Morphology of Flowering Plants

Syllabus

Morphology and modifications; Tissues; Anatomy and functions of different parts of flowering plants: Root, stem, leaf, inflorescence- cymose and recemose, flower, fruit and seed (To be dealt along with the relevant practical of the Practical Syllabus).

Content Index

Classification of Plants

(A) On the Basis of Habit

On the basis of their form or habit, the flowering plants are usually classified into the following three categories

(a) **Herbs:** Herbs are small plants with soft stems. They may be annual *(e.g., Mustard=Brassica campestris)* , biennial *(e.g. , Radish=Raphanus sativus)* , or perennial *(e.g., Canna).*

(b) **Shrubs:** Shrubs are medium sized perennial woody plants which branch profusely from the base and attain a bushy appearance *e.g.,* China rose *(Hibiscus rosa-sinensis), Capparis decidua* etc.

(c) **Trees:** A tree has a main stout and woody trunk which gives off branches only at some distance above the ground *e.g.,* Mango *(Mangifera indica),* Shisham *(Dalbergia sissoo)*

and banyan *(Ficus benghalensis).*

Concept Builder

On the basis of their branching, trees are classified into the following three categories.

(i) Caudex (Columnar). The stem is unbranched and usually bears a crown of leaves at the apex, *e.g.*, Date palm *(Phoenix dactylifera)*, Fan palm *(Borassus flabellifer)*, etc.

(ii) Excurrent. The branches arise from the main stem in acropetal succession and the tree assumes a cone like appearance *e.g., Pinus, Eucalyptus, Casuarina,* etc.

(iii) **Decurrent (Deliquescent).** The lateral branches grow more vigorously and outcompetes the main trunk, giving a dome-shaped apperance, *e.g.*, Mango *(Mangifera indica),* Shisham *(Dalbergia sissoo)* and Banyan *(Ficus benghalensis).*

(B) On the Basis of Mode of Nutrition

1. **Autotrophs.** These are photosynthetic plants synthesizing their own food, *e.g.,* all green plants.
2. **Heterotrophs.** These plants can not synthesize their own food. They are of following types –

(a) Parasitic plants.

- Depend on other plants for food and water. They have special structures for absorption of food and water. They may be

(i) Obligate or total parasite. Depend on other plants for both food and water.

- **Total stem parasites.** *e.g., Cuscuta, Cassytha* and *Arceuthobium* (smallest among angiospermic parasite, only the flowers are visible externally, A. *minutissimum* is found on stem of *Pinus wallichiana).*
- **Total root parasite.** *e.g., Orobanchae* (Broom rape), *Balanophora, Rafflesia, Sapria, Cistanche.*

(ii) Partial or semi -parasites. Depend on other plants for water and minerals only.

- **Partial stem parasites.** *e.g., Viscum* (Mistletoe), *Loranthus .*
- **Partial root parasites.** *e.g., Santalum, Striga, Thesium.*

(b) Saprophytic plants.

- Grow on dead organic matter *e.g., Monotropa* (Indian pipe), *Neottia* (Bird's nest). They are mycotrophic plants.

(c) Symbiotic plants.

- Symbiosis or mutualism is obligatory beneficial partnership of two organisms *e.g.,* lichens (algae and fungi), *Rhizobium* (N_2 fixing bacteria and leguminous plants), mycorrhiza (fungi and roots of higher plants).
- Symbiotic relationship between ants and some higher plants is another good example

where the ants obtain food and shelter from the plant.

- They protect the plant from other animals *e.g., Acacia sphaerocephala* (Stipules are hollowed to function as ant shelter, leaflet tips and rachis possess feeding materials).

(d) Insectivorous or carnivorous plants.

- They grow in soil deficient in nitrogen.
- They trap insects and digest their protein.
- These are chlorophyllous plants thus can synthesize their own food.
- So all insectivorous plants are producers and secondary consumers.

Concept Builder

Some insectivorous plants are:

(i) *Utricularia* **(Bladder wort).** It is a rootless aquatic plant with highly dissected leaves. Some of the leaf segments are modified into small bladders which have trap valves for catching small animals like *Cyclops* and *Daphnia.*

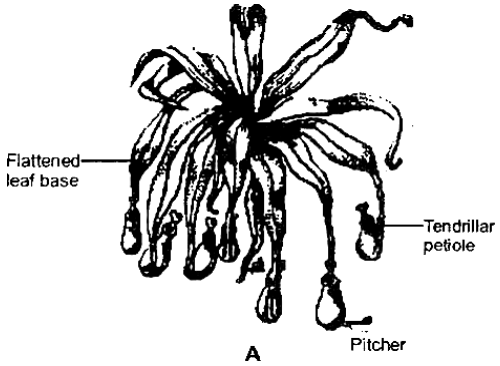
(ii) *Drosera* **(Sundew).** It is a herbaceous plant growing in water logged places. The upper surface of its leaves possess club shaped tentacles. The tentacle heads secrete sticky purple juice that shines in the sun (hence called **sundew).** An insect touching a tentacle is stuck up and trapped by bending of tentacles. The trapped insect is then digested by enzymes secreted by digestive glands and amino acids are absorbed by the leaf.

(iii) *Dionaea* **(Venus fly trap).** It is a herbaceous plant bearing rosette leaves. Leaves have winged petiole and lamina modified into two toothed jaws (bilobed) normally open at an angle forming a trap. Each jaw contains several teeth. Upper surface of each jaw (lobe) bears sensitive hair, spines or bristles (three in number) and digestive glands.

Stimulation of a sensitive spine or hair by an insect causes folding of leaf and secretion of digestive juices.

(iv) *Nepenthes* **(Pitcher plant).** It is a climber. The pitcher is formed from the lamina of leaf and the lid is the modified leaf tip. The flattened leaf like part below the petiole is the leaf base. Petiole is elongated and tendrillar. A large number of glands are situated on the upper half of the inner wall of pitcher which secrete proteolytic enzymes. The enzymes hydrolyse the protein of insects and amino acids so produced are absorbed by the plant. *Sarracenia, Darlingtonea* and *Cephalotus* are other insectivorous pitcher plants.

(v) *Aldrovanda* **(Water flea trap).** It has a thin **rootless** floating stem, which bear whorls of modified leaves. Each leaf has a spathulate stalk and a folding two lobed lamina with teeth round the edges. The surface bears numerous sensitive joined hairs and digestive glands.



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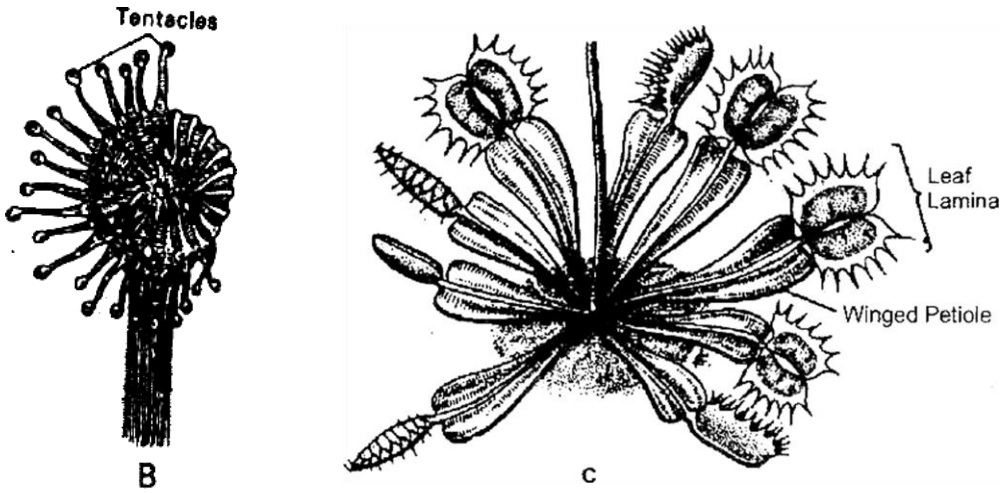


Leaf modified into insect catching structures:
A. *Nepenthes*, B. *Drosera*, C. *Dionaea*

(e) Epiphytes.

- These plants grow on other plants for shelter only (for physical support).
- They synthesize their own food.
- They have special hanging roots called **hygroscopic roots** to absorb moisture from atmosphere by thin walled cells lying outside called **velamen**, *e.g.,* Orchids like *Vanda, Dendrobium,* etc.

(C) On the Basis of Life Span

- Three categories of plants are recognised on this basis

(i) Annuals:

- The plants which complete their life cycle in a single season or few weeks or few months are called **annuals**.
- They grow and produce flowers and fruits within this period and then die off, *e.g.,* mustard *(Brassica campestris),* pea *(Pisum sativum),* wheat, maize, *Euphorbia prostrata.*

(ii) Biennials:

- The plants which complete their life cycle in two growing seasons are called **biennials**.
- In the first season, they grow vegetatively and in the next season, they produce flowers, fruits and seeds, *e.g.,* carrot *(Daucus carota)*, radish *(Raphanus sativus)* and turnip *(Brassica rapa).*

(iii) Perennials:

- These are the plants which continues to grow for many years, *e.g.,* peach *(Prunus*

persica) and apple *(Pyrus malus).*

- Perennials can be, monocarpic (which flower and fruit only once in life time) *e.g.,* bamboo *(Bambusa tulda),* century plant *(Agave),* or polycarpic (which flower and fruit many times in life time), *e.g.,* mango, pear.

Conceptual

What type of plants grow on other plants for support only?

Orobanchae and *Rafflesia* are_____parasites.

Insectivorous plants are exclusively consumers by nutritional pehaviour. (Ture/False)

Venus fly trap is the common name of_____ .

Give one word for unbranched stem having crown of leaves at tip.

Ans. **1.** Epiphytem, **2.** Total root, **3.** False, **4.** *Dionaea*, **5.** Caudex/Columnar

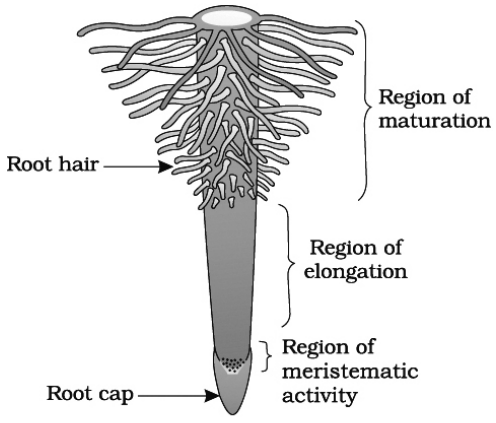
Let us discuss various parts of a flowering plant THE ROOT

- True roots develop from radicle of seed.
- They are non green, underground, positively geotropic, positively_hydrotropic and negatively phototropic.
- Roots usually do not bear buds, but buds are present for vegetative propagation in adventitious root of sweet potato *(Ipomoea)* and tap root of Indian red wood *(Dalbergia).*
- They do not bear nodes and internodes.
- They have unicellular roots hairs.
- Lateral roots arise **endogenously,** *i.e.,* from pericycle.

Zonation in Roots

(i) Root cap.

- At the apex of root a smooth cap shaped structure is present which is called as **root cap**.
- It is protective.
- Multiple root cap is found in aerial roots of screwpine *(Pandanus).*
- In hydrophytes, root cap is either absent or replaced by root pocket, *e.g., Pistia, Lemna, Eichhornia.*



Different zones in a typical root

(ii) Zone of cell formation or division.

- The cells of this region are inactive state of division and their number increases continuously.
- Vacuoles are small or absent.

(iii) Zone of cell elongation.

- Maximum growth in the cells occurs in this zone.

- Cells have a large central vacuole.

(iv) Zone of cell maturation.

- The cells in this region are differentiated into permanent tissues depending upon the functions they have to perform.
- Root hairs are also present in this zone which help in absorption of water.
- In hydrophytes, root hairs are absent because they absorb water through general body surface.

Types of Roots

- Roots are of two types :

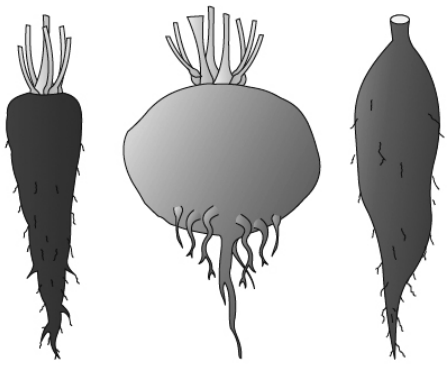
(1) **Tap roots.** Primary root developing from radicle. The primary root grows and gives rise to secondary and tertiary roots forming the tap root system, *e.g.,* dicots.

(2) **Adventitious roots.** They develop from any part of the plant body other than the radicle. They are called adventitious roots, *e.g.,* monocots.

1.Modifications of Tap Root :

A. Storage or fleshy tap roots.

- They store food and assume various shapes.



A. Conical root of carrot; B. Napiform root of turnip; C. Fusiform root of radish.

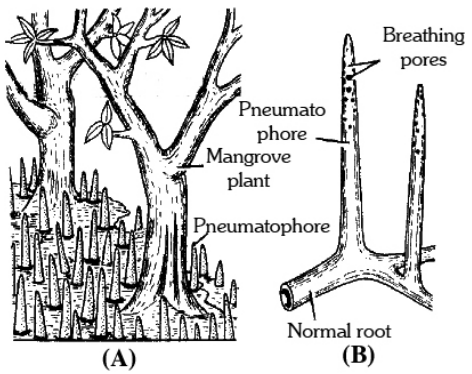
(i) **Conical:** Cone like, *e.g.,* carrot.

(ii) **Napiform:** Swollen in the upper part and apruptly tapers in lower part, *e.g.,* turnip and beet root.

(iii) **Fusiform:** Spindle shaped, *e.g.,* radish.

B. Respiratory root.

- Some plants like *Avicennia* and *Sonneratia,* which grow in salty marshes (mangroves) develop special kinds of roots for respiration.
- These roots are called **respiratory roots** or **pneumatophores.**
- They arise in conical shape from the branches of underground tap root and grow vertically upwards *(i.e.,* negatively geotropic) into the air.
- The upper portions of these roots have numerous aerating pores, called



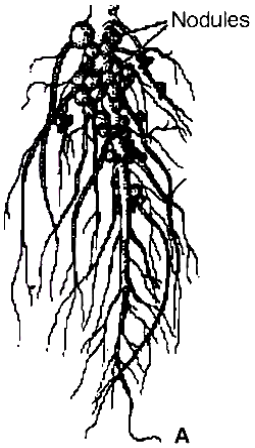
pneumatothodes.

Pneumatophores (respiratory roots) of a mangrove tree:

A. Main plant with emerging pneumatophores; B. Pneumatophores enlarged

C. Nodulated roots –

- These are found in members of family Papilionaceae for nitrogen fixation. Symbiotic bacteria of the genus *Rhizobium* are present in nodules to fix atmospheric nitrogen.



Nodulated roots of pea

2.Modifications of Adventitious Root

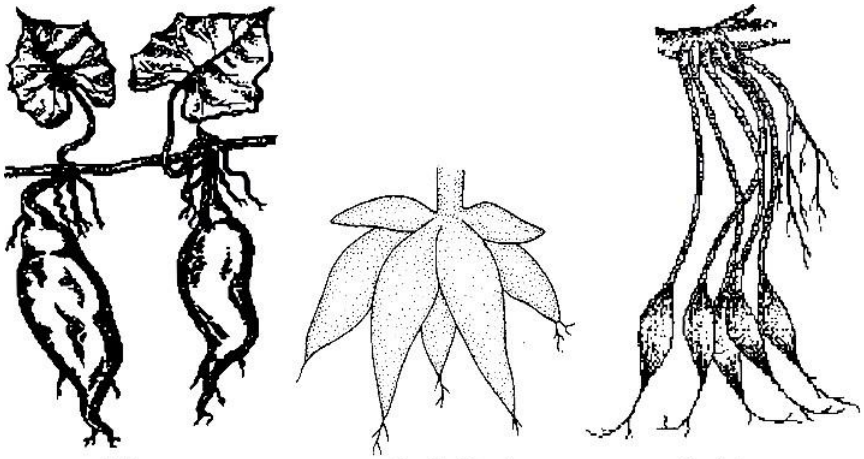
A. Storage adventitious roots

(i) **Tuberous.** Single root arises from node of stem and becomes tuberous and fleshy for storage of food, *e.g.,* sweet potato.

(ii) **Fasciculated.** Roots arise in bunch (cluster) from lower node of stem and become fleshy, *e.g., Dahlia, Asparagus.*

(iii) **Nodulose.** Root apex becomes swollen and fleshy, *e.g.,* mango ginger *(Curcuma amada).*

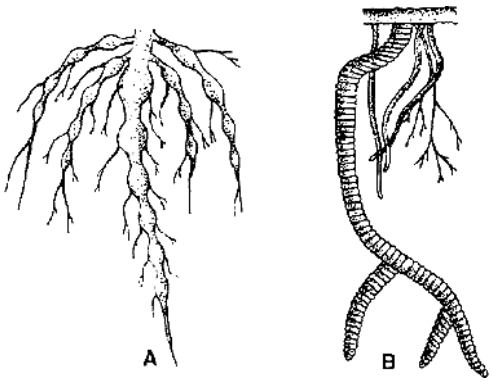
(iv) **Beaded or Moniliform.** Roots swell up at regular intervals forming beaded structure, *e.g., Portulaca, Momordica* (bittergourd).



