Morphology : Flowering Plants

→ Study of external characters of plant body

Angioplant

- ① Vegetative part
  - Root
    - ✱ Structure
    - ✱ regions
    - ✱ types of roots
    - ✱ Modification
  - Stem
    - ✱ structure
    - ✱ characters
    - ✱ modification
  - Leaf
    - ✱ Structure
    - ✱ venation
    - ✱ Phyllotaxis
    - ✱ types of leaf
    - ✱ Modification
- ② Reproductive
  - flower → ✱ Inflorescence
  - fruits → ✱ types → structure
  - Seed → ✱ type → Struc

✱ **Families**

- Fabaceae (Pea)
- Solanaceae (Potato)
- Liliaceae (Onion)
- Brassicaceae (Mustard)
- Poaceae (Wheat)

Roots

General Characters

(i) It develops from Radicle of Seed, or it may develop from any other part such as stem or leaf → Adventitious root

(ii) Roots are normally +ve geotropic (towards gravity) & -ve phototropic (opposite to light)

(iii) Roots grow +vely Hydrotrophic (towards water).

(iv) Roots are underground hence → non green → don't perfor photocythesis

(Exception :- Tinospora & Trapa)
(green photosynthetic roots)

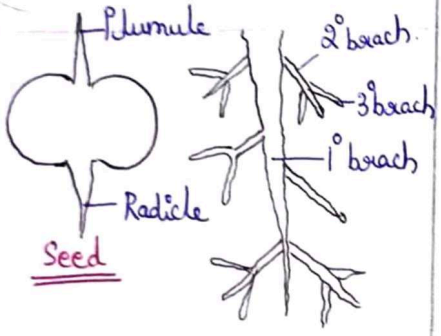
- Terrestrial plants have well developed & deep root system.
→ Roots are most well developed in Xerophytes (Desert).
→ Roots are either absent or small (Reduced) in aquatic plants.
Smallest angiosperm ← Wolffia (microscopic & aquatic)

Types of Root :-

* Fibrous root are also a type of Ad. root

① Tap Root System —

- A main primary root develops from radicle of seed.
- This primary root will persists through out the life.

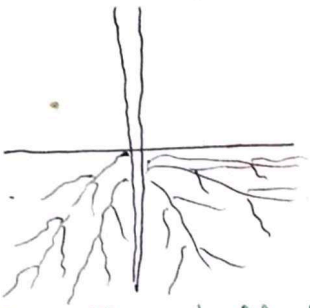


- 1° Root give rise to 2° & tertiary branches.

Eg :- Dicot plants
Fabaceae (Pea)
Solanaceae (Potato)
Brassiceae (Mustard)

② Fibrous Root System (झकड़ा)

- The primary root which was formed by Radicle get dry & shed off.
- There is no primary root.
- Cluster of fibres arise from the base of stem called fibrous roots.

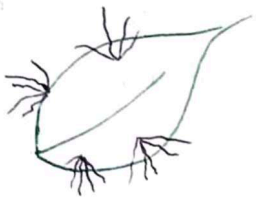


Eg :- Monocot plants
Liliaceae (Onion)
Poaceae (wheat)

③ Adventitious Roots अपस्थानिक

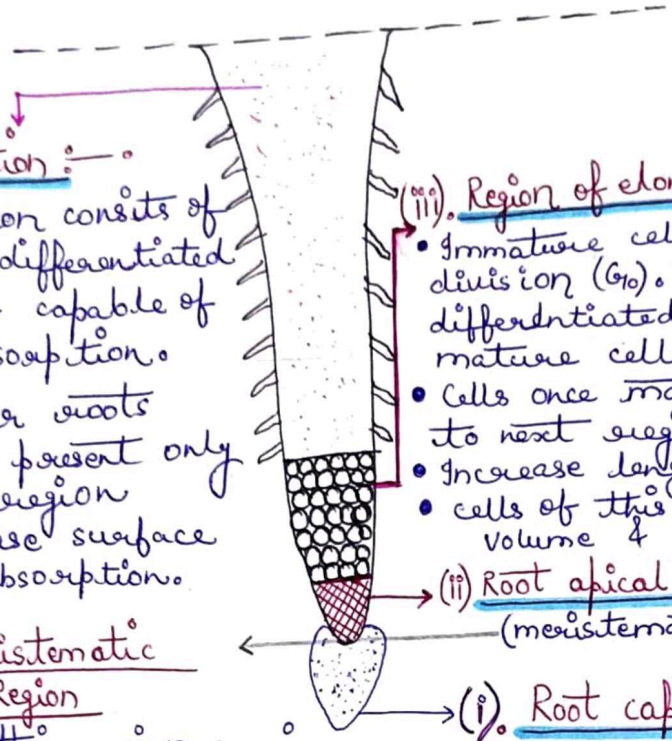
- roots developing from any parts of plants other than Radicle.

Eg :- ① Sweet Potato (Convolvulaceae) (Dicot) → stem
② Bryophyllum (leaf)



③ grass
④ Monstera
⑤ banyan tree

Regions of Roots



(iv). Maturation :—

- This region consits of mature differentiated cells are capable of water absorption.
- Unicellular roots hairs are present only in this region to increase surface area of absorption.

(iii). Region of elongation —

- Immature cells that stop cell division (G_0). these cells get differentiated to form mature cells.
- Cells once mature are added to next region.
- Increase length of root.
- cells of this region, increase volume & elongate.

(ii) Root apical Meristem — (meristematic Region)

Meristematic Region

- Cells of this region remain in cell cycle and continuously divide to add new cells above & below. Cell are metabolically active Thincoalled, large Nucleus, dense cytoplasm.

(i). Root cap —

- It is a cap like Protective structure.
- Provide protection against soil friction.
- It always contain new cells.
- Root cells are rich in golgi apparatus → Release → mucilage (mucus) → "Provide lubrication"
- Multiple root caps in 'Screw pine'. and Root cap absent in aquatic plants instead a root Pocket is present.

Modification of Root :-

Reproductive parts → fruits
Vegetative parts → vegetables

The primary function of Root is to absorb water minerals and provide anchorage.

→ In some cases root get modified (different) to perform some other function.

(i). Food Storage :-

Such roots become fleshy and bulky due to storage of foods.

Examples

Tap Root

(i). Fusiform Root —
Narrow from tips & Broad from centre.
Eg :- Radish

(ii). Cone Shape —
Eg :- Carrot
(Brassicaceae)

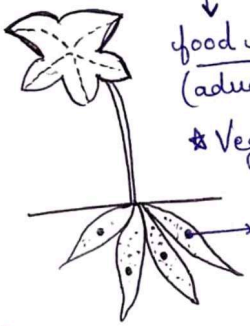
(iii). Napi form —
Eg :- Turnip & Beet Root
(Brassicaceae)

→ Mustard family

(iv). Tuberous Root —
tuber like.
Eg :- mirabilisjalapa
(4'o clock plant)

Adventitious Root

(i). Sweet potato (dicot)
(convolvulaceae) (tuberous)



food storage (adventitious)
* Vegetative ~~buds~~ Reproduction.
Adventitious buds

(ii). fasciculated
Swollen Roots
Eg :- Dahelia & Asparagus
(liliaceae)

(ii). Respiratory Roots (Pneumatophores) → Purpose Respiration

→ These are present in 'Halophytes'. (Plants which grow in Saline marsh).

"Sunderban" delta is largest in world.
↳ abundance of 'Rhizophora' (Sundari), Sonneratia

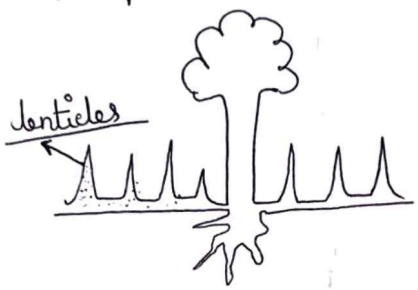
↓

Roots become Positively Phototrophic & -ve geotropic and come out soil surface for 'exchange of gases'.

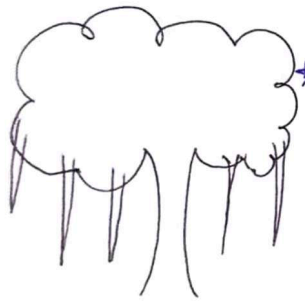
↓

Through pores called lenticels → Pneumatophores
↓
Respiratory roots.

★ It is modification of Tap roots.



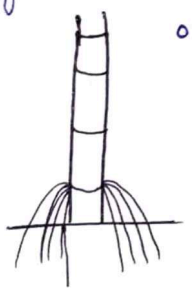
(iii). Support :- @. Prop roots :- large woody, pillar like roots which arise from Banyan tree (ficus beghalensis) ↳ 'Branches'



★ They are modification of Adventitious roots.
★ Root cap present as they ~~end~~ ultimately become underground.
★ Purpose provide support.

(b). Still roots —

- found in monocots like Maize and Sugarcane.
- Adventitious roots fibres arise from lower node of stem & provide mechanical support.



Special Roots —

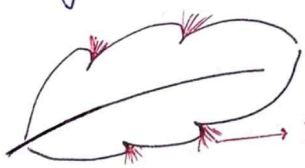
(i). Floating roots :- Spongy & filled with air cavities.
Eg :- Jussiae

(ii). Assimilation :- Roots become green & photosynthetic
* they come in contant with sun's light.
Eg :- Tinospora & Trapa (water chest nut)
(गिलोय) (सिंघाड़ा)

(iii). Haustorial roots :- injection like sucking roots.
Eg :- Parasitic plants → cuscuta & viscum
(अमरबेल)

(iv). Hygroscopic roots :- water loving roots.
found in Epiphytes (space parasites).
Eg :- Orchids grow on mango tree
Orchids hang fluffy spongy roots from Branches
↓
Velamen tissue :- can absorb air moisture.

