

Morphology of Reproductive Organs

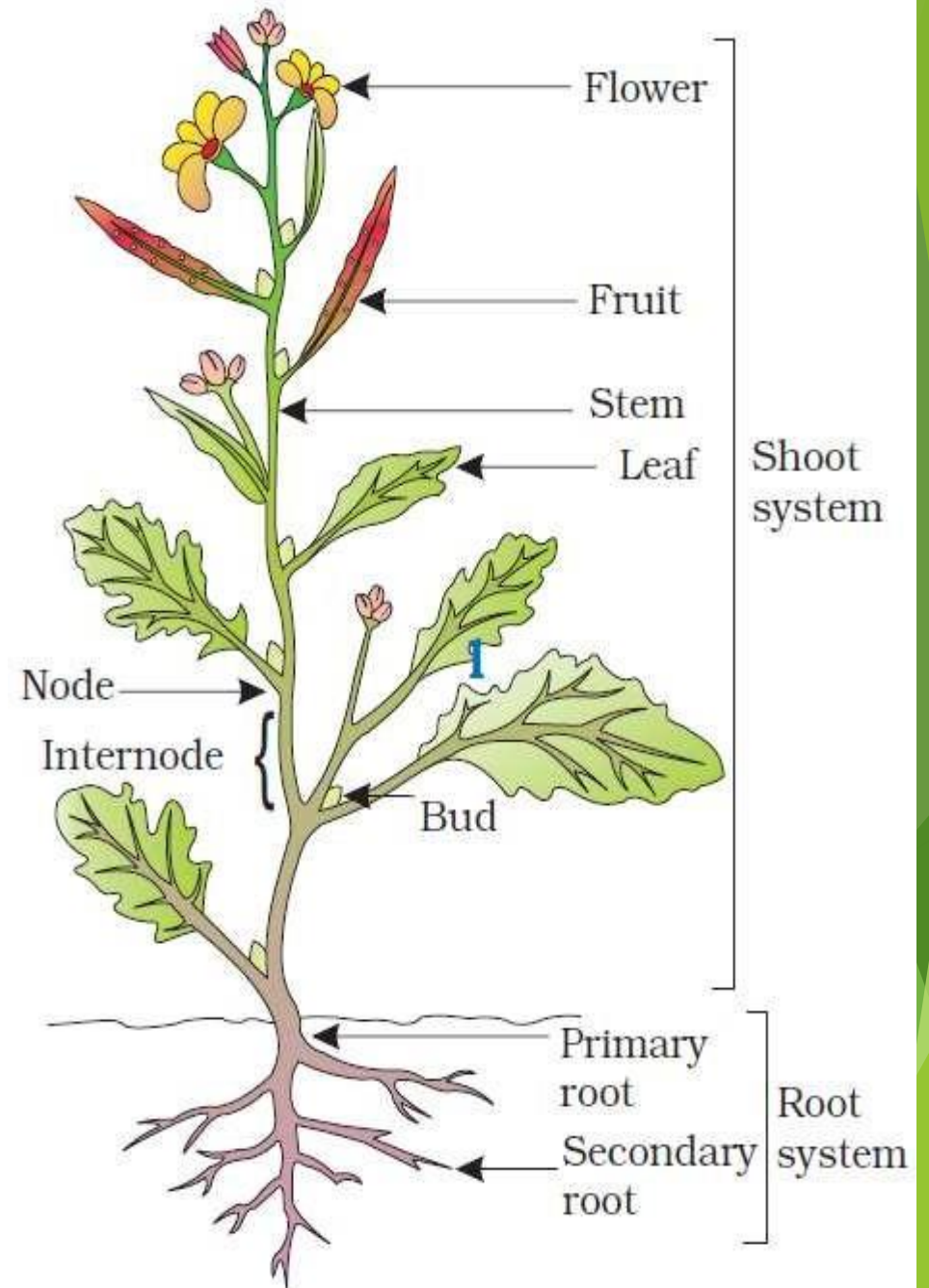
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MORPHOLOGY OF FLOWERING PLANTS

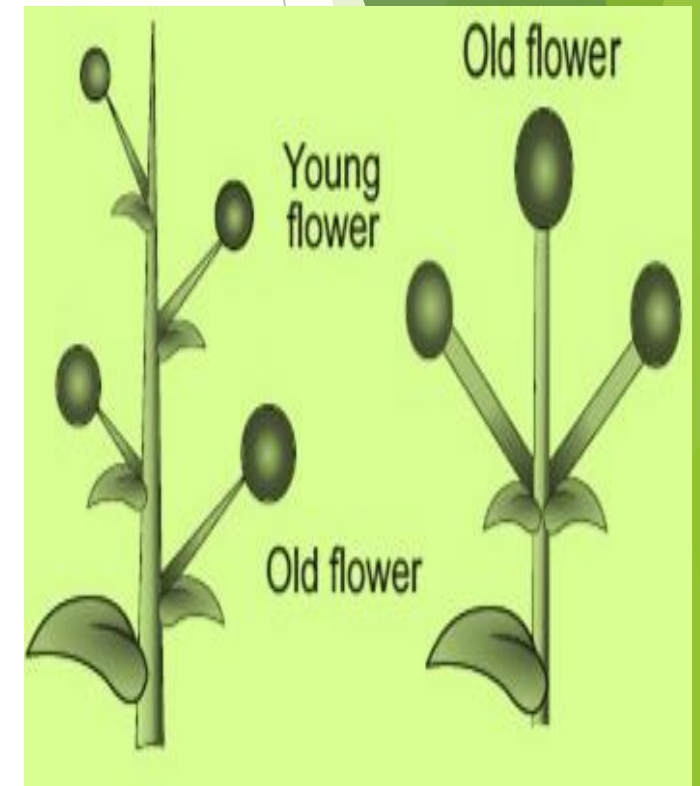
- Root
- Stem
- Leaf
- Flower
- Fruit
- Seed



Morphology of Reproductive Parts

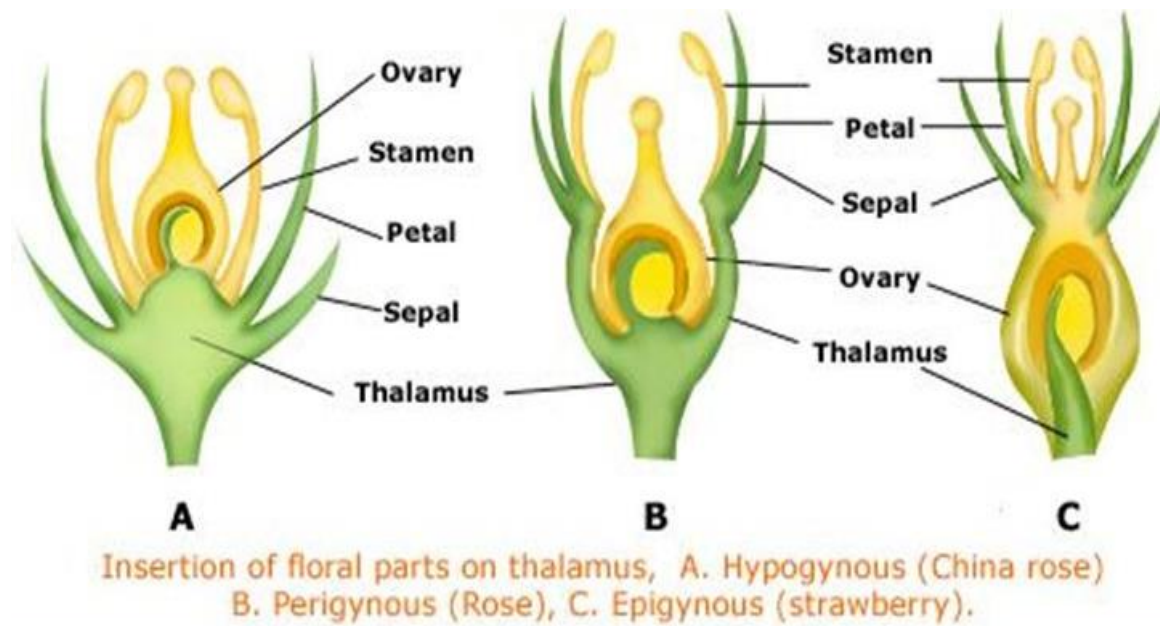
Characteristics :

1. Plant organs which produces male and female gametes are called reproductive organs.
2. Flowers are the reproductive organs of the plant develop Singly or in bunches called Inflorescence.
3. They are arranged on the floral axis either in Cymose or Racemose Fashion.
4. Flowers may Bisexual or Unisexual arranged on floral axis.



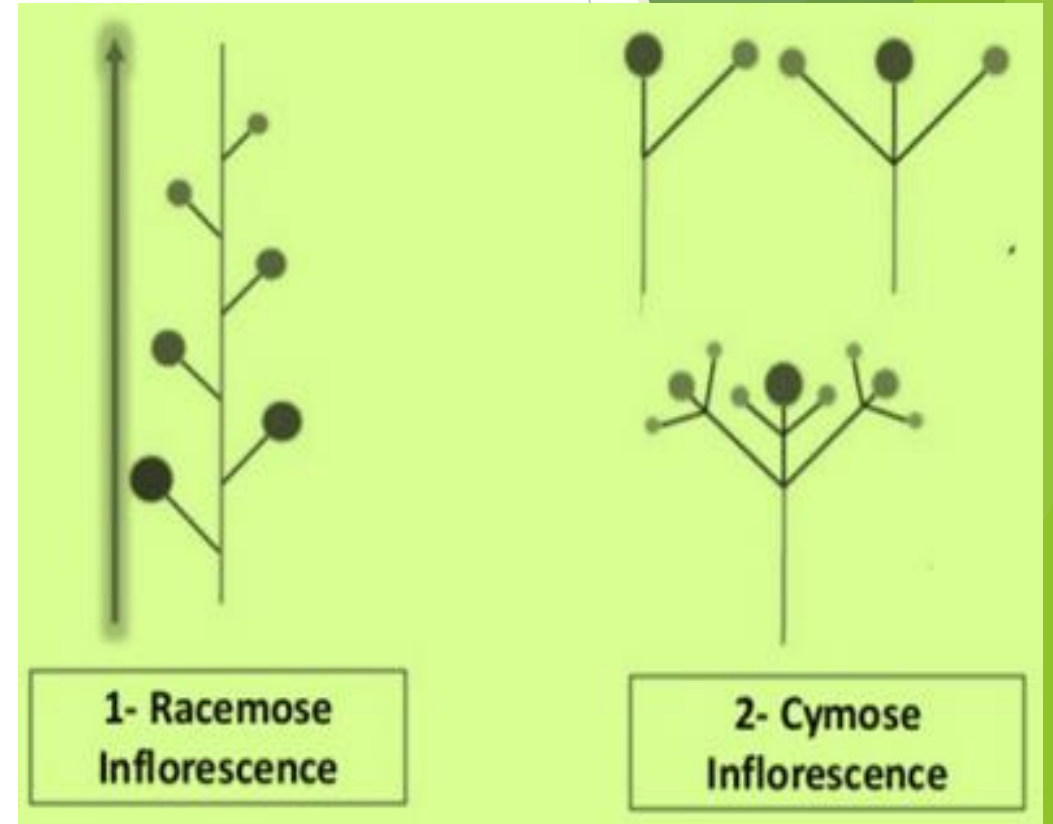
Functions of Flower

- ❑ It helps in sexual reproduction.
- ❑ It bears male sex organs i.e., stamens and female sex organs i.e., carpels.
- ❑ Ovary after fertilization ripens into fruit which contains seeds and thus is responsible for continuation of the race.



Types of Inflorescences

- Inflorescence is pattern of flowers are arranged on an axis. An inflorescence may either be of racemose or cymose types.
- **Racemose / Indefinite / Indeterminate** type of Inflorescence is with monopodial branching.
- The arrangement in which the youngest flower is present near the apex and older towards the base, i.e., in acropetal succession.

