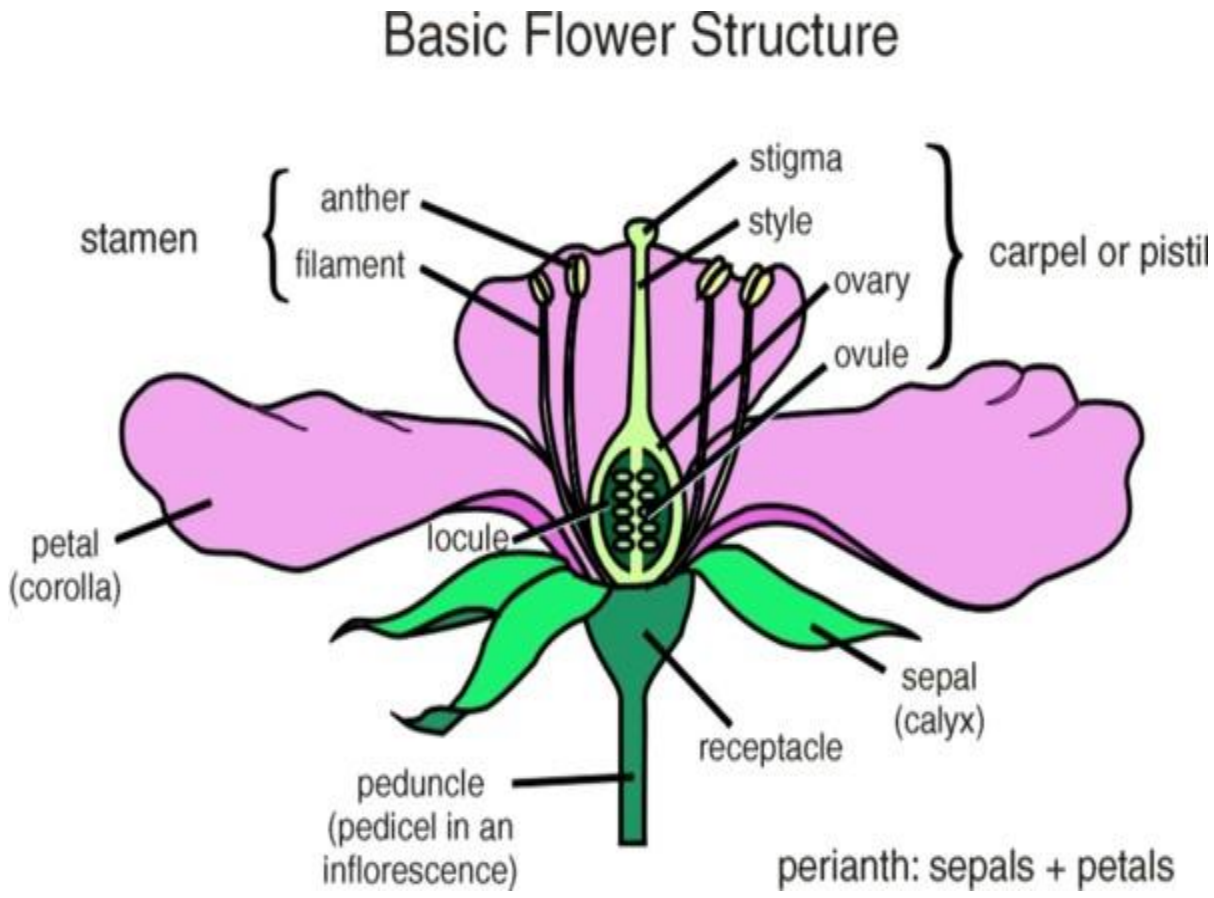
Angiosperms- Morphology of Flowering Plants



A flower is a modified condensed shoot specialized to carry out sexual reproduction in higher plants. Like a branch, it arises in the axil of a small leaf-like structure called **bract**.



Bracts- bracteate
Bracteoles-bracteolate
Parts:

1. Pedicel
2. Thalamus
3. Whorls of flower

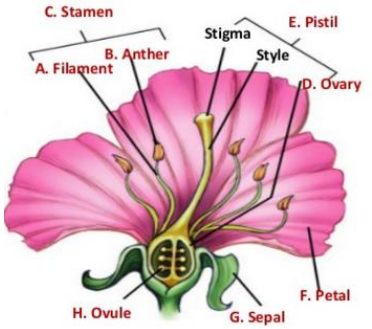
Accessory Whorls of flower- The calyx and corolla are non- reproduction whorls supporting in function. Hence they are described **accessory whorls**.

- **a. Calyx-** Outermost whorl composed of sepals. Usually green in colour. Primary function is protection of inner parts of the flower. Green in colour, it can also do the photosynthetic function. The calyx may be regular or irregular. The sepals are free from one another and is said to be **polysepalous,** when united, it is **gamosepalous.**

- **b. Corolla-** The corolla is the second accessory floral whorl consisting of petals. The petals of the corolla are usually variously coloured and of delicate texture. They may be free (**polypetalous**) or united (**gamopetalous**). The primary function of the corolla is to attract insects for polinatioin and also serves to protect the essential organs.

- **Perianth-** Most flowers of monocot plants have perianth, where there is no difference between calyx and corolla. The function of the perianth leaves is to protect the inner part of the flower. When brightly coloured, they attract insects for pollination. They may be free (**polyphylous**) or united (**gamophylous**).

Description of a flower



The following technical terms are used in connection with the description of flower.

1. Floral whorls

- 1. **Complete**: When all the four whorls. (Calyx, Corolla, Androecium, and Gynoecium) are present in a flower, it is termed complete.
- 2. **Incomplete**: When one or more whorls are absent the flower is described incomplete.
- a. **Monochlamydeous**: Some flowers have only one accessory whorl and they are called monochlamydeous.
- b. **Dichlamydeous**: Normally flowers have two outer whorls which are usually differentiated into calyx and corolla. Such flowers are known as dichlamydeous.
- c. **Achlamydeous**: There are number plants, where the flowers have neither calyx nor corolla. Such flowers are described naked or achlamydeous.

Complete

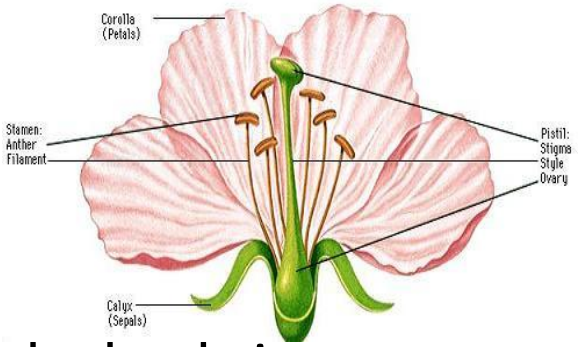
Incomplete

Dichlamydeous

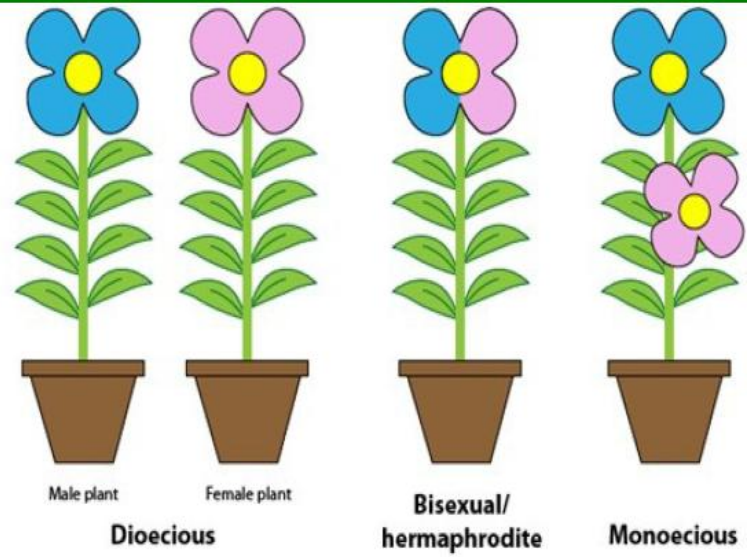
Monochlamydeous

Achlamydeous

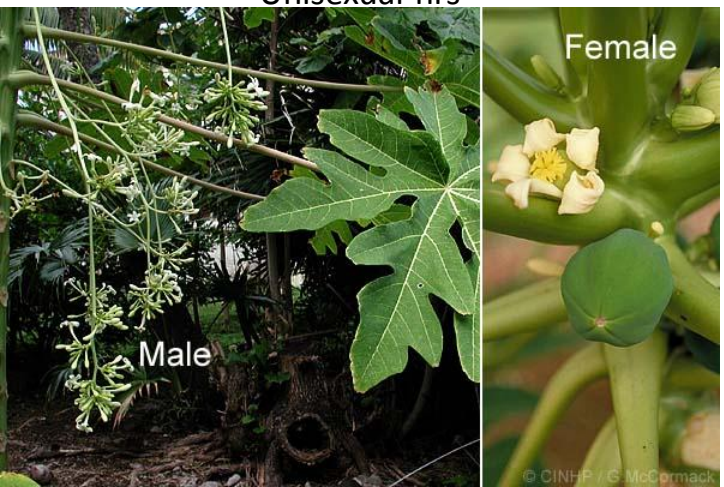
2. Sex distribution

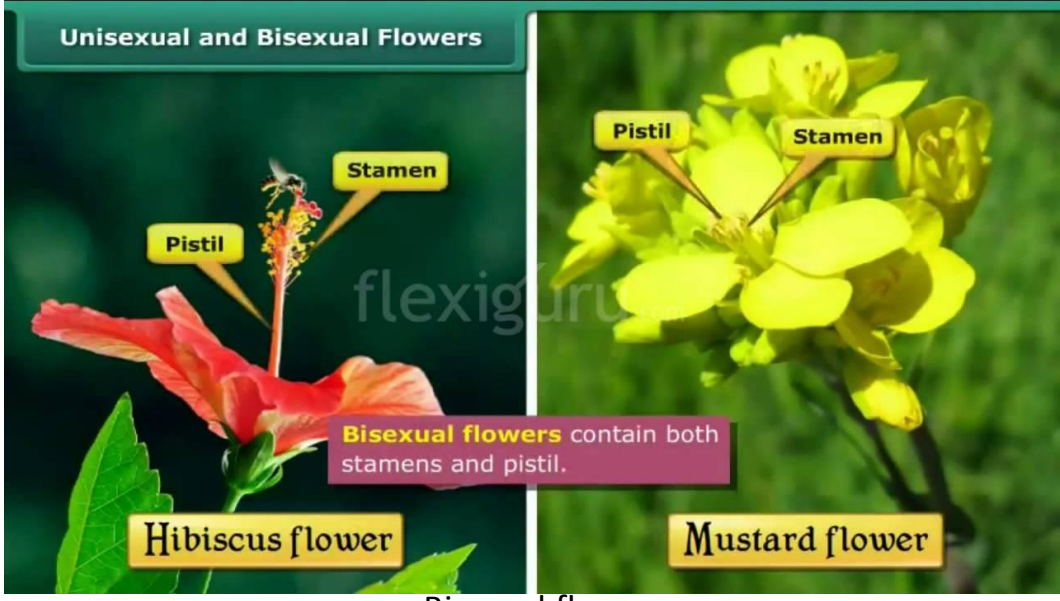


- **i. Bisexual or Perfect**: When both the essential whorls i.e., androecium and gynoecium are present in a flower, it is called bisexual or perfect.
- **ii. Unisexual or imperfect**: A flower having only one of the essential whorls is called unisexual or imperfect. The unisexual flowers may be of two types.
- a) **Staminate**. Male flower with androecium, only
- b) **Pistillate**. Female flower with gynoecium only
- **iii. Monoecious-** If male and female flowers develop in the same plant, it is called Monoecious eg. **Coconut, Maize,** etc.
- **iv. Dioecious-** If male and female flowers are borne on separate plants, it is termed dioecious eg. **Papaya, Mulberry,** etc.
- **v. Polygamous-** If a plant develops three kinds of flowers i.e. staminate, pistillate and bisexual flowers, it is called polygamous. eg. **Mango, Cashew nut** etc.