(v). Epiphillous roots :- Roots which grow from leaves.
Eg :- Bryophillum (पत्थरचट्टा)



(vi). Reproductive roots —
Eg :- Sweet potato → having adventitious buds which perform vegetative propogation.

Stem

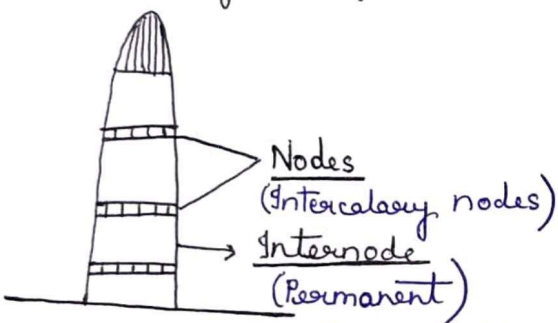
→ Usually hard, Dark brown, erect aerial structure → Hold or Bear leaves, flowers & fruits. It hold the leaves up to a certain height so that it attain max. sunlight.

→ It consist of vascular tissue xylem & phloem.
- xylem → transport water/minerals
- phloem → food transport

→ Stem also synthesize a PGR (Plant growth regulator)
- PGR → Plant harmon
- Auxin (stem tip)

→ **Identification :-**

→ Stem have nodes and Internodes.
- nodes → growing area where intercalary meristem found
- Internodes → Region of Permanent cells



→ It is elongation of plumule (embryo).

→ It is usually ascending part (+ve ly phototrophic)

Stem bear buds (buds)

→ a bud is a group of dividing cells which can generate new structure like leaf, branch, flower.

→ Stem branches are exogenous in origin, where as root branches are endogenous, what would be easy to pluck → Stem branches.

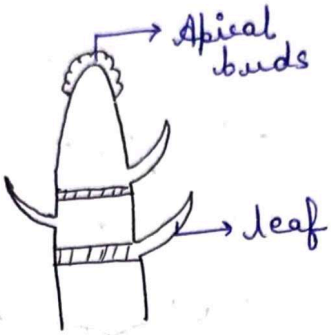
→ On the basis of location buds are of 2 types :-

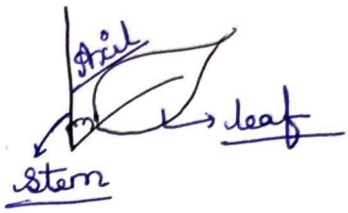
Terminal / Apical buds

- These buds are located at the tip of stem.
- They give rise to branches & leaves

Lateral / Axillary buds

- They arise in the axil of leaf.

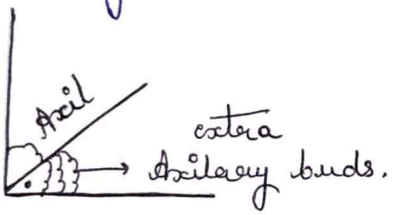




Lateral buds —

→ Other types :-

1. Floral bud → flower formation
2. extra axillary bud —



3. Adventitious — buds which arise from any part other than stems.

Ex → Sweet potato (Root bud)
Ex → Bryophillum (leaf bud)

Stem Modification —

Sometimes stem get modified to perform some specific functions →

(i). Underground stem (4)
(ii) Sub aerial stem (4)
(iii). Aerial stem (4)

Underground Stem :-

→ Usual purpose = food storage (hence fleshy)
→ They bear buds hence they help in perennation. (Poss stress)

→ (i). Tuber :-

→ Usually annual (Complete life in one years)
→ Undifferentiated structure, usually spherical.
→ Covered by brown leaves hence nodes and internodes aren't visible.
→ Very fleshy (soft) ⟶ store food → starch
↓
give violet blue colour with iodine.
→ Roots are absent, Auxiliary buds are present.
→ These buds are commonly called as eyes of potato → can give rise to new plant.

Eg :- Potato

(ii). Rhizome —

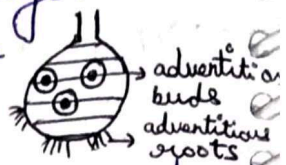
→ These are the underground branches of main stem, which grow parallel to soil surface.
→ Also undifferentiated and perennial (many years).
→ Nodes and internodes are visible.
→ Adventitious roots arise from lower surface and axiliary buds are present.

Rhizome

Eg :- Ginger & Turmeric & Dryopteris
(Zingiber) (Curcuma longa) (fern)
↓
yellow substance curcumine.
↓
Base ⟶ Red

ii). Corm —

→ They are also underground stem → food storage.
→ They are similar to rhizome but corm are spherical of and annual.



→ Nodes and internodes are present and visible.
→ Adventitious roots on lower surface, axillary buds are present

Eg :- Alocasia (arbi), Amorphophallus (zamikand or elephand foot) Colocasia (Kachalu), crocus (केसर)

iii). Bulb :-

→ It is an extremly reduced (discoid) underground stem (don't store food).
→ It give rise to buds & leaves above and adventitious roots below.

→ Leaves are of 2 types :-

(i). Scale leaves → Protection
(ii). Spring leaves → green & photosynthetic

BULB

Tunicated
Tunica is present → Covering of leaves
Eg :- Concentric.

Onion
'Alium cepa'

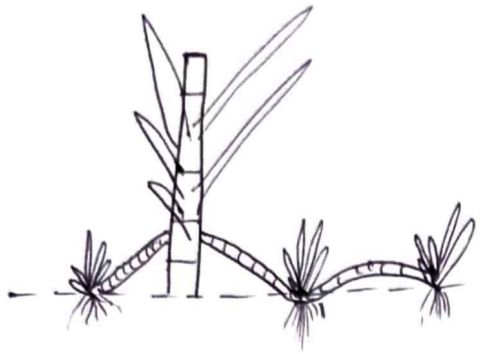
Non-tunicated
Tunica absent
lily → liliaceae
Ex :- garlic
'Alium sativum'

Sub aerial stem —

Half underground & half aerial.

i). Runner :—

→ These are horizontal branches which arise from lower nodes of main stem.
→ When these branches touch the soil, it produce cluster of leaves above & below root.



→ They cover a large area in a short time span →

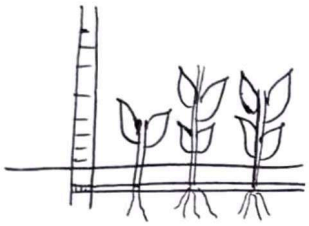
Runner

Eg :- Doob grass (lawn grass), Oxalis & Centella (Bhrami booti)

(ii) Sucker :-

→ These are underground branches of main stem.
→ They grow beneath soil for a while & then come out of surface, lower node give rise to Adventitious Roots.
→ Accidental breakdown form new plant.

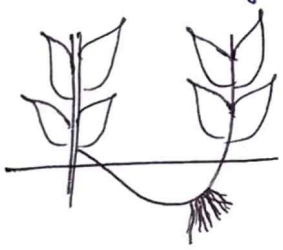
Ex :- Chrysanthimum
Banana
Pineapple & Strawberry



(iii) Stolon —

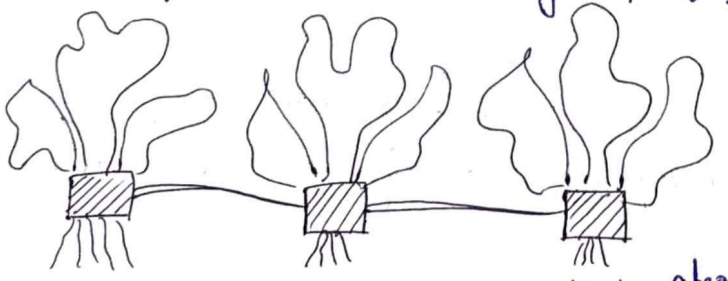
→ These are lower arched branches which come in contact with soil & give rise to new plants.

Eg :- Mint, Jasmine & wild Strawberry —



(iv) Offset :-

→ These are also horizontal branches, similar to runner but they found in aquatic plants (still water)
→ Short branches (Usually one internode long) they produce cluster of leaves above & group of roots below (Adventitious)



Ex :- Eichornia & Pistia
(water hyacinth)
↓
Terror of bengal
(invasive weed)

absorb dissolved O_2 from

Purpose of these stem ⇒ Vegetative Propogation
⇓
Mitosis division (Asexual)

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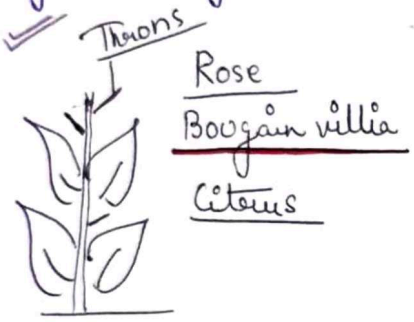
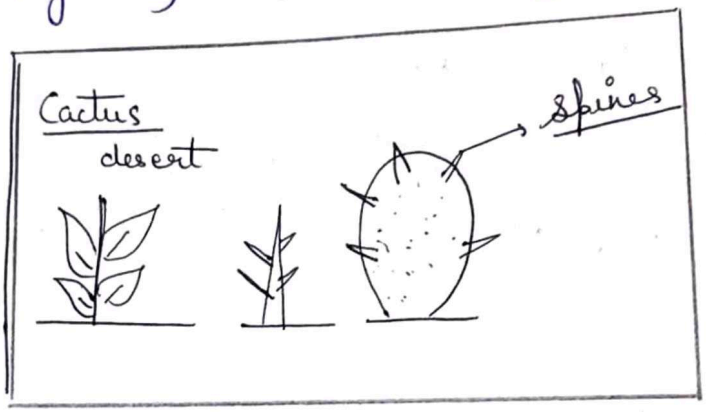
Aerial Modification —

(i). Thorns —

These are woody hard, Pointed spiny structures formed by axiliary buds (exogenous).