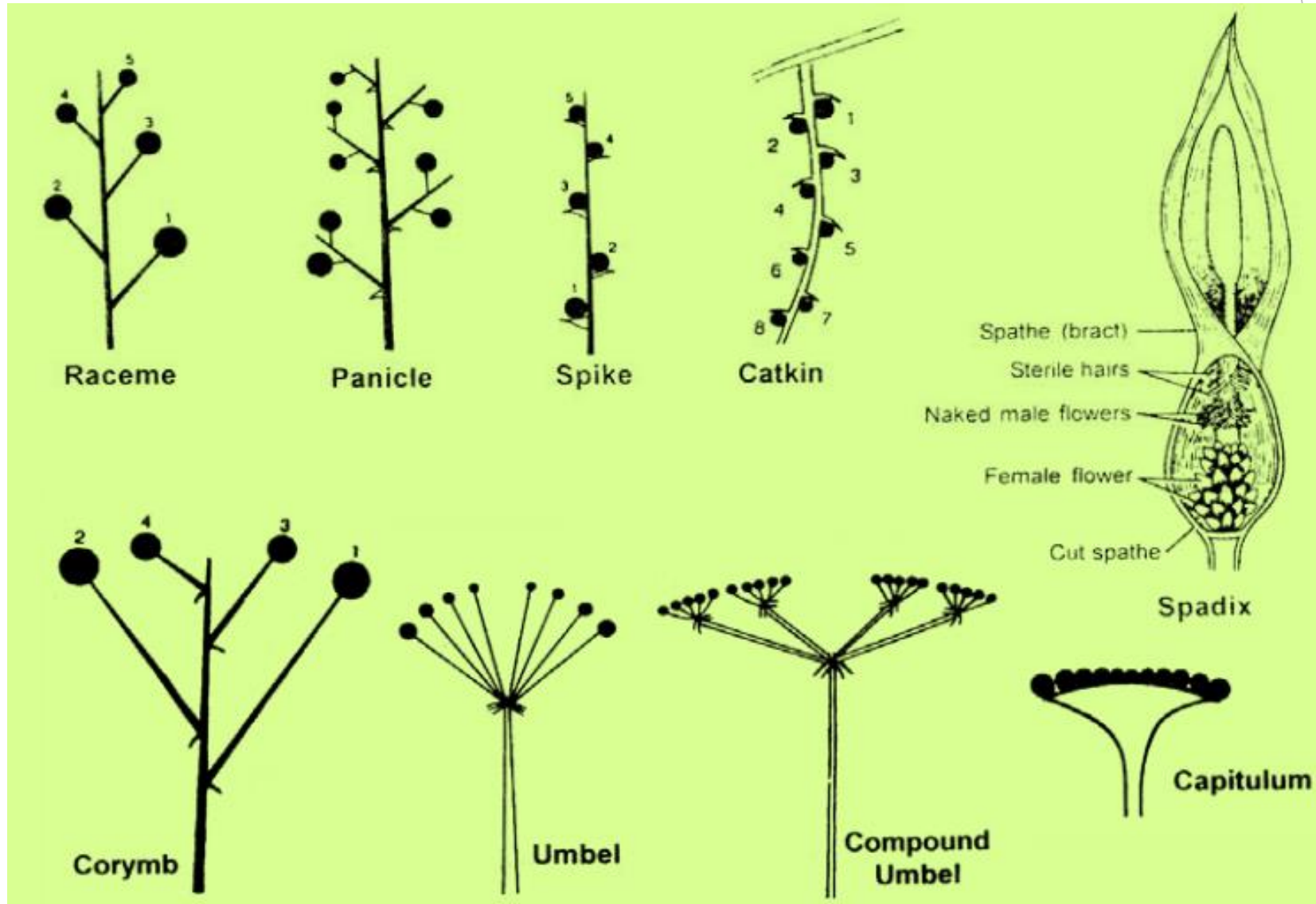


Types of Inflorescences-Raceme

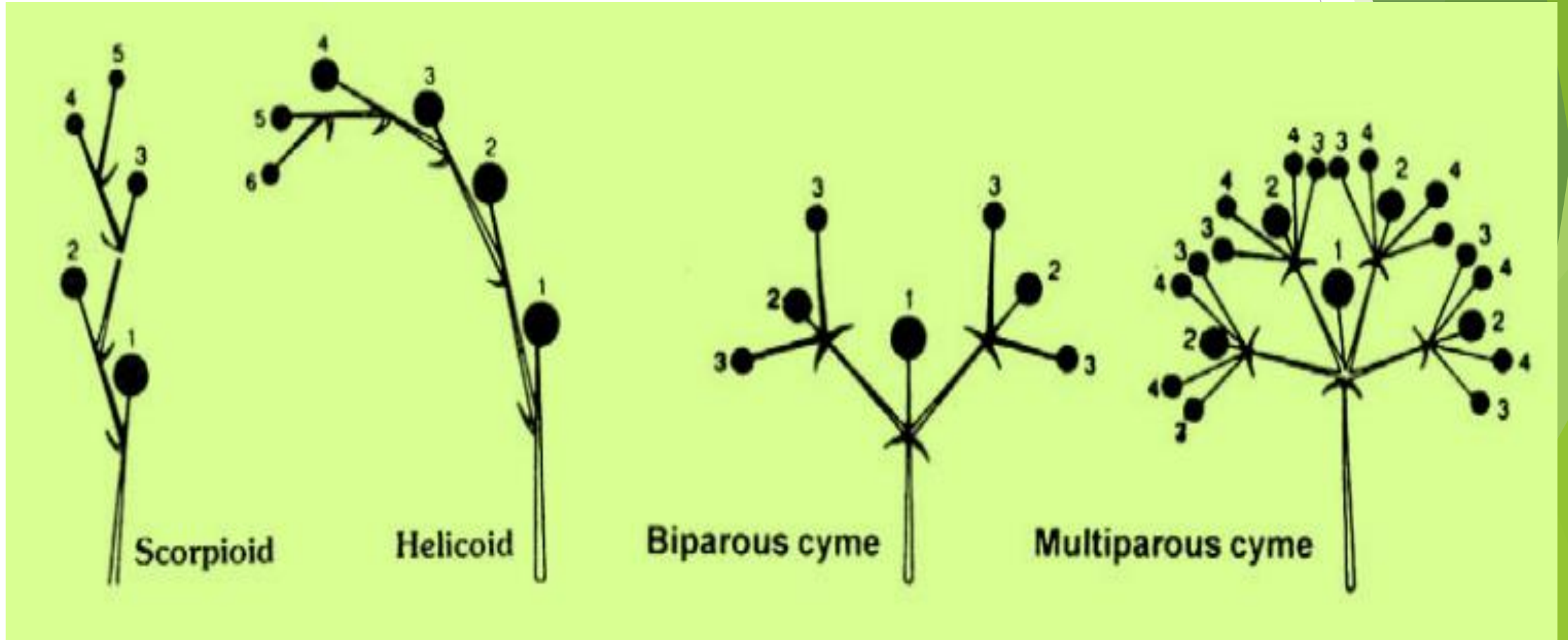
RACEME: Inflorescence having a common axis and stalked flowers in acropetal succession, e.g., *Brassica*.

- **Corymb-** A raceme with lower pedicels elongated so that the top is nearly flat, e.g., Candytuft.
- **Spike-** Inflorescence with sessile flowers along axis, e.g., *Achyranthes*.
- **Catkin-** A spike with unisexual flowers and pendulous rachis, e.g., *Moms*.
- **Umbel-** An arrangement of flowers springing from a common centre and forming a flat or rounded cluster, e.g., *Coriandrum*, *Foeniculum*, etc.
- **Spadix-** A racemose inflorescence with elongated axis, sessile flowers, and an enveloping spathe, e.g., *Colocasia*, *Alocasia*, Palm, *Musa*, etc
- **Capitulum-** An inflorescence of sessile flowers or florets crowded together on a receptacle and usually surrounded by an involucre
- **Hypanthodium-** An inflorescence with concave capitulum on whose walls the flowers are arranged,

Types of Inflorescences-Raceme



Types of Inflorescences-Raceme



Types of Inflorescences-Cymose

▶ Cymose or Definite or Determinate Type of Inflorescence

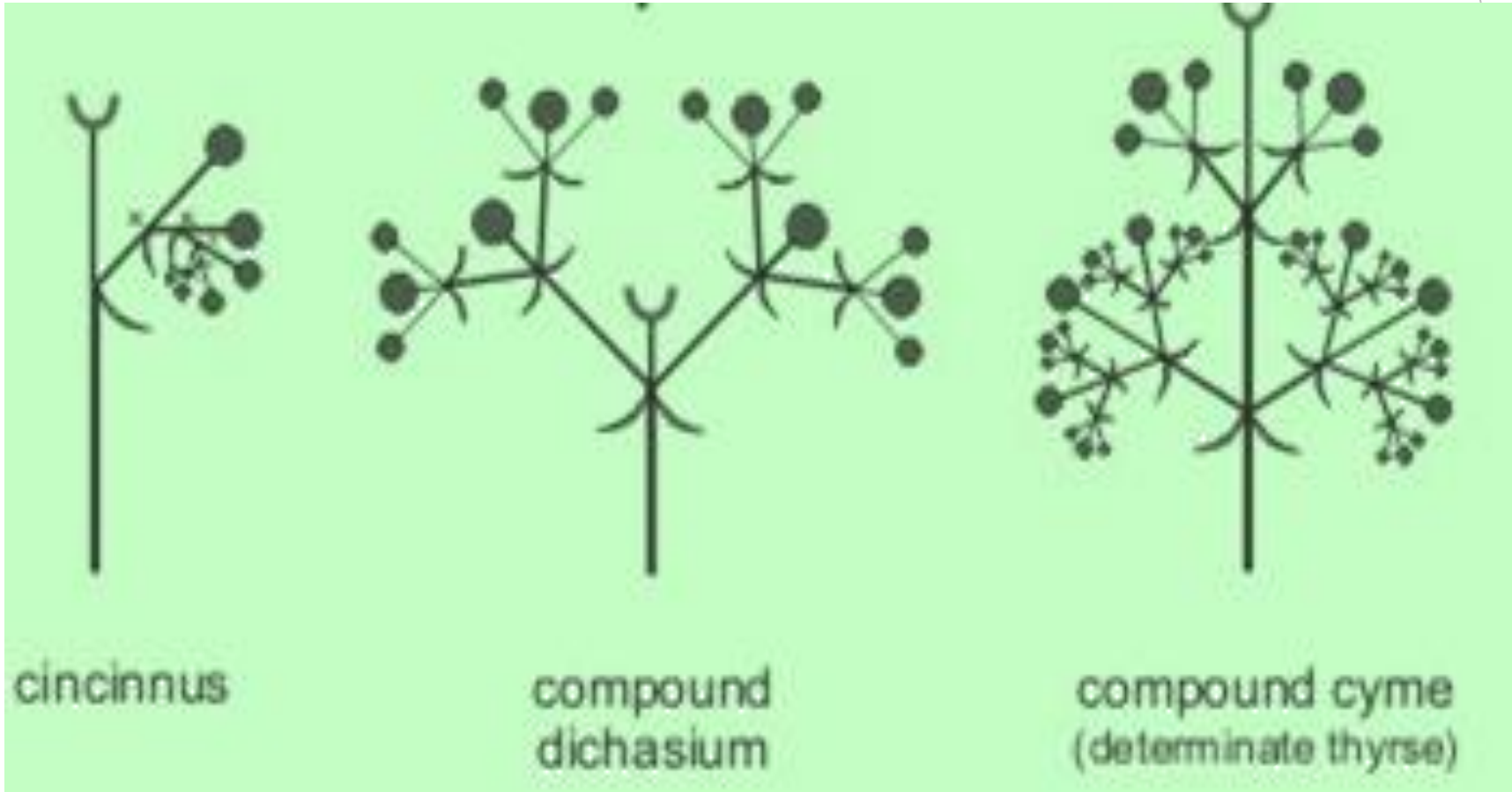
When the apical growth of the floral axis is checked by the formation of a flower, it is called cymose inflorescence.