Modifications of adventitious roots : A. Tuberous roots of sweet potato;

B. Fasciculated roots of *Dahlia;* C. Nodulose roots of mango ginger

(v) **Annulated.** Roots having series of ring like swellings *e.g.,* Ipecac *(Psychrotia).*



Modifications of adventitious roots:

A. Moniliform roots of *Momordica;* **B.** Annulated roots of Ipecac.

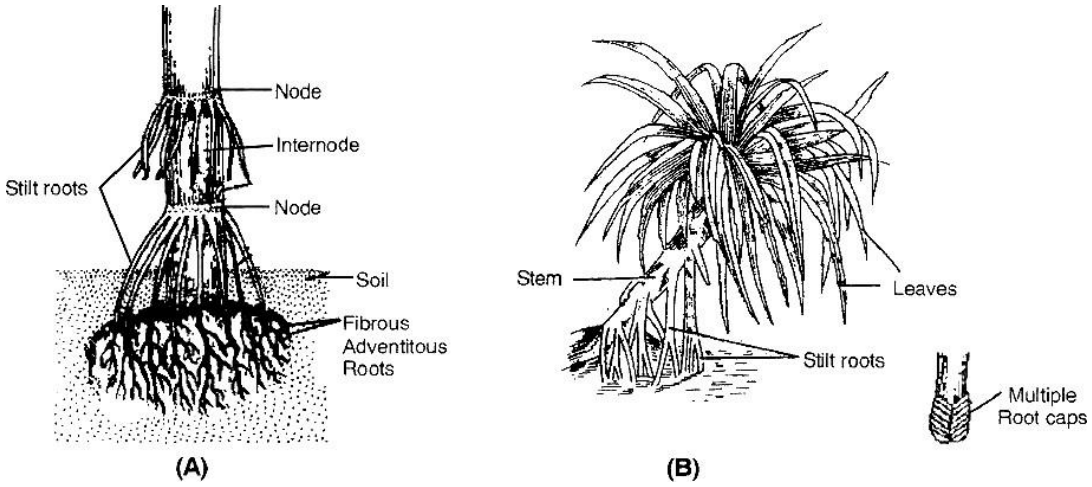
B. Adventitious roots that provide extra support

- They are of following types:

(i) **Prop roots.** They arise from the branches of stem for providing mechanical support to heavy branches, as pillars, *e.g.,* old banyan tree *(Ficus benghalensis).*

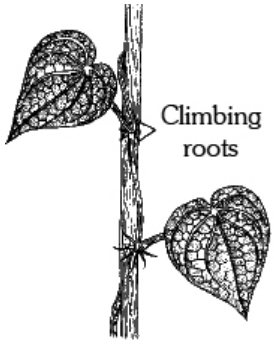
Modification of adventitious root: Prop roots of banyan

(ii) **Stilt roots.** They arise from lower nodes of stem to support main axis and enter the soil obliquely, *e.g.,* sugarcane, maize, screwpine *(Pandanus).*



Modifications of adventitious root: A. Stilt root of sugarcane; B. screw pine

(iii) **Climbing roots.** They arise from nodes and help the plants in climbing, *e.g., Pothos, Piper.*



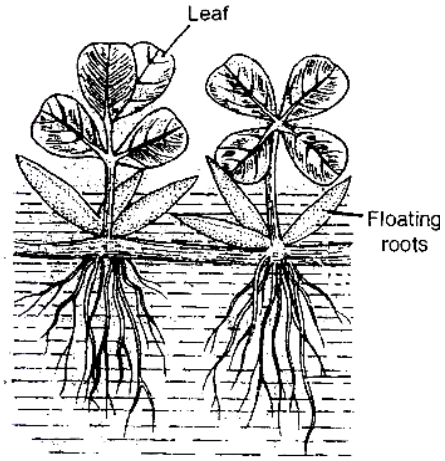
Modification of adventitious roots: Climbing root of *Piper*

(iv) **Buttress roots.** They arise from basal parts of main stem and spread in different directions in the soil, *e.g. , Bombax, Ficus religiosa .*

Concept Builder

Adventitious root with special functions

(i) **Floating roots.** In aquatic plants *(e.g., Jussiaea)* white spongy roots arise from branches and help in floating and respiration.



Floating roots of *Jussiaea*

(ii) **Assimilatory roots.** The aerial roots of *Tinospora* and submerged roots of *Trapa* (Water chestnut) become green and synthesize food. *Podostemon* also has green assimilatory roots.

(iii) **Sucking or haustorial roots.** These roots suck food and water from host and are found in parasitic plants *e.g., Cuscuta, Orobanche, Viscum.*

(iv) **Hygroscopic roots.** These are found in epiphytes, specifically orchids and help in absorption of moisture from the atmosphere using special tissue called **velamen.**

(v) **Contractile roots** -They shrink 60 -70% of the original length and bring underground organ at proper depth in the soil *e.g.,* corm of *Crocus* (saffron), *Freesia* .

(vi) **Root thorns** -These are hard, thick and pointed thorns *e.g., Pothos armatus* and *Acanthorhiza.*

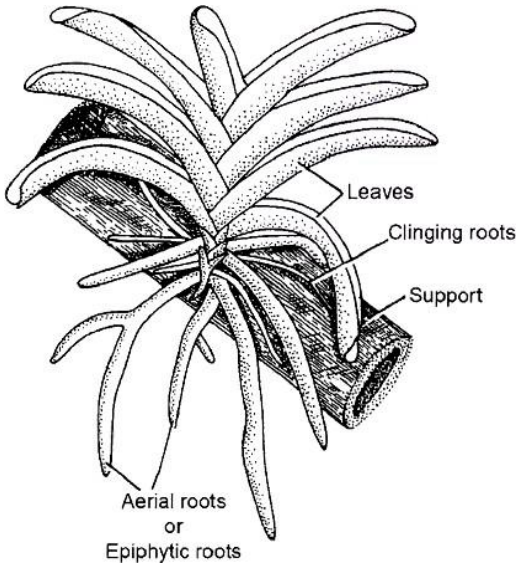
(vii) **Clinging roots** - These are non absorptive

adventitious roots arising either from nodes *(e.g., Tecoma,* betel), internodes *(Ficus pumila)* or both *(e.g.,* juvenile stage of Ivy).

(viii) **Reproductive roots -** These are fleshy, adventitious roots used for vegetative reproduction *e.g.*, sweet potato *(Ipomoea batatas)* , *Dahlia.*

(ix) **Leaf roots** - In *Salvinia,* one leaf of each node modifies into root like structure for balancing the plant in water.

(x) **Epiphyllous roots** - These roots arise from the margins of leaf lamina for vegetative reproduction *e.g., Bryophyllum.*



Modification of adventitious root: Epiphytic roots of *Vanda* (an

Functions of Root

- The root performs various functions like –

Fixation, Absorption, Conduction, Storage, Reproduction, Assimilation, Nitrogen fixation, Floating and Balancing and provides Mechanical support.

Conceptual

Give one word for the following:

1. Roots arising from lower nodes of stem in sugarcane.
2. Roots arising to support heavy branches in banyan tree.
3. Nutrient absorbing roots of Viscum.
4. Respiratory roots of Rhizophora.
5. Hygroscopic tissue in the roots of orchids.

Ans. **1.** Stilt roots, **2.** Prop roots, **3.** Sucking or haustorial roots, **4.** Pneumatophore, **5.**

THE STEM

- Stem is ascending part of plant and formed by the prolongation of the plumule of

embryo.

- It is positively phototropic and negatively geotropic and hydrotropic.
- It bears nodes and internodes.

Leaf bearing part of stem is called shoot.

- It has buds.

- It may bear multicellular hair on external surface.
- Lateral branches arise from the cortex (exogenous origin).
- **Bud** is a condensed, immature or embryonic shoot with closely placed nodes.
- These have a growing point surrounded by closely arranged immature leaves.
- Cabbage is the largest bud.
- Buds can be Vegetative, Floral and Modified

1. Vegetative buds.

- These buds develop into vegetative shoots. They can be:

(a) **Terminal** or **apical bud** - Present on the tip of branches.

(b) **Axillary** or **lateral bud** - Present in the axil of leaves.

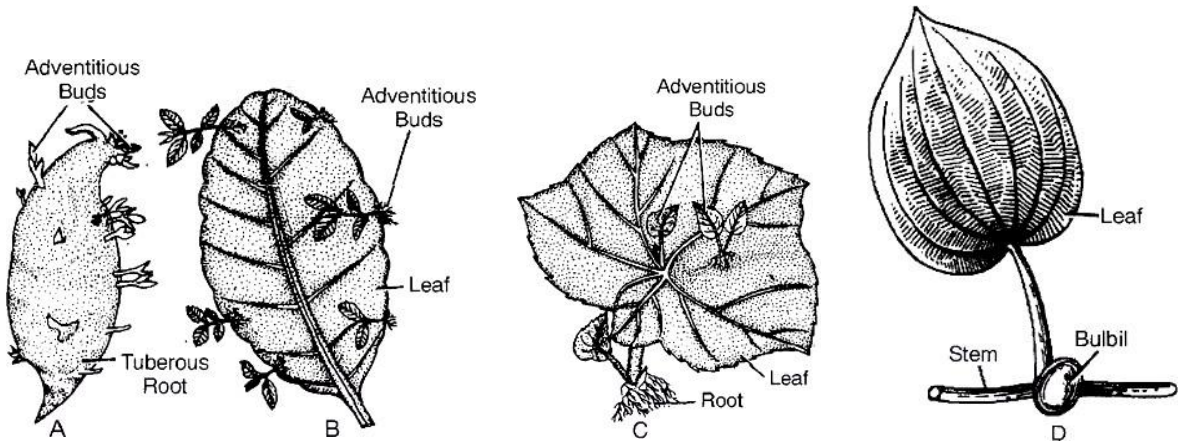
(c) Some plants regularly produce some extra buds on the side of axillary buds called as **accessory** or **supernumerary buds**.

(d) Buds which develop from any part of the plant body other than the above mentioned ones are called **adventitious buds**. These can be :

(i) **Cauline buds** - Arise directly from stem *e.g., Artocarpus* (Jack fruit).

(ii) **Radical buds** - Arise on roots *e.g.,* Sweet potato, *Dalbergia.*

(iii)**Foliar buds** - Buds which develop on the leaves *e.g., Bryophyllum, Begonia* (Elephant ear plant), *Kalanchoe* etc.



Adventitious buds: A. Radical buds of sweet potato **B.** Foliar buds of *Bryophyllum* , ***C.*** Foliar buds of *Begonia* **D.** Bulbil of *Dioscorea*

2. Floral buds : These buds always develop into flowers.

3. Modified buds: They can be both vegetative or floral buds.

a. Vegetative bud modification

(i) *Tendrlis – e.g., Passiflora* (Passion flower).

(ii) Thorns – e.g., *Citrus* (Lemon) , *Duranta, Carissa*

(iii)Bulbils – e.g., *Dioscorea* (Yam). *Cycas* (gymnosperm).

b. Floral bud modifications

(i) **Tendrils** – e.g., *Cardiospermum* (Balloon vine).

(ii) **Bulbils** – e.g., *Allium sativum* (Garlic)

Types and Modifications of Stem

A. Aerial stems (Epiterranean stem)

- It may be reduced, erect and weak.

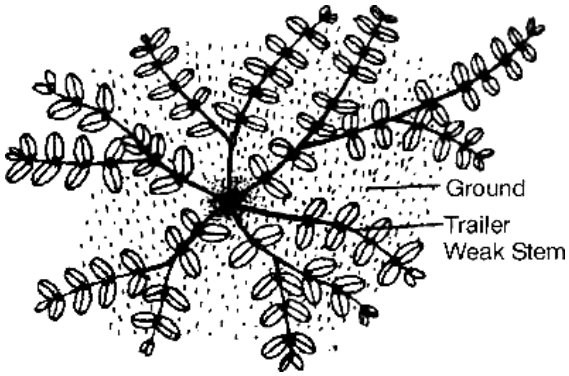
1. **Reduced -**Stem reduced to a disc. *e.g .,* Radish, Carrot, Turnip.
2. **Erect stem** -It is strong and upright *e.g.,* Maize, Wheat, Mango. An erect stem with swollen nodes is called **culm** *(e.g.,* bamboos).
3. **Weak stems -**These are thin, soft and weak and need support. They can be upright or prostrate.

(a) **Creepers.** The stem creeps on earth and the roots arise at the nodes, *e.g.,* grasses, strawberry,
Oxalis.

(b) **Trailers** – The stem creeps on the ground, but the roots do not arise at the nodes. They may be:

(i) **Prostrate or procumbent.** The stem creeps on ground totally, *e.g., Evolvulus.*

(ii) **Decumbent.** When prostrate stem projects its tip, *e.g., Portulaca, Lindenbergia.*



Tralling weak stem of *Euphorbia prostrata*

(c) **Lianas** (Stem climber). **Woody perennial climbers** found in tropical rain forests are lianas. They twine themselves around tall trees to secure sunlight, *e.g., Hiptage, Bauhinia vahlii (Phanera).*

(d) **Climbers.** Plants are with long weak stem and have organs of attachment to climb the object.

They maybe

(i) **Rootlet climbers.** Roots produced at nodes help in climbing *e.g., Tecoma, Pothos, Piper betel* (pan).

(ii) **Hook climbers.** In *Bougainvillea, Ouranta* and *Carrisa,* the thorn is modification of axillary vegetative bud which helps in climbing. In *Bignonia,* terminal leaflet is converted into hook. *Artobotrys* and *Uncaria* are also hook climbers.

(iii) **Tendril climbers.** Tendrils are thread like structures which help the plants in climbing.

Concept Builder

Tendrils are modifications of:

- **Entire leaf** -Leaf tendril *e.g., Lathyrus sativus.*
- **Leaflet** -Leaflet tendril *e.g., Pisum.*

- **Petiole** -Petiolar tendril *e.g., Clematis, Nepenthes.*
- **Stipule** -Stipular tendril *e.g., Smilax.*
- **Leaf apex** -Leaf apex or tip tendril *e.g., Gloriosa.*
- **Inflorescence** -Inflorescence tendril *e.g., Antigonon.*
- **Stem** -Stem tendril *e.g., Vitis* (modified apical bud), *Passiflora* (modified axillary

(e) **Twiners.** The stem body twines around the support without any special organ of attachment.

e.g., Cuscuta, Dolichos and *Quisqualis.*

B. Underground Stem Modifications

(a) Rhizome:

- It grows parallel or horizontal to soil surface.
- It bears nodes, internodes, buds and scaly leaves *e.g.,* Ginger, Banana, Turmeric, Ferns.
- It is of two types:

(i) Rootstocks:

- It is upright or oblique with the tip almost reaching the soil surface *e.g.,Dryopteris.*

(ii) Straggling:

- It is horizontal and branched.
- Branching may be –

  Racemose - Axis is monopodial, *e.g., Saccharum,* Lotus.

  Uniparous cymose - Axis is sympodial, *e.g., Zingiber officinale* (ginger), *Curcuma domestica*

  (turmeric) and *Canna.*

(b) Tuber.

- It is terminal portion of underground stem branch which is swollen on account of accumulation of food, *e.g.,* Potato, *Helianthus tuberosus* (Jerusalem artichoke).

(c) Corm.

- It grows vertically beneath soil surface.
- It is usually unbranched.
- It bears nodes, internodes, buds and scale leaves, *e.g., Colocasia, Gladiolus, Colchicum, Crocus, Amorphophallus.*

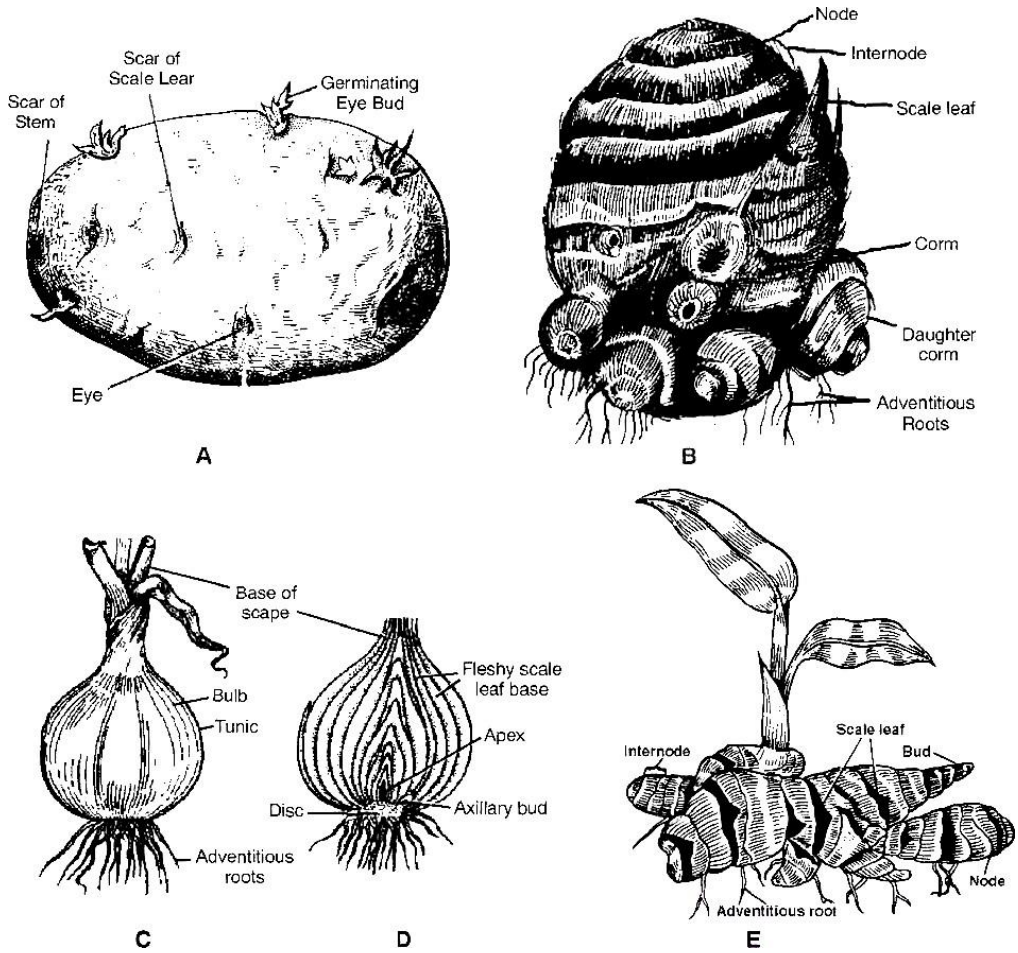
(d) Bulb.

- Stem is reduced and disc shaped.
- The bud is surrounded by many concentric scale leaves.
- Leaf bases of inner ones are fleshy and edible and of outer ones are dry *e.g.,* onion, lily,

garlic.

- It is of two types -tunicated and scaly.
- Tunicated bulb is covered by a sheath of membranous scales called **tunic.**
- It may be **simple tunicated bulb** -covered by a sheath *e.g.* onion and *Narcissus;* or **compound tunicated** bulb-concentric rings of bulblets surrounded by a white membranous sheath or tunic
  e.g. garlic.

- **Scaly or naked** bulbs do not have tunic. *e.g.*, lily.



Underground modifications of stem: A. Tuber of potato; **B.** Corm of *Colocasia* **C, D.** Tunicated bulbs of onion (**C**, entire; **D,** longitudinally cut) **E.** Rhizome of ginger

C. Sub-aerial Weak Stem

(a) Runner.

- It is elongated, prostrate, aerial branch with long internodes and roots at nodes
  e.g., Oxalis, grasses, *Hydrocotyle.*

(b) Sucker.

- It arises by axillary bud of underground part of stem.
- This lateral branch creeps below the soil surface and grows obilquely upward and produces new shoot.
  e.g., Banana, *Pin epple, Chrysanthemum,* rose.

(c) Offset.