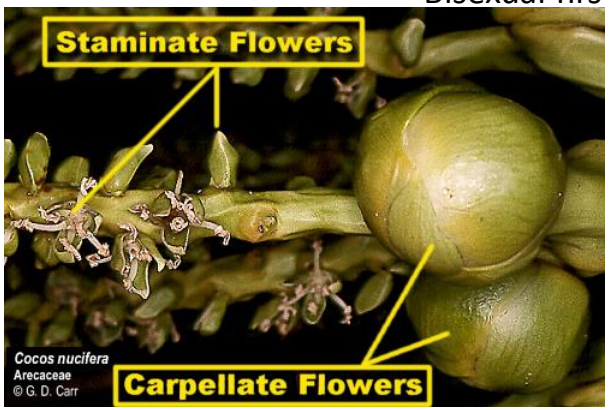


Unisexual flrs

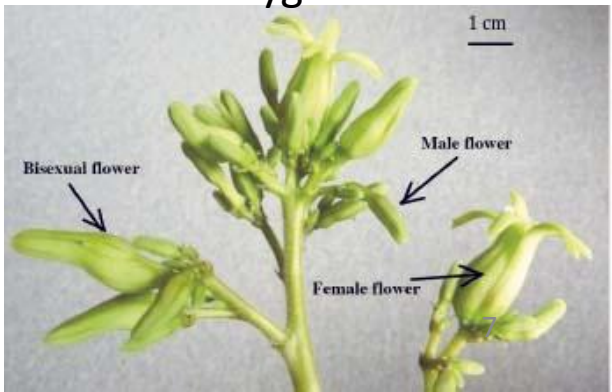




Bisexual flrs

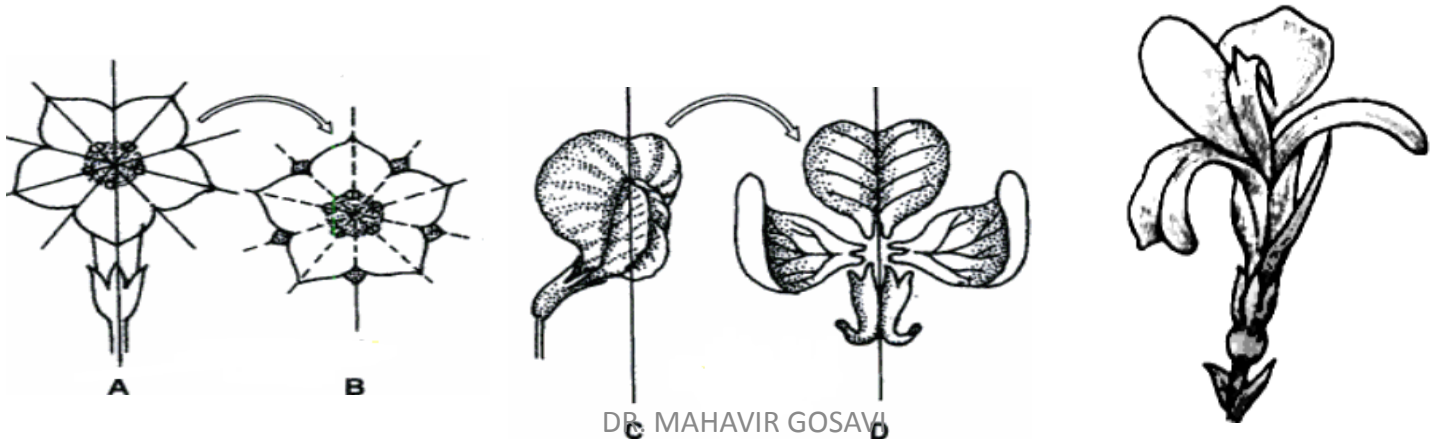


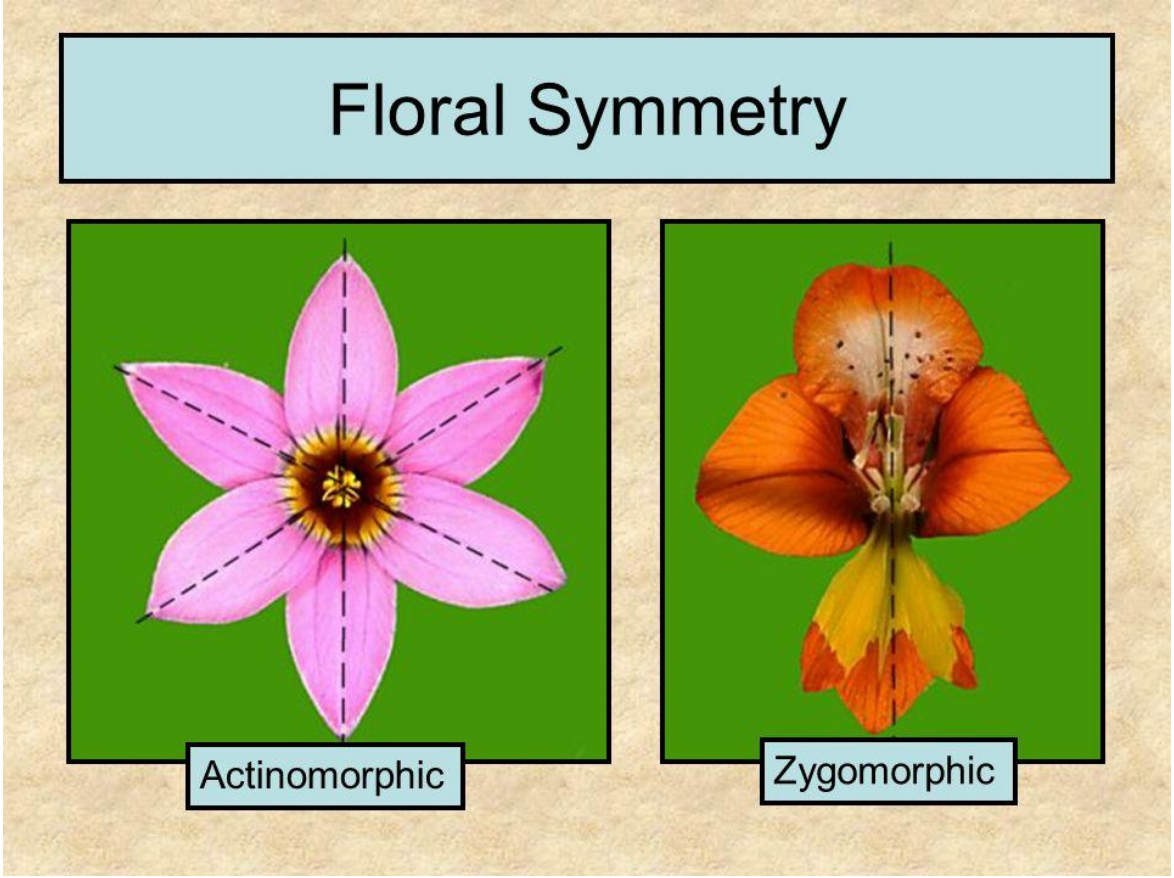
Polygamous flrs

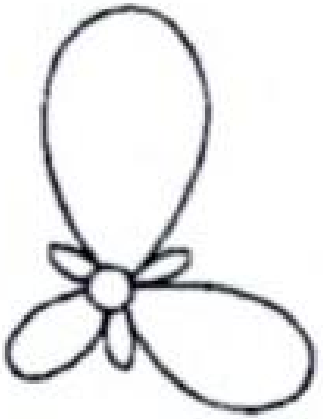


Flower symmetry

- The shape, size and arrangement of floral appendages (i.e. Calyx, corolla, androecium and gynoecium) around the axis of a flower is called floral symmetry. On the basis of floral symmetry there may be following three conditions of a flower.
- **i. Actinomorphic**: A flower with radial symmetry, i.e., the parts of each whorl is similar in size and shape. The flower can be divided into two equal halves along more than one median longitudinal plane, eg. ***Hibiscus***
- **ii. Zygomorphic**: A flower with bilateral symmetry, i.e. the parts of one or more whorls is dissimilar. The flower can be divided into two equal halves in only one vertical plane, eg. ***Pisum***
- **iii. Asymmetric**: A flower which cannot be divided into two equal halves along any vertical plane, eg. ***Canna***
-




Floral Symmetry
Actinomorphic
Zygomorphic


ASYMMETRIC

Asymmetric


Clitoria ternatea
Fabaceae
© G. D. Carr

Image for Actinomorphic flowers

Pumpkin

Catharnthus

Kaduru

Shoe flower

Temple flower

Wrightia

Image for Zygomorphic flowers

Salvia

Leucus zeylaniea

Crotolaria

Thunbergia

Sesbenia

Caesalpinia

Flower as a modified shoot- FLOWER - A Metamorphosed Shoot

- **The** concept that the flower is a modified or a metamorphosed shoot for the purpose of reproduction is an old one and the concept is gradually developed through the past and is accepted at the present by a majority of morphologists.

- **Linnaeus** expressed this idea in his **Philosophia Botanica** (1751) by the phrase **"vegetative metamorphosis"**. This concept that floral leaves were a modification of vegetative leaves was further elaborated by **Caspar Wolff** and **Decandolle**. The 'foliar theory' of the flower of the earlier botanists is held today by many though modified in one form or other by other botanists.

- That the flower is a modified shoot, is only a figurative expression, and implies that the floral leaves are vegetative leaves and transformed to do a different function of reproduction, in the place of the ordinary function of photosynthesis.

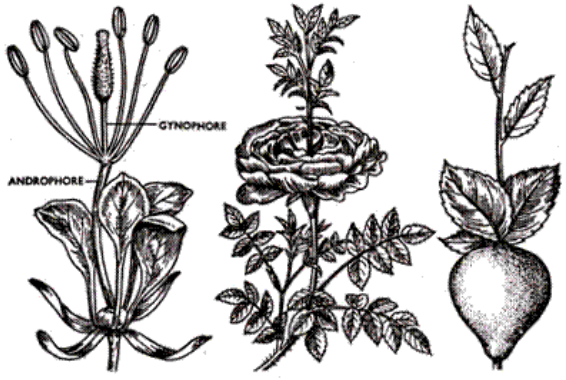
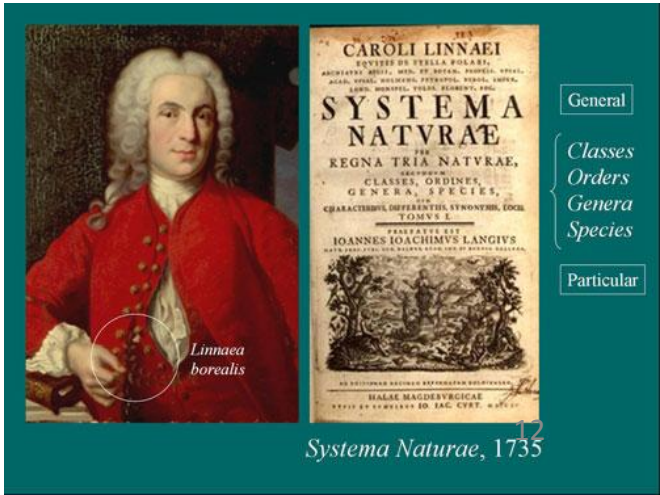


FIG. 299 FIG. 300 FIG. 301

FIG. 299. Thalamus internodes (androphore and gynophore) in *Cleome gynandra*.
FIG. 300. Monstrous development in rose. FIG. 301. Monstrous development in



Systema Naturae, 1735

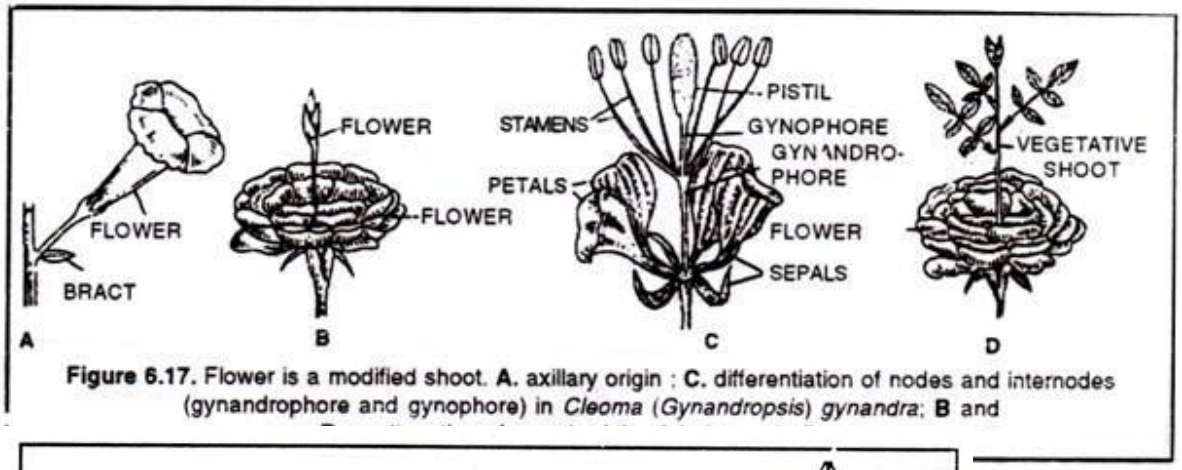


Figure 6.17. Flower is a modified shoot. **A.** axillary origin ; **C.** differentiation of nodes and internodes (gynandrophore and gynophore) in *Cleoma* (*Gynandropsis*) *gynandra*; **B** and

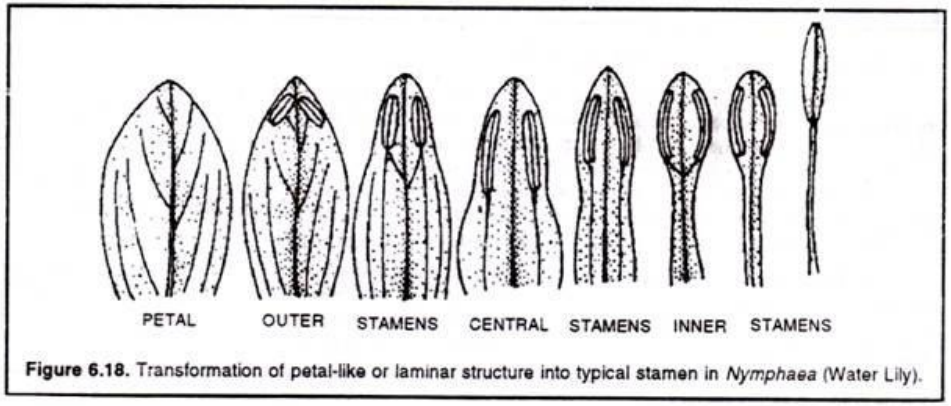


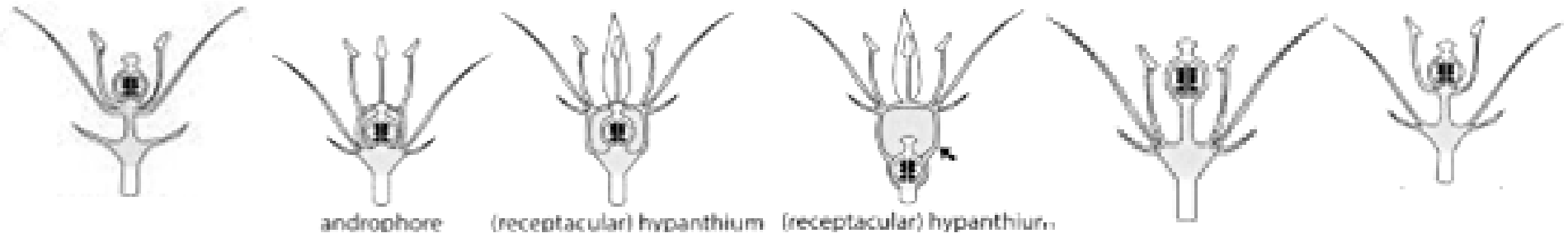
Figure 6.18. Transformation of petal-like or laminar structure into typical stamen in *Nymphaea* (Water Lily).