▶ **Uniparous (monochasial)** - Having a cymose inflorescence with one axis at each branching. Biparous (dichasial). Dichotomously branched cymose inflorescence, e.g., Ixora, Saponaria.

▶ **Helicoid cyme** - An uniparous inflorescence produced by suppression of successive axes on same side, thus causing the sympodium to be spirally twisted, e.g., Begonia, Juncus.

▶ **Scorpioid-** An uniparous inflorescence in which the lateral branches develop on alternate sides evidently forming a zigzag, e.g., Heliotropium.

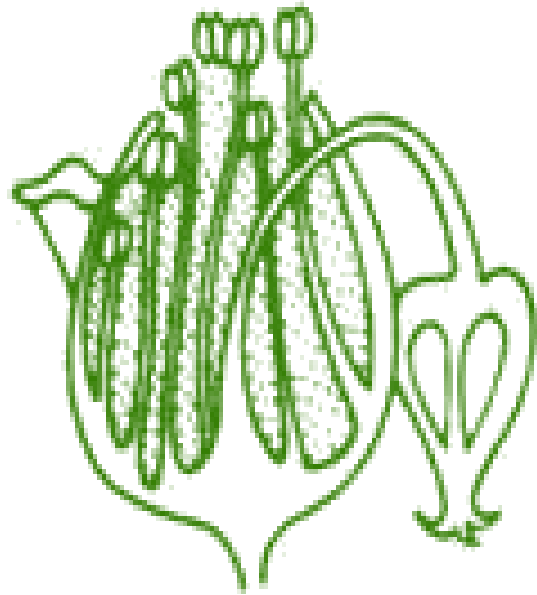
Types of Inflorescences-Cymose



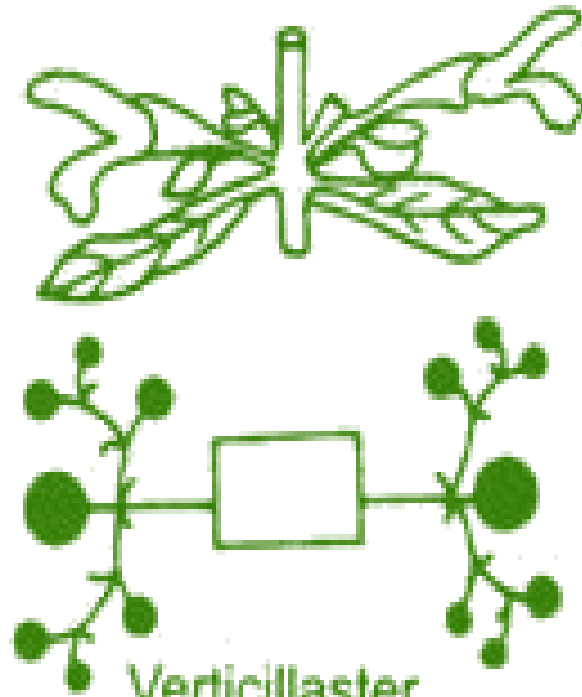
Types of Inflorescences- Special Types

- **Cyathium-** The peculiar inflorescence in Euphorbia, a cup-shaped involucre with stamens and stalked gynoecium, each stamen and the gynoecium being a separate flower.
- **Verticillaster-** A much condensed cyme with appearance of whorl, but in reality arising in axils of opposite leaves, e.g., characteristic of Labiatae.
- **Panicle-** A compound branched raceme, e.g., Mango, Melia.
- **Spikelet-** A secondary spike of grasses, bearing few flowers.
- **Compound umbel-** Umbel of umbels.
- **Compound corymb-** Corymb of corymbs.
- **Solitary flower-** Single flower.
- **Solitary axillary-** Single flower in the axil of leaf, e.g., *Cucurbita*.

Types of Inflorescences- Special Types



Cyathium



Verticillaster

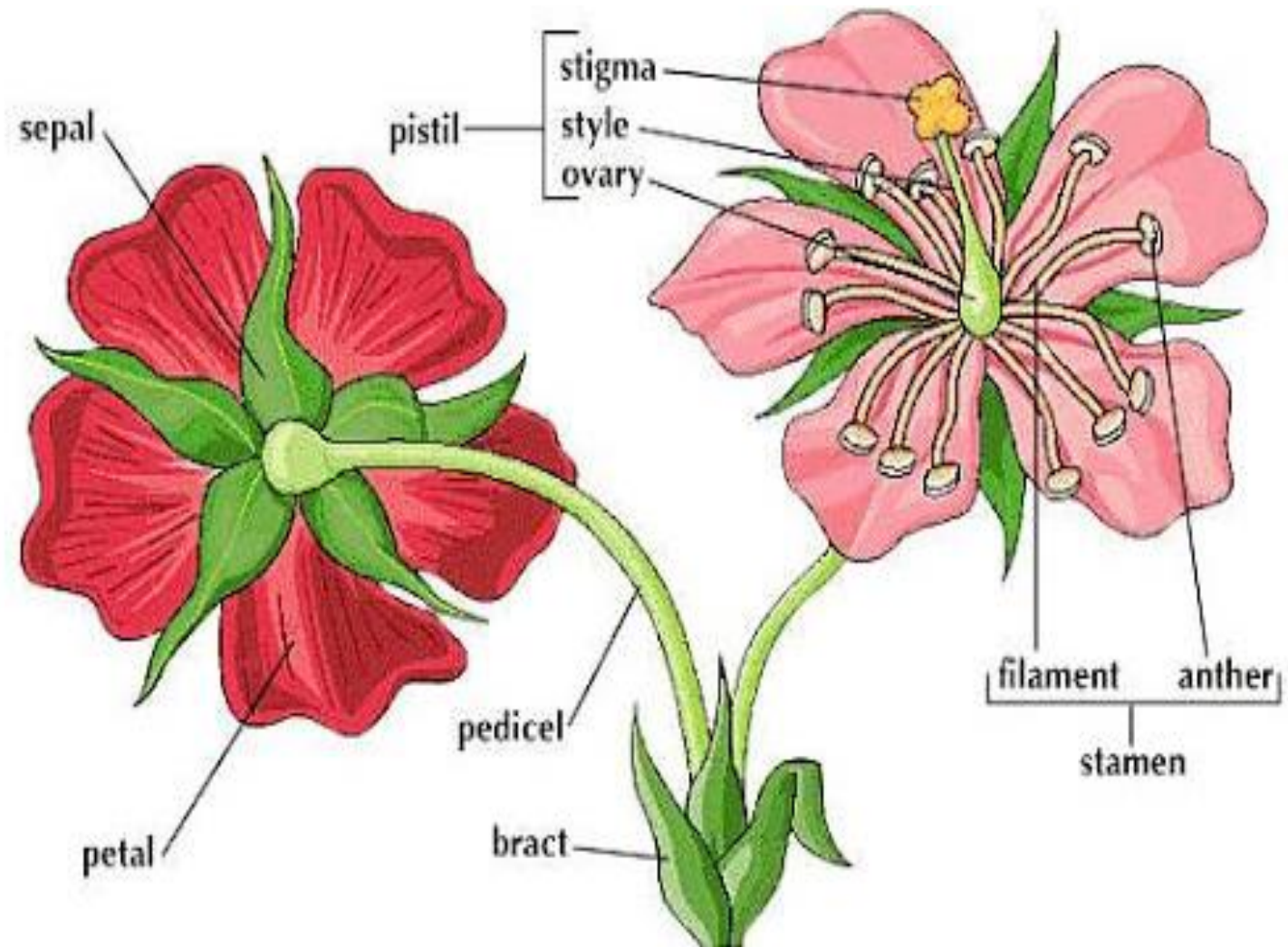


Hypanthodium.

Flowers of Angiosperms

- ▶ The blossom of a plant, comprising generally sepals, petals, stamens and pistil a leafy shoot adapted for reproductive purposes. Flower develops on the mother axis (stem) in the form of floral bud.
- ▶ **Bract** -It is a leaf like structure in whose axil a flower often develops.
- ▶ **Pedicel** -It is the stalk of the flower which may be short, long or even absent.
- ▶ **Bracteoles**-They are scaly appendages present on pedicel.
- ▶ **Receptacle** - It is the swollen or expanded tip of the pedicel which bears four whorls i.e. calyx, corolla, Androecium and Gynoecium.

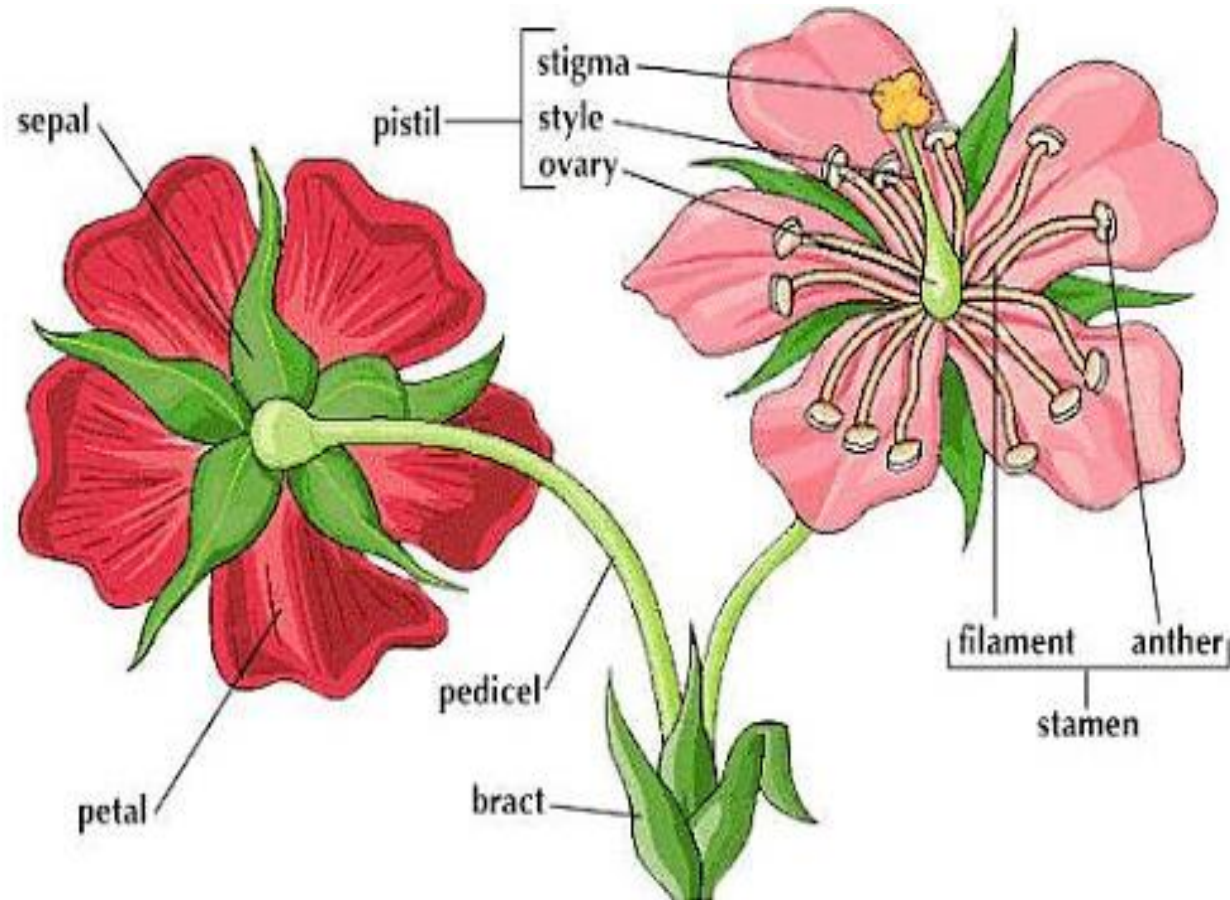
Flowers of Angiosperms



Floral whorls

- **Calyx-** It is the first or outermost protective whorl. Individual member of calyx is called a sepal which is generally green.
- **Corolla** - It is the second or attractive whorl present inner to calyx. Each member of corolla is called a petal.
- **Androecium-** It is the third or male whorl. It is a collection of male parts called stamens. Each stamen is a modified leaf or microsporophyll. Each stamen consists of 3 parts - filament, anther and connective.
- **Gynoecium or Pistil-** It is the fourth or female whorl, and its functional units are called carpels (= megasporophylls). A typical carpel consists of ovary, style and stigma

Floral whorls



Floral Bracts

Bracts are specialized leaves from the axil of which bracteate flowers arise.