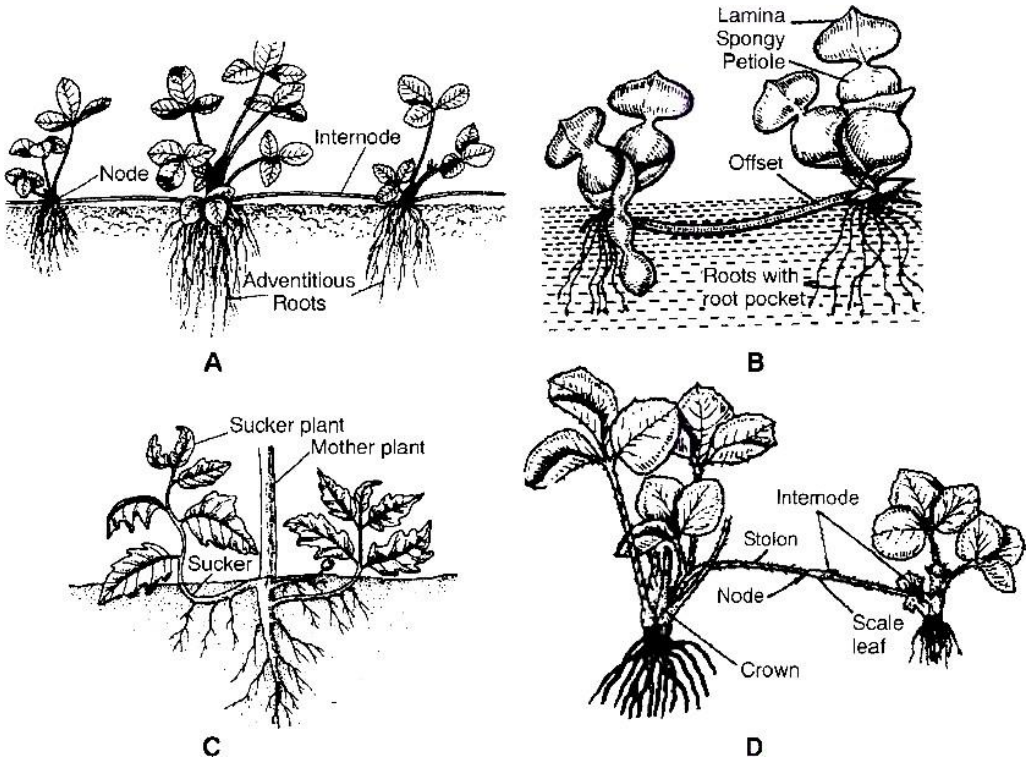
- Short horizontal branch producing a cluster of leaves above and the cluster of roots below.
  e.g., Pistia, Eichhornia.

(d) Stolon.

- It is subterranean long lateral branch arising from base of the stem.

e.g., Colocasia, Rubus, Fragaria

- It first grows obliquely upward and then bends down to the ground surface.
  e.g., *Jasminum*



Subaerial modifications of stem: A. Runner of *Oxalis;* **B.** Offset of *Pistia;* ***C.*** Sucker of *Chrysanthemum;* **D.** Stolon of *Fragaria*

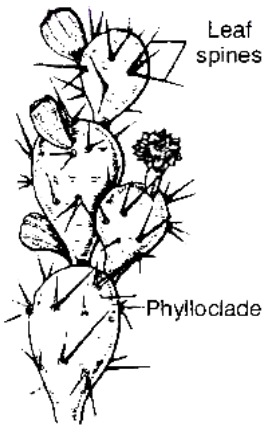
D. Special Stem Modifications

(a) **Phylloclade.** It is green flattened or rounded succulent stem with leaves either feebly developed or modified into spines *e.g., Opuntia, Casuarina, Muehlenbeckia.*

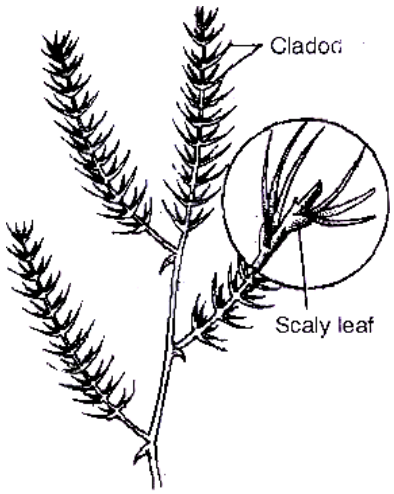
(b) **Thorn.** It is modification of axillary bud, *e.g., Bougainvillea, Duranta, Carissa.* Thorns of *Alhagi* possess flowers, while thorns of *Duranta* bears leaves.

(c) **Cladode.** Phylloclade usually having one internode long, is called cladode, *e.g., Asparagus, Ruscus.* It is of limited growth.

(d) **Stem Tendril. It** is a leafless, spirally coiled structure found in climbers. It may be a modification of axillary **bud,** *e.g., Passiflora* or **terminal bud** *e.g., Vitis.*



Phylloclade of *Opunita*



Cladode of *Asparagus*

(e) **Bulbils.** A condensed, axillary fleshy bud is called bulbil. It helps in vegetative reproduction.

e.g., Dioscorea, Globba, Agave, Oxalis.

Functions of a Stem :

1. **Mechanical support**
2. **Conduction**

These two are normal functions of any stem . Some special functions performed by stem are

3. **Food Storage**
4. **Water Storage**
5. **Perennation**
6. **Photosynthesis**

Self Assessment

Which of the following is a partial root parasite?

(1) *Santalum* (2) *Viscum* (3) *Nepenthes* (4) *Monotropa*

Hygroscopic roots are found in

(1) *Rhizophora* (2) *Vanda* (3) *Curcuma* (4) *Loranthus*

Thick roots arising in *Ficus* to support heavy branches are called

(1) Stilt roots (2) Prop roots (3) Assimilatory roots (4) Floating roots

In *Amorphophalfus* and *Crocus* vegetative reproduction occurs by means of

(1) Offset (2) Rhizome (3) Corm (4) Both (1) & (2)

Stem tendrils occur in

(1) Cucumber (2) Watermelon (3) Pumpkin (4) All of these

Thorn is a stem structure because it

(1) Develops from stipule (2) Arises from leaf directly

(3) Develops from axillary bud (4) Is structure of defence

A. Multiple root caps are found in *Pandanus*.

B. *Chrysanthemum*, Pineapple and *Jasminum* are examples of sucker.

C. A fleshy bud is called bulbil.

D. Root cap is absent in hydrophytes.

(1) All are correct (2) All are correct, except B

(3) A & B are correct (4) B & C are correct

Reduced, discoid and underground stem is found in

(1) Ginger (2) Turmeric (3) Potato (4) Onion

Find odd one out w.r.t. polycarpic perennial plants

(1) Pear (2) Mango (3) Apple (4) Bamboo

All given modifications belong to adventitious roots, except

(1) Nodulose root of *Curcuma* (2) Assimilatory root of *Tinospora*

(3) Conical roots of carrot (4) Buttress root of *Bombax*

Ans. Q.1 (1), Q.2 (2), Q.3 (2), Q.4 (3), Q.5 (4), Q.6 (3), Q.7 (2), Q.8 (4), Q.9 (4), Q.10 (3)

THE LEAF (PHYLLOPODIUM)

- Leaves are lateral, flat, green and expanded parts of plant which arise from the nodes on the stem or branches.
- Usually leaf has a bud in its axil.
- The chief function of leaf is photosynthesis and transpiration.

Parts of a Leaf

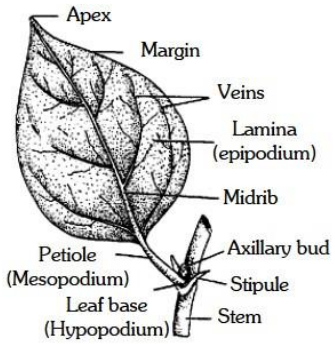
- A leaf consists of following three parts:

(i) Leaf base (Hypopodium)

- Leaves are attached to stem by leaf base.
- In some plants, leaf base becomes swollen and is called **pulvinus** which is responsible for sleep movement *e.g., Cassia, Mimosa,* bean.
- In some plants, leaf base expands into **sheath** (sheathing leaf base), *e.g.,* grasses and banana (monocots).
- A tongue like structure is also present between leaf base and axis in grasses, called **ligule.** When the leaf base partially encloses the stem, it is called **semi amplexicaul** *e.g., Prickly poppy*, *Calotropis procera* (Madar); if it completely encloses the stem, it is called **amplexicaul** *e.g.*, *Sonchus*, *Polygonum*.

(ii) Petiole (Mesopodium)

- The stalk of leaf is called **petiole**.
- Petiole in *Eichhornia* becomes spongy and bulbous.
- In orange *(Citrus),* petiole becomes winged.
- Petiole is modified to tendrils in *Nepenthes.*
- In Australian *Acacia,* petiole is modified into leaf like flat structure called **phyllode.**



Parts of typical leaf

(iii) Lamina (Epipodium)

- The broad, green, flat part of the leaf is called lamina ('leaf blade).
- All the leaves of a plant are collectively called as **phyllome.**
- Leaves are of the following types -

(1) **Cotyledonary leaves:** Embryonic or seed leaves, distinct in plants having epigeal

germination.

(2) **Foliage leaves:** Common green, photosynthetic leaves.

(3) **Scale leaves (Cataphylls)** : Reduced scaly leaves.

(4) **Bract leaves (Hypsophylls)** : They bear flowers in their axil.

(5) **Fertile leaves (Sporophylls)** : They bear sporangia on their ventral surface.

(6) **First leaf (Prophyll)** : First few leaves different from the rest *e.g., Citrus.*

Prefoliation : Arrangement of leaves in bud condition. It is of two types:

(1) **Ptyxis:** The manner in which each individual leaf is folded or rolled in bud condition.

(2) **Vernation:** Arrangement of leaves with respect to each other in bud condition.

Leaf insertion

(1) **Radical:** Leaves borne on reduced stem, appear to arise directly from the roots *e.g.,* radish, turnip.

(2) **Cauline:** Leaves found directly on the nodes of main stem *e.g.,* maize, hollyhock.

(3) **Ramal:** Leaves present on the nodes of the stem branches *e.g., Dalbergia, Zizyphus.*

Types of Leaf

A. Simple leaf

- Leaf which may be entire or incised, and the incisions do not touch the midrib *e.g.,* mango, banyan.

B. Compound leaf

- Leaf blade is incised upto midrib or petiole thus, divides it into two or more leaflets.
- They are of two types :

(1) Palmately compound leaves. It has no rachis and all the leaflets are joined to a common point

i.e., at the tip of petiole. They may be :

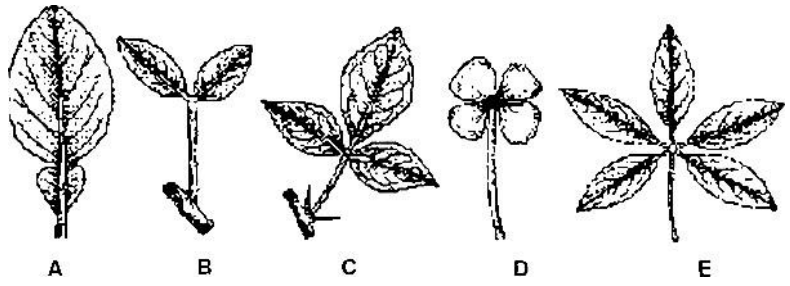
(i) **Unifoliate** *e.g., Citrus* (lemon and orange).

(ii) **Bifoliate** *e.g., Bignonia.*

(iii) **Trifoliate** *e.g., Dolichos, Trifolium, Aegle, Butea*

(iv) **Quadrifoliate** *e.g., Marsilea, Paris*

(v) **Multifoliate** *e.g., Bombax* (silk cotton tree)

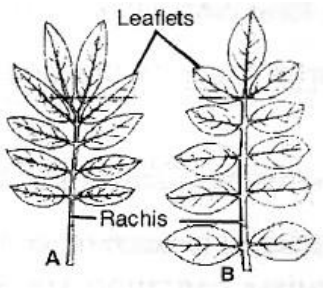


Palmately Compound Leaves: A. Unifoliate; **B.** Bifoliate; **C.** Trifoliate; **D.** Quadrifoliate; **E.** Multifoliate (digitate)

(2) Pinnately compound leaves. Rachis bears a number of lateral leaflets. These may be :

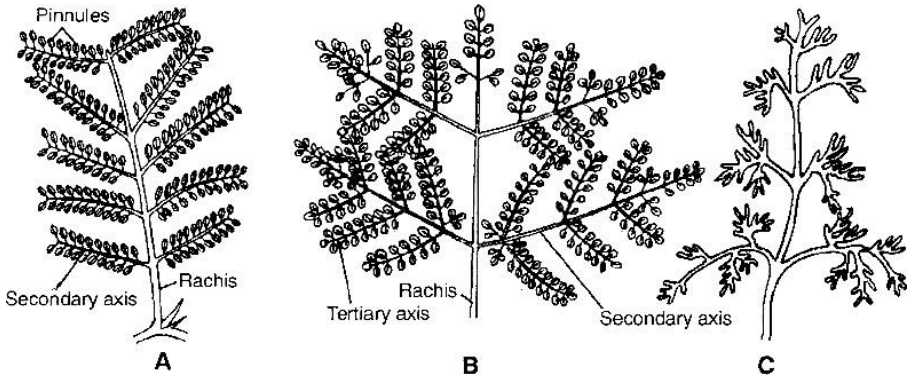
(i) **Unipinnate.** Midrib of the leaf directly bears the leaflet and is now called **rachis**. The unipinnate compound leaf is called **paripinnate** when terminal leaflet is absent (leaflets are in

even number) *e.g., Cassia, Tamarindus* or **imparipinnate** when terminal leaflet is present (leaflets are in odd number) *e.g., Rosa, Tephrosia, Azadirachta.*



Unipinnate Leaves: A. Paripinnate; **B.** Imparipinnate

(ii) **Bipinnate.** Midrib produces secondary axis or branches which bear leaflets *e.g., Acacia, Mimosa, Delonix.*



Pinnate leaves: A. Bipinnate; **B.** Tripinnate; **C.** Decompound

(iii) **Tripinnate.** Secondary axis produce tertiary axis which bear leaflets *e.g., Moringa, Melia.*

(iv) **Decompound.** Rachis is divided repeatedly without any definite pattern so that the lamina is dissected into narrow segments *e.g.,* Carrot, *Parthenium, Coriandrum.*

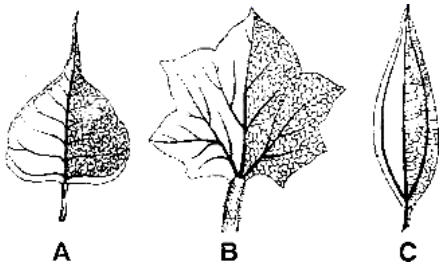
Venation in Leaves

- Arrangement of veins and the veinlets in the lamina is called **venation.** It is of three types :

1. Reticulate venation.

The branches of veins form a network, *e.g.,* dicots. However there are some dicots which show parallel venation *e.g., Calophylum, Eryngium* and *Corymbium.* It may be

(i) **Pinnate or unicostate** : Having only one **midrib** which gives rise to lateral veins



bearing vein lets forming reticulation *e.g.,* Peepal , China rose.

Reticulate venation: A. Pinnate (unicostate);
B. Palmate (multicostate) divergent; **C.** Palmate (multicostate) convergent

(ii) **Palmate or multicostate** : Many veins arise from the tip of the petiole and reach the apex or margins of the lamina. Their lateral veins form reticulation. It is of 2 types

(a) **Convergent** : Veins is converge towards the apex of the lamina *e.g., Zizyphus* and *Smilax* (a monocot) .

(b) **Divergent:** Veins diverge towards the margins *e.g.,* Castor *(Ricinus), Luffa, Vitis* (grape vine), etc.

(2) **Parallel venation.** The veins remain parallel to each other and veinlets are inconspicuous *e.g.,* monocots. **Some monocots which show reticulate ventation are *Smilax, Dioscorea, Alocasia, Colocasia.***

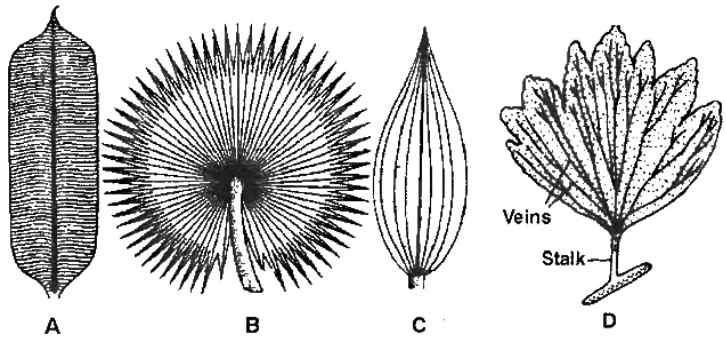
(i) **Pinnate or unicostate parallel venation** - Only one principal vein (midrib) is present and lateral veins run parallel without reticulation, e.g. , Banana, Canna

(ii) **Palmate or multicostate parallel venation** - Many principal veins arise from the base of the lamina. They may be:

(a) **Convergent** e.g., Bamboo, Grasses

(b) **Divergent** e.g., Fan palm

(3) **Furcate venation** - The veins branch dichotomously but the reticulum is not formed by the finer branches e.g., *Adiantum* (fern), *Circeaster* (angiosperm).



Parallel venation : A. Pinnate (unicostate); **B.** Palmate (multicostate) divergent; **C.** Palmate (multicostate) convergent **D.** Furcate venation

STIPULE

- Small, lateral, leaf like appendage which arises in pair from the petiole axis of leaf is called **stipule**.
- Stipule gives protection to the young axillary buds.
- Leaves having these are called **stipulate**, while not having these are called **exstipulate**.
- They may be of following types :

(i) **Free lateral.** On either side of leaf *e.g.,* China rose, cotton.

(ii) **Adnate.** United with petiole *e.g.,* Rose.

(iii) **Ochreate.** Form tube like covering *e.g., Polygonum .*

(iv) **Scaly -**Small membranous stipules *e.g., Desmodium*

(v) **Axillary or intrapetiolar -**Situated within the petiole towards axis *e.g., Gardenia*

(vi) **Interpetiolar -**Situated between the petioles of opposite leaves. *e.g., Anthocephalus, Ixora.*

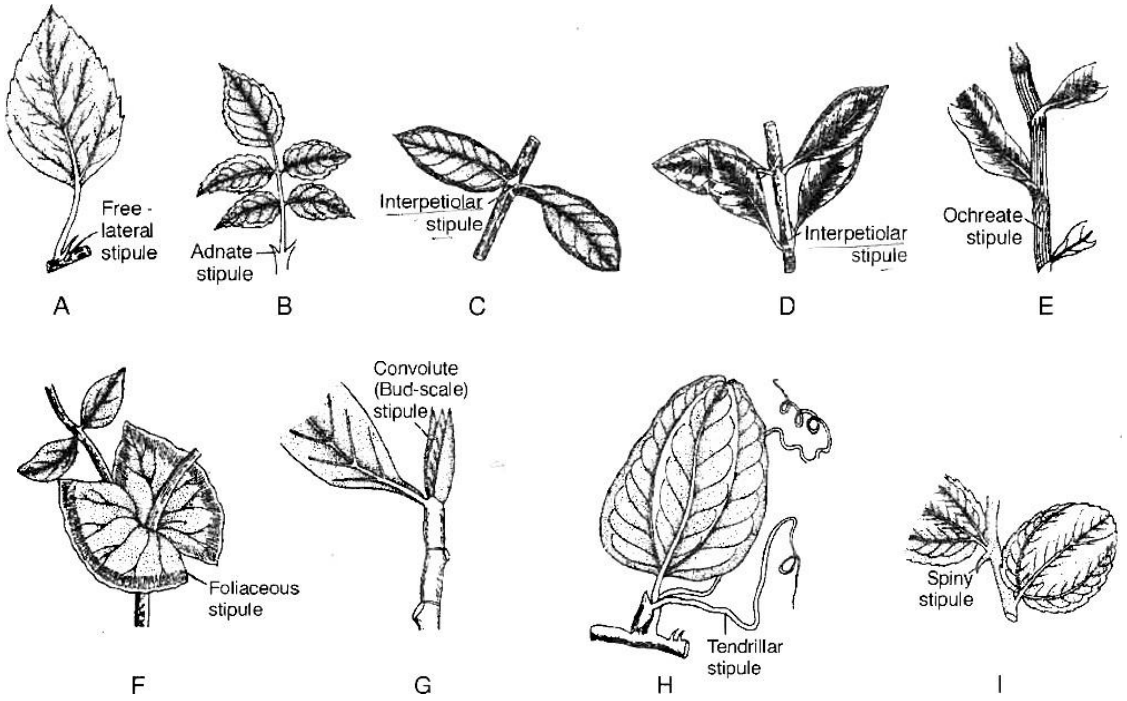
(vii) **Bud scales -**Protect the young bud *e.g., Ficus.*

Modification of stipules

(1) **Tendrillar stipule.** In *Smilax,* stipule changes into tendril and helps in climbing.