Evidences to support that flower is a modified shoot

1. The position of flower buds and shoot buds is same, i.e., they are terminalor axillary in position.
2. In some plants, the flower buds are modified into vegetative buds or bulbils, eg. ***Agave***, **Onion, *etc***.
3. In some plants, the thalamus elongates to form a vegetative branch or another flower above the first flower, ***e.g.*** **Rose**.
4. In ***Nymphaea*** (Water Lily), the flowers show all transitional stages between a sepal and petal and between a petal and stamen.

Thalamus &Variation of the Receptacle

- **The receptacle (thalamus) -** The thalamus is the short floral axis, with compressed nodes and internodes on which various floral leaves are inserted.



Anthophore **Androphore** **Gynophore** **Andro-gynophore**

Variation of the Receptacle

In a few cases, internodes become distinct and elongated. The elongated internode between the calyx and corolla is the **anthophore** as in Caryophyllaceae.
The internode elongated between the corolla and the androecium is called the **androphore** eg. ***Passiflora*** (family - Passifloraceae).
The elongated internode between the androecium and the gynoecium is called the **gynophore** as in ***Capparis*** [Capparidaceae] When both androphore and gynophore are present, they are called **gynandrophore** or **androgynophore** e.g. ***Gynandropsis***. When the thalamus is prolongated beyond the ovary, it is called the **carpophore** as in the ***Coriander, Foeniculum*** etc.

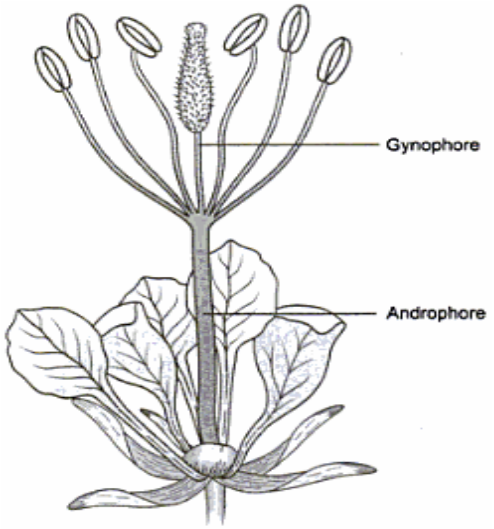
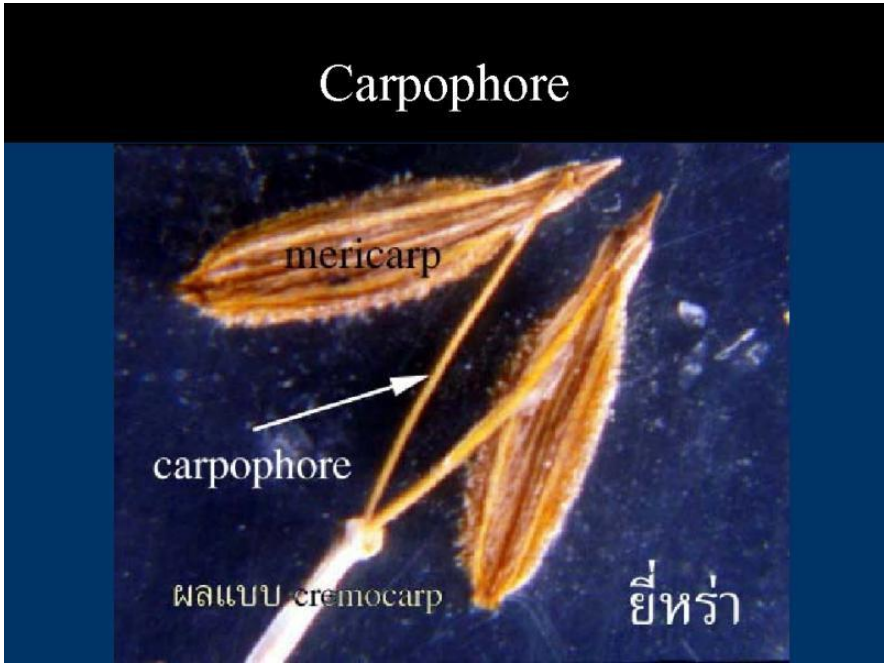


Fig. *Gynandropsis* showing well developed androphore and gynophore.

Androphore

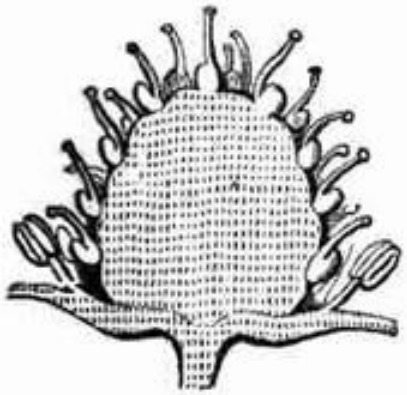
Gynophore

Androgynophore

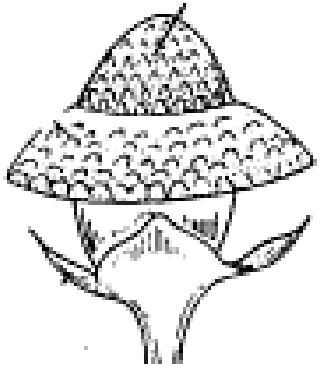


Types of Thalamus

- **1. Elongated-** here thalamus is somewhat elongated. Eg. *Michelia.*
- **2. Conical -** thalamus is somewhat conical bearing floral leaves spirally. Eg. *Anona.*
- **3. Inverted-** the thalamus is like an inverted cone, spongy & flat. Eg. Lotus.
- **4. Cup shaped** – it can be cup shaped as found in epi/perigynous flowers. Eg. Rose **.**

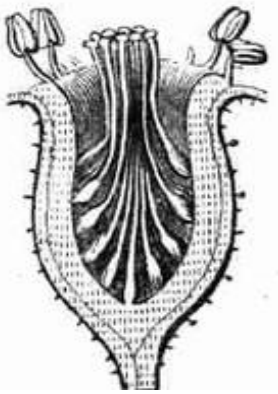


Elongeted



Conical

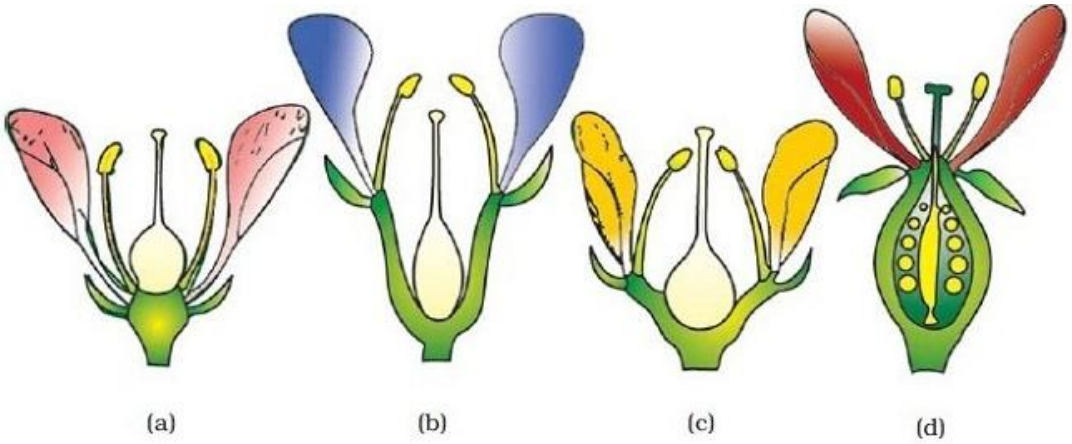
Inverted



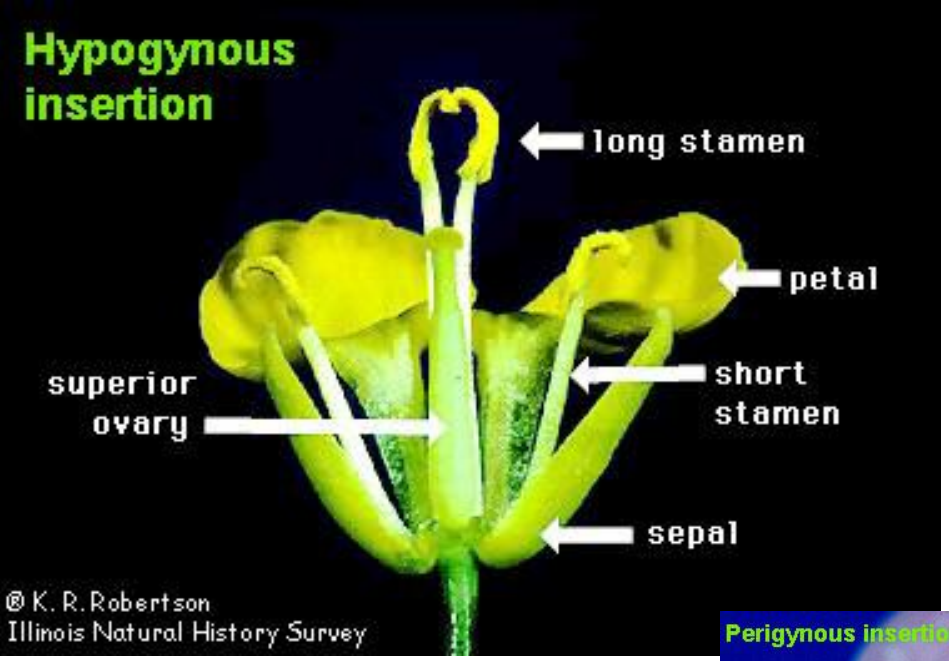
Cup shaped

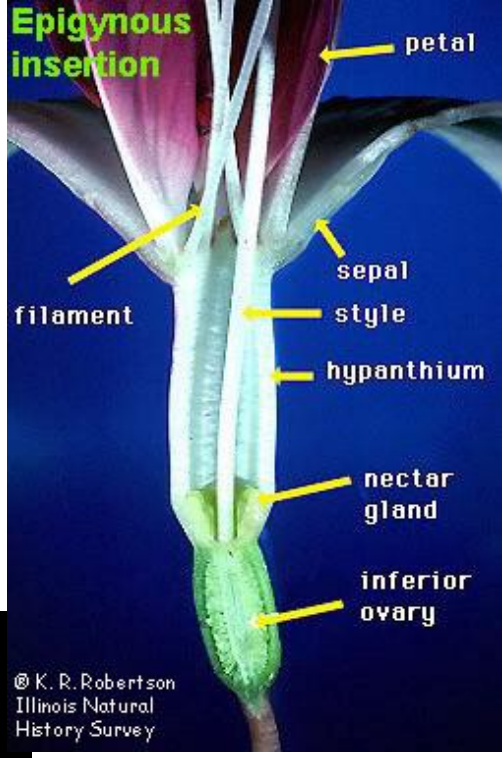
Insertions of floral leaves on the thalamus

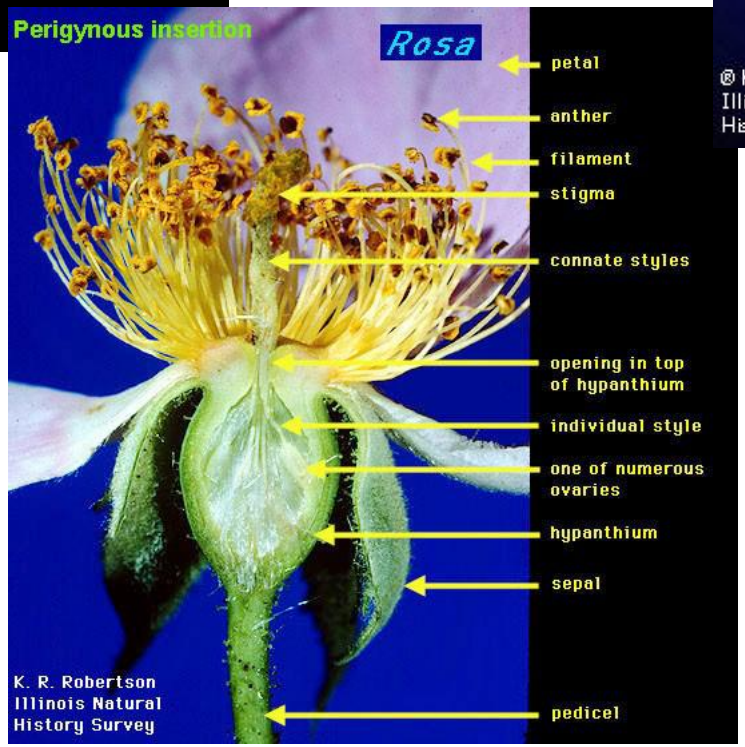
- **1. Hypogyny-** When the thalamus is convex or elongated; the carpel occupies the top most position on it. The other floral members (sepals, petals, and stamens) are placed below them. This mode of arrangement is called **hypogyny**. The flower is described as hypogynous. The ovary is known as superior. eg. **Malvaceae, Annonaceae** etc.
- **2. Epigyny -** When the thalamus is cup shaped, the lower part of the ovary is situated at the bottom of the cup and also fused with the inner wall of thalamus. The other floral members appear to be inserted upon the ovary. This mode on arrangement is called **epigyny**. Then the flower is said to be epigynous. The ovary is said to be inferior. eg. ***Asteraceae, Cucurbitaceae, Rubiaceae*** etc.
- **3. Perigyny -** In this condition, the receptacle is flat or slightly cup-shaped. The carpels are situated at its centre and other floral members are inserted on its margin. This mode of arrangement is called **perigyny**. The flower is known as perigynous. In this case, the ovary is still described as half inferior. eg. ***Fabaceae, Rosaceae*** etc.