- **Foliaceous or Leafy bracts-** Green, flat and leaf like, e.g., *Acalypha*, *Adhatoda*, *Gynandropsis*.
- **Spathe-** Large, boat-shaped and tightly coloured bract enclosing lowers, e.g., banana, palms, *Colocassia*.
- **Petaloid bracts-** Brightly coloured bracts like petals, e.g. *Poinsettia* (*Euphorbia pulcherrima*)
- **Involucre-** Group of bracts in one or more whorls around luster of flowers, e.g., sunflower.
- **Epicalyx-** Whorl of bracteoles arising at the base of tie calyx, e.g., cotton, lady's finger, strawberry.
- **Glumes-** Small and dry scaly bracts found only in gasses and sedges.
- **Scaly bract-** Present at the base of each floret of members of Compositae, e.g., Sunflower.

Floral Bracts



Leafy



Spathe



Petaloid



Involucre



Glumes



Scaly

Calyx/Sepals

- ▶ **Polysepalous** - Having free or distinct sepals, e.g., Mustard.
- ▶ **Gamosepalous** - With coherent sepals, e.g., China rose

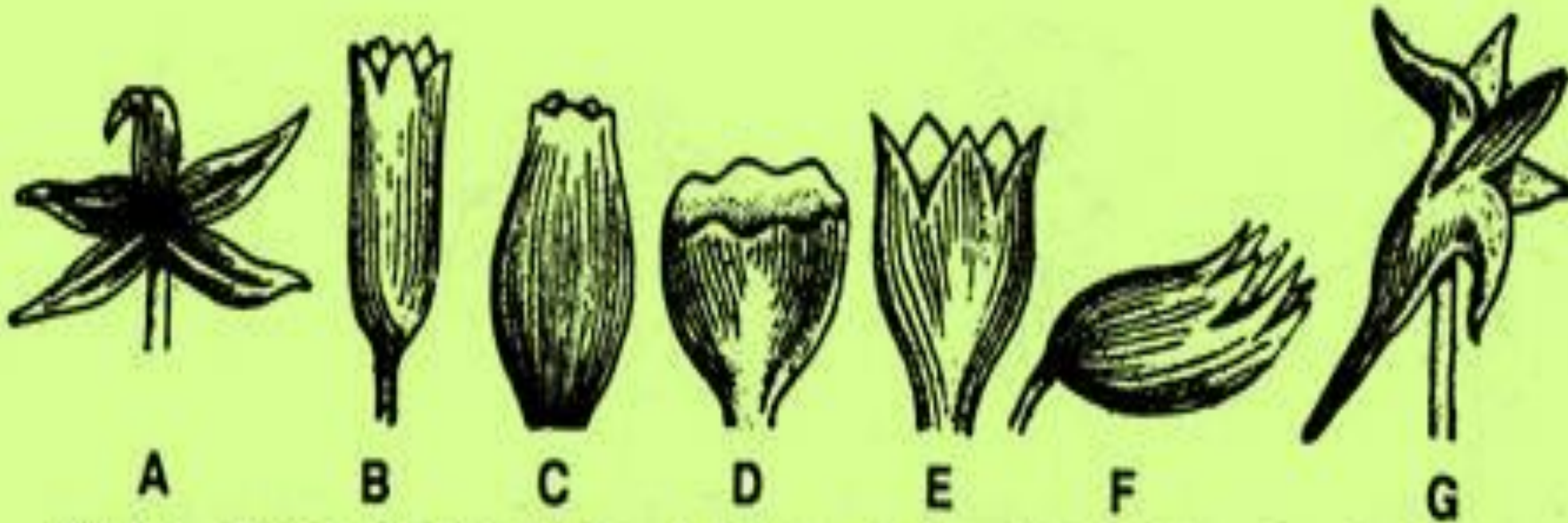


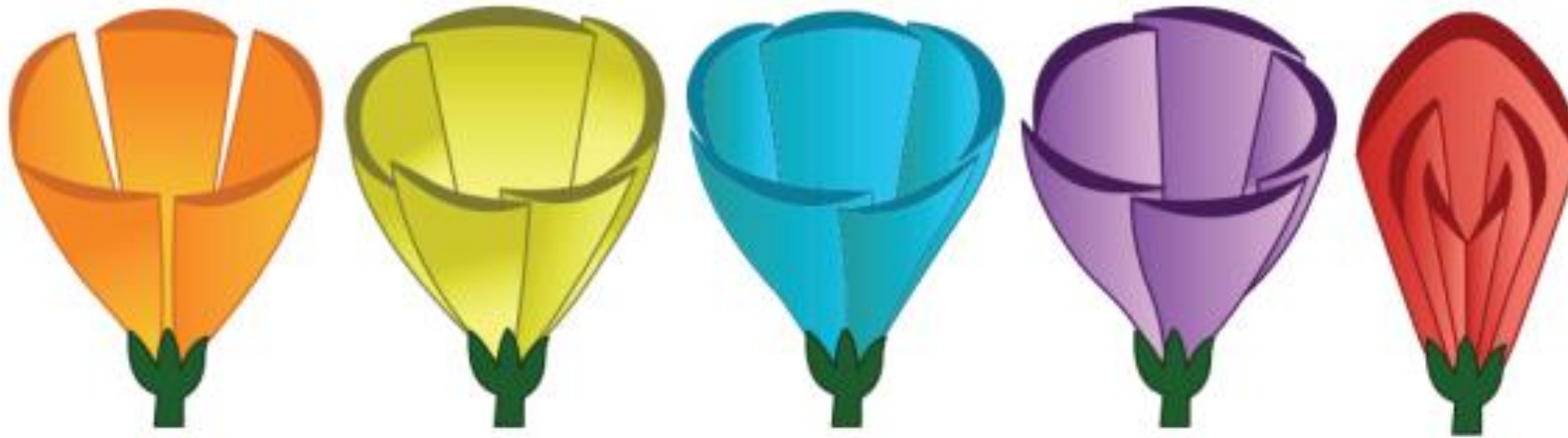
Fig. 81. *Forms of calyx. A, Free; B, Tubular; C, Urceolate; D, Cupulate; E, Campanulate; F, Bilabiate; G, Spurred.*

Aestivation

The arrangement of the parts of the floral envelopes in bud.

- ❖ **Valvate-** An aestivation when the segments of corolla are so placed that their edges touch each other, not overlap, e.g., Solanum.
- ❖ **Valvate induplicate-** Valvate aestivation with the margins of the petals folded inwards, e.g., Ipomoea.
- ❖ **Twisted-** Also known as contorted; one margin of the petal overlaps that of the next one, and the next margin overlaps the third one.
- ❖ **Imbricate-** A mode of aestivation in which one member of whorl is outside all the others the others overlap by one margin only.
- ❖ **Quincuncial-** An imbricate (aestivation with 5 petals out of which two are exterior, two interior and the fifth has one margin exterior and one interior).
- ❖ **Vexillary-** An imbricate (descending imbricate), in which out of the five petals the posterior one is the largest and covers the two lateral petals, and the lateral petals overlap the two anterior and smallest petals (keels

Aestivation



A.Valvate



B.Twisted



C.Imbricate



D.Quincuncial



E.Vexillary

Shapes of Corolla

- ❖ **Cruciform-** The corolla with four free petals arranged in the form of a cross; each petal is being differentiated into a claw and a limb, e.g., Brassica.
- ❖ **Caryophyllaceous-** The corolla with 5 free petals; the petals are with long claws and with limbs placed at right angles to the claws, e.g., Dianthus.
- ❖ **Rosaceous-** The corolla with five or more free petals, not distinguished into limbs and claws and spreading regularly outwards, e.g., Rosa.
- ❖ **Campanulate-** Bell-shaped; the petals are fused to each other, e.g., Ipomoea, Cuscuta.
- ❖ **Infundibuliform-** Funnel-shaped corolla; e.g., Ipomoea, Petunia.
- ❖ **Salver-shaped (hypocrateriform) -** A gamopetalous corolla with a long tube horizontal limb, e.g., Mussaenda.

Shapes of Corolla

- **Rotate-** Wheel-shaped gamopetalous corolla, e.g., Solanum, the gamopetalous corolla with a flat and circular limb at right angles to the short tube.
- **Papilionaceous-** Butterfly-like, as corolla of pea family; the corolla possesses one large posterior standard, two lateral wings and two innermost and smallest keels.
- **Bilabiate-** Two lipped; zygomorphic gamopetalous corolla, e.g., Justicea, Ocimum, Salvia.
- **Personate-** Zygomorphic, gamopetalous corolla with two lips, as in Antirrhinum.
- **Ligulate-** Zygomorphic, gamopetalous corolla forming a short, narrow tube below and ligule-like flat structure above, e.g., Sonchus

Shapes of Corolla

- **Tubular-** Tube-like, gamopetalous corolla, e.g., Helianthus, Ageratum.
- **Spur-** A sac-like or tubular projection of a petal, e.g., Viola, Tropaeolum.
- **Nectary-** A nectar-secreting gland in petals, e.g., Salvia, Ranunculus.
- **Corona-** The appendages found in between corolla and stamens, or on the corolla, e.g., Calotropis, Asclepias.