(2) **Foliaceous stipule.** In *Pisum* and *Lathyrus,* stipules become leaf like.

(3) **Spinous stipules.** In *Acacia* and *Zizyphus,* stipule is modified into spines.



Types of stipules : A. Free lateral stipules, **B.** Adnate stipules, **C.** Interpetiolar stipules, **D.** Intrapetiolar stipules, **E.** Ochreate stipules, **F.** Foliaceous stipules, **G.** Bud scales, **H.** Tendrillar stipules, **I.** Spiny stipules

Phyllotaxy

- It is the mode of arrangement of leaves on the stem or its branches. It is of following types :

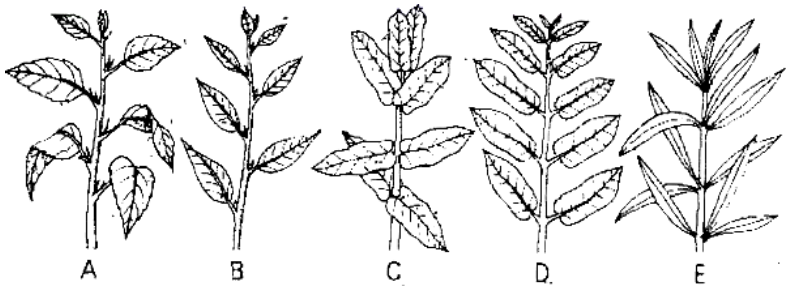
(1) **Alternate.** Single leaf arising at each node, *e.g.,* Mustard.

(2) **Opposite.** Leaves occurring in pairs at the node. They may be :

(a) **Decussate.** Leaves that stand at right angle to upper or lower pair of leaves at nodes, *e.g., Calotropis,* Sacred basil, *Zinnia.*

(b) **Superimposed.** Successive pair of leaves stand directly over a pair in the same plane, *e.g., Psidium* (Guava), *Syzygium* (Jamun), *Quisqualis.*

(3) **Whorled.** More than two leaves at each node, *e.g., Nerium, Alstonia.*



Phyllotaxy : A. Spiral; B. Alternate; C. Opposite decussate; D. Opposite superimposed; E. Whorled

Modification of Leaves

(1) **Storage leaves** - *e.g.,* Members of family Crassulaceae have thick succulent leaves which store water (hydrophillic colloids). Such storage leaves prevent the leaf against desiccation *e.g., Bryophyllum.*

(2) **Leaf tendrils** : These coil around the support and help the plant to climb.

(3) **Spines:** *e.g. , Opuntia, Berberis .* This is a xerophytic adaptation, as spines reduce transpiration loss, besides it helps to protect the plant from grazing animals.

(4) **Phyllode:** *e.g., Acacia auriculiformis* (Australian acacia). Here, the leaflets fall off early and petiole becomes flattened to function as leaf. This is also a xerophytic adaptation.

(5) **Insect catching leaves** - *e.g., Nepenthes, Drosera, Utricularia,* etc.

(6) **Scale leaves** -Small dry membranous, brownish leaves, *e.g., Casuarina, Ruscus.*

(7) **Coloured leaves** - Leaves near inflorescence are brightly coloured to attract the insects, *e.g., Euphorbia pulcherrima (Poinsettia) .*

Conceptual Questions

1. In some leguminous plants the leaf base may become swollen, which is called_____.
2. Phyllode is a succulent, photosynthetic fleshy or cylindrical modified stem. (True/False).
3. Spines in *Opuntia* are modifications of_____.
4. Leaves in silk cotton tree are_____.
5. Provide one word for phyllotaxy when a leaf pair on one node stand at right angle to upper or lower pair of leaves of other nodes.

Ans. **1.** Pulvinus, **2.** False, **3.** Leaves, **4.** Multifoliate (a type of palmately compound leaves), **5.** Decussate

THE INFLORESCENCE

- The arrangement of flowers on the floaral axis (peduncle) is called inflorescence. It is basically of two types -Racemose and Cymose.

A. Racemose (Indefinite)

- Main axis of inflorescence does not end in a flower but continues to grow.
- The development of flowers is acropetal.
- The opening of flowers is centripetal.

Concept Builder

Racemose inflorescence is of following types :

(i) **Raceme.** Peduncle has bisexual and pedicellate flowers arranged acropetally, *e.g.*, Larkspur, radish.

(ii) **Panicle.** Peduncle branched and branches have pedicellate flowers, *e.g.* , Gulmohr, *Rhus.*

(iii) **Spike.** Peduncle has bisexual and sessile flowers, *e.g.* , *Achyranthes*, *Adhathoda.*

(iv) **Spikelet.** It is a small, special spike. Flowers are produced in the axil of fertile bracts called **lemma**, *e.g.*, wheat, grasses (Poaceae).

(v) **Catkin.** It is pendulous spike in leaf axis which bears unisexual flowers, e.g., *Morus*, Birch, Oak, *Acalypha*.

(vi) Spadix. It is spike with fleshy axis and having both male and female flowers. It is surrounded by large coloured bracts called **spathe,** *e.g., Musa,* Palm, *Colocasia, Alocasia* **(characteristically found in monocots).**

(vii) **Corymb.** The main axis is short. Lower flowers have long pedicels than upper ones so that all the flowers are brought more or less to the same level, *e.g., Iberis, Capsella.* **Compound corymb,** *e.g.,* Cauliflower. **Corymbose raceme** is found in mustard.

(viii) **Umbel.** The main axis is reduced very much and all flowers appear to be arising from the same point. At the base of flowers, cluster of bracts form an involucre, *e.g., Hydrocotyle.* **Scapigerous umbel** is found in onion. **Compound umbel** *e.g.,* Coriander.

(ix) **Capitulum or head.** Main axis becomes flat and called receptacle. It bears many sessile and small florets. Peripheral florets called ray florets are pistillate or neuter and zygomorphic, whereas disc florets are bisexual and actinomorphic *e.g.,* Sunflower, *Zinnia, Cosmos* (Asteraceae).

B. Cymose (Definite)

- Main axis terminates in a flower. The development of flowers is **basipetal** and opening of flowers is **centrifugal.**

Concept Builder

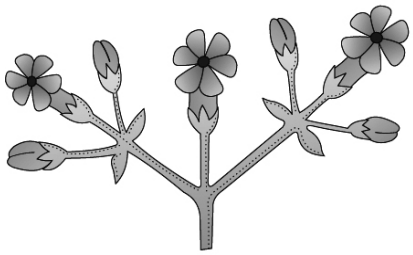
Cymose inflorescence is of following types :

(i) **Monochasial or uniparous cyme.** A single lateral branch arises from a cymose axis which terminates in a flower. It is of two types:

(a) **Helicoid cyme.** When the lateral axis develop successively on the same side, forming a helix *e.g., Atropa, Datura, Begonia, Heliotropium* .

(b) **Scorpioid cyme.** Lateral branches (successive flowers) arise alternately on left and right sides (in zig zag manner), *e.g., Ranunculus.*

(ii) **Dichasial or biparous cyme.** Two lateral branches arise at a time from a cymose axis, which end into flower, *e.g., Dianthus, Nyctanthes.*



Cymose inflorescence

(iii) **Polychasial or multiparous cyme.** More than two lateral branches arise at a time from a cymose axis and all of them end into flowers, *e.g., Hamelia, Calotropis.*

(iv) **Capitate.** Large number of sessile flowers grow on a suppressed axis to form a globose structure. *e.g., Acacia, Mimosa, Anthocephalus.*

Special inflorescences : These are of following types :

(i) **Verticillaster.** A cluster of sessile or subsessile flowers borne on a dichasial cyme ending in monochasial cyme (scorploid) in the form of condensed whorl on either side of the node. *e.g., Ocimum* (Tulsi), *Salvia* (Lamiaceae).

(ii) **Cyathium.** It looks like a single flower. A cup shaped involucre formed by bracts encloses a single female flower and a number of male flowers. Each male flower is represented by single stamen, while a single pistil represents a female flower *e.g., Poinsettia (Euphorbia pulcherrima)*, *Pedilanthus .*

(iii) **Hypanthodium.** Fleshy receptacle forming a hollow cavity with an apical opening called **ostiole.** The flowers are developed on inner wall of the hollow cavity. The male flowers are situated at the top near the opening, at the bottom are situated the female flowers with long styles and in between both are situated short styled **gall flowers** which are sterile. *e.g., Ficus* (Banyan, Fig, Gular).

(iv) **Coenanthium.** In *Dorstenia,* the receptacle becomes saucer shaped and its margins are slightly curved. The arrangement of florets is similar to hypanthodium.

Self Assessment

Leaf base expands into a sheath in

(1) Grasses (2) Legumes (3) Prickly poppy (4) *Mimosa*

Select an **incorrect** match

(1) Cauline leaf –Maize (2) Unifoliate leaf – Silk cotton tree

(3) Bipinnate leaf –*Mimosa* (4) Simple leaf – Banyan

Petiole when becomes green, flat, tend to function as leaf, it is called as

(1) Phyllociade (2) Cladode (3) Cladophyll (4) yllode

Calophylum, Corymbium and *Eryngium* show

(1) Parallel venation (2) Unicostate reticulate venation

(3) Divergent reticulate venation (4) Convergent reticulate venation

Stipule changes into tendril and helps in climbing in

(1) Pisum (2) *Lathyrus* (3) *Smilax* (4) *Acacia*

Pendulous spike in leaf axis that bears unisexual flowers is called

(1) Panicle (2) Catkin (3) Spikelet (4) Raceme

Select an incorrect statement w.r.t. capitulum inflorescence of sunflower

(1) Main axis becomes a flat receptacle (2) Florets are sessile and many

(3) Ray florets are bisexual (4) Disc florets are actinomorphic

Select an **incorrect** match

(1) Wheat –Spikelet (2) *Musa* –Capitate (3) *Iberis* –Corymb (4) *Hydrocotyle* –Umbel

All given statements w.r.t. cymose infloresence are correct, **except**

(1) Centrifugal opening pattern of flowers (2) Unlimited growth of axis

(3) Main axis terminates in a flower (4) Basipetal arrangement of flowers

Stamens represent the male flowers and pistil represents a female flower in

(1) Cyathium (2) Spadix (3) Verticillaster (4) Hypanthodium

Ans. Q.11 (1), Q.12 (2), Q.13 (4), Q.14 (1), Q.15 (3), Q.16 (2), Q.17 (3), Q.18 (2), Q.19 (2), Q.20 (1)

THE FLOWER

- **Flower is defined as a highly condensed and modified reproductive shoot.**
- Instead of leaves the apex produces different kinds of floral appendages laterally at successive nodes.
- Following points can be mentioned to justify that flower is a modified shoot:

(1) Calyx, corolla, androecium and gynoecium represent four whorls of sterile and fertile leaf modifications borne at different nodes.

Sometimes, internode between calyx and corolla becomes elongated and called as **anthophor**e, *e.g., Silene Dianthus.*

The internode between corolla and androecium is known as **androphore**, *e.g., Passiflora.*

The internode between androecium and gynoecium is called as **gynophore** *e.g., Capparis.* When androphore and gynophore both are present in the same flower they are jointly termed as **gynandrophore** *e.g., Cleome gynandra.*

The prolongation of thalamus beyond carpel is known as **carpophore,** *e.g., Coriandrum, Foeniculum.*

(2) In *Mussaenda,* one sepal enlarges to form leafy structure (foliaceous sepal).

(3) Sometimes, floral bud gets transformed into vegetative bud or bulbil. *e.g., Agave.*

Concept Builder

Terminology used w.r.t. flower

(i) **Complete flower:** All four whorls (calyx, corolla, androecium and gynoecium) are present.

(ii) **Incomplete flower:** Flower with anyone of the four whorls missing.

(iii) **Bisexual flower:** Both gynoecium and androecium are present in the same flower.

(iv) **Unisexual flower:** Either androecium (staminate flower) or gynoecium (pistillate flower) is present in the flower.

(v) **Monoecious plant:** When both male and female flowers are present on the same plant *e.g.*, *Cocos, Ricinus, Zea, Colocasia, Acalypha.*

(vi) **Dioecious plant:** When male and female flowers are present on separate plants *e.g.*, Mulberry, Papaya.

(vii) **Polygamous plant:** When unisexual (male or female) , bisexual and neuter flowers are present on the same plant *e.g., Polygonum,* Mango.

(viii) **Achlamydeous flower:** Flowers are naked *i.e.,* without sepals and petals *e.g.,* Piperaceae.

(ix) **Monochlamydeous flower** :Only one whorl is present (perianth) *e.g.,* Polygonaceae, Liliaceae.

(x) **Dichlamydeous flower:** Both whorls (calyx and corolla) present in a flower *e.g.,* most of the flowers.

(xi) **Hemicyclic or spirocyclic flowers:** Some of the floral parts form circles and some are spirally arranged *e.g.,* Ranunculaceae.

(xii) **Cauliflory:** Production of flowers on old stem from dormant buds *e.g., Artocarpus*

Symmetry of Flower

(i) **Actinomorphic flower.** When a flower can be divided into two equal halves by **many vertical sections** passing through the centre. *e.g.,* Cruciferae, Malvaceae.

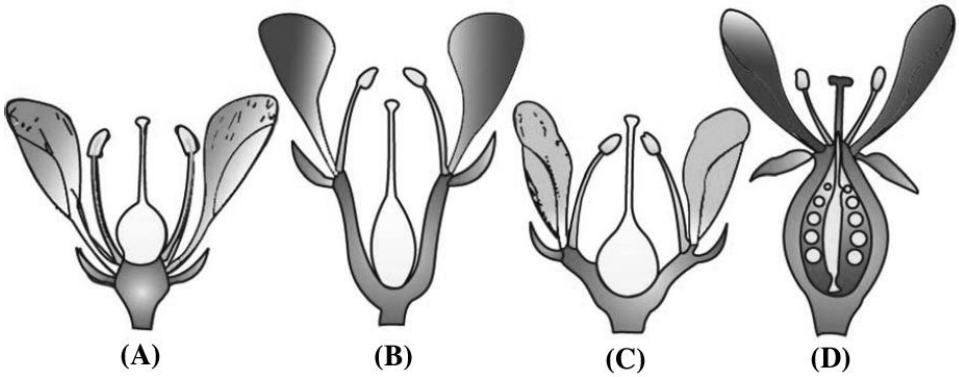
(ii) **Zygomorphic flower.** When a flower can be divided into two equal halves by **only one vertical section** passing through the centre. *e.g.,* Pea.

Position of Floral Parts on Thalamus

(i) **Hypogyny.** Ovary is at the top and separable from thalamus. Such flowers are called hypogynous and ovary is said to be superior. *e.g. , Malva, Brassica.*

(ii) **Perigyny.** Ovary is situated in centre and other parts of the flower are located on the rim of thalamus, almost at the same level. Ovary is half superior, half inferior. *e.g.,* Rose.

(iii) **Epigyny.** Calyx and corolla arise from upper side of ovary. Ovary is completely surrounded by and fused with thalamus. Ovary is called inferior and flower is said to be epigynous *e.g., Aster, Luffa.*



Position of Floral Parts on Thalamus:

(A) Hypogynous, **(B)** and **(C)** Perigynous, **(D)** Epigynous

Bracts

Bracts are specialized leaves bearing flower in the axil. They are of following types:

(i) **Petaloid bracts.** Bracts look like petals (brightly coloured). *e.g., Bougainvillea.*

(ii) **Spathy bract.** This is large bract enclosing an inflorescence. *e.g.,* Banana, Maize, Palms.

(iii) **Foliaceous bracts.** Bracts are leaf like in appearance *e.g., Adhatoda, Gynandropsis.*

(iv) **Involucre.** They are green coloured and in one or more whorls around or below the entire inflorescence. *e.g.,* Sunflower, Coriander.

(v) **Glumes.** These are small, dry, scaly bracts found in spikelet of Gramineae. *e.g.,* Wheat.

All floral whorls are described respectively :

A. Calyx

Outermost whorl of a flower is called calyx. It is the non-essential whorl and consists of sepals. Sepals may be free **(polysepalous)** or fused **(gamosepalous).** Sepals are modified as follows :

(i) **Pappus.** Sepals are modified into persistent hairy structures called pappus which help in dispersal of fruits. *e.g.,* Sunflower, *Sonchus.* (Asteraceae) .

(ii) **Leafy.** In *Mussaenda,* one sepal gets modified into large leaf like white structure.

(iii) **Spinous.** In *Trapa ,* the calyx is persistent and modified into two spines.

B. Corolla

It is second whorl of flower and consists of a number of petals which are usually bright coloured. The petals may be fused **(gamopetalous)** or free **(polypetalous).**

Concept Builder

Various forms of petals are :

(i) **Cruciform.** Four petals arranged like a cross *e.g.* , members of Brassicaceae.

(ii) **Papilionaceous.** Number of petals is five with largest petal **standard** or vexillum, enclosing two lateral petals called **wings or alae** which are free, these in turn enclose the inner most petals called **keel or carina** (united petals) , *e.g.* , Pea.

(iii) **Caryophyllaceous.** Five, free, long, clawed corolla, with limbs spreading at right angles to claws. *e.g., Dianthus.*

(iv) **Tubular.** Petals are like a tube, *e.g.* , disc florets of sunflower.

(v) **Campanulate or bell shaped.** Petals are like a bell, *e.g., Physalis.*

(vi) **Infundibuliform or funnel shaped.** Petals are like funnel, *e.g., Datura* .

(vii) **Bilabiate (two lipped).** Upper and lower lips are formed by fusion of petals, *e.g., Salvia, Ocimum.*

(viii) **Ligulate or strap shaped.** Gamopetalous petals forming tongue like structure, *e.g.,* Ray florets of Sunflower.