Position of floral parts on thalamus : (a) Hypogynous (b) and (c) Perigynous (d) Epigynous


Hypogynous insertion
long stamen
petal
superior ovary
short stamen
sepal
® K. R. Robertson
Illinois Natural History Survey


Epigynous insertion
petal
sepal
filament
style
hypanthium
nectar gland
inferior ovary
® K. R. Robertson
Illinois Natural History Survey


Perigynous insertion
Rosa
petal
anther
filament
stigma
connate styles
opening in top of hypanthium
individual style
one of numerous ovaries
hypanthium
sepal
pedicel
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The Perianth

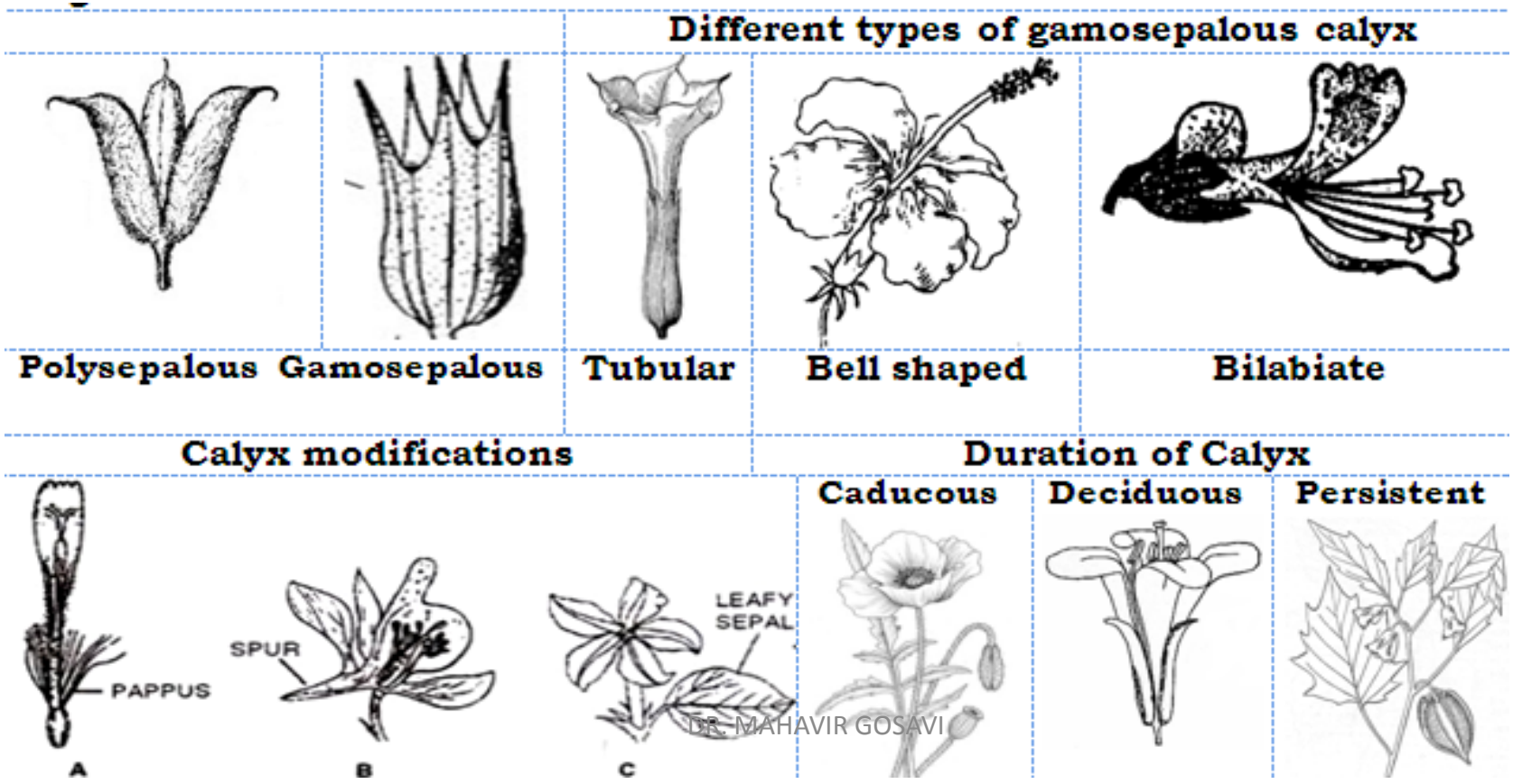
- Most flowers of monocot plants have perianth, where there is no difference between calyx and corolla. In families of monocotyledons, the perianth is brightly coloured and highly developed, which is known as Petaloid perianth as in ***Gloriosa superba***. Some families of dicotyledons have also **petaloid** perianth e.g. **Polygonaceae**.

- The function of the perianth leaves is to protect the inner part of the flower. When brightly coloured, they attract insects for pollination.

Petaloid perianth in ***Gloriosa superba***

The accessory whorls: A) Calyx types

- Sepals may be free – Polysepalous (***Brassica***) or fused with each other – Gamosepalous(***Hibiscus***).
- **A.1) Different types of gamosepalous calyx**
- **1. Tubular –** calyx long and tubular in structure, eg. ***Datura***
- **2. Bell shaped –** looks like small bell, eg. ***Hibiscus***
- **3. Bilabiate –** sepal are divided into 2 distinct lips at the mouth, **eg. *Ocimum***



Polysepalous

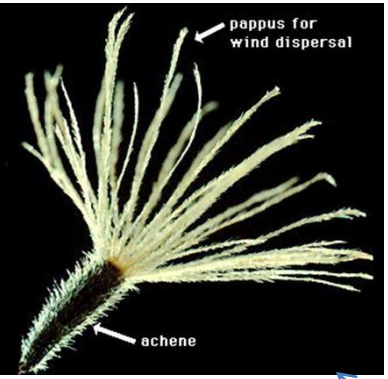
Gamosepalous

Tubular

Cup shaped

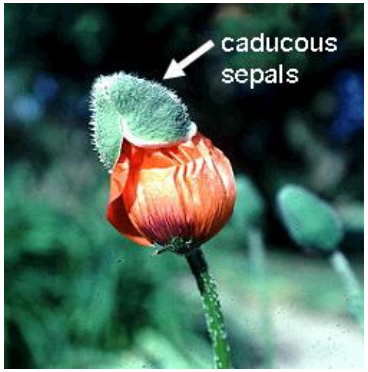
Bilabiate

Different types of gamosepalous calyx



Pappus

Petaloid Sepal



Caducous sepals

Deciduous sepals

Spurred Calyx

Modification

Duration

Persistant calyx

A.2) Calyx modifications-

a. Pappus- The calyx may sometimes be absent or modified into scaly structure as in **Sunflower**. In some cases, it is modified into a bunch of hair - like structures called **pappus** eg. ***Vernonia.***

b. Spurred- Provided with spur in the posterior sepal of ***Impatiens balsamina***. One or more sepals spurred in many other plants like ***Antirrhinum***, ***Delphinium***.

c. Petalloid sepal- The sepals are usually green in colour, but sometimes, become brightly coloured then, said to be **petaloid** as in ***Caesalpinia pulcherrima,*** in ***Musseanda frondosa*** the sepals are transformed into large, yellow or white and leafy structure.

A.3) Duration of Calyx –

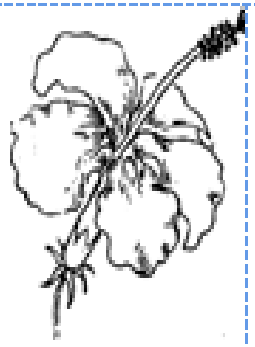
a. Caducous – The calyx falls off as soon as the flower opens e.g. Poppy

b. Deciduous – The calyx falls off along with the petals just after fertilization e.g. Mustard

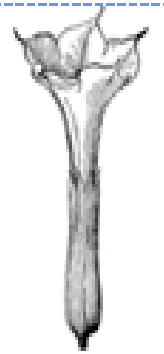
c. Persistent – The calyx remains attached to the ripe fruit . if it remains small and dried then it is marcescent e.g. Guava, Brinjal. But if the persistent calyx grows and covers the fruit then it is accrescent e.g. ***Physalis***.

Corolla types

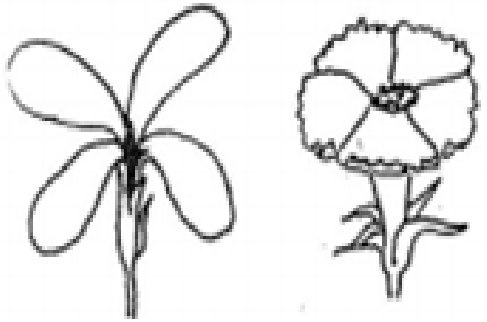
- Petals may be free – Polypetalous (***Hibiscus***) or fused with each other – Gamopetalous (***Datura***).
- **B.1) Polypetalous and Regular-**
- **i. Cruciform:** When the corolla consists of four clawed petals arranged at right angles to one another. eg. ***Brassica***, Radish, etc.,
- **ii. Caryphyllaceous:** when the corolla consists oof five clawed petals with spreading limbs; claws and limbs are at right angles to one another. eg. ***Dianthus***
- **iii. Rosaceous:** when the corolla consits of five spreading petals, without any claw eg. Wild Rose.
- **B.2) Polypetalous and Irregular – Papillonaceous**: when he corolla consists of 5 petals, one large – the vexillum or standard petal which is posteior and outemost, two lateralsalae or wings at the sides and two partially fused structures - the keel or carina. eg. ***Clitoria***



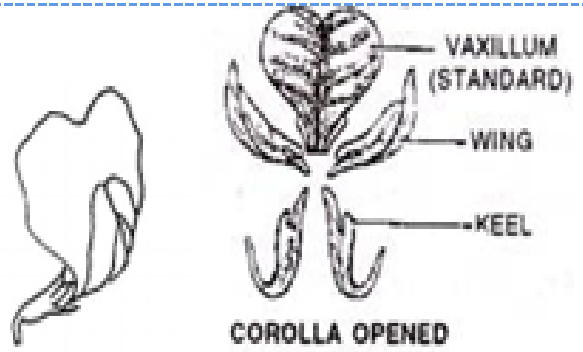
Polypeta-lous



Gamope -talous



Polypetalous and Regular corolla



Polypetalous & Irregular corolla

Polypetalous

Cruciform

Caryophyllaceous

Types of polypetalous corolla

Gamopetalous

Rosaceous

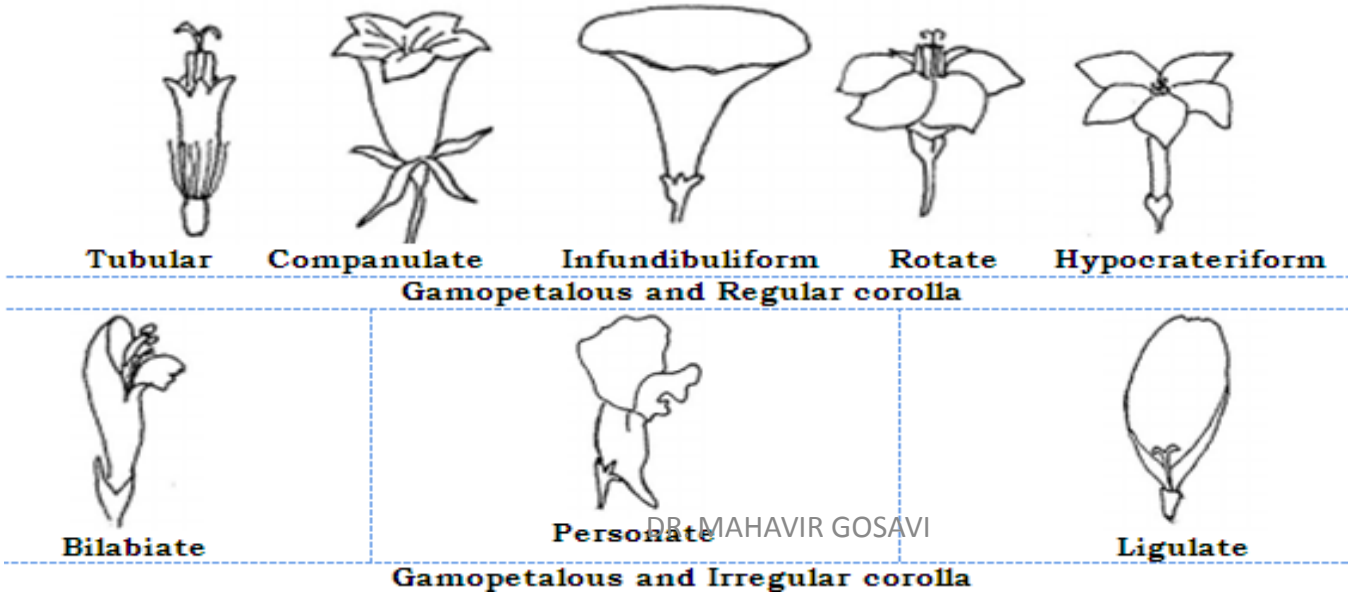
Papilionaceous

B.3) Gamopetalous and Regular –

- **I. Tubular**: Corolla tube is more or less cylindrical. Eg. Disc florests of ***Helianthus***
- **II. Companulate**: when the corolla tube is inflated below and winded out at the top. It looks bell-shaped eg. ***Coccinia indica.***
- **III. Infundibuliform**: corolla is funnel-shaped structure. eg. ***Ipomoea/Datura.***
- **IV. Rotate**: When the corolla tube is short with spreading limbs at right angle to it. It looks like a wheel in shape eg. ***Nyctanthus.***
- **V. Salver-Shaped or Hypocrateriform** - Corolla tube is long and narrow with spreading limbs. eg. ***Vinca***.