Rose
Bougain villia
Citrus



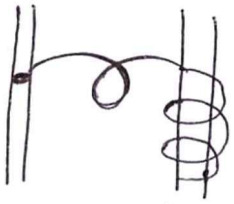
→ Function of thorns :-
Protection from Herbivores.

(ii). ~~Leaf~~ Stem Tendrils —

leaf tendrils & stem tendrils are analogous.

→ Tendrils are long, coiled, Theard like structure. which coil around any support & Provide strength to week stem (climbers)

→ These arise from axiliary buds.



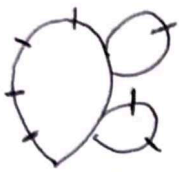
Eg :- grape vine &
Cucurbitaceae → Cucumber
→ melon
→ Pumpkin
→ Gourd

(iii). Phylloclade —

→ These are flat, fleshy, green, photosynthetic stem found in Xerophytes (Desert plants) → grow in Arid (dry) Zone. Purpose → Photosynthesis

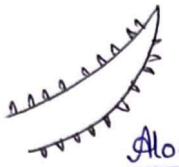
→ because leaves have been converted in to spine.

Eg :- Cactaceae
↳ Opuntia, Euphorbia



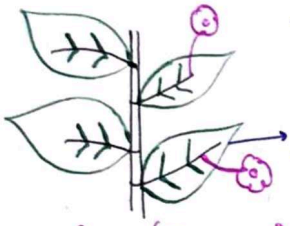
Opuntia

Euphorbia



Aloe (liliaceae)

(iv) Cladode —



→ In some plants branches may become leafy. Purpose → Photosynthesis

leafly branch

Eg :- 'Ruscus' and 'Asparagus' (Liliacae)

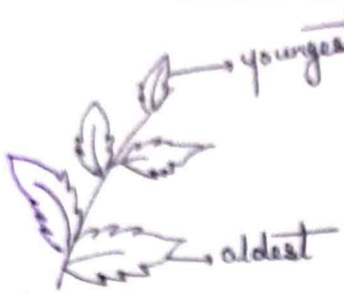
leafy branch (one internode long)

Budbils → These are fleshy, heavy buds due to food storage, when they fall they form a new plants (vegetative propogation)

Eg :- Agave (century plants → flowers in 100 yrs) / Oxalis.

LEAF

- One of the most important part of plant body (Organ)
- * Cotyledons → first leaves of plant life, present in seed.
  ↳ fleshy and provide nutrition to embryo.
- * Foliage leaf → flat, green, photosynthetic, typical leaves which arise from node of stem, produced exogenously.
  → foliage leaves perform photosynthesis, leaves are arranged in acropetal manner on stem or branch



→ Usually an axillary bud located in the axil of leaf.

→ for respiration stomata are present.

Accepital arrangement

(iii). Lamina or leaf blade — Mesophyll tissue → Photosynthesis

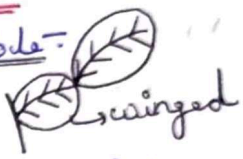
Midrib (elongation of Petiole) → (Xylem / Phloem) → (transport & rigidity)

Veins

Veinlets

Special cases :-

① Winged Petiole — Eg :- Citrus



② Phyllode — Swollen green petiole. Eg :- Australian acacia.

(ii). Petiole — → long stalk, which hold the leaf at a height where it attain maximum sunlight. it also transport materials (Xylem / Phloem).

Internode

Node

Stipule — → a small green leaf located at the leaf base of a foliage leaf. (May or may n't)

In Pea → large stipule present.

(i). Leaf Base — → It is the swollen basal part of leaf. (attach the leaf with node).

Special case → In legume plants (fabaceae) leaf base is swollen (food storage) → Pulvinus leaf base.

→ It makes the junction weak.

→ In monocot, leaf base become flat, sheathy & cover the stem → sheathy leaf base.

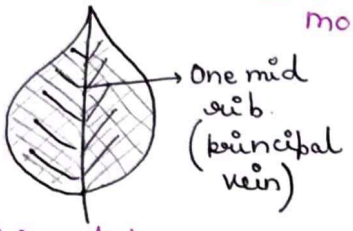
Venation

→ Arrangement of veins & veinlets on leaf lamina.

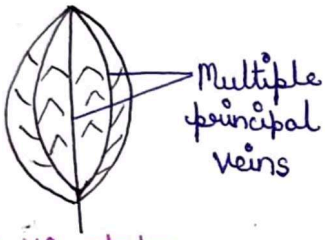
Reticulate

→ Veins & veinlets form a network on lamina.

Eg :- Dicots (Exception :- ~~Some~~ Smilax is a monocot with reticulate)



Unicostate Pepal leaf



Multicostate (Convergent)

Eg :- Ziziphus

Multicostate (Divergent)

Luffa (Cucurbitaceae)

Parallel

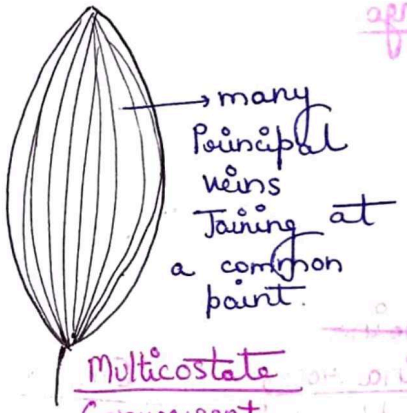
→ Veins & Veinlets Run parallel to each other.

Eg :- Monocots

(Exception :- calophyllum is a dicot with parallel veinlets)

Unicostate

Banana & leaves of agave



Multicostate Convergent

Bamboo

Many Principal veins, arise from common base but go in diff. direction

Multicostate (divergent)

fan palm

Types of leaf

→ On the basis of cuts or incisions present on lamina leaf is of 2 types.

Simple leaf

→ In this type leaf lamina is either (no cuts) or ~~inner~~ incised cuts are present but they don't meet the mid rib.

Eg :-
Entire — Chrysanthemum, ~~Luffa~~
Leaf & Mango

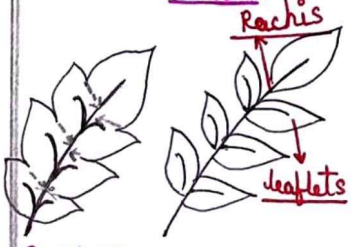
~~Lobed~~
China rose, maple, Luffa — Cannabins

Compound leaf

→ Incisions in leaf lamina are ~~two~~ deep that they meet the midrib or the petiole, Breaking the leaf into many small leaflets.

Pinnately Compound

- In this type incisions meet the mid rib breaking leaf into small leaflets.
- A common Axis that bear the leaflets is called Rachis.



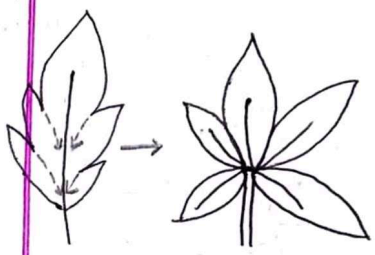
① Unipinnate :-
When leaf divide once in pinnate fashion. Pinnae or leaflets are located opposite on a common axis called Rachis.

Paripinate
tip of Rahis don't bear leaflet (even)
Eg :-
Cassia

imparipinnate
Rachis tip have leaflet (odd)
Eg :-
Neem (Azadirachta indica)
Rose (Rosa indica)

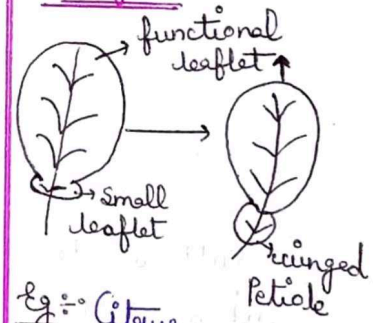
Palmately Compound

→ Incision of lamina are deep that they meet the petiole.



→ There is no rachis. Palm like structure.

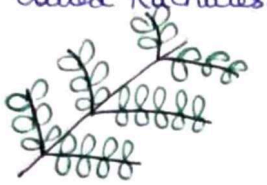
① Unifoliate leaflet —



Eg :- Citrus

Compound leaf —

② **Bipinnate** —
divide twice, Rachis & its branches called Rachules.



Eg :- Acacia
&
Mimosa pudica
(touch me not)

③ **Tripinnate** :- Eg :- Moringa

④ **Decompound leaves** —
(Divide more than twice).
Eg :- Coriender and Radish

② **Bifoliate** —

② functional leaflets
Eg :- Bigonia

③ **Trifoliate** —

Eg :- Trifolium (Fabaceae)

④ **Quadrifoliate** — 4
Ex :- Paris

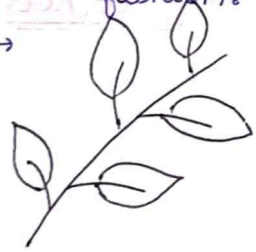
⑤ **Multifoliate** — 50 or more
Ex :- Silk cotton
(Bombax)

PHYLLOTAXY

(Arrangement of leaves on stem or branch)

Alternate Phyllotaxi

→ One node bear only leaf in an alternate fashion.