Shapes of Corolla



Infundibuliform



Papilionaceous



Campanulate



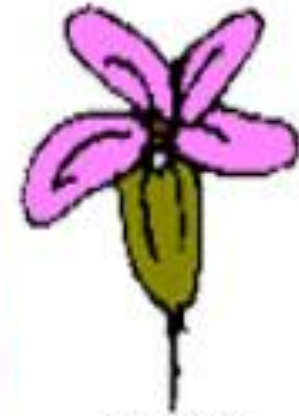
Bilabiate



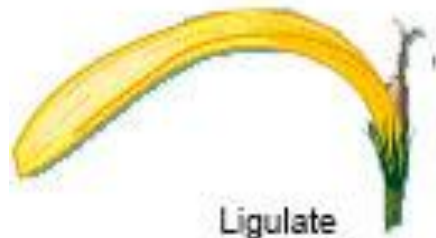
Rotate



Tubular



Cruciform



Ligulate



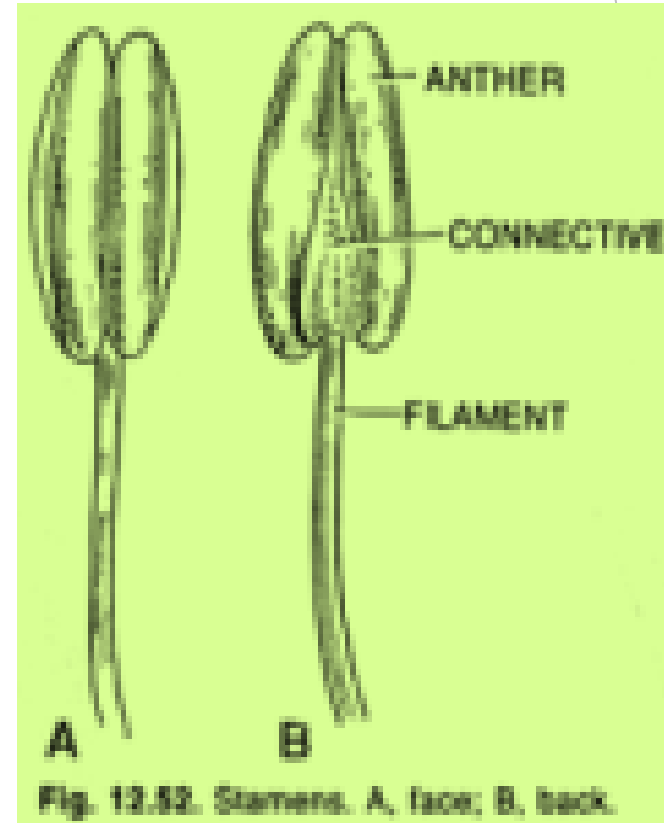
Spurred

Forms of corolla

Androecium

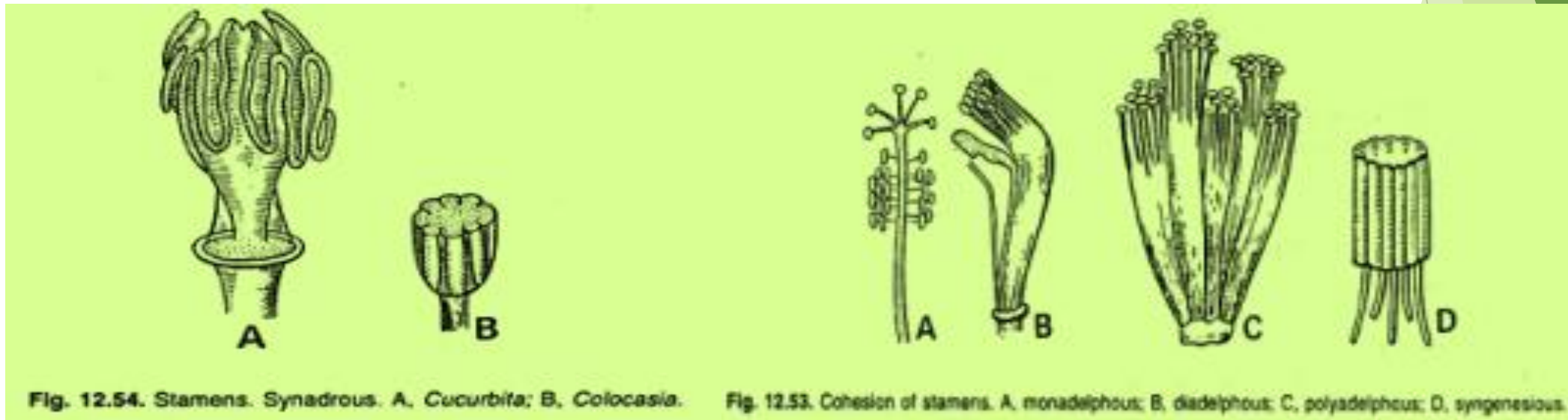
Collective term for all the stamens and staminodes.

- **Androphore** : A stalk bearing the androecium.
- **Stamen** : A modified leaf in flowering plants bearing pollen sacs. It consists of filaments and anthers.
- **Staminode** : Rudimentary stamens which do not bear fertile pollen, e.g., *Stellaria*.



Androecium

- **Polyandrous-** Androecium that consists of free stamens, e.g., Poppy.
- **Monadelphous-** United into one bundle by the filaments, e.g., Hibiscus.
- **Diadelphous-** Stamens arranged in two bundles, e.g., many members of Papilionaceae.
- **Polyadelphous-** Stamens united in many bundles, e.g., Citrus, Bombax.
- **Syngenesious-** With anther cohering in a ring, e.g., many members of Compositae, (e.g., Helianthus).



Androecium

- **Epipetalous**- Stamens born on the petals or corolla tube, e.g., Convolvulus, Ipomoea, Justicea, Solarium, etc.
- **Epitepalous**- Stamens born on the tepals, e.g., Asphodelus.
- **Gynandrous**- Stamens adhering to the carpels, e.g., Calotropis.
- **Obdiplostemonous**- Stamens found in two alternating whorls and that of the outer whorl opposite the petals, e.g., Murraya, Geranium.
- **Tetradynamus**- With four long and two short stamens, e.g., Brassica, Raphanus, Eruca, etc
- **Didynamous** In an Androecium four stamens in two pairs one pair shorter than the other, e.g., Ocimum.



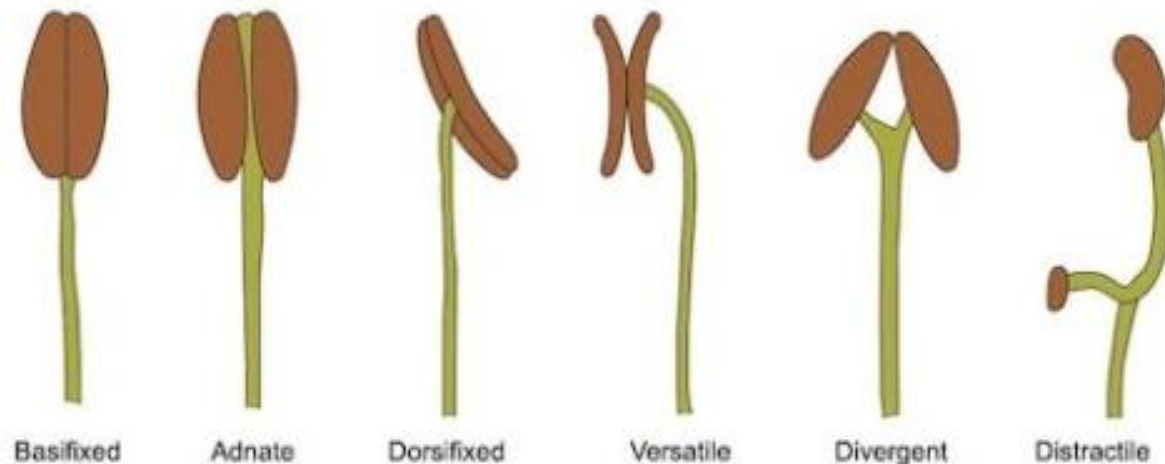
Didynamous
(two long and two short
stamens)



Tetradynamous
(four long and two short
stamens)

Androecium

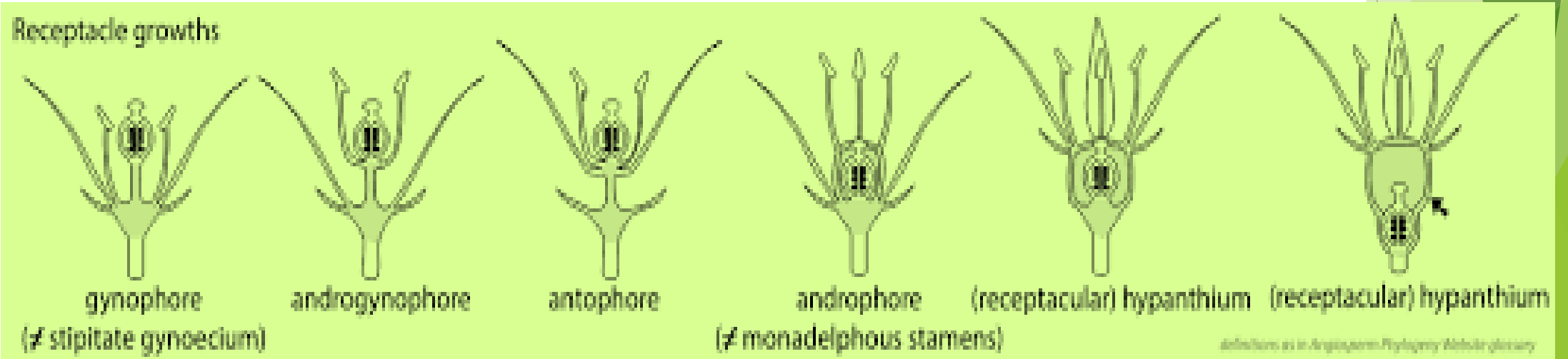
- **Monothealous**- Single-celled anther, e.g., Hibiscus.
- **Dithealous**- Two-celled anther, e.g., Papaver.
- **Basifixed** - Fixed to the filament (stalk) at the base, e.g., Brassica,
- **Dorsifixed** - Filament attached to the dorsal side of the anther, e.g., Bauhinia
- **Versatile** - The anther can move in any way, e.g., Gramineae
- **Adnate** - The fusion of unlike parts (anther and filament), e.g., Michelia.
- **Introrse** - Anthers facing inwards, e.g., Hibiscus, Solanum, Stellaria, etc.
- **Extrorse** - Facing outward from the centre of the flower referred for anthers, e.g., Papaver, Argemone



Gynoecium

The carpel or assemblage of carpels; collective name for the carpels of a flower.

- **Gynophore** - Elongated thalamus in between androecium and gynoecium, e.g., *Cleome*.
- **Androgynophore** - An axis or stalk bearing both stamens and pistil above the point of perianth attachment, e.g., *Gynandropsis*.



Gynoecium: Carpel / Pistil

The modified leaves which bear the ovules, a simple pistil or one of the segments of a compound pistil. **Pistil-** A collective term for ovary, style and stigma.

Compound pistil : Where many pistils are aggregated together; the condition may be bicarpellary; e.g., Brassica; Tricarpellary, e.g., Lillaceae; tetracarpellary, e.g., Datura; pentacarpellary, e.g., Melia; polycarpellary, e.g., Sida, Papaver, etc.

- ❖ **Apocarpous-** Carpels in a flower free from each other, e.g., Ranunculus.
- ❖ **Syncarpous-** United carpels, compound ovary, e.g., Citrus.
- ❖ **Superior-** Situated above another member, a superior ovary has its base above the insertion of calyx; e.g., Brassica.
- ❖ **Inferior-** Epigynous condition; the ovary is borne below attachment of all other floral envelopes and adnate to them, e.g., Coriandrum
- ❖ **Semi-inferior-** Intermediate condition between superior and inferior, e.g., Pea

Gynoecium: Carpel / Pistil

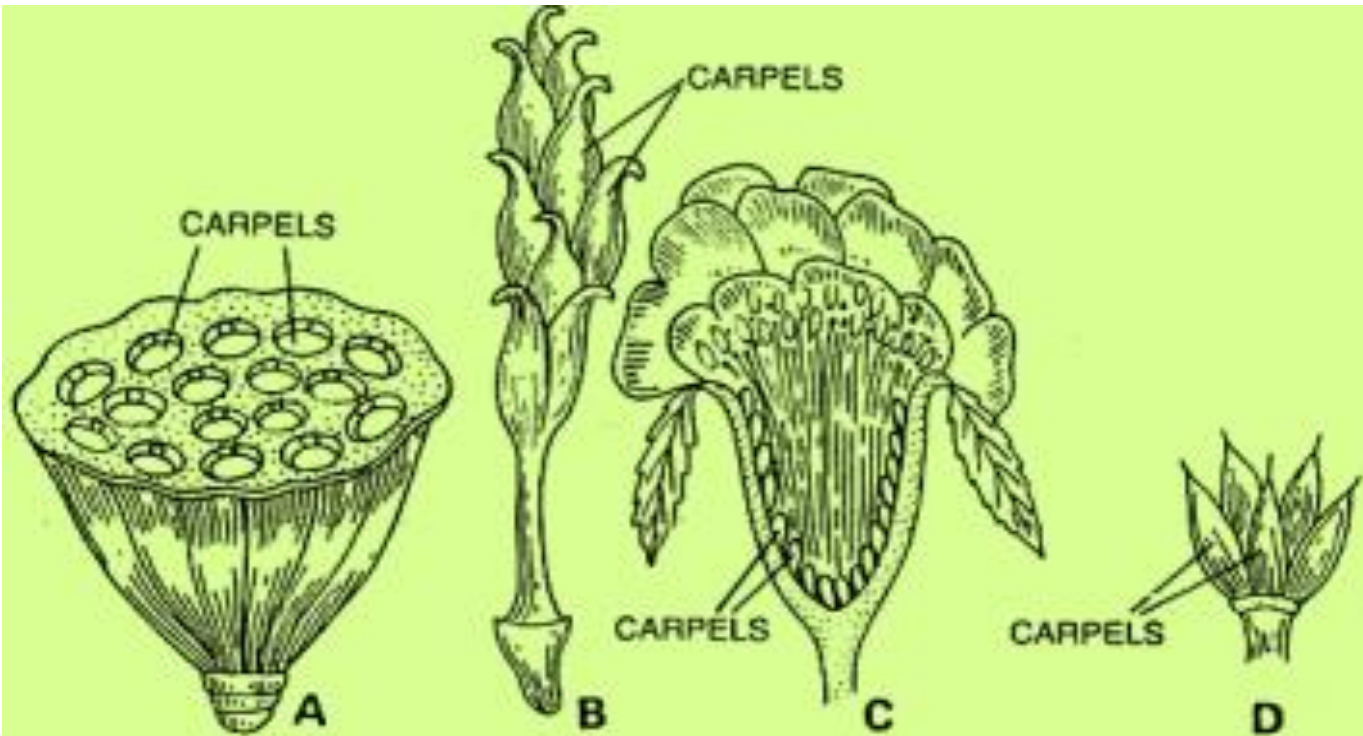


Fig. 12.59. Apocarpous pistil. A, Lotus; B, Michelia; C, Rose; D, Sedum.