B.4)Gamopetalous and Irregular

- **i. Bilabiate:** Limb of the corolla is divided into two projecting lips eg. ***Ocimum***
- **ii. Personate:** Corolla shows bilabiate condition with mouth closed by the projecting lip. eg. ***Antirrhium***
- **iii. Ligulate:** Strap-shaped. When the corolla tube is short and tubular at the base but flat above like a strap. eg. **Ray florets of *Helianthus.***



Tubular

Companulate

Infundibuliform

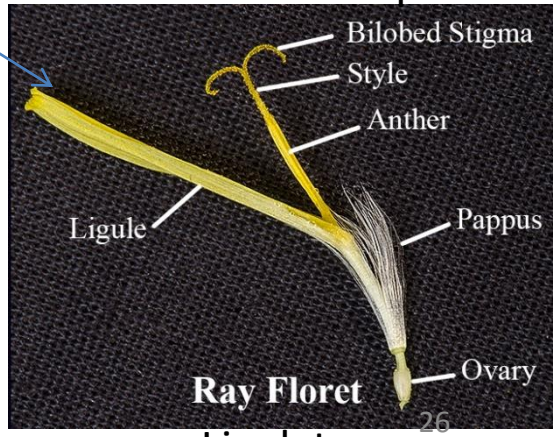
Rotate

Salver shaped

Types of Gamopetalous Corolla

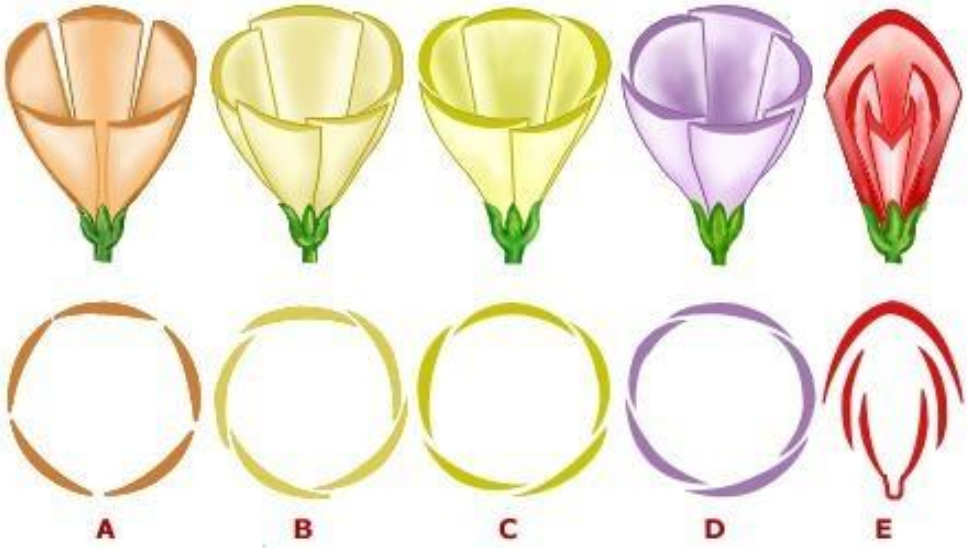
Bilabiate

Personate



Ligulate

Aestivation



Different types of aestivation of calyx and corolla
A, Valvate, B, Twisted, C. Imbricate, D.Quincuncial, E. Vexillary

The mode of arrangement of either sepals or petals of a flower in bud condition is said to be an Aestivation.

***The Aestivation is of the following types**

1. Valvate Aestivation -Sepals or petals in a whorl just meet by their edges without overlapping. eg. Petals of ***Anona.***

2. Twisted Aestivation -In this mode of aestivation one margin of each sepal or petal overlaps the next one, and the other margin is overlapped by a preceding one. Here the over lapping is regular in one direction-clockwise eg. ***Petals of Hibiscus*** or anticlockwise i.e. **Contorted** eg. Petals of ***Thevetia.***

3. Imbricate - In this type, one sepal or petal is internal or being overlapped on both the margins and one sepal or petal is external with both of its margins overlapping of the remaining sepals or petals, one margin is overlapping and the other margin overlapped. There are two types of imbricate aestivation descendingly imbricate and ascendingly imbricate. eg. Petals of ***Caesalpinia.***

4. Vexillary Aestivation: In this type of aestivation the posterior petal of overlaps one margin of the two lateral petals. The other margin of these two lateral petals overlaps the two anterior petals, which are united. Thus the overlapping is in descending order and hence the name eg. Corolla of Papilionaceae.

5. Quincuncial -It is modification of imbricate aestivation in which two petals are internal, two are external and the fifth one has one margin external and the other margin internal. eg. ***Guava/ Callistemon.***

Androecium

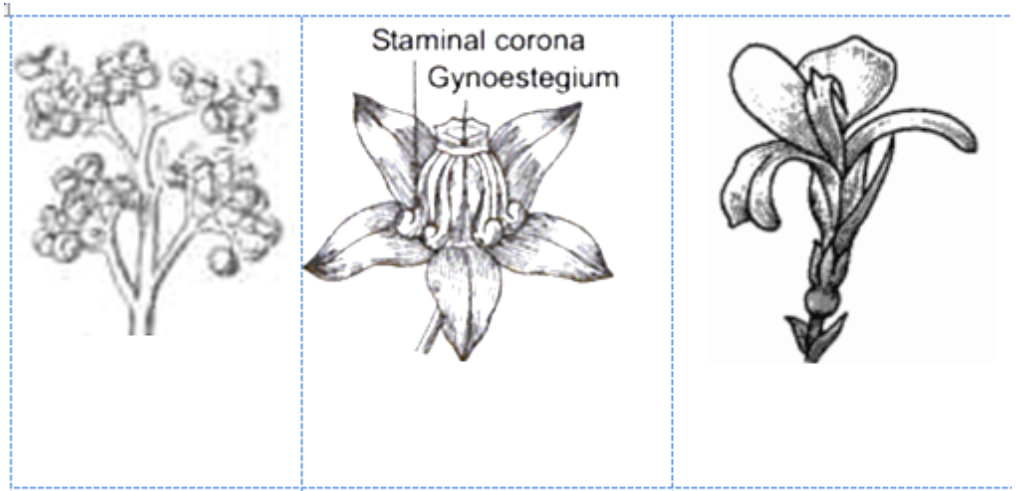
- It is the third whorl of the flower. It is considered as the male part of the flower. The androecium is made up of stamens or microsporophylls. Each stamen has a slender stalk called **filament,** bearing the **anther** (microsporangial sorus). Usually the anther consists of two lobes. The two lobes of an anther are connected by a tissue called **connective**. Each **anther lobe** has **two pollen sacs** (microsporangia). Each pollen sac consists of innumerable **Pollen grains** (microspores).
- **Sterile stamen or staminode** In some plants, a stamen may not develop any fertile anther. Such sterile stamens are called **staminodes** eg. **Cassia.**

A) Modification of filament—

1) Branched filament - In castor the filament is branched with anthers at the tips of branches e.g. ***Ricinus communis***.

2) Staminal corona - The filament sometimes bear appendages which may be hairy or horny called as stamiinal corona e.g. ***Calotropis gigantia***.

3) Petalloid filaments - In some plants filaments appear petal like e.g. ***Canna indica.***



Stamens

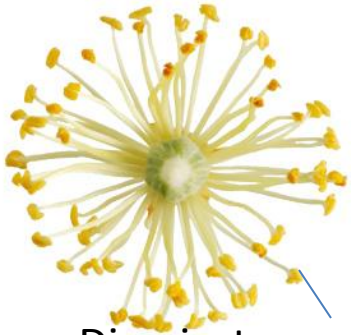
Branched filament

Petalloid filaments

Staminal corona

Modification of filament

Discrete



Divaricate

Distractile

Appendiculate

Prolonged

Types of connective

Unilocular

Introse

Extrose

Types of anthers

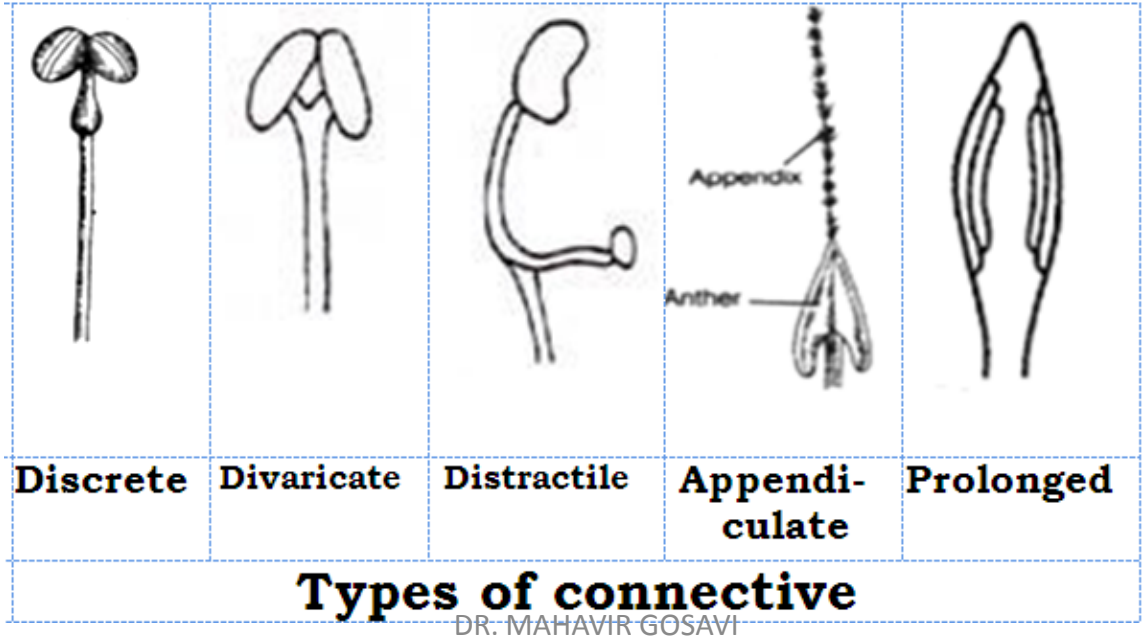
Sagitate

Sinuous

Reniform

Types of connective –

- **1) Discrete** - The anther lobes are closely placed without any apparent connective e.g. ***Euphorbia pulcherrima***.
- **2) Divaricate -**Two anther lobes get separated due to a bifurcate connective e.g. ***Tilia***.
- **3) Distractile connective**-The connective is long and stalked seperating the two lobes widely. One anther lobe is abortive while the other is fertile e.g. ***Salvia***.
- **4) Appendiculate -** The connective is prolonged and often feathery e.g.**Nerium**.
- **5) Prolonged -**The connective extends beyond the anther lobes and protrudes beyond their tip e.g. ***Annona***, ***Michelia***.



C) Types of anthers—

1) Unilocular - Instead of four locules , each anther has only one locule (dueto fusion of locules or abortive locule) e.g. ***Hibiscus rosa siensis***.

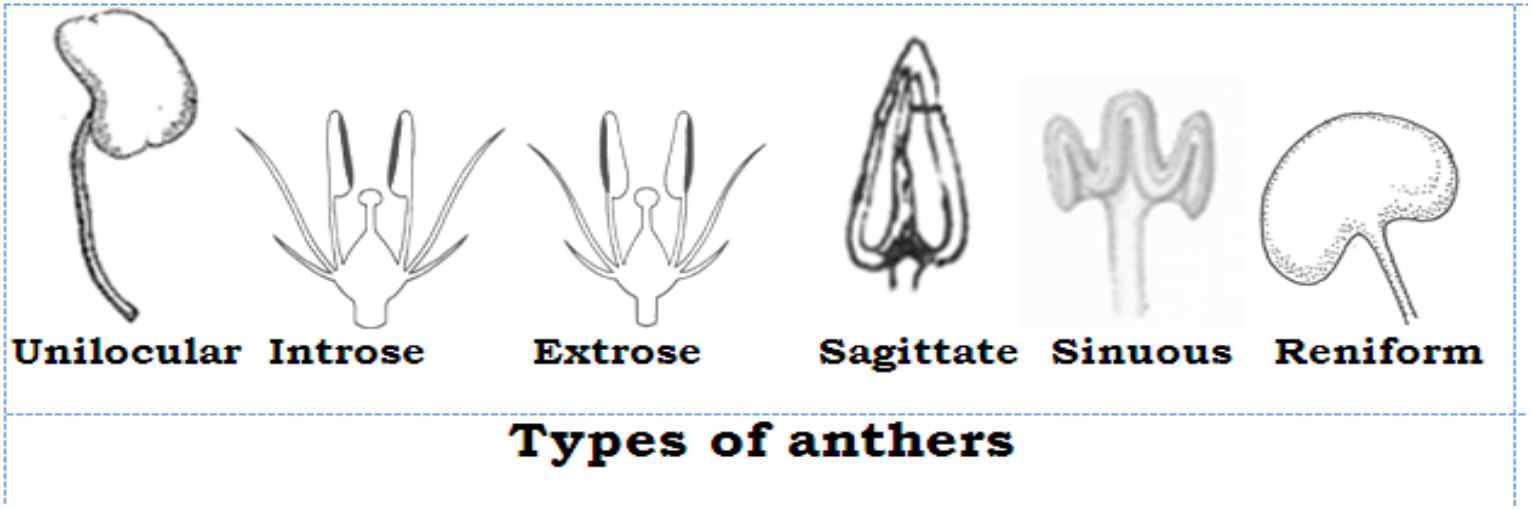
2) Introrse - The two lobes of the anther face toward the centre of the flower e.g. ***Physalis minima***

3) Extrorse - The two lobes of the anther face towards the corolla e.g. ***Gloriosa superba***

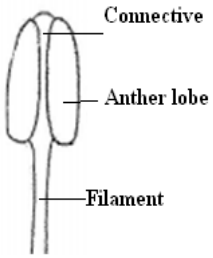
4) Sagittate - Anther lobes form an arrow –head shaped structure e.g. ***Vinca***

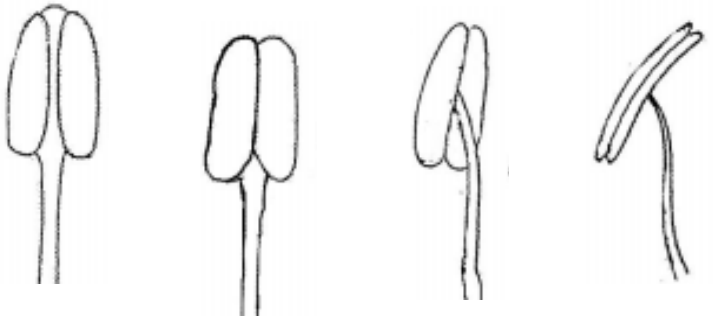
5) Sinuous - Anthers of stamens are united and have a wavy appearance e.g. ***Coccinia indica*** (Cucurbitaceae)