(ix) **Personate.** Corolla is bilabiate, but the lips are so near to each other as to close the mouth of the corolla, *e.g., Antirrhinum.*

Aestivation

Arrangement of floral parts in a floral bud with respect to the other members of the same whorl is known as aestivation. It may be of following types.

(i) **Valvate.** When sepals or petals lie very close to each other, without overlapping *e.g.,* Mustard.

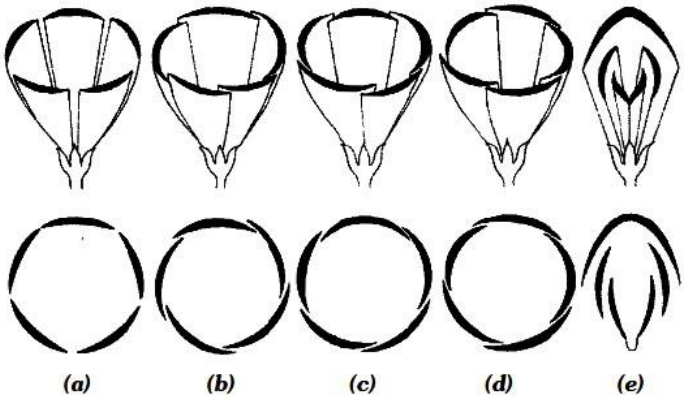
(ii) **Twisted or contorted.** When one margin of the sepal or petal overlaps the margin of next and other margin is overlapped by the third one. *e.g.,* China rose.

(iii) **Imbricate.** When both margins of one of the petals are covered by others and both margins of another one are external and of the remaining partly internal, partly external. *e.g., Cassia, Caesalpinia.*

(iv) **Quincuncial.** When two petals are inner, two are outer and one is partly outer and partly inner

e.g., Ranunculus.

(v) **Vexillary.** The posterior one is largest and almost covers the two lateral petals and the latter in turn nearly overlap the two anterior petals, *e.g. ,* Pea (Papilionaceae).



Different types of aestivation : (a) Valvate, (b) Twisted, (c) Imbricate, (d) Quincuncial (e) Vexillary

C. Androecium

- Androecium is the third and male whorl of the flower and is made up of one or more stamens (equivalent to microsporophylls).
- Each stamen consists of **filament, anther** and **connective.** The two lobed anther is called

  bithecous anther *e.g.,* Pea.
- The anther with one lobe is called **monothecous** anther. *e.g.,* members of **Malvaceae.**
- When stamens are free from each other the condition is called **polyandrous,** *e.g.,* lily, mustard.
- A sterile stamen is called **staminode**.

Cohesion of Stamens

- Fusion of stamens among themselves is called **cohesion**.

(i) **Monadelphous.** Stamens may be united by means of their filaments in one bundle with free anthers. *e.g.,* China rose, lady's finger, cotton **(Malvaceae).**

(ii) **Diadelphous.** When the filaments are united into two bundles and the anthers remain free, *e.g.,*

Pea, bean, gram **(Papilionaceae).**

(iii) **Polyadelphous.** When the filaments are united into more than two bundles but anthers are free

e.g., Castor **(Euphorbiaceae),** Lemon **(Rutaceae)**

(iv) **Syngenesious.** When anthers are united but the filaments are free, *e.g.,* Sunflower **(Compositae).**

(v) **Synandrous.** When anthers as well as filaments of stamens are united throughout their whole length, *e.g. ,* members of **Cucurbitaceae.**

Adhesion of Stamens

- Fusion of stamens with other floral parts.

(i) **Epipetalous.** When stamens are united to the petals. *e.g.,* China rose, *Solanum,* Sunflower.

(ii) **Episepalous.** When stamens are united to sepals. *e.g., Verbena.*

(iii) **Epiphyllous (Epitepalous).** When stamens are united to perianth (Tepal). *e.g.,* members of Liliaceae.

(iv) **Gynandrous.** When stamens are attached to gynoecium (carpel) either throughout their whole length or by their anthers only, *e.g., Calotropis,* (forming gynostegium).

Length and arrangement of Stamens

(i) **Didynamous.** 4 stamens, two outer small and two inner long, *e.g., Ocimum, Salvia* **(Lamiaceae)**.

(ii) **Tetradynamous.** 6 stamens, two *outer* small and four inner long, *e.g.,* Mustard, Radish **(Brassicaceae)**.

(iii) **Heterostemony.** Stamens are of different lengths, *e.g., Cassia.*

Concept Builder

Obdiplostemonous condition:

Two whorls of stamens, outer lying opposite to the petals (anti-petalous) and inner whorl lying opposite to sepals (anti-sepalous), *e.g., Stellaria, Spergula* and members of Rutaceae.

Diplostemonous condition:

Two whorls of stamens, outer whorl lying opposite to sepals (antisepalous) and inner whorl lying opposite to petals (antipetalous), *e.g., Cassia.*

D. Gynoecium

- It is the female part of flower comprising of carpels bearing ovules.
- It consists of **ovary**, **style** and **stigma**.
- The gynoecium may be monocarpellary (one carpel) or polycarpellary (many carpels).

Cohesion of Carpels

(i) **Apocarpous.** Carpels are free (no cohesion), *e.g.,* Ranunculaceae.

(ii) **Syncarpous.** Carpels more than two and fused, *e.g.,* most of the plants.

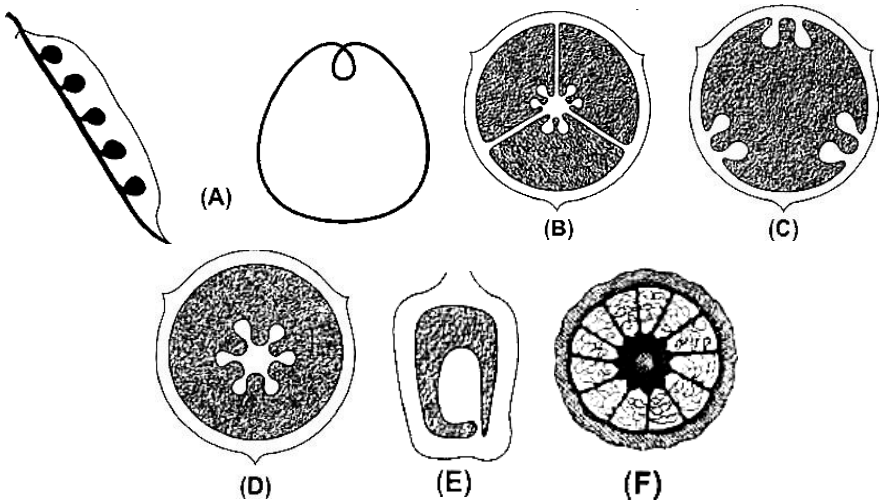
Number of locules. Ovary has locules or chambers having ovules and may be unilocular, bilocular, trilocular, tetralocular or pentalocular (multilocular).

Placentation

- The arrangement of ovules on placenta within the ovary is called **placentation**.
- It is of following types:

(i) **Marginal.** Placenta developing along the junction of the two margins of the carpel in one chambered ovary. It is characteristic feature of family Leguminosae. *e.g.,* Pea, gram.

(ii) **Axile.** The ovary is two to many chambered and placenta bearing ovules develop from the central axis *e.g.,* Tomato, orange, cotton, china rose, lily. (A)



Placentation types: (A) Marginal; (B) Axile; (C) Parietal; (D) Free central; (E) Basal; (F) Superficial

(iii) **Parietal.** Ovary is one chambered and the placenta bearing the ovules develop close to the inner wall of the ovary, *e.g.,* Mustard, radish, cucumber, *Argemone.*

(iv) **Free central.** Ovary is one chambered and the placenta bearing the ovules develop all round the central axis. Septa are absent, *e.g., Dianthus, Stellaria.*

(v) **Basal.** Ovary is unilocular and the placenta develops at the base of ovary on thalamus and bears a single ovule, *e.g.* , Wheat, maize, *Aster, Zinnia,* sunflower. It is most advanced.

(vi) Superficial. Ovary is multilocular with numerous carpels as in axile type of placentation but placenta develops all round the inner surface of the partition wall, *e.g.,* Water lily. **It is most primitive.**

Style. It is generally terminal but may be lateral, *e.g.,* Poaceae, mango.

Gynobasic style arises from base of the ovary, *e.g.,* Lamiaceae.

Conceptual

Select mismatched pair

(1) Basal placenta – Wheat

(2) Epipetalous stamen – Potato

(3) Vexillary corolla – China rose

(4) Inferior ovary – Sunflower

Persistent hairy structures formed of sepals are called_____in asteraceas.

Foliaceous sepal is found in *Mussaenda* (True/False).

Specialized leaf bearing flower in the axis is called_____.

Lateral style is found in mango (True /False).

Ans. **1.** (3), **2.** Pappus, **3.** True, **4.** Bract, **5.** True

Self Assessment

Flower in angiosperms

(1) Is a modified reproductive shoot

(2) Possess different floral appendages at successive nodes

(3) Have floral appendages which are modified leaves

(4) More than one option is correct

Different internodes may elongate in floral shoots of all given plants, except

(1) Silene (2) Passiflora (3) Zea (4) Capparis

Find odd one out w.r.t. monoecious plants

(1) Mulberry (2) Cocos (3) Ficus (4) Ricinus

Small, dry, scaly bracts found in spikelet of grasses are called

(1) Spathe (2) Involucre (3) Glumes (4) Petaloid bracts

A. Advertisement flag of *Mussaenda* is a modified sepal.

B. Pappus is persistent hairy petal in asteraceae.

C. In *Trapa*, calyx is modified into two spines.

(1) All are correct (2) B is incorrect (3) C is incorrect (4) A & B are correct

Large posterior petal is characteristic to vexillary aestivation found in members of

(1) Solanaceae (2) Liliaceae (3) Fabaceae (4) Malvaceae

When only the filaments of stamens are united into more than two bundles, the condition is called

(1) Monadelphous (2) Diadelphous (3) Polyandrous (4) Polyadelphous

In which placentation type, the overy is two to many chambered and the ovules arises from central axis?

(1) Axile (2) Marginal (3) Parietal (4) Basal

Select a correct match

(1) Didynamous stamen –Cassia (2) Tetradynamous stamen –Mustard

(3) Epiphyllous condition -China rose (4) Syngenesious condition –Cucumber

Flower is perigynous and the ovary is said to be half inferior in

(1) Rose (2) Peach (3) Plum (4) All of these

Ans. Q.21 (4), Q.22 (3), Q.23 (1), Q.24 (3), Q.25 (2), Q.26 (3), Q.27 (4), Q.28 (1), Q.29 (2), Q.30 (4)

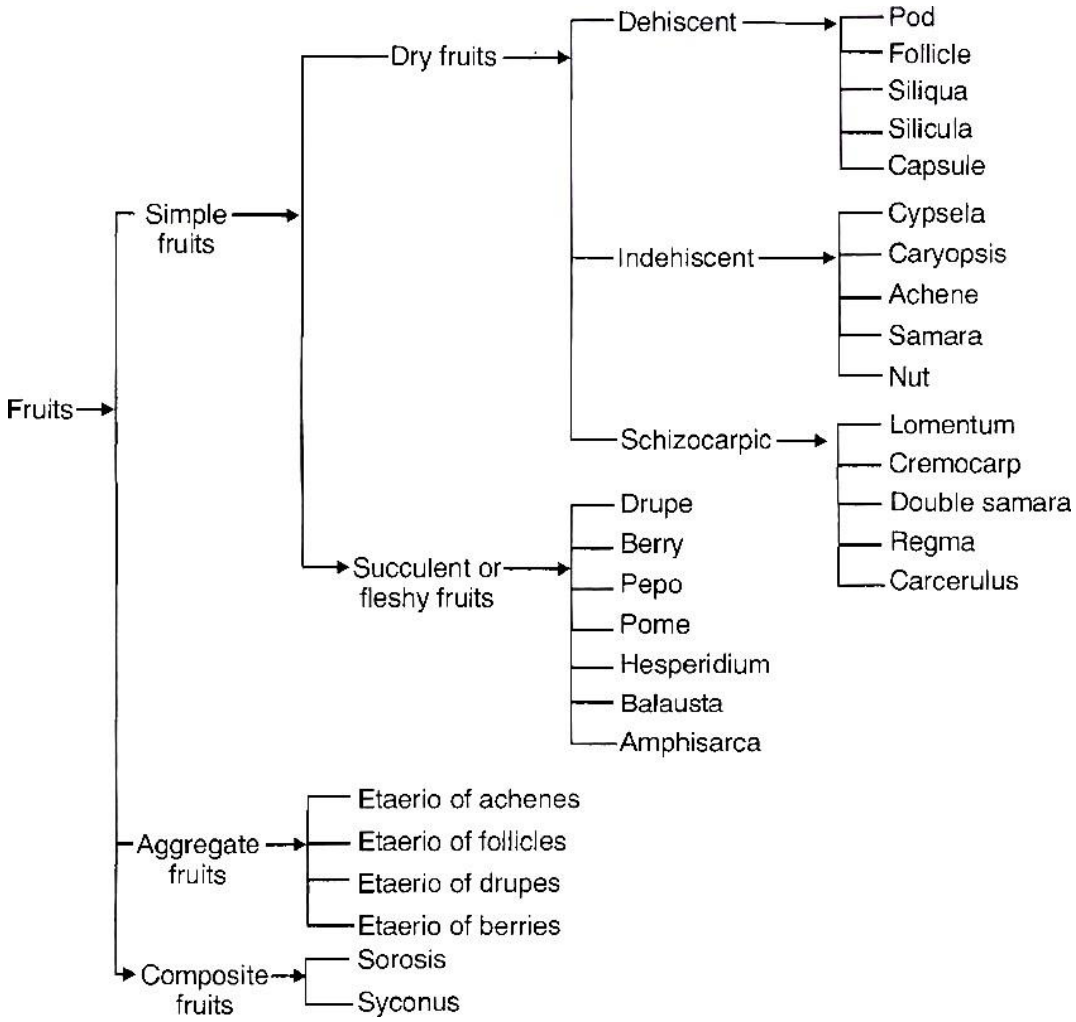
THE FRUITS

- Fertilized and ripened ovary is fruit.
- A fruit consists of (i) Pericarp (fruit wall)-developing from wall of ovary and may differentiated into epicarp, mesocarp and endocarp. (ii) Seeds-developing from ovules.

- In some plants ovary grows into fruit without fertilization, such fruits are called **parthenocarpic fruits**.
- They are seedless *e.g.,* Banana, grapes, oranges.

- The fruit which develops from ovary is called **true fruit**.
- Most of the fruits are true fruits.
- If any floral part other than ovary takes part in fruit formation , it is called **false fruit (pseudocarp)**. *e.g.,* Apple, Pear.

Schematic presentation of different kinds of fruits



Types of Fruits

1. Simple fruits

- Fruit developing from the syncarpous ovary of the single flower with or without accessory parts is called **simple fruit**. Simple fruits are of following types:

A. **Dry indehiscent fruits.** They do not split or burst. Seeds are liberated only by the decomposition or destruction of pericarp.

Concept Builder

(i) **Caryopsis.** Develops from monocarpellary, unilocular ovary. Fruit wall or pericarp completely fused with seed coat. *e.g.*, wheat, maize, rice (Graminae).

(ii) **Achene.** It develops from monocapellary, unilocular ovary. Fruit wall (pericarp) is not completely attached with seed coat (as that of caryopsis), *e.g.*, *Mirabilis.*

(iii) **Cypsela.** Develops from bicarpellary, unilocular and inferior ovary. Calyx is hair like and called **pappus** which helps in dispersal of fruits (seeds), *e.g.,* Sunflower, *Sonchus, Zinnia, Taraxacum.* It is characteristic fruit of family Compositae (Asteraceae).

(iv) **Samara.** Develops from superior ovary. Fruits are winged and wings develop from pericarp,
e.g., Holoptelea, Dioscorea, Hiptage.
If wings in fruits develop from sepals they are called **samaroid,** *e.g., Shorea* (Sal), *Dipterocarpus, Hopea.*

(v) **Nut.** Develops from polycarpellary superior ovary. Pericap is hard (stony) and sometimes woody, *e.g., Anacardium* (cashew nut), *Litchi* (marking nut), *Trapa* (water chestnut) and *Quercus* (oak).

B. Dry dehiscent fruits. These fruits burst automatically and discharge their seeds.

Concept Builder

(i) **Legume or pod.** Dry, one chambered fruit developing from a superior and monocarpellary ovary. Mature fruit dehisces by both sutures or margins, *e.g.,* Gram, lentil, pea.

(ii) **Follicle.** Develops from bicarpellary, ovary. Mature fruit dehisces by one suture only, *e.g., Delphinium, Catharanthus.*

(iii) **Siliqua.** Develops from bicarpellary, unilocular ovary with parietal placentation, dehiscence of fruits occur by both the halves from base to apex, *e.g.,* Mustard, radish. This is characteristic fruit of family **Cruciferae or Brassicaceae.**

(iv) **Silicula.** A short, broad, flat siliqua with few seeds is known as silicula. *e.g., Iberis, Capsella.*

(v) **Capsule.** Develops from multicarpellary, syncarpous ovary. Dehiscence occurs by many ways.

(a) **By Pores.** Porocidal, *e.g., Opium* (Poppy), *Argemone.*

(b) **By locules or valves.** Loculicidal, *e.g.,* Cotton.

(c) **By Septa.** Septicidal, *e.g.,* Linseed.

(d) **Septa breakdown into fragments.** Septifragal, *e.g., Datura.*

C. Dry schizocarpic fruits. They are intermediate between dehiscent and indehiscent fruits. On maturation they break into a number of indehiscent parts **(mericarp)** or dehiscent parts (cocci).

Concept Builder

(i) **Lomentum.** Pod is constricted or chambered between the seeds into a number of one seeded compartments, *e.g., Acacia, Mimosa, Arachis, Inga dulce, Tamarindus.*

(ii) **Cremocarp.** Develops from bicarpellary inferior ovary. Fruit splits into two indehiscent one seeded mericarps, *e.g., Coriander,* cumin (Umbelliferae or Apiaceae).

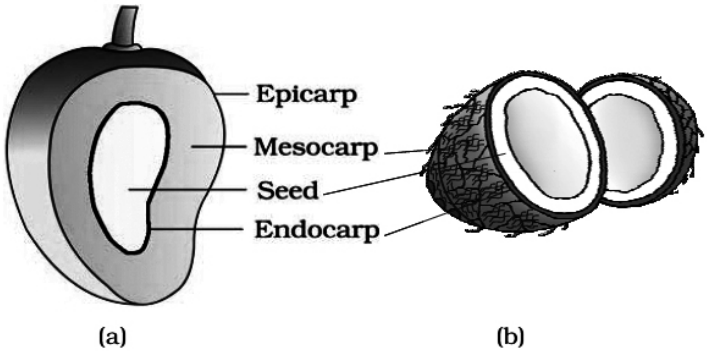
(iii) **Regma.** Develops from tricarpellary, syncarpous, trilocular, superior ovary with axile placentation. Fruits split into three one seeded dehiscent units called cocci, *e.g., Euphorbia, Ricinus* (castor), *Geranium, Jatropa.*

(iv) **Double samara.** Just like samara, but at maturity splits into two one seeded samaras. *e.g., Acer*
(maple).