Eg :- Chinarose (malvaceae),
Sunflower, (asteraceae),
cotton.

Opposite

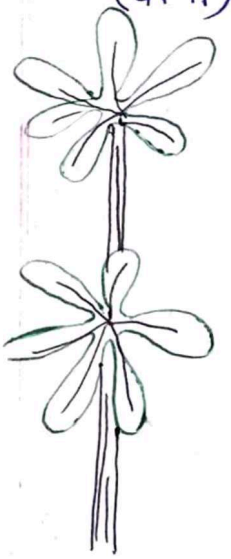
One node bear 2 leaves in an opposite fashion.

Eg :- Guava

Special Case —
Decussate opposite
↓
leaves at adjascent node arise in a right angle (90°)
Eg :- Calotropis,
Tulsi (Ocimum Sanctum)

Whorled

→ More than 2 leaves at each node
→ 3 → in → Nerium
→ 5 in alstonia.
(चप्पा)



Modification of leaf

①. Leaf Tendrils —

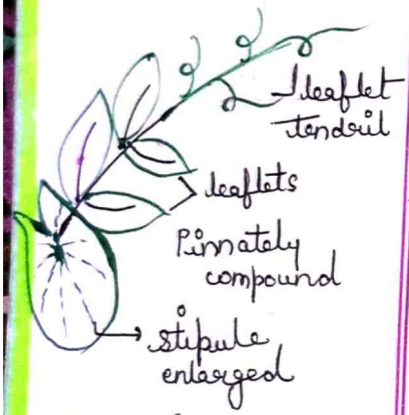
→ leaves get modified in tendrilar structure (long, thread like & coiled)

→ Purpose provide → strength (support)

→ Eg :-

Fabaceae

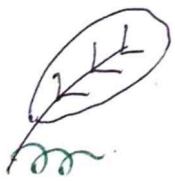
- Lathyrus — entire leaf into tendril
- Pea — leaflet tendrils.



* Exception :-

Smilax

Stipul form tendril.



②. Spine —

→ needle like, hard, wood & pointed structure,

→ modified from leaves to reduce rate of transpiration & protection.

→ Spines are found in arid zonal plants (dry).

Eg :- Cactaceae

- → opuntia
- → Euphorbia

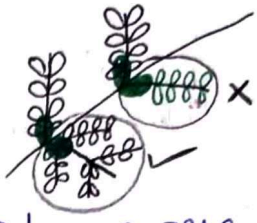
③. Fleshy edible leaves —

→ Cotyledons & Scale leaves of Onion & garlic.

④. Phyllodes

↓

Australian acacia.



→ leaves are extremely Reduced so their petiole become fleshy, green & Photosynthetic to increase surface area of photosynthesis

⑤. Leaf Pitchers —

→ In certain plants such as Pitcher plant leaves are modification into insect trapping Pitchers (Insectivorous Plants)

↓

These plants are autotrophic. but to complete N_2 requirement they trap insects, digest flesh and obtain Nitrogen.

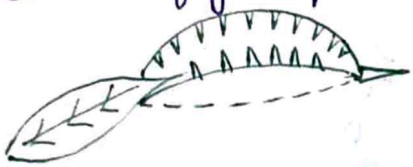
① Nepenthus (Pitcher plant)

Ex :-

② Sarracenia —

→ In some plants leaves get modified into insect catching traps.

Ex :- ① Venus fly trap.



② Drosera —

INFLORESCENCE

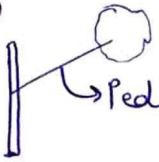
→ Unit of Sexual Repro. in plant is flower.

→ flower is a modified "shoot"

Apical shoot meristem ⟶ floral meristem ⟶ flower.

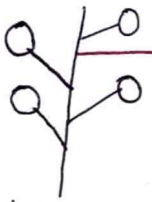
complete floral meristem ⟶ single flower.

Ex :- Hibiscus (china Rose)



Solitary flower

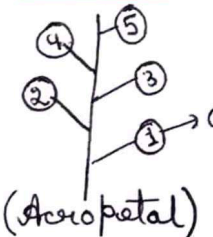
→ When floral meristem produce a group of flower on a common axis (Peduncle).



Inflorenseence

Inflorenscence are of two type on the basis of arrangement of flower

Racemose



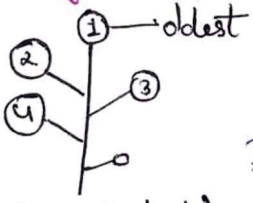
(Acropetal)

Ex :- Mustard, Radish, Lupin (~~Hibiscus~~)

→ Peduncle in definate growth.

→ tip is always free.

Cymose



(Basepetal)

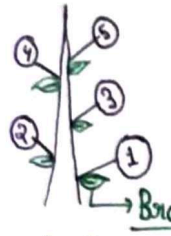
Ex :- Begonia & Solanum.

→ Peduncle show limited growth.

→ first flower terminate the tip.

Type of Racemose

① Raceme —



→ Peduncle is long which bear bractate & Pedicilate flowers in acropetal manner.

→ Radish [B] (Raphanus Sativa)

→ Lupin [f]

② Spiklet —

→ Peduncle is short covered by glumes and bear sessible flowers

Ex :- Wheat, [Poaceae] Maize

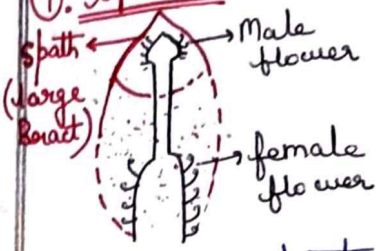
③ Catkin —

→ Peduncle is pendular.

Ex :- Mulberry

→ bear Sessible bracteate flower.

④ Spadix :-



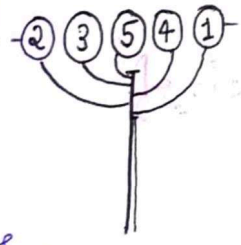
→ Peduncle is short & thick bear unisexual flower

Eg :- Banana

⑤ Corymb —

→ Peduncle is very short.

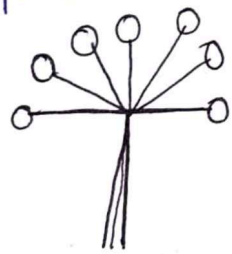
→ lower flower bear long pedicel & upper bear short → all flower at - same level.



Ex :- Cauliflower [B]

⑥ Umbel —

→ Peduncle is extreme short all flower arise from one point.

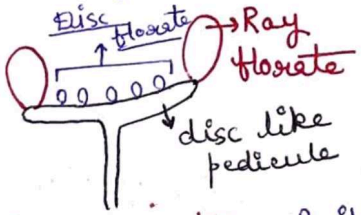


Ex :- Onion [L] (Umbelliferae)

⑦ Capitulum — (Head)

→ Peduncle is short, fleshy & flat (disc like)

→ Two type flower —



(i) Ray Floret :- Peripheral flowers → Usually female flower with inferior ovary or sterile.

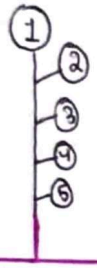
(ii) Disc floret :- Dark or black in colour and bisexual.

Eg :- Sunflower & Marigold (Asteraceae)

Types of Cymose

Monochasial/ Uniparous

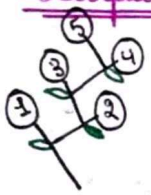
→ flowers arise in one direction on Peduncle.



Helicoid

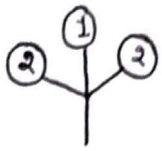
Ex :- Begonia & Drosera

Scorpioid



Ex :- Heliotropium & Ranunculaceae (buttercups)

Bichasial/diparous.



Eg :- Bougainvillea, Jasmine & Rose.

3 Special Inflorenscence

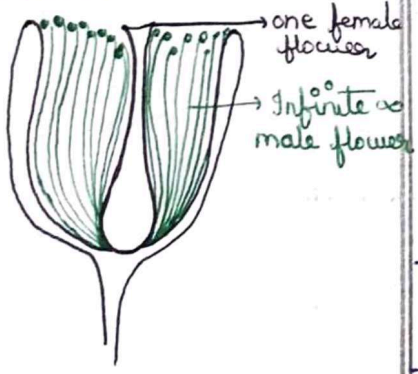
(i) Cyathium —

found in Euphorbeaceae

↓

Euphorbia (Cactus)

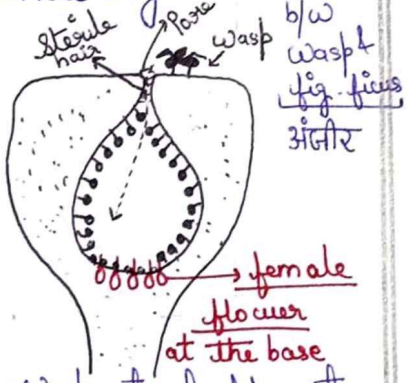
→ Peduncle form a cup like structure.



(ii) Hyphanthodium —

→ peduncle form a closed capsule.