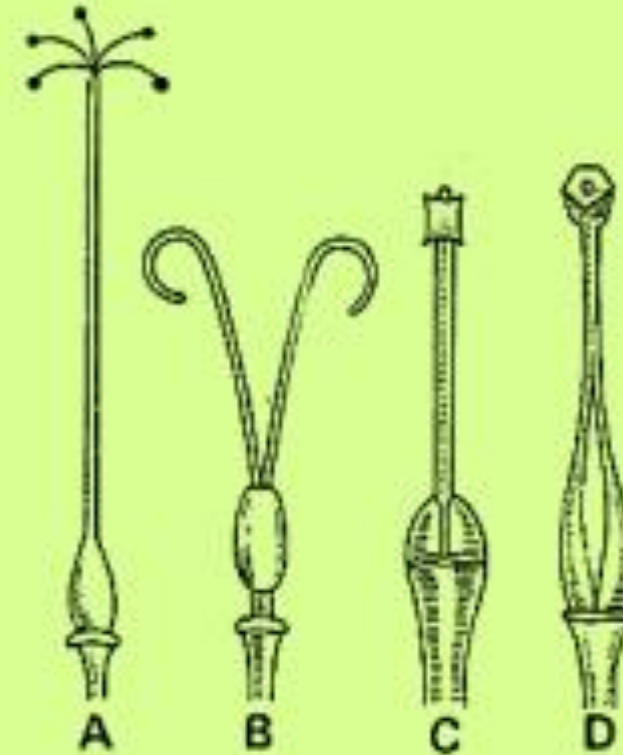


Fig. 12.60. Cohesion of carpels. A, pistil of *Hibiscus rosa-sinensis* with free stigmas; B, pistil with free styles; C, pistil of *Nerium* with free ovaries; D, pistil of *Calotropis* with free ovaries and styles.

Gynoecium: Placentation

Type of arrangement of placentas in a syncarpous ovary;

- Parietal; carpels are fused only by their margins, placentas then appearing as internal ridges on ovary wall, e.g., Argemone, Viola, Brassica, etc.
- Axile; margins of carpels fold inwards, fusing together in centre of ovary to form a single, central placenta; ovary is divided into as many compartments (loculi) as there are carpels, e.g., Asphodelus, Hibiscus',
- Free-central; placenta arising as a central up-growth from ovary base, e.g., Stellaria,
- Marginal; placenta develops along the junction of two carpels, in a unilocular ovary, e.g., pea;

Gynoecium: Placentation

- Basal; the ovules are few or reduced to one and are borne at the base of ovary, the ovules when solitary often filling the cavity,, the ovary is unilocular, e.g., Compositae;
- Superficial; carpels numerous, the placentae develop all round the inner surface of the partition wall, ovary multilocular, e.g., Nymphaea
- Lamellate; this is modified parietal placentation, e.g., Papaver



Marginal



Axile



Parietal



Basal



Free central

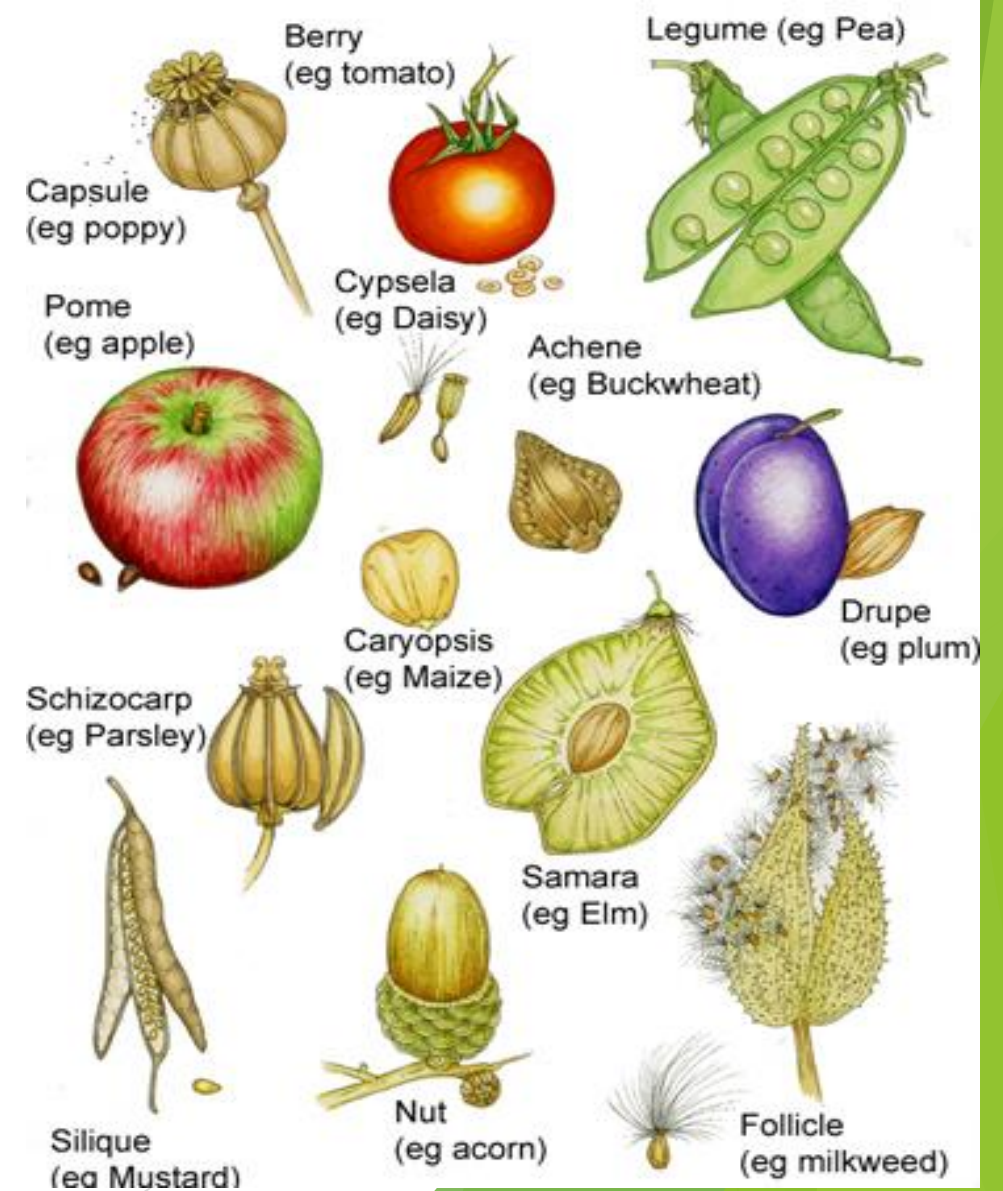


Superficial

Placentation

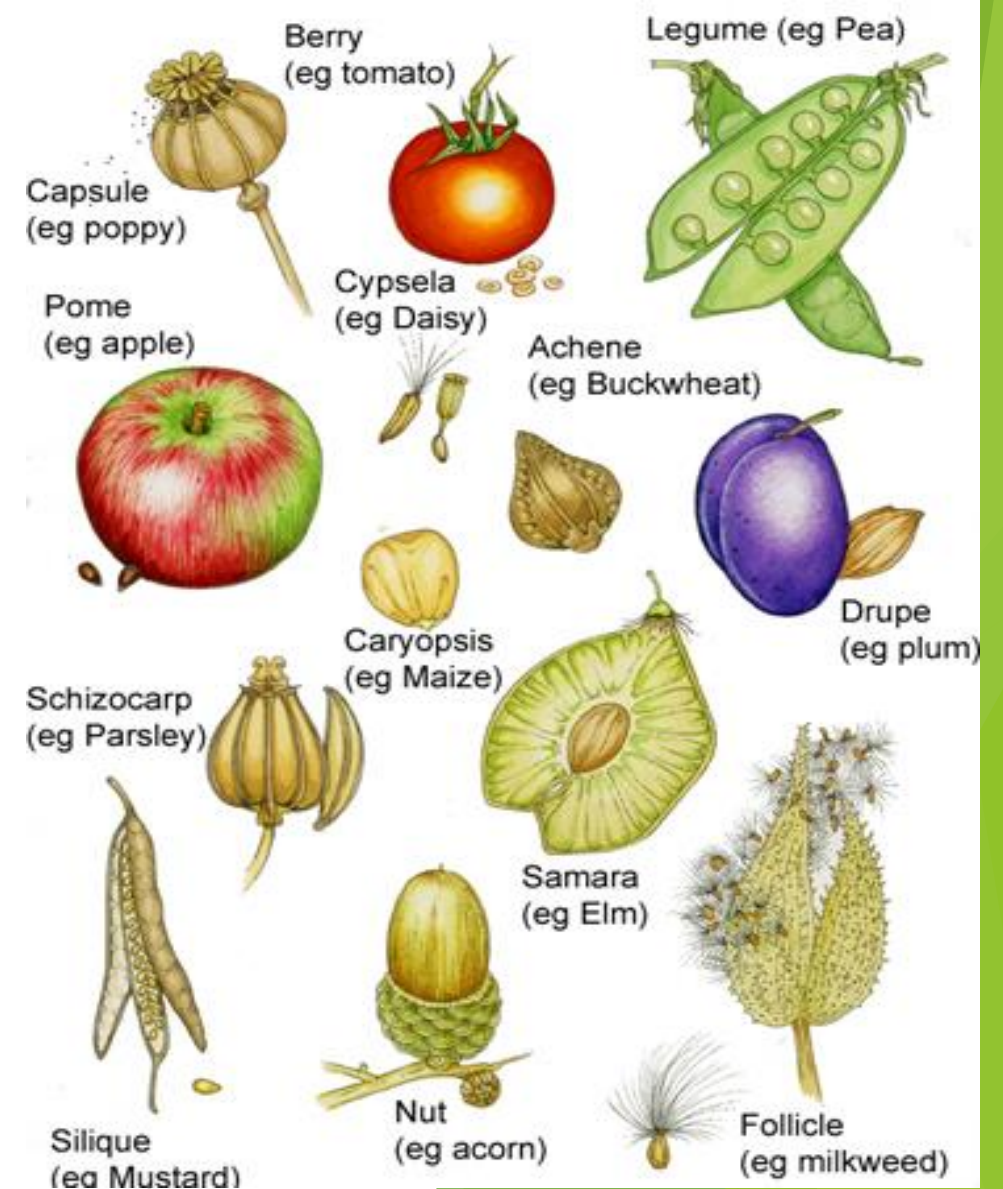
Gynoecium: Fruit

- **Simple fruit-** When a single fruit develops from the ovary of a flower with or without accessory parts, it is said to be a simple fruit.
- **Legume or Pod-** A dry monocarpellary fruit developing from a superior, one chambered ovary and dehiscing by both the sutures, e.g., pea, bean, pulses.
- **Follicle** A dry, monocarpellary, superior one-chambered fruit like the legume, but it dehisces by one suture only, e.g., *Calotropis*, *Asclepias*, *Vinca*, *Michelia*.