6) Reniform - Anther lobes are rounded e.g. ***Tradeschantia***



Types of anthers





- **D) Attachment of anthers to filament-**
- **i. Basifixed (Innate)**: Filament is attached to the base of the anther, eg. ***Brassica***.
- **ii. Adnate**: Filament is continued from the base to the apex of anther, eg. ***Verbena, Michelia***.
- **iii. Dorsifixed**: Filament is attached to the dorsal side of the anther, eg. ***Citrus, Passiflora***.
- **iv. Versatile**: Anther is attached lightly at its back to the slender tip of the filament so that it can swing freely, eg. **Grass, *Delonix*.**

E). Cohesion of Stamens – stamens fused among themselves.

a. Adelphy- filaments are fused to form one or more bundles while anthers remain free. They are of following types.

i. Monadelphous: All the stamens of a flower are united in one bundle by fusion of their filaments only. The anthers are free, eg. ***Hibiscus.***

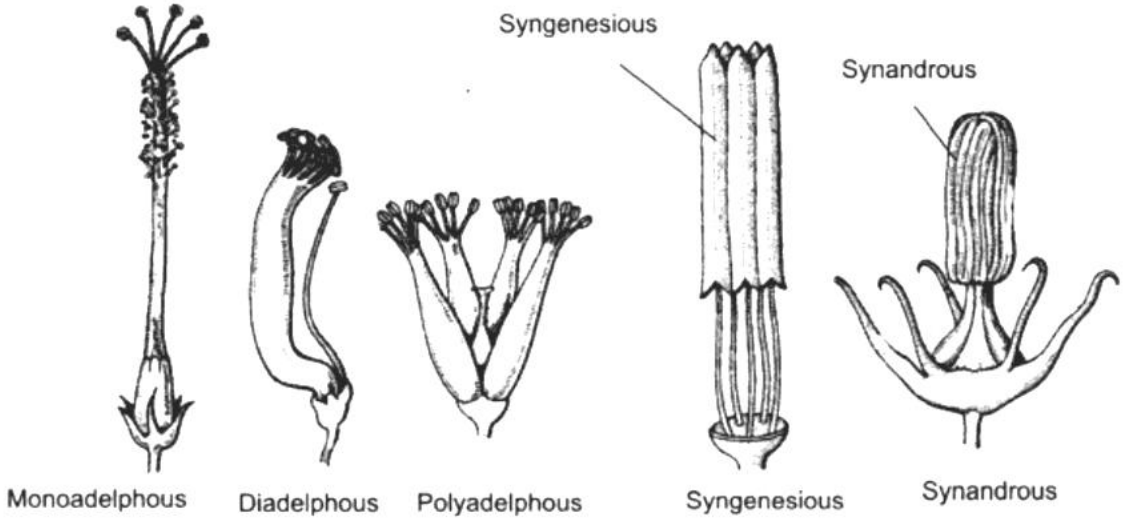
ii. Diadelphous: All the stamens of a flower are united in two bundles by fusion of their filaments only. The anthers are free, eg. ***Clitoria***

iii. Polyadelphous: Filaments of all the stamens unite to form more than two bundles. The anthers are free, eg. ***Bombax***/***Citrus***.

b. Syngeny: Anthers of all the stamens of the flower unite to form a cylinder around the style. The filaments are free, eg. **Disc floret of *Helianthus***.

c. Synandry: Anthers as well as the filaments are fused throughout their length, eg. ***Coccinea* male flowers.**

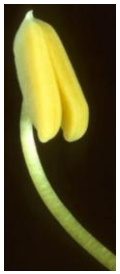
iv. Polyandrous: Stamens are indefinite and free, eg. ***Ranunculus***.



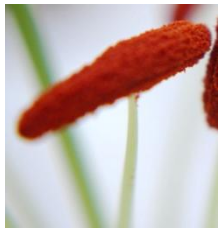
Basifixed

Adnate

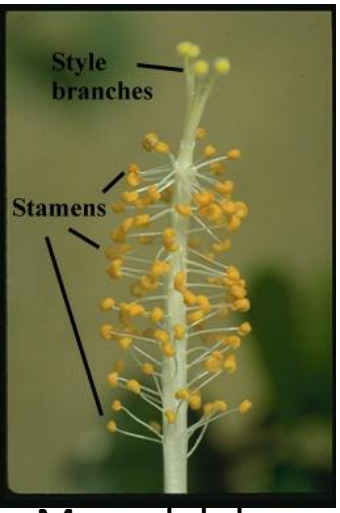
Dorsifixed



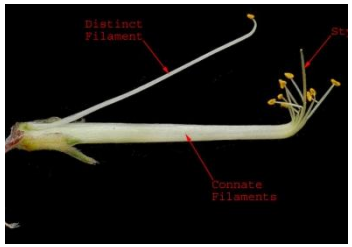
Versatile



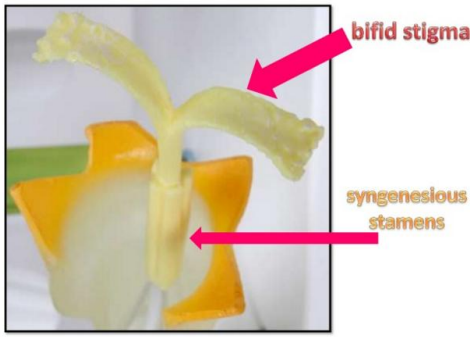
Attachment of anthers to filament-



Monadelphous



Didelphous



Syngeny

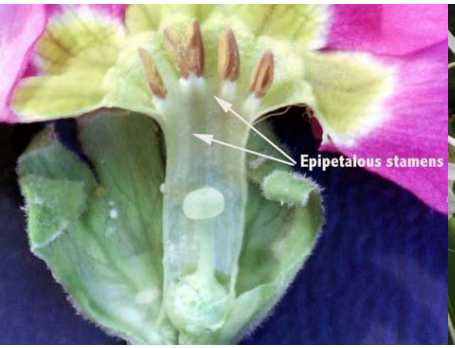
Cohesion of Stamens

Synandry

Adelphy

Polyadelphous

Adhesion of stamens



Epipetalous

Epiphyllous

Gynandrous

Insertion of stamens

Didynamous

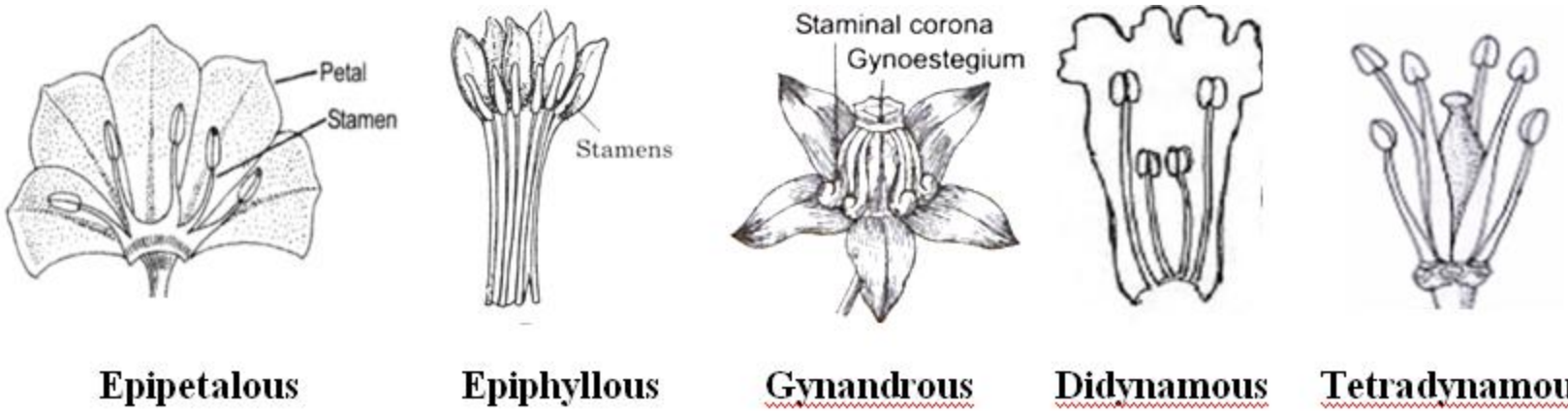
Tetradynamous

F). Adhesion of stamens- stamens fused with other members

- **i. Epipetalous**: Stamens adhre to the petals by their filaments and hence appearing to arise from them, eg. ***Ipomoea*.**
- **ii. Epiphyllous**: When stamens united with the perianth leaves, the stamens the stamens are said to be Epitepalous. eg. **Tuberose.**
- **iii. Gynandrous**: Stamens adhere to the carpels either throughout their length of by their anthers only. eg. ***Calotropis***.

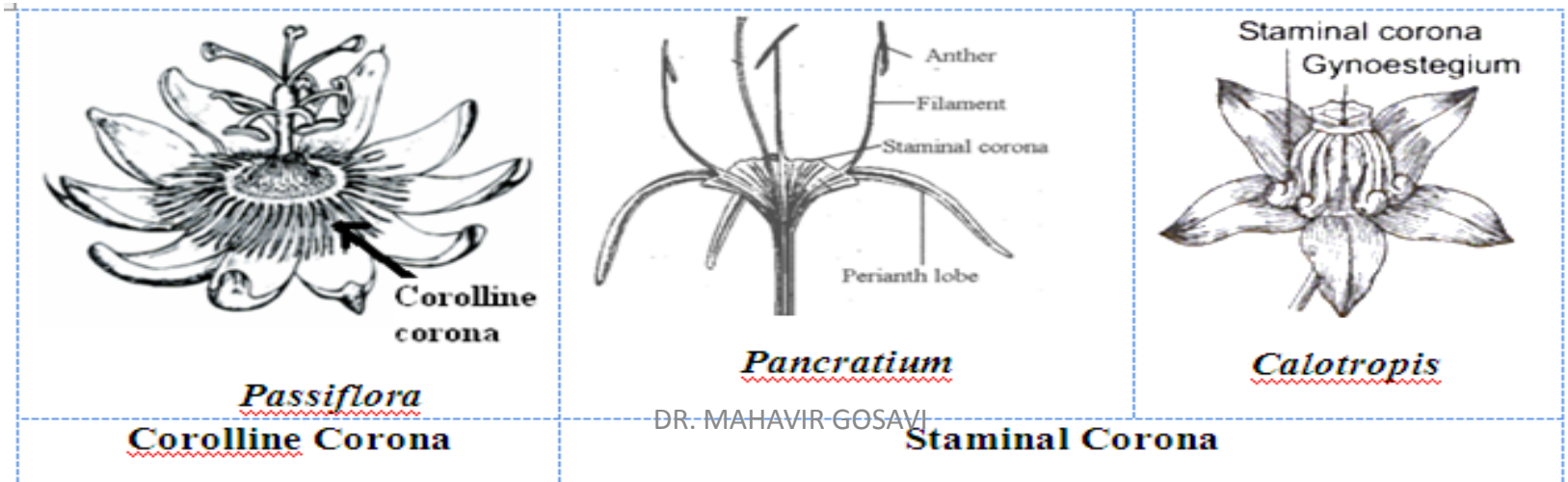
G). Insertion of stamens:

- **i. Didynamous**: Out of four stamens in a flower, two are long and two are short, eg. ***Clerodendron / Ocimum.***
- **ii. Tetradynamous**: Out of six stamens in a flower, two outer are short and four inner are long, eg. ***Brassica***.



Types of Corona

- Corona is the appendages arising from petals (**Corolline Corona**) or stamens (**Staminal Corona**). Corona is primarily meant for attraction of insect and sometimes also foe secretion & storing of nectar.
- **1. Corolline corona – eg. Passiflora**. In *Passiflora,* numerous corona filaments are arranged in 2-3 series associated with corolla.
- **2. Staminal corona – eg. *Calotropis***. In *Calotropis* , 5 stamens are fused by their filament forming a staminal tube. This tube shows associated 5 plate like appendages termed as staminal corona. In ***Pancratium***, 6 epiphyllous stamens arranged in 2 whorls. Filaments are long & lower part of them flattened & fused with others forming cup shaped staminal corona.