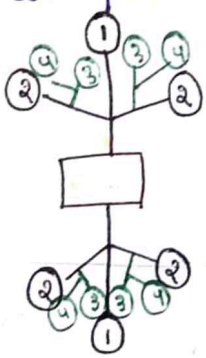
Show symbiotic relation b/w wasp & fig. ficus अंजीर



→ Wasp get safe place to lay eggs.

(iii) Verticellaster —

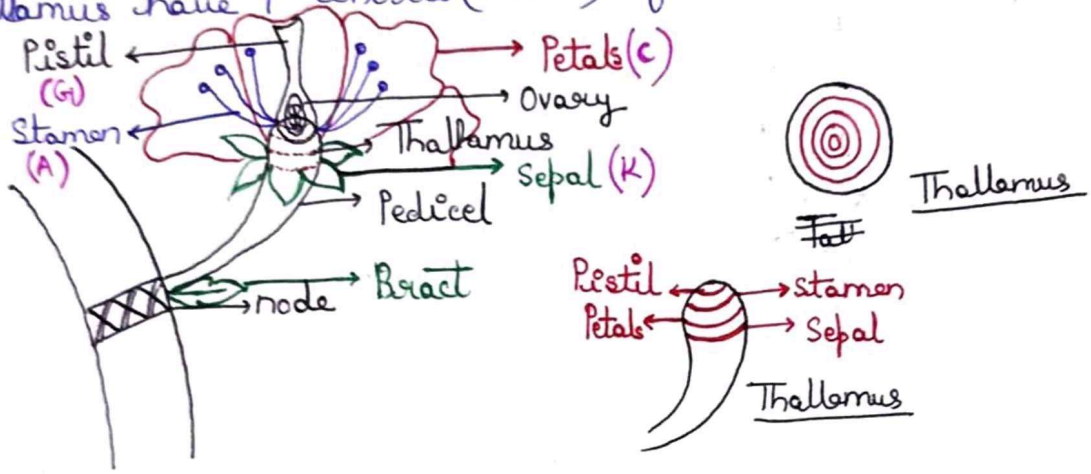
→ It starts with ~~bas~~ bichasial cyme & ends in monochasial scorpiod.



Eg :- Ocimum & Salvia (Lamiaceae)

Structure of flower —

→ Modified stem
→ flower is also called as reproductive shoot.
→ The stalk which arise from node & bear floral leaves is called Pedical.
→ Pedical Present → Pedicillate flower.
→ Pedical absent → Sessil flower
→ The tip of pedicel is swollen and called as Thallamus
→ Thallamus have 4 whorls (circle) of nodes.



Branch

Flower bear 4 appendages —

Non essential
(i). Sepal (calyx)
(ii). Petals (Corolla)
(Only accessory Parts)

Essential
(i). Stamen [Androecium]
(ii). Pistil [Gynoecium]
{Sex Organs}

Types of flower —

(i). Presence of bract — Br (Bractate) bract Present & Ebr (Ebractate) bract absent

(ii). no. of floral leaves —

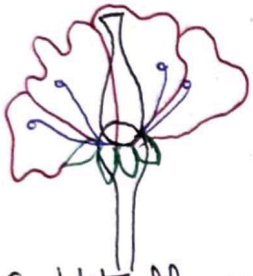
Trimerous — If the no. of appendages are either 3 or in multiple of 3

Eg :- Liliaceae (Onion)

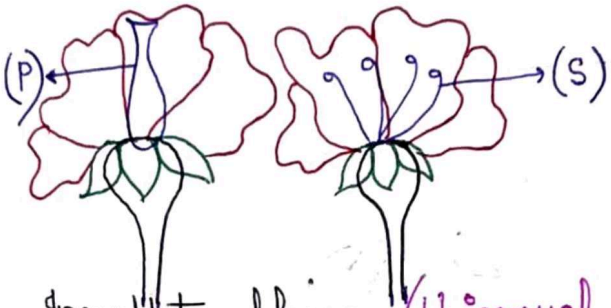
Tetramerous :- 4 or in multiple of 4. Eg :- Brassicaceae (Mustard)

Pentamerous :- 5 or in multiple of 5.
Eg :- Solanaceae (Potato)
Fabaceae (Pea)

(iii). Type of flower on the basis of sexuality —



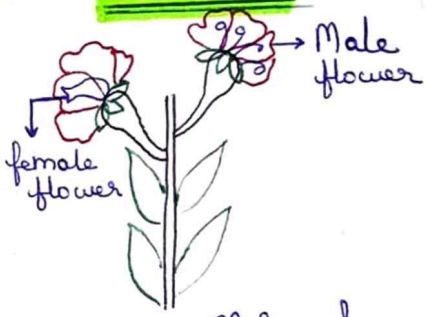
Complete flower
(Bisexual flower)
→ They have both stamen & pistil
Eg :- Solanaceae, Liliaceae & fabaceae.



Incomplete flower (Unisexual flower)
One flower bear only one type of sex organ
either Stamen (Staminate flower)
or Pistil. (Pistilate flower)
→ Male & female flower seperated.

Staminoids → Sterile male flow

MONOCIOUS



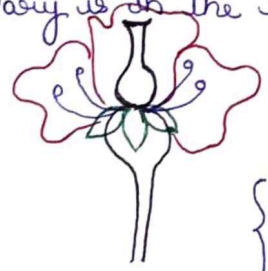
Eg :- Maize & Cucurbitaceae

DIOECIOUS

Eg :- Pappaya & Date palm

(iv). Type of flower on basis of position of Ovary —

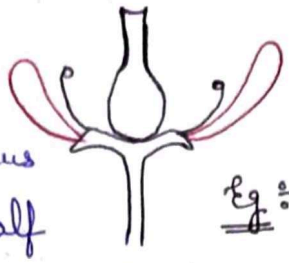
① Hypogynous flower —
→ Ovary is superior
→ ovary is located above the level of other floral parts.
→ Represented as (G)
→ Ovary is in the top most position.



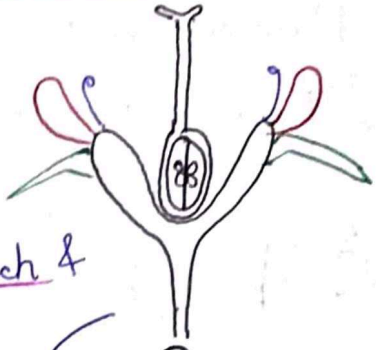
Eg :- Mostly flowers are hypogynous.
{ Solanaceae, Liliaceae, Brassicaceae, fabaceae, Poaceae, Malvaceae }

②. Perigynous flower —

→ Ovary is at same level with other floral parts on thallamus
→ Half superior & half inferior
→ Represented by (G^{-})



Eg :- Plum, Peach & Rose

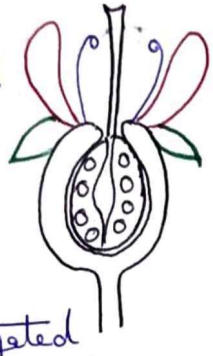


(A). (B)

→ Thallamus may be elongated but not fused with ovary.
→ This is also Perigynous.

③. Epigynous flower —

→ Ovary is lower than other floral appendages on the thallamus.
→ Inferior ovary
→ Represented $(\underline{G})$.
→ Thallamus is elongated but fused with ovarian wall.



Eg :- * apple & * Pear (false fruit)
Edible part is thallamus.
* Guava, * Cashewnut
* Cucurbitaceae → cucumber
→ melons
→ pumpkin
→ Gourds
* Ray floral of sunflower.

⑤. Type of flower on the basis of symmetry —

Actenomorphic
→ Radial symmetry
→ Can be divided into 2 equal halves by more than one plane.
→ Eg :- Solanaceae,
→ Symbol :-

Calotropis, liliaceae Brassicaceae. China Rose (malvaceae)

Zygomorphic flower.
→ It shows Iso-bilateral symmetry
→ Can be divided into 2 equal halves from only one plane.
Symbol :- %
→ Eg :- fabaceae (Pea)
Petal arrangement → butterfly like

Asymmetric
→ Can't be divided into 2 equal ~~parts~~ halves by any plane.
Eg :- canna

FLORAL APPENDAGES :-

(i). Sepals [Calyx (K)]

These are small green leaves located at the outermost whorl on Thallamus.

→ They cover the flower during bud stage.
↳ function is to protect the flower against excess transpir

→ They can be fused → Gamosepalous
or free → poly sepalous

→ They usually get dry & shed off after fertilization

Except :- Tomato, brinjal & Chilly → Persistant Sepal are present even after fertilization on fruit.
(Brinjal → false fruit)

* In asteraceae (Sunflower) → sepals turns into hairy structure called 'pappus' → help in Seed dispers

(ii). Petals [Corolla (C)] :-

→ These are large, Bright coloured, fragmented leaves to attract polinating agents

→ If not large & bright coloured → flower is either self polinate or polinated by abiotic agent.

→ They can be fused → gamopetalous or free → Polypetalous.

→ They get dry & shed off after fertilization.

Special :- In bougainvillia petaloid bracts present.

(ii). Tepals [Perianth (P)]

→ In some flower Sepal & Petals can't differentiated clearly in such case these are called tepals.

→ They can be free → Polytepalous
or fused → gamotepalous.

Eg :- liliaceae (onion)

AESTIVATION :-

The arrangement of both Sepal & petal on thallamus is flower bud with respect to the leaf of same whorl.