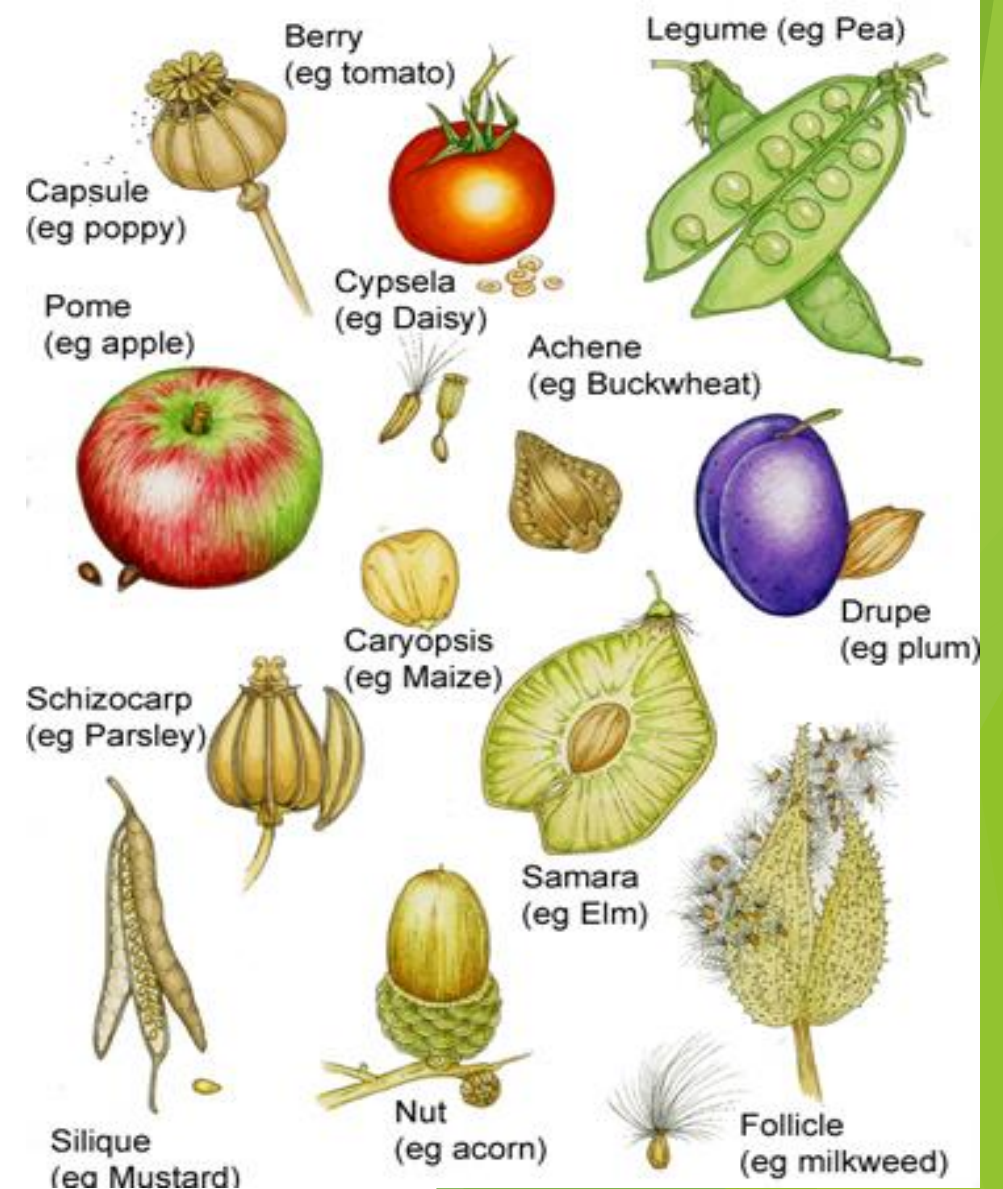
Gynoecium: Fruit

- **Silique-** A long, narrow many seeded fruit developing from a superior, bicarpellary ovary with two parietal placentae, dehiscing from below upwards by both the sutures, e.g., *Brassica*, *Raphanus*.
- **Silicula-** When a silique is much shorter and contains only a few seeds, e.g., *Capsella*, candytuft.
- **Capsule-** A many-seeded, uni or multilocular fruit developing from a superior, bi or polycarpellary ovary, and dehiscing in various waysovary, with the pericarp fused with the seed-coat, e.g., Gramineae.



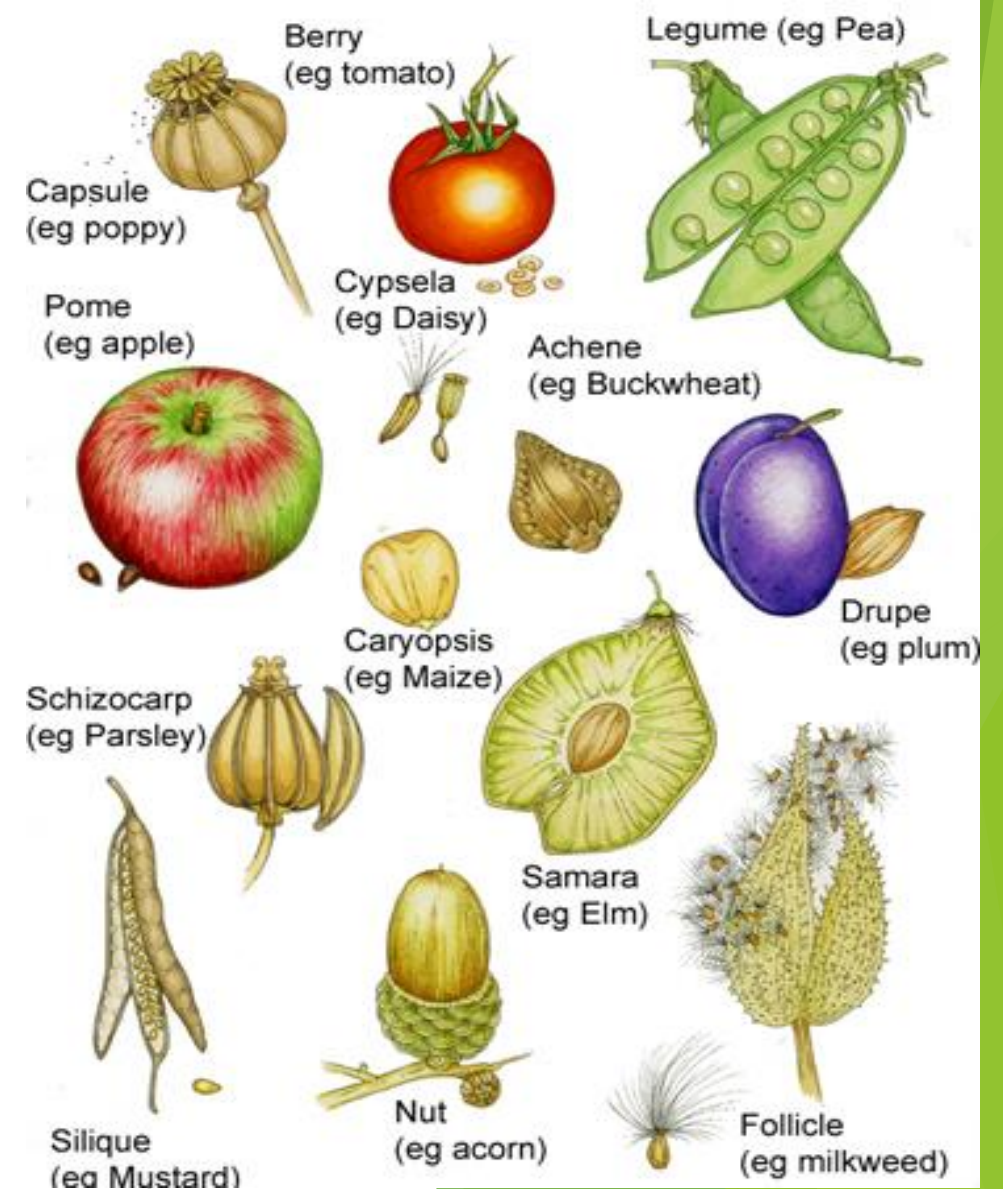
Gynoecium: Fruit

- ▶ **Caryopsis-** A very small, dry one-seeded fruit developing from a superior, monocarpellary ovary, with the pericarp fused with the seed-coat, e.g., Gramineae.
- ▶ **Achene-** A small, dry, one-chambered and one-seeded fruit developing from a superior, monocarpellary ovary; a single flower produces an aggregate of achenes, e.g., Clematis, Naravelia
- ▶ **Cypsela-** A dry, one-chambered and one-seeded fruit developing from an inferior, bicarpellary ovary with the pericarp and the seed-coat free, e.g., Sunflower, marigold. Cosmos.