(v) **Carcerulus.** Develops from bi-or multicarpellary, superior ovary. Fruits split into two, four or more indehiscent parts e.g., *Ocimum, Salvia*

D. Fleshy or succulent fruits. These are of following types:

(i) **Drupe.** Mostly one seeded fruits with pericarp differentiated into **epicarp**, **mesocarp** and hard and **stony endocarp**, *e.g., Mangifera indica* (Mango-epicarp forms skin, mesocarp-fleshy, juicy and edible, endocarp is hard and stony), *Cocos nucifera* (Coconut-Mesocarp is fibrous which is used in making coir so called as **fibrous drupe**), *Juglans regia* (walnut).



Parts of a fruit : (a) Mango (b) Coconut

(ii) **Berry.** One to many seeded fruits. Epicarp forms the outer skin. Middle thick and fleshy part is called **mesocarp** with a membrane like endocarp, *e.g.,* Tomato, guava, papaya, grapes, banana, brinjal, chillies. **Betel nut is a one seeded berry**.

(iii) **Pepo** (hard walled berry). Develops from tricarpellary, syncarpous, unilocular and inferior ovary. Epicarp forms skin of fruit. Mesocarp and endocarp are fleshy and edible. Sometimes, fruits are bitter in taste due to tetracyclic triterpenes *e.g.,* Cucumber, gourd, watermelon.

(iv) **Pome.** Develops from syncarpous inferior ovary which is surrounded by fleshy thalamus. So, true fruit lies inside the swollen fleshy and edible thalamus. It is false fruit or pseudocarp. *e.g.,* Apple, pear. Edible part is fleshy thalamus.

(v) **Hesperidium.** Develops from multicarpellary, multilocular, syncarpous, superior ovary with axile placentation. The epicarp and mesocarp fused together to form skin or rind of the fruit. Endocarp projects inwards forming a number of distinct chambers. The juicy unicellular hairs are present on the inner side of the endocarp. e.g.,Orange and all citrus fruits.

(vi) **Balausta.** Develops from multilocular,syncarpous, inferior ovary. Epicarp is tough and leathery. Endocarp is membranous. Seeds are irregularly distributed inside the fruit.

Juicy testa of the seeds is edible. The fruit has persistent calyx *e.g.,* pomegranate.

(vii) **Amphisarca.** Develops from multicarpellary, syncarpous, multilocular and superior ovary. The epicarp is hard and woody, mesocarp, endocarp and swollen placenta are fleshy and edible *e.g., Aegle marmelos* (wood apple or bael), *Feronia limonia* (Kaith or elephant apple).

2. Aggregate fruits

- Aggregate fruits are formed from polycarpellary, apocarpous ovary.
- Each carpel develops into a fruitlet and all fruitlets together form an aggregate fruit.
- An aggregate of simple fruits borne by apocarpous ovary of a single flower is otherwise known as '**etaerio**'.
- Aggregate fruits are of the following types -

(i) **An etaerio of achenes** *e.g.,* Strawberry, Rose, *Clematis.*

(ii) **An etaerio of berries** *e.g., Artobotrys, Polyalthia, Annona* (custard apple) .

(iii) **An etaerio of follicles** *e.g., Delphinium, Michelia.*

(iv) **An etaerio of drupes** *e.g.,* Raspberry.

3. Multiple or composite fruits

- The multiple fruit develops from the entire inflorescence. These fruits are of two types :

(i) **Sorosis.** These fruits develop from spike, spadix or catkin inflorescence. The flowers fuse together by their sepals or perianth and the whole inflorescence forms a compact mass *e.g.,* Jackfruit, mulberry, pineapple.

(ii) **Syconus.** This fruit develops from hypanthodium inflorescence *e.g., Ficus* sp. (fig, gular, banyan, peepal). The fruitlets are achenial in nature.

Edible parts of some common fruits and their types

Common / English name	Botanical Name	Type	Edible parts
I. Simple fruis			
Pea	*Pisum sativum*	Legume	Seeds
Lady's finger/Okra	*Abelmoschus esculentus*	Capsule	Entire fruit
Wheat	*Triticum aestivum*	**Caryopsis**	Entire fruit
Corn/Maize	*Zea mays*	Caryopsis	Entire fruit
Cashew nut	*Anacardium occidentale*	Nut	Cotyledons and fleshy thalamus
Litchi	*Litchi chinensis*	Nut	**Aril**
Water chestnut	*Trapa bispinosa*	Nut	Seeds
Ground nut	*Arachis hypogea*	**Lomentum**	Seeds
Coriander	*Coriandrum sativum*	Cremocarp	Entire fruit
Mango	*Mangifera indica*	**Drupe**	**Fleshy mesocarp**
Coconut	*Cocos nucifera*	**Drupe**	**Endosperm**
Almond	*Prunus amygdalus*	Drupe	Seeds
Walnut	*Juglans regia*	Drupe	**Cotyledons**
Apple	*Pyrus malus*	**Pome**	**Fleshy thalamus**
Pear	*Pyrus communis*	Pome	Fleshy thalamus
Tomato	*Lycopersicon esculentum*	Berry	Pericarp and placentae
Grape	*Vitis vinifera*	Berry	Pericarp and placentae
Date palm	*Phoenix dactylifera*	Berry	Pericarp

Banana	*Musa paradisica* var. *sapientum*	**Berry**	**Mesocarp and endocarp**

Guava	*Psidium guajava*	**Berry**	Pericarp, placenta and thalamus
Betel nut	*Areca catechu*	**Berry**	Seeds
Bottle gourd	*Lagenaria siceraria*	Pepo	Mesocarp, endocarp and young
Cucumber	*Cucumis sativus*	**Pepo**	Mesocarp, endocarp and young
Loose skinned orange	*Citrus reticulata*	Hesperidium	Placental glandular hair along with endocarp
Pomegranate	*Punica granatum*	Balausta	**Succulent testa**
II. Aggregate fruits			
Strawberry	*Fragaria vesica*	Etaerio of achenes	Fleshy thalamus and seeds
Custard apple	*Annona squamosa*	Etaerio of berries	Inner layer of pericarp and thalamus
III. Multiple or composite fruits			
Mulberry	*Morus alba* and *M.nigra*	**Sorosis**	Succulent perianth and fleshy axis
Pineapple	*Ananas comosus*	**Sorosis**	Fleshy axis, bracts, fused perianth and pericarp
Jack fruit	*Artocarpus heterophyllus*	Sorosis	Fleshy axis, bracts, perianth and seeds
Fig	*Ficus carica*	**Syconus**	**Fleshy receptacle or thalamus**

THE SEED

- Morphologically, **ripened** ovule after fertilisation is known as seed. Seeds are characteristic of **spermatophytes** (Gymnosperms and Angiosperms).

Parts of Seed

1. Seed coat

- Outer, protective covering of the seed is called **seed coat**, which develops from integuments of ovule.
- In seeds developing from bitegmic ovules, there are two distinct layers in seed coat.
- The outer layer is thick, hard and leathery (developing from outer integument), called **testa,**

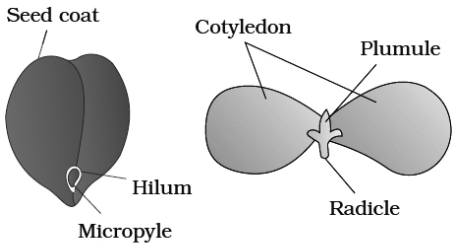
whereas inner layer is thin and papery (developing from inner integument), called **tegmen.**

- In seeds, developing from unitegmic ovules there is single seed coat.
- All the structures inside seed coat constitute **kernel,** while **Hilum** is a scar on seed coat through which the developing seeds are attached to the fruit.

2. Embryo

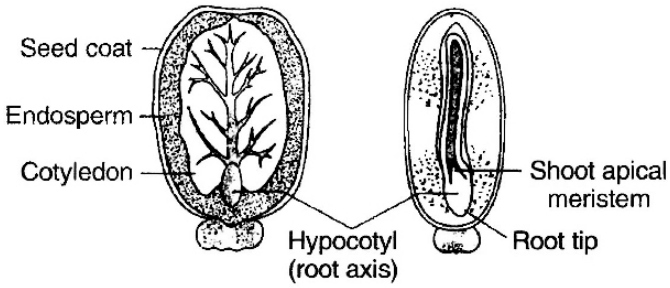
- Embryo is the most important part of the seed, which represents tiny future plant.
- The embryo is having an embryonal axis or main axis called **tigellum,** to which one or two cotyledons (seed leaves) are attached, depending upon whether the seed is monocot or dicot.

- The portion of embryonal axis or tigellum below the point of attachment of cotyledons, is called **hypocotyl,** which bears **radicle** or future root at its tip.
- Similarly, portion of embryonal axis or tigellum above the point of attachment of cotyledons, is called **epicotyl,** which bears **plumule** (future shoot) at its tip.



Structure of dicotyledonous seed

In **castor** seed *(Ricinus communis),* there is a specific outgrowth called **caruncle** present over hilum. It is formed by proliferation of cells of outer integument at tip. Caruncle is somewhat **spongy** and helps in absorption of water during germination of seed.



Structure of Castor seed (vern Arind).

- Based upon presence or absence of endosperm the seed may be of two types:

(1) **Non-endospermic or exalbuminous seeds:** In seeds like gram, pea, groundnut, the endosperm is completely consumed by the embryo, thus the seeds are called non-endospermic or exalbuminous *e.g.,* dicots.

(2) **Endospermic or albuminous seed:** In monocots and castor bean (dicots) embryo does not consume all endosperm. So it persists in the mature seed. Such seeds are called endospermic or albuminous seeds. In these seeds food is stored in endosperm.

Perispermic seeds:

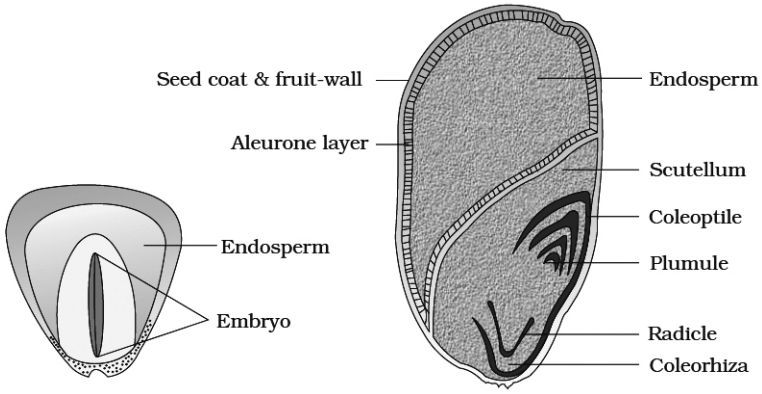
- Mostly nucellus is consumed after fertilization due to absorption of food by the endosperm and embryo.
- Sometimes, the nucellus remains persistent in the seed and is called **perisperm.**
- Such seeds are called perispermic seeds, *e.g., Piper nigrum* (black pepper).
- **Chalazosperm** is perisperm like tissue in chalazal region. It is a substitute for endosperm *e.g., Cynastrum.*

Internal structure of maize seed

- On the outside of the grain is present a single thin but hard covering.
- It is formed by the fusion of the seed coat or **testa** and the fruit wall or **pericarp.**
- Below the grain covering are present two structures, **endosperm** and **embryo.**
- The endosperm consists of two parts, horny **aleurone** and mealy **storage.**
- The aleurone region lies immediately below the grain covering.

- The cells have thick walls and dense cytoplasm filled with aleurone or **protein grains.**
- The latter produce enzymes during the process of grain germination.

- The **storage region** of endosperm is whitish or yellowish.
- It is rich in starch grains.
- The embryo occurs in the pointed part of the grain, mostly towards the upper side.
- It consists of an **embryo axis** containing a **radicle, a plumule** and a single, shield shaped, lateral **cotyledon.**
- It has two protective sheaths, radicle sheath is called **coleorhiza** and a conical protective sheath of plumule is known as **coleoptile.**
- Coleoptile has a terminal pore for the emergence of first leaf during germination.
- The sheath is capable of growth.
- It assists the future shoot in passing through the soil during germination.



Structure of a monocotyledonous seed

- The single cotyledon of Maize grain is called **scutellum.**
- It occupies the major portion of the embryo region of the grain.
- The outermost layer at the boundary of endosperm and embryo is known as epithelial layer.
- It is both secretory and absorptive.
- The epithelial layer secretes hormones into the endosperm for the synthesis of enzymes required for solubilisation of food.
- The solubilised food is absorbed by it and then transferred to the embryo axis.
- On opposite side of scutellum is present a tongue shaped flap like outgrowth called **epiblast**, it represent the remains of second cotyledon.

Conceptual

Fill in the blanks

1. Persistent nucellus in the seed is called_____.
2. _____represents triploid proteinaceous layer in maize seed.
3. _____is edible in pomegrariate.
4. In coconut Which is a drupe, the mesocarp is_____.
5. Most common fruit of family fabaceae is_____.

Ans. **1.** Perisperm, **2.** Aleurone, **3.** Succulent testa, **4.** Fibrous, **5.** Legume/pod

Self Assessment

Which of the given fruit develops from a inferior ovary?

(1) Cypsela (2) Caryopsis (3) Nut (4) Samara

Fruit develops from monocarpellary, superior and unilocular ovary, where the pericarp is fully fused with seed coat is

(1) Follicle (2) Caryopsis (3) Achene (4) Capsule

All given are dry, schizocarpic fruits, except

(1) Lomentum (2) Cremocarp (3) Aegma (4) Silicula

Select an incorrect match

(1) Legume – Pea (2) Lomentum – Gram

(3) Siliqua – Mustard (4) Nut – *Anacardium*

Edible part in porne fruit of apple is

(1) Bract (2) Thalamus (3) Cotyledon (4) Endosperm

Mesocarp and endocarp are edible in

(1) Pomegranate (2) Banana (3) Coconut (4) Mango

Syconus fruit of fig develops from hypanthodium inflorescence, its fruitlets are___in nature.

(1) Achenes (2) Nuts (3) Cocci (4) Samara

Aleurone layer of maize seed stores_____and is_____in ploidy.

(1) Proteins, n (2) Cellulose, 2n (3) Proteins, 3n (4) Fat, 3n

Find odd one out w.r.t. non-endospermic seeds

(1) Gram (2) Groundnut (3) Pea (4) Castor

Scar on the seed coal through which the developing seeds are attached to the fruit is called

(1) Hilum (2) Kernel (3) Epicotyl (4) Caruncle

Ans. Q.31 (1), Q.32 (2), Q.33 (4), Q.34 (2), Q.35 (2), Q.36 (2), Q.37 (1), Q.38 (3), Q.39 (4), Q.40 (1)

SEMI-TECHNICAL DESCRIPTION OF A TYPICAL ANGIOSPERMIC PLANT

- Different characteristics of a family are the diagnotistic features which enable us to differentiate them.
- These diagnostic features are mainly based on floral characters like sexuality of flowers, symmetry of flowers, position of ovary with respect to floral whorls, bracts, and conditions of calyx, corolla, androecium and gynoecium.
- For a systematic study and quick comprehension of all the diagnostic features of a family, these characters are symbolised and put in the form of a floral formula.
- Floral diagrams are also drawn which give some extra informations like placentation, position of the mother axis, aestivation etc.

- Floral formulae and diagrams are given with the respective family descriptions later in the chapter.

Symbols used in Floral Formula

(1) Br : Bracteate flower

(2) Ebr : Ebracteate flower (bract absent)

(3) ⊕ : Actinomorphic flower

(4) % or + : Zygomorphic flower

(5) ♀♂ : Bisexual flower

(6) ♂ : Unisexual, male flower

(7) ♀ : Unisexual; female flower

(8) K : Calyx

K_n : Polysepalous

$K_{(n)}$:

Gamosepalous where n = Number of sepals

(9) Epi : Epicalyx (below sepals)

(10) C : Corolla

C_n : Polypetalous

$C_{(n)}$:

Gamopetalous where n = Number of petals

(11) P : Perianth

(12) A : Androecium

A_∞ : Infinite stamens

$\overset{\frown}{C\ A}$: Epipetalous stamens

$\overset{\frown}{P\ A}$: Epitepalous or epiphyllous stamens

(13) G : Gynoecium

$G_{(n)}$: Syncarpous ovary

G_n : Apocarpous ovary

$\underline{G}_n$: Superior ovary

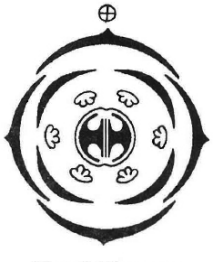
$\overline{G}_n$: Inferior ovary

where n = Number of carpels

(14) In the floral diagram the dot (•) represents the position of mother axis. It denotes the posterior side of the flower.

DESCRIPTION OF SOME IMPORTANT FAMILIES

This includes major distinguishing features and important plants of the family with floral diagram and floral formula.



Floral Diagram

1. **Family**

Cruciferae (Brassicaceae) :

Distinguishing features:

(1) Inflorescence corymb or corymbose-raceme

(2) Flowers tetramerous

(3) Cruciform corolla

(4) Tetradynamous condition, sometimes didynamous

(5) Bicarpellary, syncarpous, superior ovary, unilocular but becomes bilocular due to false septum or **replum,** parietal placentation, stigma bifid.

(6) Fruit is silliqua or silicula

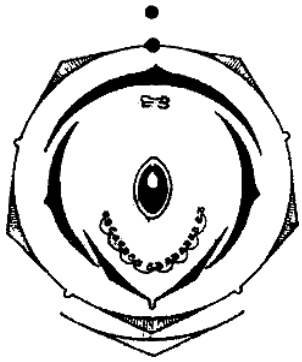
Floral Formula: Ebr. ⊕ or % ♂♀ $K_{2+2}\ C_{\times 4}\ A_{2+4}\ \underline{G}_{(2)}$

Important plants :

(1) *Brassica campestris* (Mustard)
(2) *Brassica oleracea* var. *botrytis* (Cauliflower)
(3) *B. oleracea* var. *capitata* (Cabbage)
(4) *Brassica rapa* (Turnip)
(5) *Raphanus sativus* (Radish)
(6) *Iberis amara* (Candytuft)
(7) *Capsella bursa pastoris* (Shepherd's purse)
(8) *Brassica nigra* (Black mustard)
(9) *Brassica juncea* (Indian mustard)
(10) *Sissymbrium irio*

2. **Family Papilionaceae** (Fabaceae) : Distinguishing features:

(1) Stem erect or climbing
(2) Leaves alternate, pinnately compound or simple, stipulate, reticulate venation, leaf base pulvinate.
(3) Flower bisexual, perigynous, zygomorphic.
(4) Sepals five, gamosepalous, imbricate aestivation, odd sepal anterior.
(5) Petals five, polypetalous, papilionaceous (consisting of posterior standard, two lateral wings and two anterior ones fused to form a keel) vexillary aestivation.