(i). Valvate

→ No overlaping
→ The margin of one sepal or petal just touch each other (side by side)

→ Eg :-
Calotropis,
Solanaceae,
liliaceae

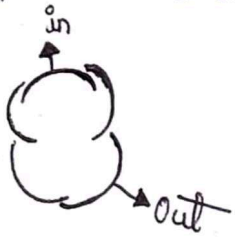
(ii). Twisted

→ One Sepal/petal overlap the successive Sepal or petal
→ even overlaping

Eg :- (Malvaceae)
China Rose,
Cotton, Okra.

(iii). Imbricate

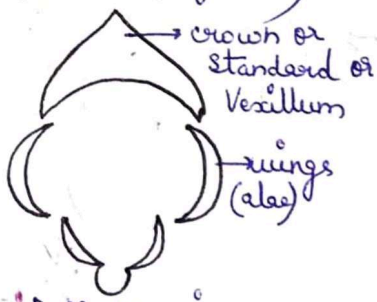
→ It show uneven overlaping.
→ One S/P is completely in, one is completely out & 3 are Twisted



Eg :- gulmohar, & Cassia

(iv). Vexillary

→ total 5 members in which one large Superior crown or standard or Vexillum is located at the anterior side.
It overlap 2 lateral wings (alae). These further overlap 2 small keels (carina)
(Kells or fused)

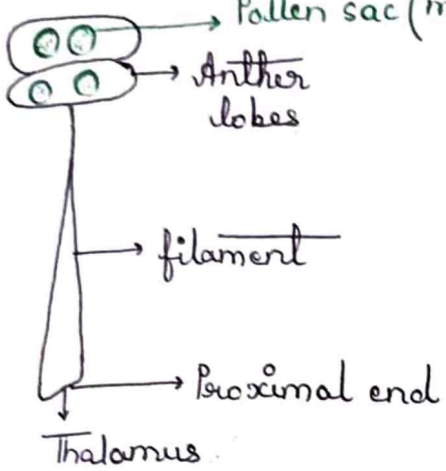


Butterfly like
(Papilionaceous aestivation)
↓
Papillo → butterfly

Eg :- Tobaccae
* (Papilionaceae)

(iv). Stamen / Androecium (A) :-

→ Male part of flower → modification of leaf → microsporophyll.
→ Consist of 2 parts → A long filament & lobes called anther lobes.



→ no. of anther lobe — commonly 2 in all plants

→ dithecous Stamen (Tetrasporangiate)

→ One in malvaceae family
→ monothecous (bisporangiate)
Eg :- China rose, Okra, cotton.

Types of Stamen o/B length of filament :-

→ length of filament is usually same in one flower.

Exception :-

(i). didynamous — total 4 Stamen
↓
2 long + 2 short

Eg :- (lamiaceae)
↓
Ocimum, (tulsi) Salvia.

(ii). tetradynamous — total 6 (2 short & 4 long)
~~(2 long & 4 short)~~
(2+4)

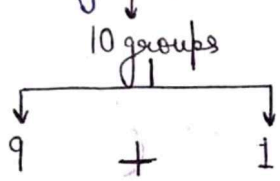
Eg :- Brassicaceae.

Cohesion of Stamen (adelphous Condition)

→ When stamen fuse together to form a group
→ All Stamen fuse to form one group → Monoadelphous

Eg :- China rose (Malvaceae)

→ When all stem fuse to form 2 different groups



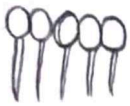
→ when all stem fuse to form more than 2 groups → Polyadelphos

Eg :- Citrus (lemon)

Eg :- Fabaceae

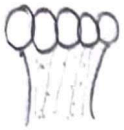
☆ Special Cases —

(i). Syngenesious → Stamen are fused only from anther (filaments are free)



Eg :- Asteraceae (marigold, sunflower)

(ii). Syandrous Condition → Stamens are fused completely → Anther & filament both fused.



Eg :- Cucurbitaceae

Adhesion of Stamen :-

→ When stamen get attached to some other floral ~~plant~~ part.

(i). Epipetalous stamen —

When stamen get attached to petals. Eg :- Solanaceae

$C_{(5)}$ A_5

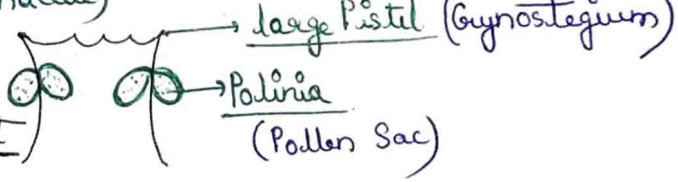
(ii). Epiphillous :-

When stamen get attached to tepals (Perianth) Eg :- Liliaceae

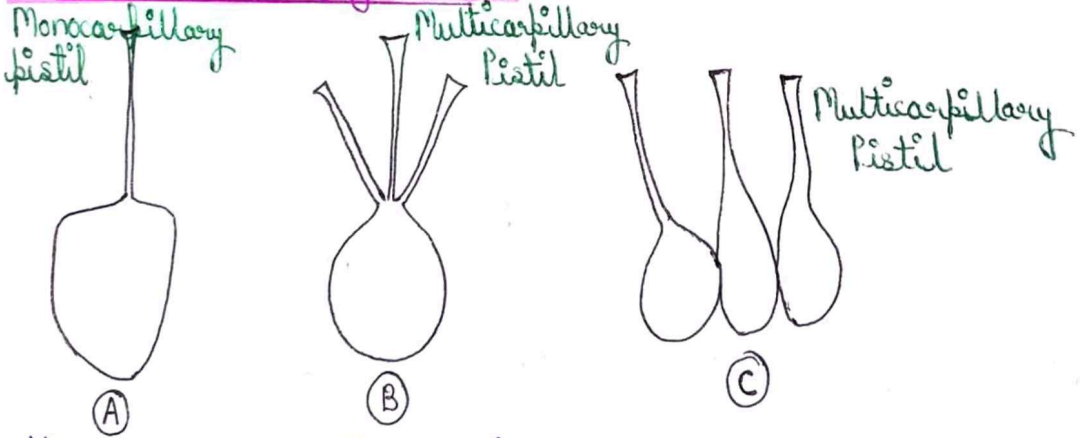
☆ Special Cases —

Stamen attached to Gynoecium (Syngynous)

Eg :- Calotropis (Apocynaceae) (आकौवा)



(V). Pistil or Carpel [Gynoecium] —



→ all three are pistil. Pistil may consist of one unit or many units. (Unit of pistil is called → Carpel] (Monocarpillary)

Multicarpillary

Syncarpous (if carpels are fused) Apocarpous (if carpels are free.

Monocarpellary

Fabaceae → G_1

Poaceae → G_1

Multicarpellary

Syncarpous

Solanaceae → G_2 → Bicarpelary Syn.

Liliaceae → G_3 → Tricarpelary Syn

Malvaceae → (China rose)

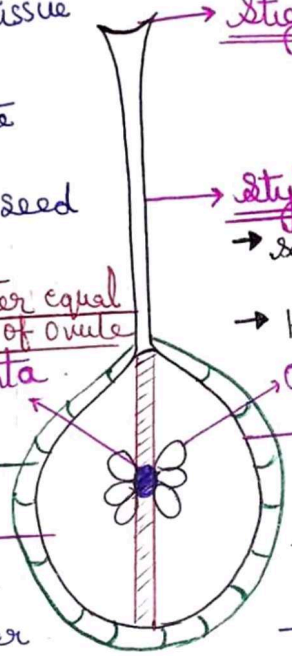
Structure of Pistil

→ Ovary is consist of a soft cushion like soft tissue called placenta.

→ Placenta attaches the ovule with Ovary.

→ Ovule develops into seed after fertilization.

→ no. of seeds → is either equal or less than no. of ovule



Stigma → Provide a platform for pollen identification & Germination. (Sugar & Boron)

Style → Passage for pollen tube. Transmission tissue.

→ Solid style : Multiple Ovules.

→ Hollow style : Hollow → few Ovule.

Placenta

Ovule

Ovary (basal swollen part of pistil)

→ Ovary form fruit after fertilization → true fruit

Ovarian wall

Locule

locule is the empty chamber of Ovary (bilocular)

→ Ovarian wall form fruit wall. (Pericarp)

Ectocarp | Mesocarp | Endocarp

Placentation

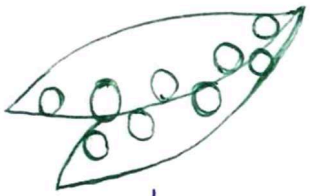
→ Arrangement of ovule/Placenta over the ovarian wall.

Types of Placentation

① Marginal Placentation

→ Ovary is unilocular, superior.

→ ovules are arranged on the ventral ~~stem~~ suture, placenta form a ridge along the ridge.



Legume (Leguminaceae)

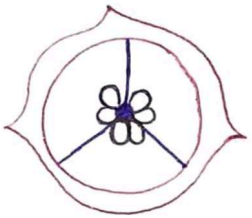
Ex :-
Fabaceae (Pea)

② Axile

→ The placenta is located at the central axis.

→ The central axis produce septa.

→ hence the Ovary become multilocular.

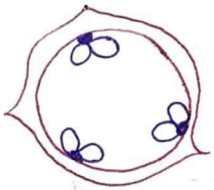


Ex :-
Solanaceae
(Tomato & Chilly)
Malvaceae
(Citrus & Orange)

③ Perital

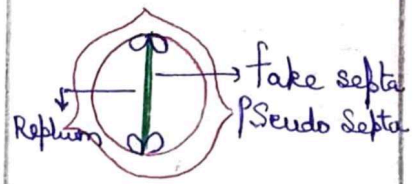
→ In this type Ovules are situated at the periphery or ovarian wall.