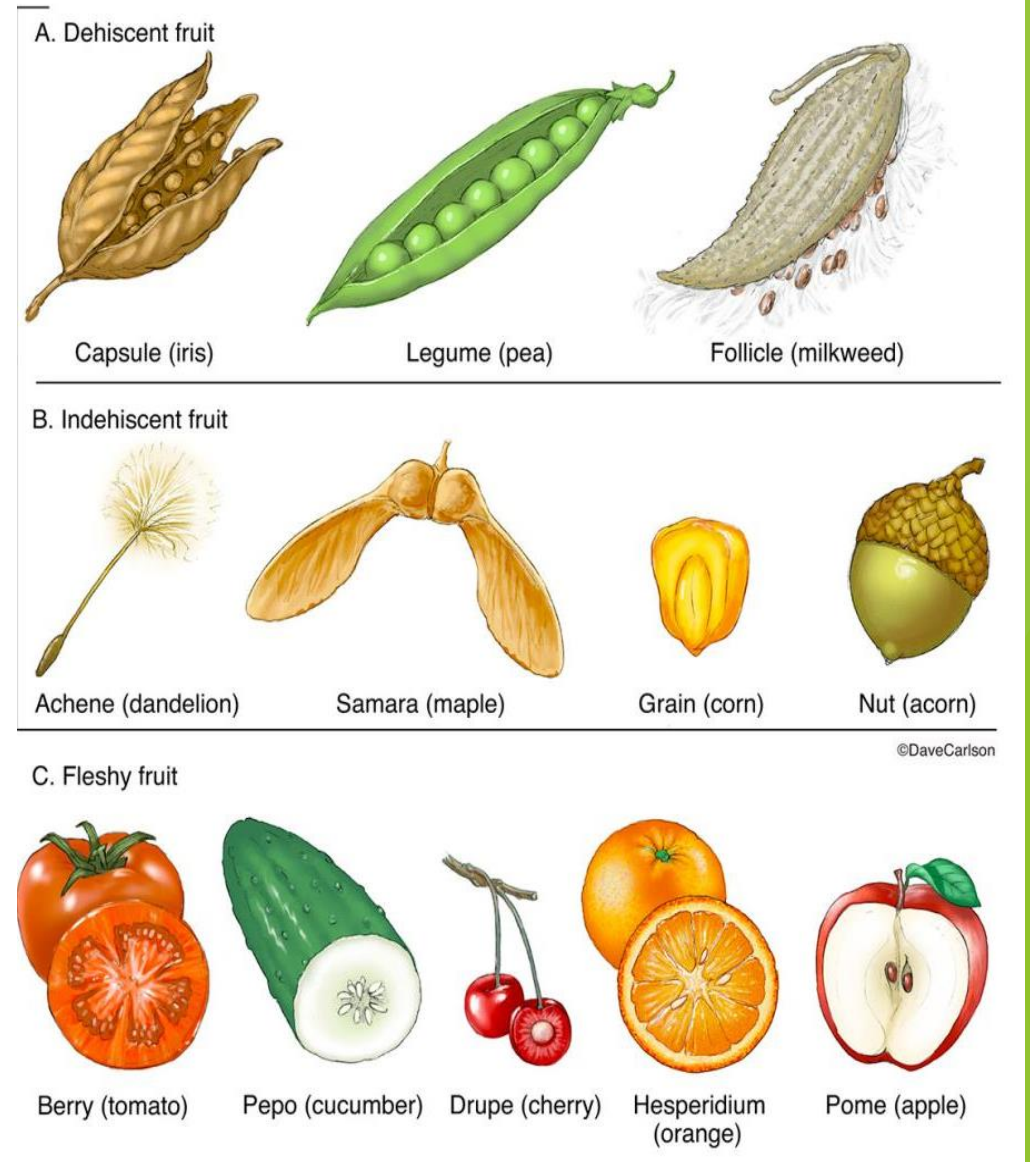
Gynoecium: Fruit

- **Nut-** A dry, one chambered and one-seeded fruit developing from a superior, bi or polycarpellary ovary, with the pericarp hard and woody, e.g., chestnut, oak, etc.
- **Samara-** A dry, indehiscent, one or two-seeded fruit developing from a superior, bi-or tricarpellary ovary, with flattened wing-like outgrowths, e.g., Hiptage.



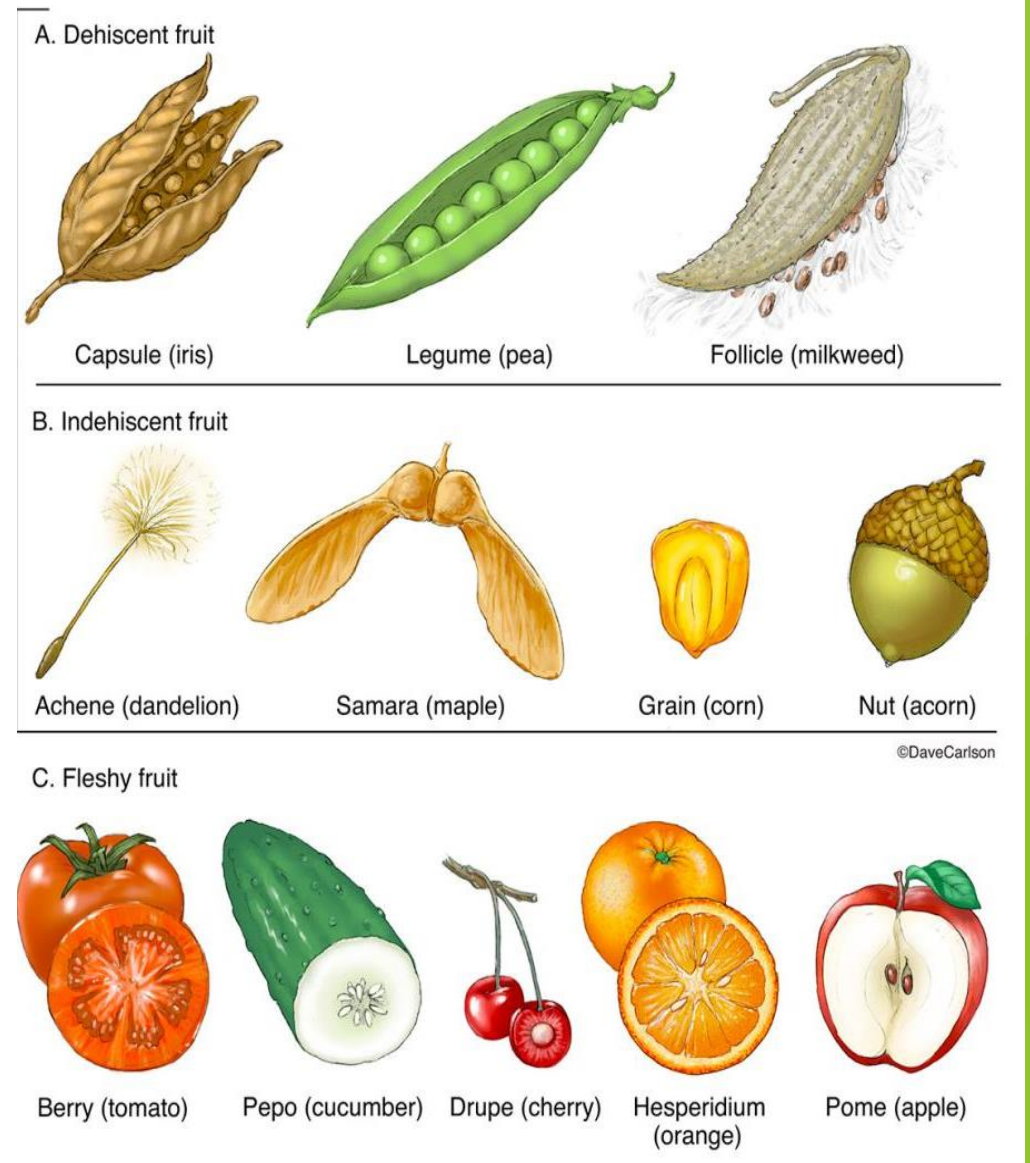
Gynoecium: Fruit

- **Lomentum-** The legume is constricted or partitioned between the seeds into a number of one-seeded parts, e.g., Acacia.
- **Cremocarp-** A dry, indehiscent, two-chambered fruit developing from an inferior, bicarpellary ovary; when ripe splits into two, indehiscent, one-seeded mericarps which remain attached to the prolonged end (carpopphore) or the axis, e.g., Umbelliferae.
- **Regma-** A dry schizocarpic fruit developing from a tricarpellary, syncarpous, superior ovary and splitting at maturity into three cocci, e.g., Ricinus.



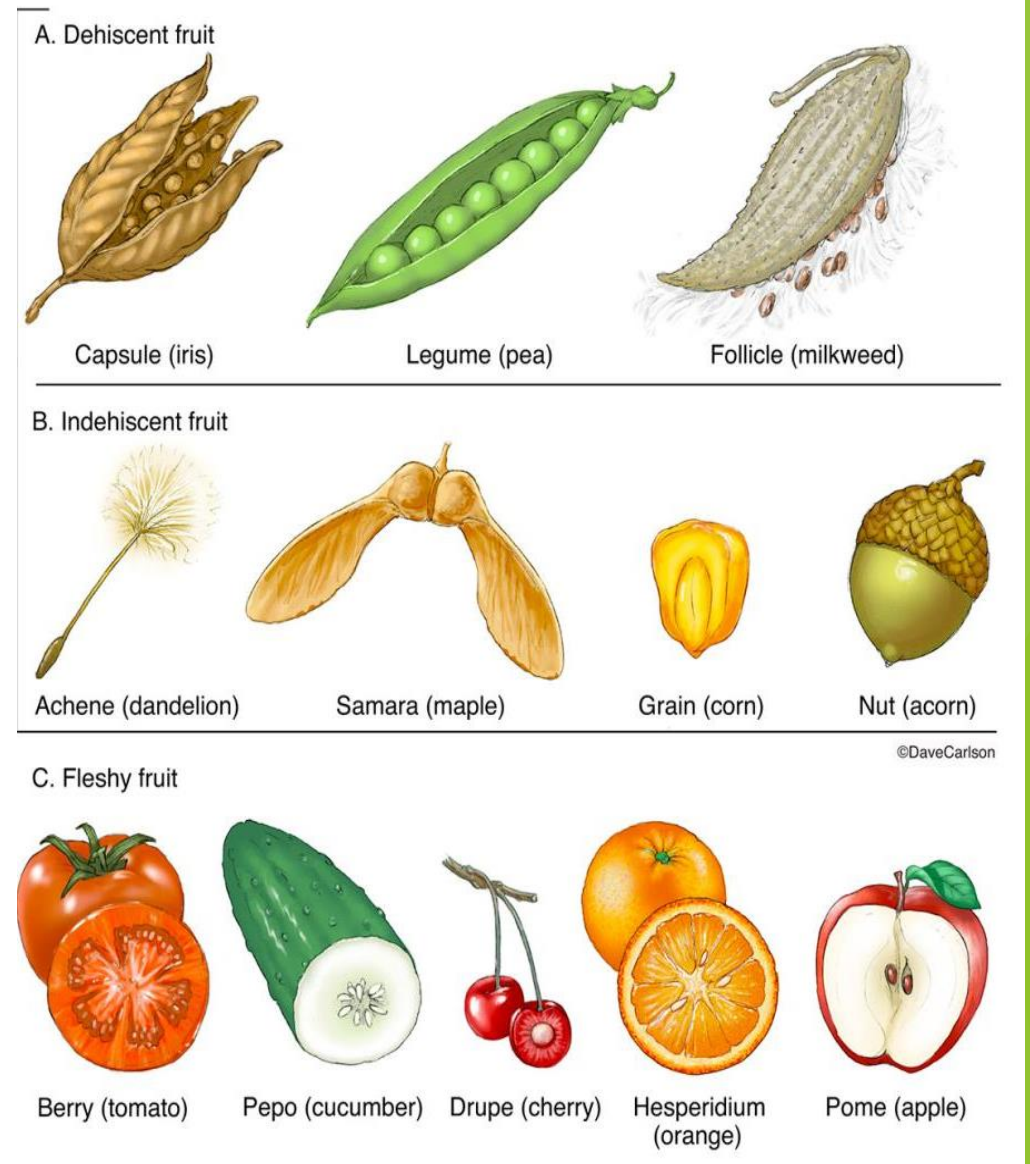
Gynoecium: Fruit

- ▶ **Carcerulus** The fruit develops from a bicarpellary pistil with a superior ovary which becomes quadrilocular owing to the formation of two false septa; at maturity the four mericarps separate from each other towards the middle, e.g., Labiatae (*Ocimum*)
- ▶ **Double samara-** It consists of two, three or four samaras, e.g., *Acer* and *Sapindaceae*.
- ▶ **Drupe-** A fleshy, one or more-chambered and one or more-seeded fruit developing from a monocarpellary or syncarpous pistil, e.g., mango



Gynoecium: Fruit

- ▶ **Pepo-** A fleshy, many-seeded fruit developing from an inferior, one-celled or three-celled, syncarpous pistil with parietal placentation, e.g., Cucurbitaceae.
- **Pome-** An inferior, two or more-celled fleshy syncarpous fruit surrounded by the thalamus, e.g., Apple, Pear.
- **Hesperidium-** A superior, many-celled, fleshy fruit developing from a syncarpous pistil with axile placentation; e.g., Citrus.



Gynoecium: Fruit

Aggregate fruit- It develops from a single flower with an apocarpous pistil, carpels being free, each of them develops into a simple fruitlet; an aggregate fruit, Each fruitlet of an aggregate may be a follicle, an achene, a drupe or a berry.

- ▶ **Aggregate of follicles-** Each fruitlet consists of two or more follicles, e.g., Calotropis, Asclepias, Aconitum, Michelia.
- ▶ **Aggregate of achenes-** Aggregate of achenes, e.g., Clematis, Naravelia, strawberry
- ▶ **Aggregate of drupes-** A number of small drupelets, developing from separate carpels of a flower, are aggregated together on a fleshy thalamus, e.g., raspberry (Rubus).
- ▶ **Aggregate of berries-** Developing from an apocarpous pistil and lying embedded in the fleshy thalamus, e.g., custard apple;