Floral Diagram

(6) Stamen ten, diadelphous, anther dithecous.
(7) Monocarpellary, unilocular, superior ovary with marginal placentation, style single.
(8) Fruit legume or lomentum.
(9) Seed: One to many, non endospermic.

Floral Formula: Br. % ♂♀ $K_{(5)}\ C_{1+2+(2)}\ A_{1+(9)}\ \underline{G}_{1}$

Important plants :

(1) *Pisum sativum* (Garden pea)

(2) *Lathyrus odoratus* (Sweet pea)

(3) *Sesbania sesban* -Green manure

(4) *Glycine max* (Soya bean) -Edible oil

(5) *Cajanus cajan* (Arhar)

(6) *Phaseolus aureus* (Moong)

(7) *Phaseolus mungo* (Urd)

(8) *Crotolaria juncea* (Sunn hemp) -Fibre from stem

(9) *Arachis hypogea* (Ground nut) -Edible oil

(10) *Cicer arietinum* (Gram)

(11) *Lens esculenta* (Masur)

(12) *Dalbergia sissoo* (Shisham)

(13) *Vida faba* (Broad bean)

(14) *Glycirrhiza glabra* (Mulathi) -Root as medicine against throat infections

(15) *Trifolium alexandrium* (Berseem) -Fodder

(16) *Cyamopsis tetragonoloba* (Cluster bean, Gwar)

(17) *Trigonella foenum graecum* (Fenugreek)

(18) *Medicago sativa* (Lucerne)

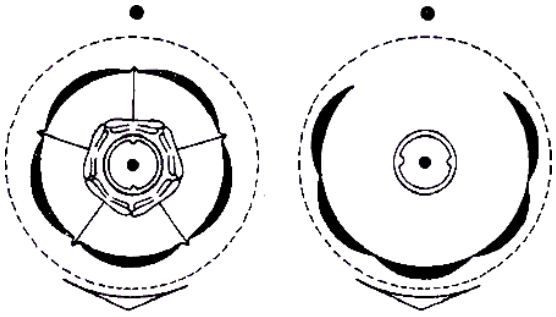
(19) *Butea monosperma* (Flame of the forest)

(20) *Indigofera tinctoria* (Indigo) -Dye

(21) *Abrus pecatorius* (Ratti, Jeweller's weight)

3. Family Compositae (Asteraceae) :

Distinguishing features:



Floral Diagram

(1) Inflorescence is head or capitulum.

(2) Flowers small, sessile, epigynous and are called **florets**.

(3) Calyx modified into hair like structure called **pappus.**

(4) Ligulate (zygomorphic) corolla in ray florets

(5) Tubular (actinomorphic) corolla in disc florets.

(6) Androecium 5, syngenesious, epipetalous, absent in ray florets.

(7) Bicarpellary, syncarpous, inferior ovary, unilocular with basal placentation.

(8) Fruit is cypsela.

(9) Largest and most advanced family of dicots.

Floral Formula: Disc floret – Br. $\oplus$ ⚥ $K_{pappus}\ \overbrace{C_{(5)}\ A_{(5)}}\ \overline{G}_{(2)}$

Ray floret – Br. % ♀ or neuter $K_{pappus}\ C_{(5)}\ A_0\ \overline{G}_{0\ or\ (2)}$

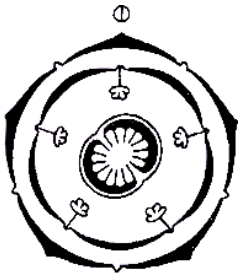
Important plants :

(1) *Helianthus annuus* (Sunflower)
(2) *Tagetes patula* (Marigold)
(3) *Carthamus tinctorius* (Safflower)
(4) *Chrysanthemum*
(5) *Dahlia*
(6) *Cosmos*
(7) *Aster*
(8) *Helichrysum* (Everlasting or paper flower)
(9) *Helianthus tuberosus* (Jerusalem artichoke)
(10) *Parthenium hysterophorus* (Congress grass or carrot grass)

4. **Family Solanaceae** :

Distinguishing features:

(1) Plants mostly herbs, shrubs and rarely small tree.
(2) Stem herbaceous, rarely woody, aerial, erect, cylindrical, branched, solid or hollow, hairy or glabrous (smooth), underground stem in potato.
(3) Leaves alternate, simple, rarely pinnately compound,exstipulate, venation reticulate.
(4) Inflorescence solitary, axillary or cymose as in *Solanum.*
(5) Flowers bisexual, actinomorphic.



Floral Diagram

(6) Sepals five, gamosepalous, persistent *(Physalis,* Brinjal) green or coloured, hairy, valvate aestivation.
(7) Petals five, gamopetalous, valvate aestivation
(8) Stamens five, polyandrous, epipetalous.
(9) Bicarpellary, syncarpous, ovary superior, bilocular with axile placentation
(10) Ovary obliquely placed, placenta swollen with many ovules
(11) Fruit berry or capsule.
(12) Seeds many, endospermous

Floral Formula: $\oplus\ \delta\ K_{(5)}\ \overset{\frown}{C_{(5)}\ A_5}\ \underline{G}_{(2)}$

Important plants :

(1) *Solanum tuberosum* (Potato).
(2) *Solanum melongena* (Brinjal).
(3) *Solanum nigrum* (Black nightshade).
(4) *Withania somnifera* (Ashwagandha-medicinal plant).

(5) *Lycopersicon esculentum* (Tomato).

(6) *Capsicum frutescens* (Shimla mirch).

(7) *Capsicum annum* (Chilli).

(8) *Cestrum nocturnum* (Night jasmine).

(9) *Brunfelsia hopeana* (Yesterday-today-tomorrow).

(10) *Datura alba* (Datura) .

(11) *Petunia auxillaris* (Petunia) .

(12) *Atropa belladona* (Belladona -medicinal plant) .

(13) *Physalis peruviana* (Raspberry)

(14) *Hyoscyamus niger* (Henbane)

(15) *Nicotiana tobacum* (Tobacco)

5. Family Liliaceae :

Commonly called the lily family, is a representative of monocotyledonous plants.

Distinguishing features:

(1) Plants are perennial herbs with underground bulbs, corms, rhizomes.

(2) Leaves are mostly basal, alternate, linear, exstipulate with parallel venation.

(3) Inflorescence is scapigerous cyme.

(4) Flowers bisexual, actinomorphic, hypogynous and trimerous.

(5) Perianth 6, in two alternate whorls, often united into tube, valvate aestivation.

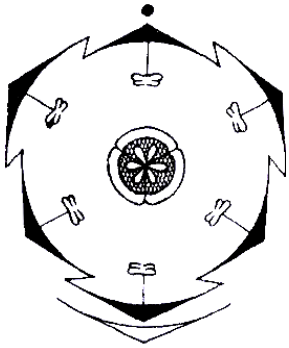
(6) Androecium 6, often epiphyllous.

(7) Tricarpellary, syncarpous, superior, trilocular ovary with many ovules, axile placentation.

(8) Fruit is capsule, rarely berry.

(9) Seeds endospermous.

(10) Unisexual flowers in *Ruscus* and *Smilax*


Floral Diagram

Floral Formula: $\oplus\ \delta\ \overset{\frown}{P_{3+3 \text{ or } (3+3)}\ A_{3+3}}\ \underline{G}_{(3)}$

Important plants:

(1) *Asphodelus tenuifolius* (Piazi)

(2) *Allium cepa* (Piaz)

(3) *Allium sativum* (Garlic)

(4) *Colchicum autumnale* (Source of colchicine)

(5) Asparagus

(6) *Aloe vera* -Medicinal plant

(7) *Yucca* (Ornamental)

(8) *Dracaena* (Ornamental)

(9) Smilax

(10) *Gloriosa superba* (Dagger plant)

(11) *Tulip* (Ornamental)

(12) Ruscus

(13) *Lilium* (Lily) (Ornamental)

(14) *Senseviera trifasciata* (Mother-in-law's tongue) -Source of 'bowstring hemp'.

6. **Family Gramineae** (Poaceae) :

Most advanced family among monocots

(1) Inflorescence spike of spikelets *(Triticum),* panicle of spikelets *(Avena).*

(2) Flowers small, sessile, surrounded by two scales, **lemma** (fertile bract, inferior or outer palea) and **palea** (superior or inner palea) . The lemma bears a long, stiff process called awn.

(3) Flowers zygomorphic, incomplete, hypogynous.

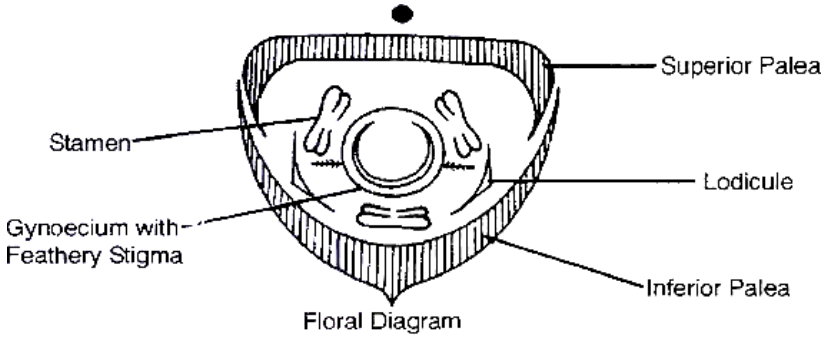
(4) Perianth represented by two or sometimes three lodicules.

(5) Androecium 3 or 6, polyandrous, versatile fixation of anthers.

(6) Monocarpellary, superior, unilocular ovary with basal placentation. Stigma is feathery.

(7) Fruit is caryopsis or nut *(Dendrocalamus)* or berry *(Bambusa)*

Floral Formula: % ♂ ♀ $P_{2 \text{ or } 3}$ (lodicules) $A_{3 \text{ or } 6}$ $\underline{G}_{1}$



Floral Diagram

Important plants

(1) *Avena sativa* (Oat)

(2) *Triticum aestivum* (Wheat)

(3) *Sorghum vulgare* (Jowar)

(4) *Pennisetum typhoides* (Bajra)

(5) *Hordeum vulgare* (Jau)

(6) *Saccharum officinalis* (Sugarcane)

(7) *Zea mays* (Maize)

(8) *Oryza sativa* (Rice)

(9) *Bambusa tulda* (Bamboo)

(10) *Cynodon dactylon* (Doob grass)

(11) *Secale cereale* (Rye)

(12) *Vetiveria zizanioides* (Khus-khus)

(13) *Cymbopogon citratus* (Lemon grass)

Concept Builder

1. Gynobasic style arises from base of the ovary *e.g.*, Labiatae (Lamiaceae).
2. Defense Mechanisms in Plants
   (i) **Thorns** : *e.g.*, Lemon, Pomegranate, *Duranta*
   (ii) **Spines** : *e.g.*, *Agave Yucca*
   (iii) **Prickles** : *e.g.*, Silk cotton tree, Rose

(iv) **Stinging hair** : *e.g., Urtica dioica*

(v) **Glandular hair** : *e.g., Jatropha, Boerhaavia,* Tobacco

(vi) **Stiff hair** : *e.g., Gnaphalium*

(vii) **Latex** : *e.g., Ficus, Nerium , Euphorbia*

(viii) **Alkaloids** : *e.g. ,* Poppy, *Datura*

(ix) **Geophilous habit** : *e.g.,* Ginger, Turmeric, *Colocasia,* Onion

(x) **Mimicry** : *e.g., Arisaema, Sansevieria*

3. **Light, minute and powdery seeds** : *e.g.,* Orchids (smallest seeds), Grasses. **Seeds** of *Moringa, Cinchona* and *Pinus* are winged. Fruits of *Acer, Hiptage, Terminalia, Dioscorea* and *Shorea* are winged.

4. (a) Pappus: In membets of Asteraceae, pappus help in wind dispersal called **parachute mechanism**. *e.g., Taraxacum. Sonchus, Tagetes.*

(b) Censer mechanism of dispersal is found in **Poppy**, *Argemone, Antirrhinum .*

(c) Rolling mechanism of dispersal is found in *Amaranthus, Carthamus.* These are called **tumble weeds**.

(d) Winged seeds : Seeds of *Moringa, Cinchona* and *Pinus* are winged.

(e) Winged fruits : Fruits of *Acer,Hiptage, Terminalia, Dioscorea* and *Shorea* are winged.

5. **Dispersal by water or Hydrochory** -Fruits and seeds showing dispersal by water have floating devices. *e.g..* spongy thalamus in lotus, spongy and fibrous outer walls in coconut and double coconut.

6. **Dispersal by explosion or Autochory:** *Ruellia* (dispersal using **jaculator**), *Ecballium* (dispersal by fountain mechanism).

7. Leguminosae is divided in three subfamilies -Fabaceae, Caesalpiniaceae and Mimosaceae -The major classifying character between these families are character of corolla and stamens.

8. Entire stem is tuberous in knol-khol *(Brassica oleracea* var. *gongyloides).*

9. Plant with largest leaf -*Victoria amazonica* (victoria lily).

10. Plant with longest leaf -*Raphia vinifera* (palm).

11. Acaulescent -Plant with reduced stem.

12. Stipule like structures in axis of leaflets are called stipels, *e.g., Dolichos.*

13. Staminodes (sterile stamens) are characteristically present in family Caesalpiniaceae.

Self

Q.41 Which of the given symbol represents epitepalous condition?

(4)

Q.4 $C_{x\,4}A_{2+4}$ condition is characteristic

(1) Asteraceae (2) Brassicaceae (3) (4)

Select an incorrect match

(1) Indigofera –Fabaceae (2) Helianthus - Asteraceae

To how many families the given plants belong?

Glycirrhiza, Glycine, Abrus, Yucca, Oracaena, Colchicum

(1) Two (2) Three (3) Four (4) Five

Mark the incorrect option (w.r.t. Floral formula of lily family)

(1) $A_{(6)}$ (2) ⚥ (3) $G_{(3)}$ (4) ⊕

Obliquely placed ovary, swollen placenta and epipetalous stamens are features of family

(1) Solanaceae (2) Liliaceae (3) Fabaceae (4) Brassicaceae

Which of the given is/are fodder plantls of fabaceae?

(1) Sesbania (2) *Trifolium*

(3) *Withania* (4) More than one option is correct

Floral formula Br % ⚥ $K_{(5)}$ $C_{1+2+(2)}$ $A_{1+(9)}$ $\underline{G}_1$ belongs to family

(1) Solanaceae (2) Srassicaceae (3) Fabaceae (4) Liliaceae

Light, minute and powdery seeds are found in

(1) Orchids (2) *Acer* (3) *Shorea* (4) *Pinus*

Method of seed or fruit dispersal by wind is termed as

(1) Autochory (2) Anemochory (3) Myrmecochory (4) Zoochory

Ans. Q.41 (2), Q.42 (2), Q.43 (3), Q.44 (1), Q.45 (1), Q.46 (1), Q.47 (4), Q.48 (3), Q.49 (1), Q.50 (2)

Summary

- Flowering plants exhibit enormous variation in shape, size, structure, mode of nutrition, life span, habit and habitat.
- They have well developed root and shoot systems.
- Root system is either tap root or fibrous. Generally, dicotyledonous plants have tap roots while monocotyledonous plants have fibrous roots.
- The roots in some plants get modified for storage of food, mechanical support and respiration.
- The shoot system is differentiated into stem, leaves, flowers and fruits.
- The morphblogical features of stems like the presence of nodes and internodes, multicellular hair and positively phototrophic nature help to differentiate the stems from roots.
- Stems also get modified to perform diverse functions such as storage of food, vegetative propagation and protection under different conditions.
- Leaf is a lateral outgrowth of stem developed exogenously at the node.
- These are green in colour to perform the function of photosynthesis.
- Leaves exhibit marked variations in their shape, size, margin, apex and extent of incisions of leaf blade (lamina).
- Like other parts of plants, the leaves also get modified into other structures such as tendrils, spines for climbing and protection respectively.
- The flower is a modified shoot, meant for sexual reproduction, The flowers are arranged in different types of inflorescences.
- They exhibit enormous variation in structure, symmetry, position of ovary in relation to other parts, arrangement of petals, sepals, ovules etc.
- After fertilisation, the ovary is converted into fruits and ovules into seeds.
- Seeds either may be monocotyledonous or distotyledonous.
- They vary in shape, size and period of viability.
- The floral characteristics form the basis of classification and identification of flowering plants.
- This can be illustrated through semi-technical description of families.
- Hence, a flowering plant is described in a definite sequence by using scientific terms.
- The floral features are represented in the summarised form as floral diagrams and floral formula.

EXERCISE – 1

Section–A

Most dominant plants of present day vegetation are

(1) Thallophytes (2) Bryophytes (3) Flowering plants (4) Pteridophytes

The origin of root hairs and lateral roots is

(1) Exogenous and endogenous respectively (2) Endogenous and exogenous respectively

(3) Both endogenously (4) Both exogenously

The primary growth in root occurs at

(1) Zone of maturation (2) Zone of cell division

(3) Zone of cell elongation (4) Meristematic region

Root shows negative geotropism in

(1) Pothos (2) Ficus (3) Acanthorhiza (4) Sonneratia

When adventitious root shows swelling at regular intervals for food storage, it is

(1) Tubercular root (2) Nodulose root (3) Moniliform root (4) Annulated root

Pneumatophores are generally present in

(1) Mangrove plants (2) Xerophytes (3) Hydrophytes (4) Epiphytes

We often come across long rope like structures hanging from the branches of an old banyan tree. What is the morphological nature of these rope-structures?

(1) They are branches of the shoot system (2) They are prop roots

(3) They are tendrils (4) They are special organs for attachment

Underground modification of stem occurs for which one of the following functions?

(1) Perennation (2) Storage of food

(3) Vegetative propagation (4) All of these

Find correct match

Column I	Column II
a. Tunicated bulb	(i) *Dioscorea*
b. Straggling rhizome	(ii) *Colocasia*
c. Stolon	(iii) *Saccharum*
d. Bulbil	(iv) *Allium*

(1) a(i), b(iii), c(ii), d(iv) (2) a(iv), b(iii), c(ii), d(i)

(3) a(iv) , b(iii), c(i), d(ii) (4) a(iii), b(iv), c(ii), d(i)

Stem modified into green, flattened branches of unlimited growth for assimilatory function is

(1) Phyllode (2) Phylloclade (3) Cladode (4) Bulbil

Leafless stem of onion which produces cluster of terminal flowers is called as

(1) Peduncle (2) Floral axis (3) Scape (4) Rachis

Analogous structure of phylloclade is

(1) Pitcher (2) Phyllode (3) Cladode (4) Bulbil

Thick and woody twiners/climbers are known as

(1) Suckers (2) Lianas

(3) Staggling climbers (4) Creepers

Which is not a modification of stem?