→ The Ovary become Unilocular, superior.



Ex :-
Brassicaceae
(Radish)
&
Cucurbitaceae

Exception :-
Mustard is bilocular



④ Free Central

Placenta is located at the central axis.

→ There are no septa

→ hence ovary become unilocular.

Ex :-
Dianthus
&
Prime Rose

⑤ Basal

→ Ovary is unilocular

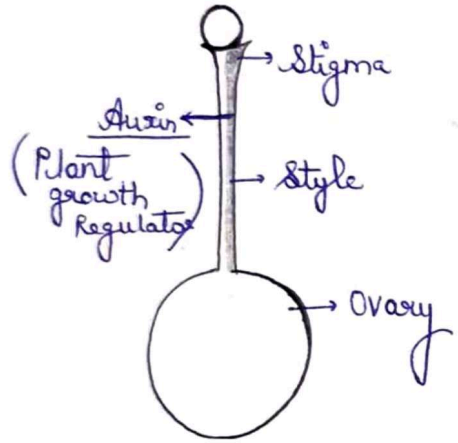
→ Usually one ovary contain only one ovule.

→ Placenta is located at the base of Ovary.

Ex :-
Poaceae (wheat)
&
Asteraceae (Sunflower)

Fruit

→ The Ripen ovary after fertilization is called fruit.
→ Such fruit which develop only from ovary are called Tone fruits.
→ The first signal for fruit formation is ~~given~~ given by stigma in form of 'Auxine'.
→ ~~The first signal for fruit formation is given by stigma in~~
→ After fertilization ovarian wall develops into fruit wall fruit wall (Pericarps) → Ectocarps (outermost)
→ mesocarps (middle)
→ Endocarps (innermost)



Parthenocarpy

→ The process of formation of fruit without fertilization is called Parthenocarpy (NEET 2017)
→ Such fruit contain unfertilized Ovules, hence they are seedless.
→ They are most pleasent to eat.
→ Example —
grapes & Bannana → Naturally Parthenoc
Orange, watermelon, Pappaya, Mango
Induced Parthenocarpy (Artifically)

Parthenogenesis

→ formation of new organism (animal) without fertilization

False fruit

→ Those fruit which develops from any other part of flower such as 'thallamus' are called false fruit.

Eg :- Apple, pear, strawberry, Brinjal
Thallamus, Peduncle, Sepal

Types of fruit

① Simple fruit

'One flower one fruit'.

→ The Ovary is either unicarpellary or multicarpellary but Syncarpous (fussed)

Dry fruit

→ fruit wall is not edible. edible part is seeds usually

Indehiscent

→ fruit wall don't burst or rupture.

(i) Caryopsis —

→ They are called grains / fruit wall & seeds coat are fused (dry)

Eg :- Poaceae (wheat, rice, maize)

(ii) Achene —

fruit wall & seed coat are not fused completely

Dehiscent

→ fruit wall burst or rupture for seed dispersal

(i) Legume —

→ fruit wall dry & Ovule arranged at ventral suture.

Eg :- Fabaceae (Pea, Soyabean)

Exception —

ground nut — Schizocarp & fruit is called

Fleshy fruit

→ fruit wall is fleshy due to food store, hence it is edible.

(i) Drupe :-

Their endocarp is stony.

Example :-

Mango & Coconut

Ectocarp	Peel	green coarse fibres
Mesocarp	Fleshy white layer on seed	Hard shell
Endocarp	Stony & hard	

Edible :- Mesocarp

Endosperm (Seed)

→ liquid endosperm (free ~~endos~~ Nuclear)

→ Solid (white) Cellular endosperm

(ii) Berry :- Single seeded

→ Ectocarp is membranous & mesocarp is fleshy & edible.

② Aggregate fruit

One flower → many small fruit (fruitlets)

→ develops from multicarpellary & apocarpous conditions.

→ each ovary develops into a fruitlets.

↓

group of fruitlets (etaria)

Example :-

(i) Strawberry (etario of achene)

(ii) Raspberry (Raspberry) (etario of drupes)

③ Composite fruit

→ Complete inflorescence.

↓

Peduncle + Thallamus + flower (ovary) = one fruit

→ Sorosis type —

Example —

Jack fruit (कटहल)

Pine apple

Mulberry (शहतूत)

→ Synconus —

→ develops from 'hypanthodium' inflorescence

Example —

Fig & ficus

Eg :- 40'clock plant (mirabilis Jalapa)

(iii). Nuts :-
→ fruit wall is extremly hard
→ edible part usually seed.
→ Eg :- Cashew nut, wall nut, waterchest nut, almonds, Pista,

☆ lichi
edible part is aril which is the sugary outgrowth of integuments

(v). ☆ Cypsella —
Pappus formation
Eg :- Astoraceae

(). Samara —
Winged achene
Eg :- Maple

domentum, geo graphic fruits. (Underground)
Arachis hypogea

(ii). Siliqua —
Eg :- Brassicaceae (Mustard)

Replum

(iii). Capsule :-
fruit wall form a hard capsule.
Eg :- Poppy (Papaver, Saniniferum)
Dat Dhatura.
Cotton → fibre → Seed wall (Gossypium)

Example :-
Chilly, Tomato, cherry grapes, Banana, Bounjal

(iii). Pepo —
→ ectocarp is hard.
→ mesocarp fleshy, swollen placenta edible.
Example :-
Cucurbitaceae

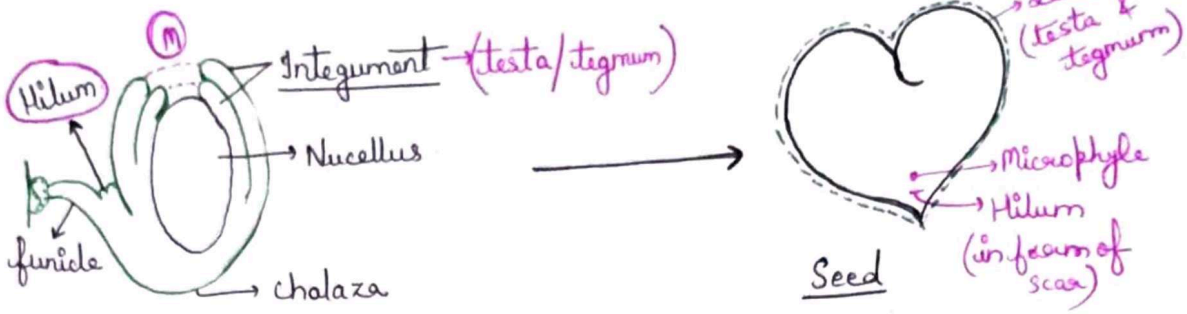
(iv). Pome :-
→ Thallamus is edible.
Example :-
Apple & Pear (false)

(v). Hesperidium :-
→ ectocarp contain oil glands
→ mesocarp is white & membranous.
→ endocarp form chambers.
→ edible part is endocarpic hairs (fleshy & Juicy) (Pulp)
Example :-
Orange & lemon.

(vi). Balausta —
→ Ectocarp is extremely hard, leatheary & shiny.
→ Mesocarp fleshy swollen Placenta form white layer.
→ edible part is fleshy seed testa
Eg :- Pomegranate.

SEED

→ after fertilization ovule develops into seeds

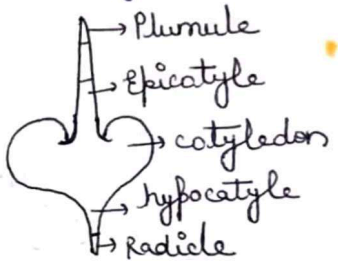


→ Apomixis (Asexual) → Process of formation of seed without fertilization.
Eg :- Cactus & lotus.

→ Structure of dicot seed → (i). Seed Coat → Made of 2 layer testa (outer) & Tegmen (inner)

→ Hilum is present in form of a scar & micropyle pore allow entry of water & gases for seed germination.

(ii). Embryo — it consists of a plumule & a radicle & 2 cotyledons (leaf).



(iii). Endosperm — It is triploid (3n) nutritive tissue formed as a result of triple fusion.

→ Provide Nutrition to developing embryo

Types of Seeds on the basis of presence of Endosperm

Endospermous (Albuminous)

→ These embryo don't consume their endosperm till maturity hence persistant endosperm is present in there seed.

Example :-
Wheat, Rice, Maize, cotton, Sunflower, coconut etc.
(Most of the seeds)

Non Endospermous (Ex-albuminous)

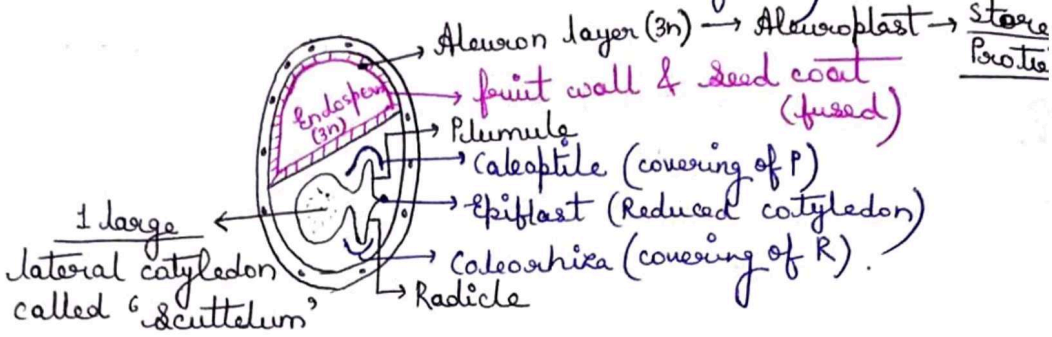
→ these embryo consume their endosperm completely till maturity hence endosperm is absent in seed.