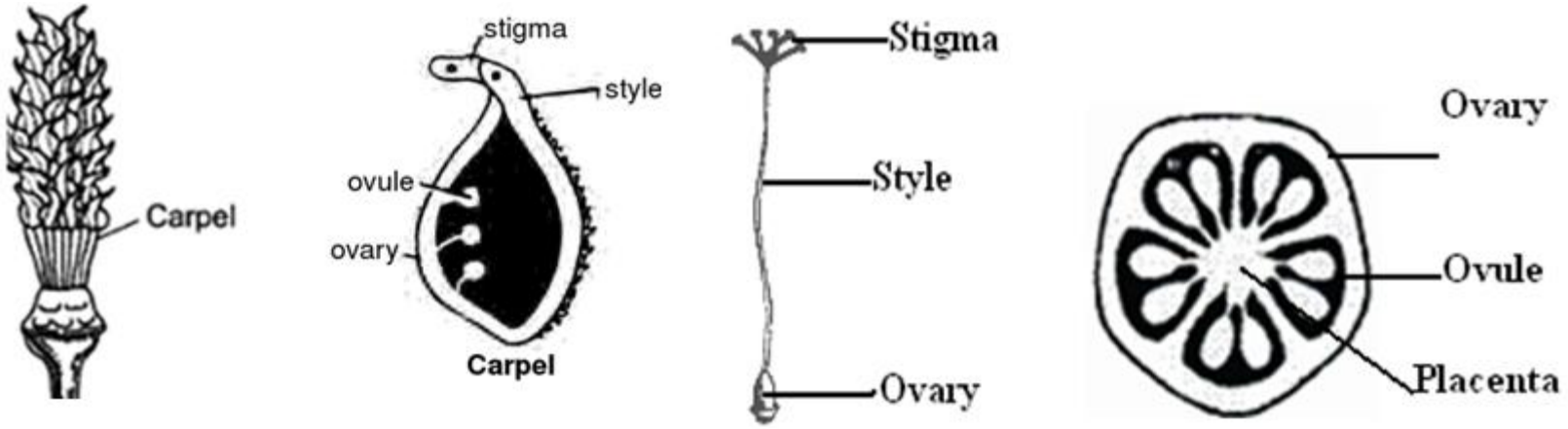
Types of Corona

Staminal corona

Corolline corona

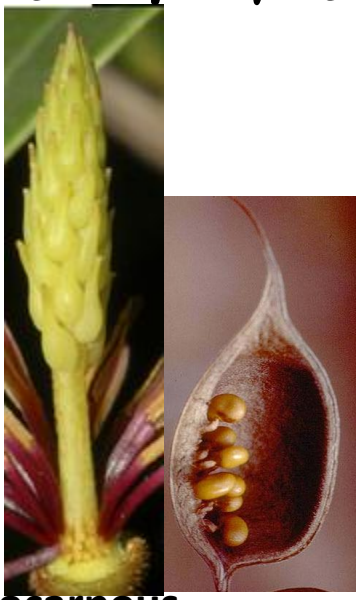
Gynoecium & its parts

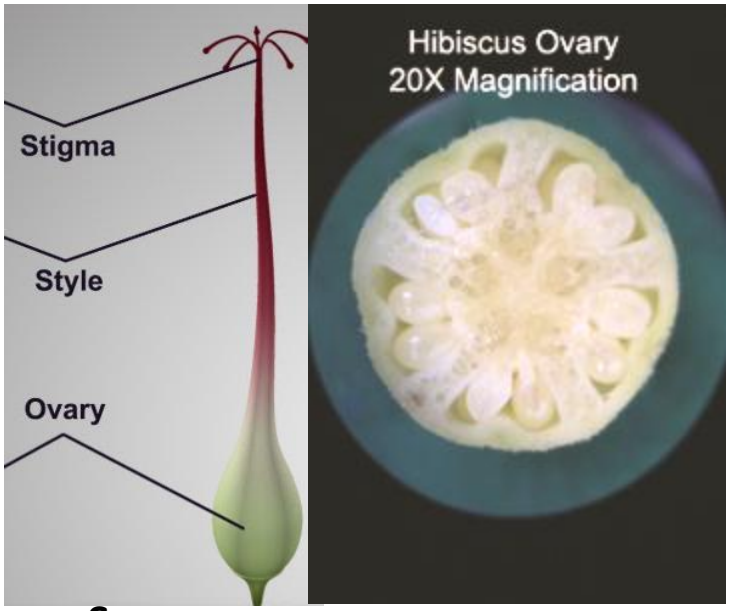
- Gynoecium is the collective term for the innermost central whorl of floral appendages. It is considered as the female part of the flower. A unit of gynoecium is called carpel. Each carpel has three parts namely stigma, style and ovary. **Ovary** is the enlarged basal part on which lies the elongated tube, the **style**. The stigma usually at the tip of the style. **Stigma** is the receptive surface for pollen grain. Each ovary bears one or more ovules. Ovule attached to a flattened cushion-like placenta in the ovary. Following technical terms and related with gynoecium.
- **1. Cohesion of Carpels**
- **i. Apocarpous**: Gynoecium made up of two or more carpels which are free; eg. ***Michelia***.
- **ii. Syncarpous**: Gynoecium consists of two or more carpels which are fused; eg. ***Hibiscus***.

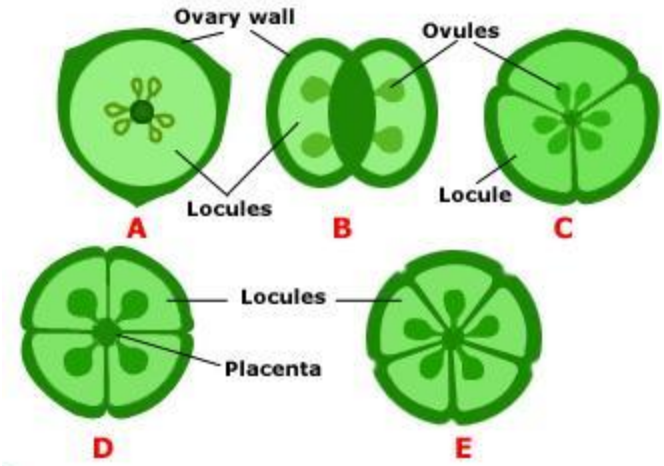


Apocarpous- *Michelia* Syncarpous- *Hibiscus*

Cohesion of Carpels

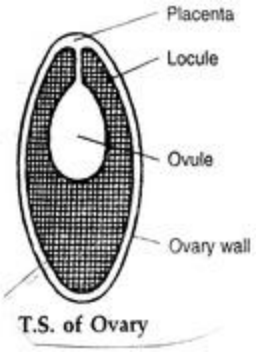






T.S. of Gynoecium showing number of locules -
A. Unilocular, B. Bilocular, C.Trilocular,
D. Tetralocular E.Pentalocular.

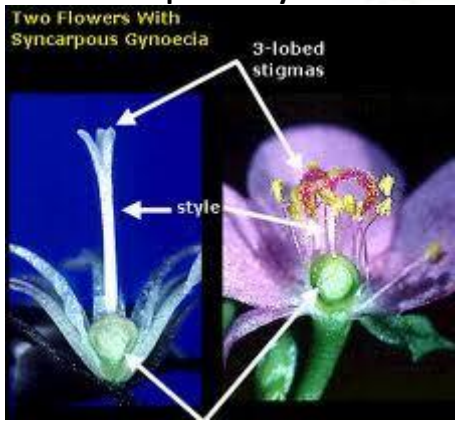
Apocarpous



Syncarpous

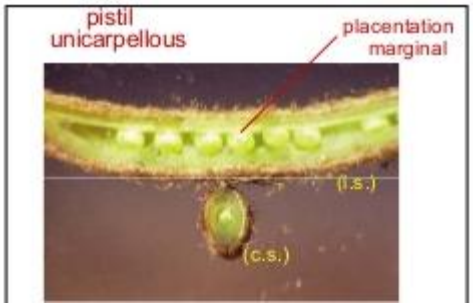
Pentacarpellary

Tricarpellary

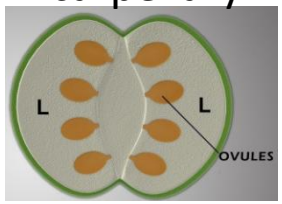


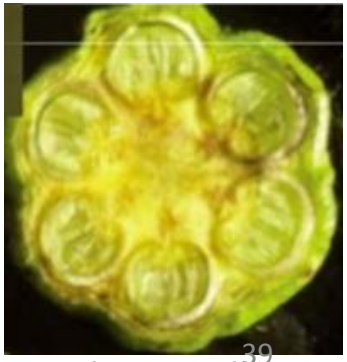
Tetracarpellary

Monocarpellary



Bicarpellary

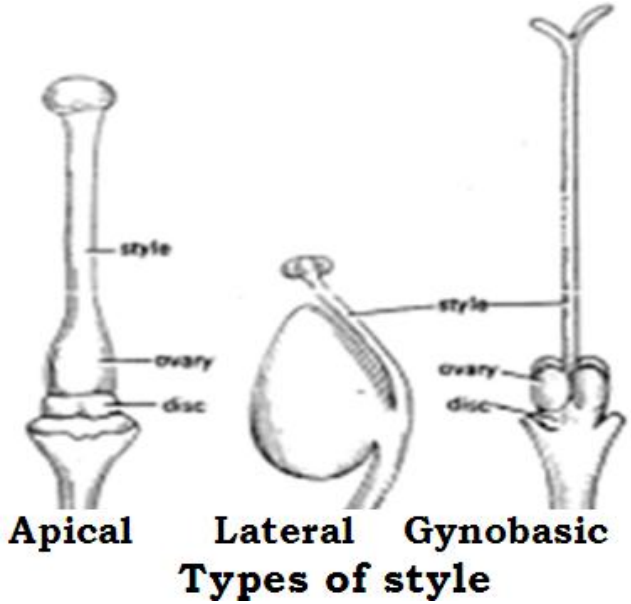




Polycarpellary

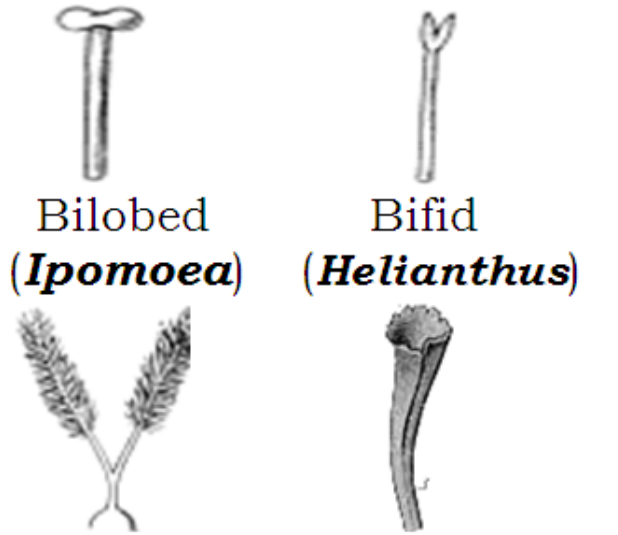
Number of Carpel

- **3. Style**- It is a tube like structure that connect the stigma to the ovary.
- **Types of style**
- **a) Apical**- Style arises from apex of the ovary e.g. ***Hibiscus***
- **b) Lateral**- The style arises from the side of ovary e.g. ***Mangifera***
- **c) Gynobasic**- The style arises from the central base of the deeply lobed ovary e.g**.** ***Ocimum***



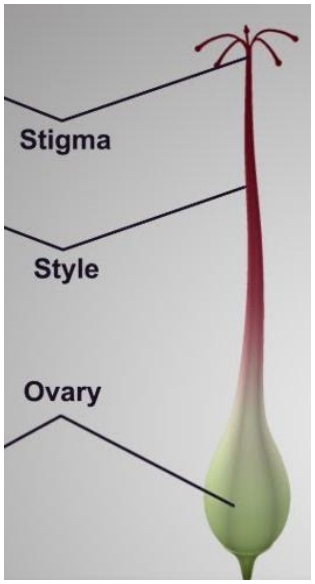
Types of style

- **4. Stigma**-is usually on top of the style. When style is absent, the stigma is sessile. Stigma is the receptive surface for pollens.
- **Types of stigmas—**
- **a)** Lobed - single lobed / bilobed (***Ipomoea plamata***)
- **b)** Bifid (***Helianthus annus***) /trifid (***Polyanthes tuberosum***)/pentafid (***Hibiscua rosa sinensis***)
- **c)** Feathery or plumose—***Zea mays***
- **d)** Funnel shaped—***Crocus sativus***



Types of stigmas

Types of Syncarpous Pistil



Types of stigmas

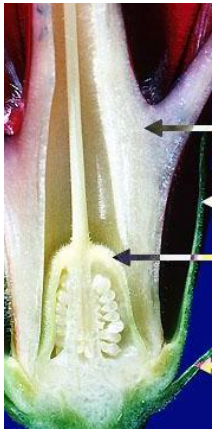

Bilobed

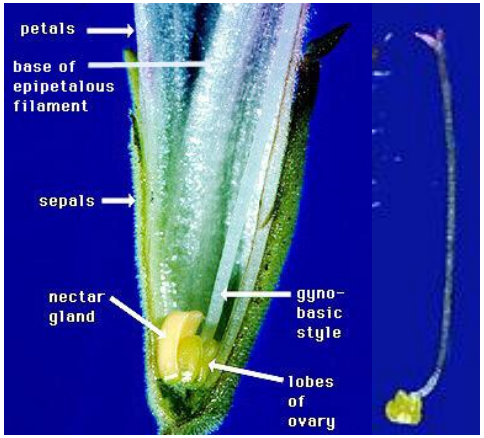

Bifid


Feathery

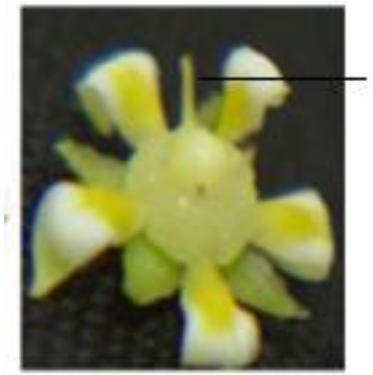

Funnel shaped

Types of style

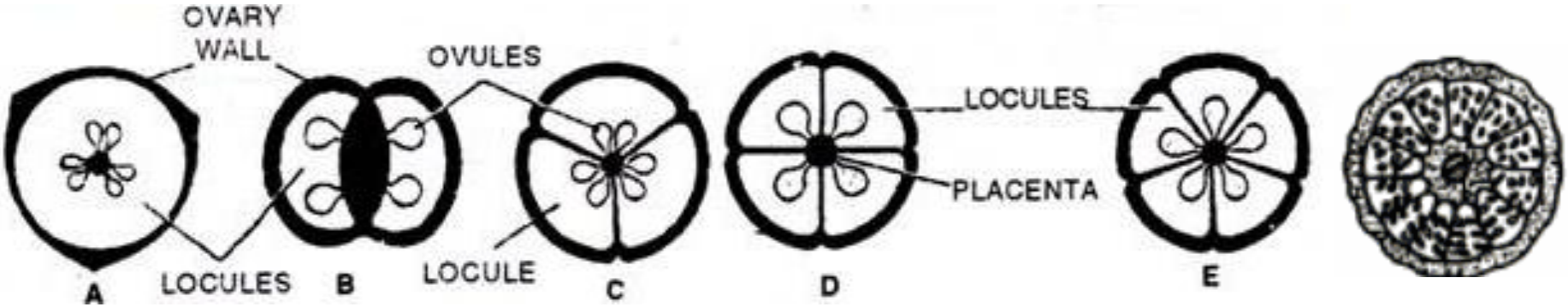

Apical



Gynobasic


Lateral

- **2. Number of Carpel**
- **i. Monocarpellary**: Gynoecium consists of a single carpel; eg. ***Clitoria***
- **ii. Bicarpellary**: Ovary consists of two carpels; eg. ***Ipomoea***
- **iii. Tricarpellary**: Ovary consists of three carpels; eg. **Tuberose**
- **iv. Pentacarpellary**: Ovary comprises of four carpels; eg. ***Hibiscus***
- **v. Polycarpellary**: Gynoecium consists of many carpels eg. **Lotus.**



Monocarpellary Bicarpellary Tricarpellary Tetracarpellary Pentacarpellary Polycarpellary

2. Cohesion of Carpels:

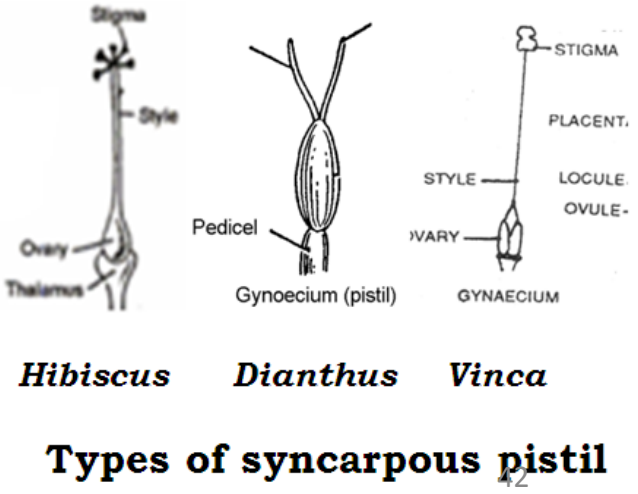
i. Apocarpous: Gynoecium made up of two or more carpels which are free; eg. ***Michelia***.

ii. Syncarpous: Gynoecium consists of two or more carpels which are fused; eg. ***Hibiscus***.

a) Ovary and style united ; stigma free e.g. ***Hibiscus rosa sinensis***

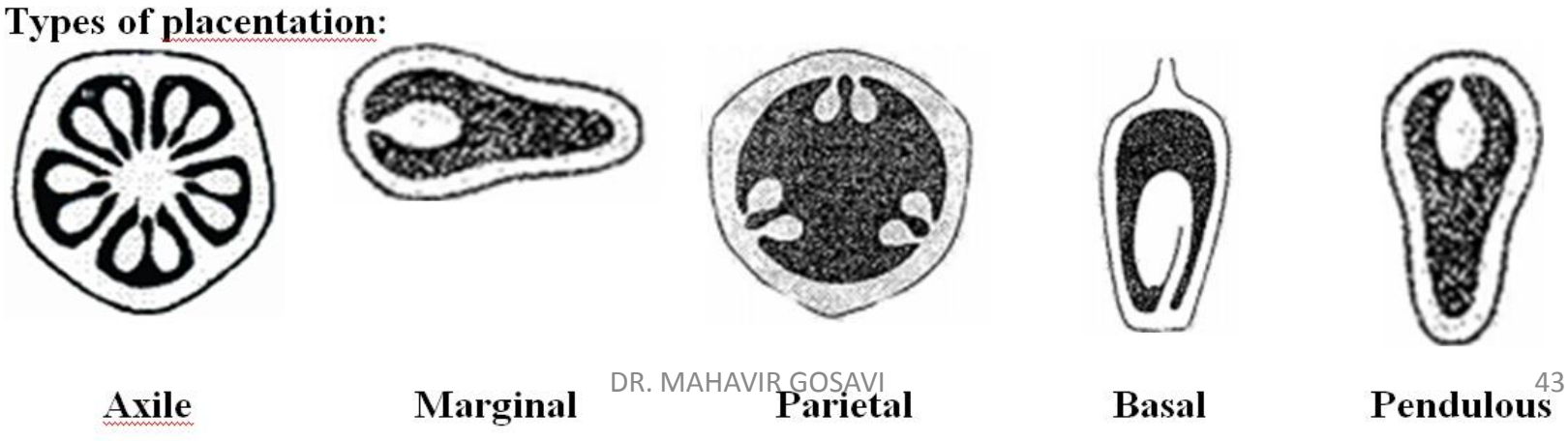
b) Ovaries united; style and stigma free e.g. ***Dianthus***

c) Ovaries are free; Style and stigma united e.g. ***Vinca, Calotropis***

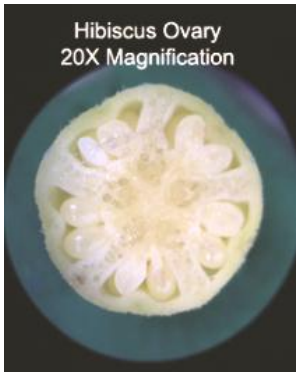


Ovary- placentation

- In Angiosperms, ovules are present inside the ovary. Placenta is a special type of tissue, which connects the ovules to the ovary. The mode of distribution of placenta inside the ovary is known as placentation. Some important types of placentation are as follows:
- **1. Axile Placentation -** This type of placentation is seen in bi- or multi carpellary, syncarpous ovary.
- The carpel walls meet in the centre of the ovary, where the lacenta are formed like central column. The ovules are borne at or near the centre on the placenta in each locule. eg. ***Hibiscus***.
- **2. Marginal Placentation -** It occurs in a monocarpellary, unilocular ovary. The ovules are borne along the junction of the two margins of the carpel. eg. ***Clitoria.***
- **3. Parietal Placentation -** This type of placentation is found in multi carpellary, syncarpous, unilocular ovary. The carpels are fused only by their margins. The placenta bearing ovules develop at the places, where the two carpels are fused. eg. ***Coccinea***
- **4. Basal Placentation -** It is seen in bicarpellary syncarpous, and unilocular ovary. The placenta develop directly on the receptacle, which bears a single ovule at the base of the ovary. eg. **Disc floret of *Helianthus.***
- **5. Pendulous Placentation-** It occurs in a monocarpellary, unilocular ovary. The placenta is apical in position, which bears one/many ovules suspended in the ovary. eg. ***Quisqualis.***

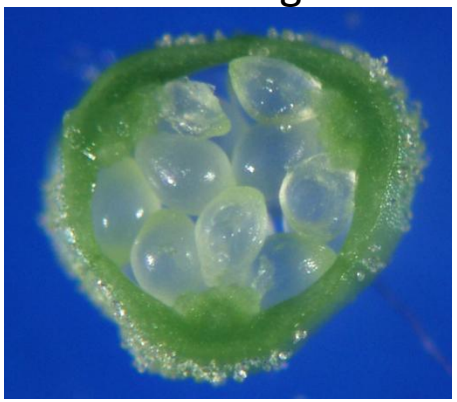


Ovary- placentation



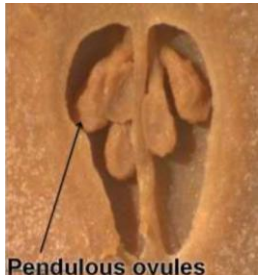
Axile

Marginal



Parietal

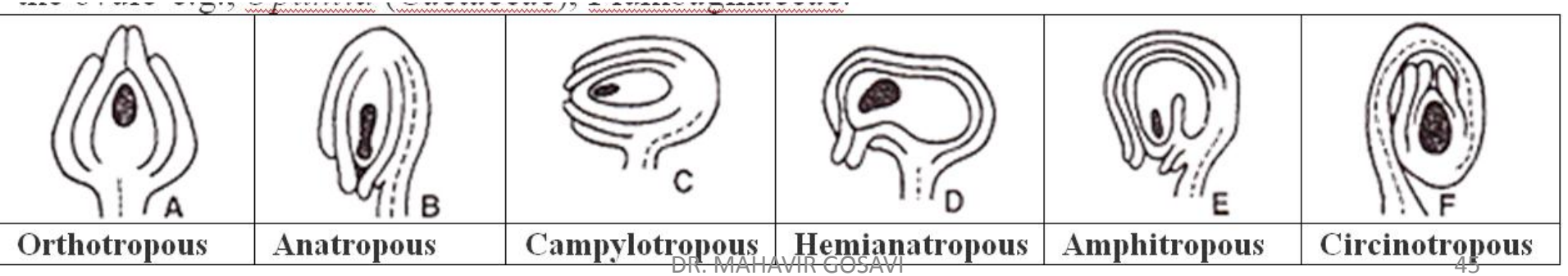
Basal



Apical/ Pendulous

Types of ovules

Ovule is a small structure attached to the placenta of locule with a stalk called **funicle.** The body of the ovule fused with the funicle in the region called **hilum.**
Hilum is the junction between the funicle and ovule. Each ovule has one or two protective envelops called **integuments**. Integument covered the ovule except an opening at the top called **micropyle**. Opposite of the micropylar end, is the **chalaza**, representing the basal part of the Ovule.
(A) Orthotropous : The micropyle, chalaza and funicle are in a straight line. This is the most primitive type of ovule e.g., *Piper*, *Polygonum*, *Cycas*.
(B) Anatropous : The ovule turns at 180^0 angle. Thus it is inverted ovule. Micropyle lies close to hilum or at side of hilum e.g, found in 82% of angiosperm families.
(C) Campylotropous : Ovule is curved more or less at right angle to funicle. Micropylar end is bend down slightly e.g., in members of Leguminosae, Cruciferae.
(D) Hemianatropous : Ovule turns at 90^0 angle upon the funicle or body of ovule and is at right angle to the funicle e.g., *Ranunculus*.
(E) Amphitropous : Ovule as well as embryo sac is curved like horse shoe e.g, *Lemna*, Poppy, *Alisma*.
(F) Circinotropous : The ovule turns at more than 3609 angle, so funicle becomes coiled around the ovule e.g., *Opuntia* (Cactaceae), Plumbaginaceae.



Floral Formula

Once the description of the plant is completed, major characters of a flower are written in a special way where a few signs and letters are used. This formula is useful in knowing major characters of a flower at one glance. In this method characters of bracts, symmetry, sex, calyx, corolla (or perianth), androecium and gynoecium are denoted in this order. Some of the commonly used denotations are given below. Choose those or modify according to the need amongst the following few.

1. Bracts and Epicalyx

Br	Bracteate
Ebr	Ebracteate
Brl	Bracteolate
E	Epicalyx

2. Symmetry

⊕	Actinomorphic
⊖ or %	Zygomorphic

3. Sex

♂	Staminate flower
♀	Pistillate flower
⚥	Hermaphrodite

4. Calyx

K	Calyx
K_4	Four free sepals (polysepalous)
$K_{(4)}$	Four fused sepals (gamosepalous)

5. Corolla

C	Corolla
C_4	Four free petals (polypetalous)
$C_{(4)}$	Four fused petals (gamopetalous)

6. Perianth

P	Perianth
P_6	Six free tepals (polytepalous)
$P_{(6)}$	Six fused tepals (gamotepalous)
P_{3+3}	Six tepals in two whorls of three each

7. Androecium

A	Androecium
A_5	Five free stamens (polyandrous)
$A_{(5)}$	Five fused stamens (monadelphous or syngenesious or synandrous)
A_{5+5}	Ten stamens in two whorls of five each
A_o	Stamens absent
A_α	Stamens idefinite in number
$C\overset{\frown}{A}$	Stamens epipetalous
$P\overset{\frown}{A}$	Stamens epiphyllous (epitepalous)

8. Gynoecium

G	Gynoecium
G_2	Two free carpels (apocarpous)
$G_{(2)}$	Two fused carpels (syncarpous)
G_o	Carpels absent
$\underline{G}_{(2)}$	Bicarpellary,syncarpous, superior ovary
$G_{(2)}$–	Bicarpellary, syncarpous, semi-inferior ovary
$\overline{G}_{(2)}$	Bicarpellary, syncarpous, inferior ovary.

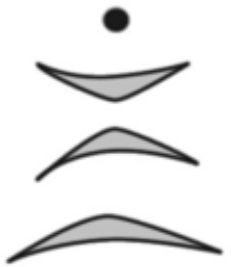
Floral Diagram

Floral diagram is a diagrammatic representation of cross-section of the floral bud in relation to its *mother axis*, and it shows many such characters of the flower which are not represented by its floral formula. The floral diagram of a flower tells us about the following characters of the flower :

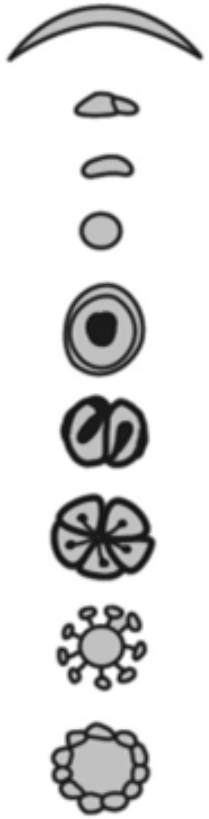
1. Presence or absence of bract and bracteoles.
2. The position of odd sepal (the sepal which is in line of the mother axis). Normally the odd sepal is posterior except in family *Leguminosae* where it is anterior.
3. The number and arrangement of floral leaves in relation to one another.
4. The cohesion (fusion of floral leaves amongst themselves) and adhesion (fusion of floral leaves with floral leaves of other whorl) of floral leaves.
5. Symmetry of the flower.
6. Aestivation of sepals and petals.
7. The monothecous and bithecous nature of anther.
8. Number of locules in the ovary and placentation.
9. Nectary glands and their position.

The symbols used in drawing a floral diagram are as follows :

1. Mother axis
2. Bract
3. Epicalyx
4. Calyx or sepals



5. Corolla or petals
6. Stamens (bithecous)
7. Stamens (monothecous)
8. Nectar secreting disc around carpel
9. Monocarpellary gynoecium
10. Bicarpellary syncarpous gynoecium
11. Polycarpellary syncarpous gynoecium
12. Monoadelphous androecium
13. Syngenecious androecium.



In the floral diagram the mother axis is shown by a circular dot in the posterior position. The epicalyx, sepals, petals or tepals, stamens and carpels are drawn by their respective symbols, in their respective position. The aestivation of sepals and petals is shown by overlapping their margins and cohesion by joining their margins. The epipetalous or epiphyllous stamen is shown by joining the middle of the symbol of the anther to the petal or tepal by a line. Gynoecium is shown in the centre of floral diagram by T.S. of the ovary. The nectary glands are shown by dots in their respective position. The bract is shown outside the sepals usually opposite to the mother axis.