→ Example :-
Fabaceae.

Perispermous Seeds :- They have persistant nucellus in the seed. The nucellus part of seed is called → Perisperm.

Example :- Black pepper & Beat root

Monocot Seed :- grans or caryopsis fruit (seed coat & fruit wall are fused)



Example :- Poaceae (wheat, Rice, maize)

Families

Solanaceae — Dicot family

Roots : ~~Dicot~~ Tap root

Stem : Aerial, erect & hard stem.

Stem modification → tuber. Eg :- Potato

leaf : Simple & Pinnately compound, broad, Reticulate venation.

Tabacco leaf are used in medicinal work (contain certain chemical)

Floral Characters

1. Inflorescence — either Solitary or cymose.
2. Bract — EBr
3. Symmetry — ⊕ Actenomorphic (Radial)
4. Sexuality — Bisexual ♀
5. Calyx (K) — Pantamerous 5, Gamosepalous, Valvate.
6. Corolla (C) — Penta (5), Gamopetalous, Valvate.
7. Androecium (A) — 5, epipentaious
8. Gynoecium (G) — Bicarpellary, Syncarpous, placentation → Axile, ovary ~~Sup~~ Superior. bilocular an oblique septa is present.

Fruit :- Usually berry fruits
Seed :- dicotyledons (endospermous)

FF → $Ebr \oplus ⚥ K_{(5)} \overset{\frown}{C_{(5)} A_5} \underline{G}_{(2)}$

Example :-
Food :-
Potato, Tomato, Makoi, Brinjal
Medicines :-
Ashwagandha & beladona & Dhatura.
Ornamental :-
Petunia
Fumigatory :-
Tobacco

Fabaceae :- (Dicot family)

Roots — Tap modification → Roots nodules for symbiotic N_2 fixation with bacteria → Rhizobium.

Stem — aerial, weak stem

Leaf — Normally simple or pinnately compound & Reticulate venation
- ☆ leaf base → Pulvinus (swollen)
- ☆ Pea → large stipules
- ☆ in pea → leaf tendrils.

Flower —
Bract → Present (Br)
Symmetry → Zygomorphic (%)
Sexuality → Bisexual ⚥
Calyx (K) → 5 Pentamerous, gamosepalous & Valvate
Corolla (C) → 5 Pentamerous [1 + 2 + 2] (Crown, wing, keel), vexillary aestivation → Papilionaceous (Butterfly like)
Androecium → total 10 → ~~diaphous~~ diadelphous → 2 group → 9+1
Gynoecium → Monocarpellary, unilocular, Superior, Marginal Placentation
Seed → Dicotyledon, Non-Endospermous

Fruit — Dry → legume फली (leguminaceae)

Example :-

Food —
Gram, pea, pulses

Fodder —
Trifolium & Sesbania

Oil —
Soyabean & groundnut

Medicinal — Mulaithi

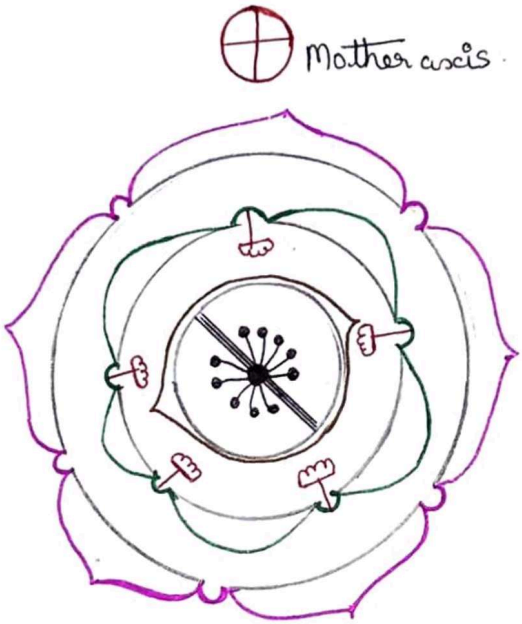
Ornamental → garden pea & lupin

dye → Indigofera

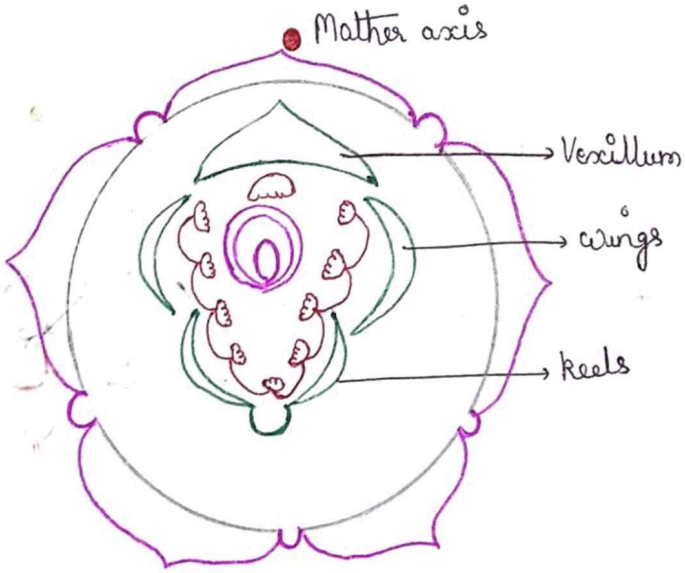
fibre → Sunhump

ff :- % ♀ $K_{(5)}\ C_{1+2+2}\ A_{(9)+1}\ \underline{G}$

Floral Diagram of Solanaceae —



Floral formula of fabaceae —



Liliaceae — Monocot family

Root :- Fibrous root

Stem :- Stem modification — 'bulb' :- Onion & Garlic

leaf :- narrow leaf with Parallel venation.

leaf base :- Sheathy

Floral Character :-

Bracted — Present (Br)

Symmetry :- actinomorphic

Sexuality :- Bisexual

~~Calyx~~ :-

Tepal (P) :- (3+3)

Androecium :- 6, Epiphyllous

Gynoecium :- tricarpellary, Syncarpous, ovary superior, trilocular, axile Placentation

Seed :- monocotyledonous, endospermous

Inflorescence :- Cymose and Umbel

Fruit :- Capsule and rarely berry

Example :-

Food —

Onion & Garlic.

Ornamental —

Water lily, gloriosa & tulip

Medicinal —

Aloe vera

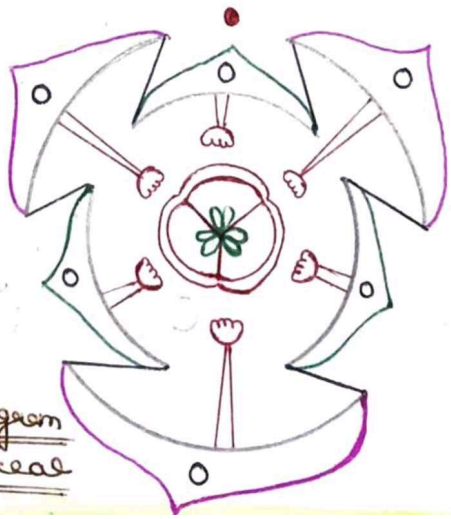
Spices —

Asparagus

Source of Cholchicine —

Cholchicum

Floral formula — $Br \oplus \female P_{3+3} A_{3+3} \underline{G_{(3)}}$.



Floral diagram of liliaceae

Brassicaceae — (Cruciferae) — Dicot family

Roots :- tap root :- modification — food storage.

Floral Characters :-

Symmetry → Actinomorphic

Sexuality → bisexual

Calyx → 4, Polysepalous.

Corolla → 4, Polypetalous.
↳ Cruciform → 'Cross formation'

Androecium → Stamens 6 (2+4), tetradynamous.

Gynoecium → ~~monocarpellary~~ bicarpellary., hypogynous, Superior ovary.

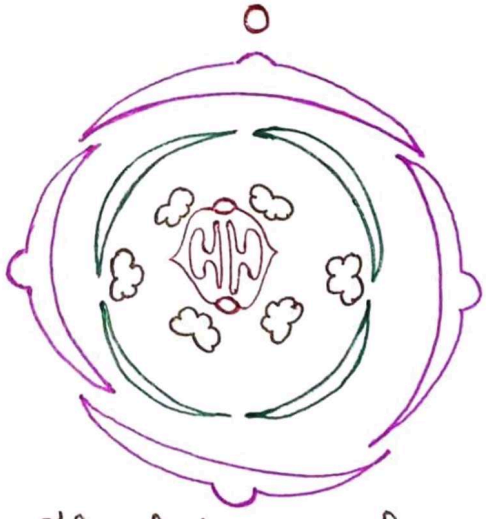
→ The ovary is unilocular in the begining but it becomes bilocular later on due to formation of a false septum (replum).

Fruit :- Siliqua

Seed :- Dicot & endospermic

Floral formula :- $\text{Ebr} \oplus \female K_{2+2}\, C_{4}\, A_{2+4}\, \underline{G}_{(2)}$

Examples :- Radish, Turnip, Cauliflower, Cabbage, Mustard, Carrot.



Floral diagram of Brassicaceae.