(1) Tuber of potato (2) Pitcher of Nepenthes
(3) Corm of Colocasia (4) Rhizome of ginger

One internode long runner is known as

(1) Sucker (2) Offset (3) Stolon (4) Root stock

Acaulescent habit is related to

(1) *Allium* (2) *Iberis* (3) *Polyathia* (4) *Palms*

Tripinnate compound leaf is the feature of

(1) *Moringa* (2) *Psidium* (3) *Rosa* (4) *Mimosa*

Reticulate venation is the feature of dicots but some monocot also exhibit this venation, like

(1) *Calophyllum* (2) *Smilax* (3) *Eryngium* (4) *Corymbium*

When leaves stand at right angle to next upper and lower pair then this phyllotaxy is called

(1) Alternate (2) Opposite decussate
(3) Opposite superposed (4) Whorled

The terminal leaflets modify into curved hook for climbing in

(1) Wild pea (2) Cockleber (3) Cat's nail (4) Tiger's nail

Find odd one out w.r.t. radicle leaves

(1) Maize (2) Radish (3) Carrot (4) Turnip

Pitcher of Nepenthes is formed from

(1) Leaf bases (2) lamina (3) Petiole (4) Leaf apex

Occurrence of more than one type of leaves on the same plant is known as

(1) Vernation (2) Venation (3) Aestivation (4) Heterophylly

Swollen petiole of Eichhornia is made up of

(1) Aerenchyma (2) Sclerenchyma (3) Chlorenchyma (4) Collenchyma

Inflorescence with thick, fleshy axis and large coloured bracts is

(1) Spathe (2) Spadix (3) Spikelet (4) Hypanthodium

Find the correct match

Column I	**Column II**
a. Achlamydeous flower	(i) Verticillaster
b. Gall flower	(ii) Hypanthodium
c. Dichasial scorpioid	(iii) Scorpioid
d. Cup-shaped involucre	(iv) Capitulum
	(v) Cyathium

(1) a(v), b(ii), c(i), d(iv) (2) a(v), b(ii), c(i), d(iii)
(3) a(iv), b(i), c(ii), d(v) (4) a(iv), b(v), c(i), d(iii)

Bisexual, sessile and bracteate flowers develop acropetally in

(1) Raceme (2) Panicle (3) Spike (4) Corymb

The inflorescence of coriander is

(1) Umbel (2) Corymb (3) Typical raceme (4) Umbel of umbels

Axis of the spikelet is known as

(1) Rachilla (2) Pedicel (3) Appendage (4) Rachis

Three types of flowers occur in the_____inflorescence

(1) Capitulum (2) Hypanthodium (3) Cyathium (4) Umbel

The most advanced type of Inflorescence is

(1) Corymb (2) Capitulum (3) Spadix (4) Polychasial cyme

Elongated part of thalamus between corolla and androecium is called

(1) Anthophore (2) Androphore (3) Gynophore (4) Carpophore

If stamens are arranged in two whorls with antipetalous outer whorl then the condition is

(1) Obdiplostamenous (2) Diplostamenous
(3) Didynamous (4) Epiphyllous

Cohesion of stamens is shown by which one of the following condition?

(1) Gynandrous (2) Gynostegium (3) Syngenesious (4) Epipetalous

Most primitive and advanced type of placentations are respectively

(1) Marginal and axile (2) Superficial and axile
(3) Superficial and basal (4) Parietal and basal

Production of flowers on old stem from dormant buds is

(1) Anthesis (2) Polycarpy (3) Anthotaxy (4) Cauliflory

Find incorrect match

(1) Campanulate – Bell-shaped corolla (2) Personate – Bilabiate corolla
(3) Caryophyllaceous – Clawless corolla (4) Papilionaceous – Butterfly shaped corolla

Inferior ovary is present in

(1) Hypogynous flower (2) Perigynous flower
(3) Dichogamous flower (4) Epigynous flower

Perianth modifies into the lodicules in plants which also contain

(1) Spikelet inflorescence (2) Monocarpellary ovary
(3) Tetramerous flower (4) Both (1) & (2)

Vexillum is

(1) Posterior largest petal (2) Anterior largest petal
(3) Found in pea family (4) Both (1) & (3)

Spirocyclic flowers where stamens and carpels are arranged spirally is found in

(1) Ranunculaceae (2) Brassicaceae (3) Fabaceae (4) Malvaceae

Fruits developing from apocarpous ovary are

(1) Simple fruits (2) Aggregate fruits (3) Composite fruits (4) Pseudocarpic fruits

Match the following

	Column I	**Column II**
a.	Amphisarca	(i) *Aegle*
b.	Pepo	(ii) Cucumis
c.	Drupe	(iii) *Ananas*
d.	Sorosis	(iv) *Juglans*

(1) a(i) , b(ii), c(iv), d(iii) (2) a(i), b(ii), c(iii), d(iv)

(3) a(iii), b(ii), c(i), d(iv) (4) a(ii), b(i), c(iv), d(iii)

Presence of pappus is the characteristic of which fruit?

(1) Caryopsis (2) Cypsela (3) Achene (4) Samara

Single shield-shaped cotyledon of monocot seed is called

(1) Coleorhiza (2) Coleoptile (3) Scutellum (4) Epiblast

Which one of the following is exalbuminous seed?

(1) Wheat seed (2) Maize seed (3) Castor seed (4) Pea seed

Scar on the seed coat through which the developing seeds are attached to fruit is called

(1) Aril (2) Caruncle (3) Hilum (4) Micropyle

Find Incorrect matching

(1) Samara – Winged pericarp (2) Schizocarp – Mericarp

(3) Balausta – Aril (4) Syconus – Hypanthodium

Thorns, spines and prickles work as____in plants

(1) Respiratory organs (2) Excretory organs

(3) Organs of offense (4) Defensive organs

Presence of tetradynamous condition and false septum i.e. replum are the features of family

(1) Solanaceae (2) Brassicaceae (3) Liliaceae (4) Fabaceae

The scientific name of black mustard is

(1) Brassica campestris (2) *B. rapa*

(3) *B. juncea* (4) *B. nigra*

Family leguminosae is classified into three sub families on the basis of which characters?

(1) Calyx and corolla (2) Symmetry of flower

(3) Corolla and androecium (4) Stamens and carpels

Perigynous flower and diadelphous condition are found in the family

(1) Papilionaceae (2) Caesalpiniaceae (3) Mimosaceae (4) Solanaceae

The symbol $\oplus\ K_{(5)}\ C\ A_5$ represents which one of the following family?

(1) Solanaceae (2) Asteraceae (3) Cucurbitaceae (4) Labiatae

There are given some plants below, select among the options that , to how many families they belongs? Plants are - *Crotolaria*, *Atropa*, *Solanum*, *Arachis*, *Bambusa* and *Chrysanthemum*

(1) 4 families (2) 6 families (3) 2families (4) 3 families

Heterogamous head possess

(1) Ray florets only (2) Disc florets only

(3) Neuter flowers only (4) Both ray and disc florets

Zygomorphic flower occurs in

(1) Papilionaceae (2) Poaceae

(3) Ray florets of Asteraceae (4) All of these

Br. ⊕ P A G represents the family with one of the followir

Floral formula

+ 3+3 3+3 (3)

plants?

(1) Crotolaria and Astragalus
(2) Lepidium and Iberis
(3) Allium and Asparagus
(4) Vetiveria and Cymbopogon

Feathery stigma and versatile stamens are the feature of family

(1) Poaceae (2) Umbelliferae (3) Liliaceae (4) Malvaceae

Aestivation in the corolla of Pisum sativum is

(1) Ascending imbricate (2) Descending imbricate

(3) Quincuncial imbricate (4) Valvate

Find correct match

Column I	Column II
a. Sinigrin	(i) Liliaceae
b. Carthamin	(ii) Brassicaceae
c. Atropine	(iii) Solanaceae
d. Aloin	(iv) Asteraceae

(1) a(ii), b(iv) , c(iii), d(i) (2) a(ii), b(iv), c(i), d(iii)

(3) a(i), b(ii), c(iii), d(iv) (4) a(i), b(ii), c(iv), d(iii)

Flowers with monadelphous condition and pentacarpellary ovary are present in

(1) China rose family (2) Pea family (3) Potato family (4) Yucca family

Largest angiospermic family with advanced type of placentation is

(1) Poaceae (2) Asteraceae (3) Cucurbitaceae (4) Both (1) & (2)

Find out a set of common N_2 fixing fodder plants

(1) *Trifolium, Atropa* (2) *Withania, Abrus*

(3) *Sesbania, Trifolium* (4) *Aloe, Gloriosa*

Plant yielding colchicine belong to the family

(1) Liliaceae (2) Asteraceae (3) Lamiaceae (4) Arecaceae

Section–B

'Zone of cell maturation' is an important part of root. because

(1) It helps in the absorbtion of water

(2) It bears unicellular root hairs

(3) A and B both are correct

(4) In hydrophyte root hairs are absent in the zone of cell maturation

Find out the incorrect match. (Type of Root – Plants)

(1) Fusiform – Rhaphanus sativus (2) Conical – Brassica rapa

(3) Napiform – Beta vulgaris (4) Tuberous – Mirabilis

Ipomoea batata (Sweet Potato) is a tuberous root for storage of food. It is a

(1) Tap root (2) Adventitious root

(3) Modified stem (4) Either tap root or adventitious root

Prop and Stilt roots both are for extra support. Which is/are present in maize ?

(1) Prop root (2) Stilt root (3) Both A and B (4) Climbing root

Cladode and phylloclade are modified stem, the only difference is

(1) Cladode is the modification of entire stem but phylloclade is the modification of only single internode

(2) Phylloclade is the modification of entire stem but cladode is the modification of only single internode

(3) Cladode is common in Casuarina

(4) Phylloclade is common in Asparagus

Rhizome is modified stem. Which is correct for it ?

(1) It grow vertical to the soil surface

(2) It is reported in Banana

(3) They are swollen at the terminal end due to storge of food

(4) Rhizome is not found in fern

Which pair is the correct combination of sub aerial modification of stem

(1) Sucker and Offset (2) Sucker and Rhizome

(3) Offset and Rhizome (4) Rhizome and Bulb

Woody perennial climber found in tropical rain forest are modified stem. They are called

(1) Climber (2) Lianas (3) Twiners (4) Trailers

What is correct match.

a. Pod – Gram, Pea b. Siliqua – Mustured, Radish

c. Silicula – Iberish, Capsella d. Capsule – Cotton, Datura

(1) Only a is correct (2) Only b and c are correct

(3) All are correct (4) All are incorrect

Caryopsis type of fruit is

(1) Characteristic fo cypreceae family

(2) Not split or brust for discharge of seed

(3) Fruit wall and seed coat do not completly fused

(4) Not present in wheat

Which one of the following is incoreect w.r.t obligate stem parasite.

(1) Cuscuta (2) Cassytha (3) Arceuthobium (4) Sapria

Which of the following is incorrect match

(1) Orobanchae – Broom rape (2) Monotropa – Indian Pipe

(3) Neottia – (Bird's nest fungus) (4) Viscum – Mistletoe

Match the Column I & Column II.

Column I	**Column II**
(i) Utricularia	(a) Water flea trap
(ii) Drosera	(b) Venus fly trap
(iii) Dionaea	(c) Sundew
(iv) Aldrovanda	(d) Bladderwort

(1) i – a, ii – b, iii – c, iv – d (2) i – d, ii – c, iii – b, iv – a

(3) i – c, ii – d, iii – b, iv – a (4) i – d, ii – c, iii – a, iv – b

Which of the following is not true for epiphytes

(1) They are usually found in tropical rain forest.

(2) They contain velamen tissues

(3) The roots are hygroscopic

(4) They have tentacles over leaves

Choose the false statement.

(1) Phylloclades are photosynthetic in function

(2) Pitcher of Nepenthes is a modification of stem

(3) bulb of garlic and onion have disc shaped stem.

(4) Cladode is found in Asparagus

Which of the following statement is incorrect

(1) Prop roots are found in Ficus benghalensis

(2) Stilt roots provide extra support to Pandanus

(3) Scape is leafless flower bearing branch of mustard

(4) Cluster root is fonud in Dahlia

a-A fleshy vegatative bud is called bulbil. b-

Multiple root cap is found in Screwpine

c-Root cap is absent in hydrophytes

d-Phylloclade is found in opuntia.

(1) All are correct except b (2) All are correct

(3) a & b are correct (4) b & c are corret

Cauliflory is the formation of flowers

(1) On the young branches from new buds (2) On old branches from new buds

(3) From epiphyllous buds (4) In bunch

Heterophylly of Limnophila is

(1) Adaptive (2) Developmental (3) Habitual (4) Environmental

Which of the following is odd one out w.r.t reticulate venation?

(1) Dioscorea (2) Colocasia (3) Smilax (4) More than one option

The stem of which of the following is not a rhizome:

(1) Nelumbo (2) Curcuma (3) Crocus (4) Zingiber

Which of the following is not correct.

(1) Leaf develops at the node.

(2) Axillary bud develops into a branch

(3) Leaves originate from Shoot apical meristem

(4) Leaf is not important due to lack of photosynthesis

Identify the incorrectly matched pair

(1) Lianas – Tropical rain forests

(2) Scape – Leafless Stem of onion bearing flowers

(3) Pitcher of Nepenthes – Modification of Stem

(4) Cocoloba – Phylloclade

In root, branches (secondary roots) are-

(1) Stellar in origin (2) Cortical in origin
(3) Stellar and endogenous (4) Cortical and exogenous

Root pockets act as balancers and found in-

(1) Hygrophytes (2) Free floating hydrophytes
(3) Fixed floating hydrophytes (4) Submerged hydrophytes

Root hair lost during transplantation but reappear within a week. These root hairs are found in-

(1) Zone of division (2) Zone of elongation
(3) Zone of maturation (4) All zones

The factors which initiate development of respiratory roots in Avicenia and other mangroves are-

(1) Saline marshes (2) Poor oxygen supply
(3) Soil is physiologically dry (4) All the above are correct

Potato tuber is a modified-

(1) Stem (2) Root (3) Bulb (4) Stolon

Buds typically are found-

(1) At the tips of branches and roots
(2) At the tips of branches and at the bases of leaves
(3) Along roots and at the bases of leaves
(4) Only on the bases of leaves

In which of the following stem is most reduced-

(1) Rhizome (2) Corn (3) Phylloclode (4) Bulb

Cladode are common among-

(1) Liliaceae (2) Malvaceae (3) Mimosoideae (4) Solanaceae

In opuntia the leaves are modified into-

(1) Scales (2) Spines (3) Thorns (4) Phylloclades

The cladode among the following is-

(1) Parkinsonia (2) Acacia (3) Opuntia (4) Asparagus

The mode of arrangement of leaves on the stem and branch is knwon as-

(1) Vernalization (2) Vernation (3) Venation (4) Phyllotaxy

Main photosynthetic organs of lathyrus sativus plant-

(1) Leaves (2) Leaflets (3) Stipules (4) Phyllodes

The main axis of the inflorescence is elongated in a-

(1) Corymb (2) Capitulum (3) Cyanthium (4) Catkin

Cyathium is a type of-

(1) Fruit (2) Inflorescence (3) Bacterium (4) Algae

Verticillaster is a type of-

(1) Phyllotaxis (2) Placentation (3) Inflorescence (4) Venation

The axis of inflorescence is known as-

(1) Thalamus (2) Peduncle (3) Pedicel (4) Petiole

In onion the inflorescence is-

(1) Raceme (2) Corymb (3) Umbel (4) Spike

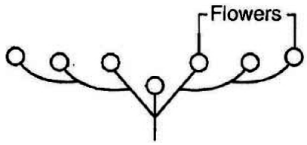
The name compositae is based on-

(1) Inflorescence (2) Corolla (3) Gynoecium (4) Fruit

Q.42 Select a correct set

Plant	Organ	Function
(1) Vanda	Tap root	Moisture absorption
(2) Jasmine	Offset	Photosynthesis
(3) Pineapple	Sucker	Propagation
(4) Nepenthes	Leaf tip	Photosynthesis

Which kind of inflorescence is shown in the figure given below.



(1) Simple dichasial cymose (2) Verticiliaster

(3) Simple monochasial cymose (4) Polychasial cymose

Most common fruits of fabaceae and brassicaceae are respectively

(1) Lomentum and Siliqua (2) Legume and Samara

(3) Lomentum and Sllicula (4) Legume and Siliqua

Family fabaceae is corcerned with

(1) Diadelphous stamen, marginal placentation, obliquely placed ovary and vexillary corolla

(2) Vexillary corolla, diadelphous stamen, marginal placenta and large posterior petal

(3) Basal placentation, versatile stamens, spikelet inflorescence

(4) Axile placentation, non·endospermic seed, legume fruit

Select an incorrect match

(1) Whorled phyllotaxy -Alstonia, Nerium

(2) Decussate phyllotaxy -Quisqualis, Psidium, Syzygium

(3) Alternate phyllotaxy -Mustard, China rose, Sunflower

(4) Opposite phyllotaxy - Zinnia, Calotropis

Cuscuta, Viscum and Orobanche are similar in having

(1) Hygroscopic roots (2) Assimilatory roots

(3) Epiphyllous roots (4) Haustorial roots

Leaflet tendril and entire leaf tendril are found in respectively

(1) Cucurbifa, Smilax (2) Pisum, Lathyrus sativus

(3) Passiflora, Vilis (4) Luffa, Pisum

In Coriandrum, the prolongation of thalamus beyond the carpel is called as

(1) Gynophore (2) Gynandrophore (3) Androphore (4) Carpcphore

A. *Citrus* and *Ricinus* have synandrous condition.

B. In epitepalous condition, the cohesion occurs bewteen tepal and filament of stamen.

C. Tetradynamous condition consists of two long and four short stamen filaments

(1) All are incorrect
(2) Only A is incorrect
(3) Only C is incorrect
(4) Only B is incorrect

Scutellum is a

(1) Food storing haploid structure in grass embryo
(2) Remnant of cotyledon in maize
(3) Shield shaped and large cotyledon of grasses
(4) Protective covering of plumule in grasses

Answers Key

Section–A

Q.1	3	Q.2	1	Q.3	3	Q.4	4	Q.5	3	Q.6	1	Q.7	2
Q.8	4	Q.9	2	Q.10	2	Q.11	3	Q.12	2	Q.13	2	Q.14	2
Q.15	2	Q.16	1	Q.17	1	Q.18	2	Q.19	2	Q.20	3	Q.21	1
Q.22	2	Q.23	4	Q.24	1	Q.25	2	Q.26	1	Q.27	3	Q.28	4
Q.29	1	Q.30	2	Q.31	2	Q.32	2	Q.33	1	Q.34	3	Q.35	3
Q.36	4	Q.37	3	Q.38	4	Q.39	4	Q.40	4	Q.41	1	Q.42	2
Q.43	1	Q.44	2	Q.45	3	Q.46	4	Q.47	3	Q.48	3	Q.49	4
Q.50	2	Q.51	4	Q.52	3	Q.53	1	Q.54	1	Q.55	1	Q.56	4
Q.57	4	Q.58	3	Q.59	1	Q.60	2	Q.61	1	Q.62	1	Q.63	2
Q.64	3	Q.65	1										

Section–B

Q.1	3	Q.2	2	Q.3	2	Q.4	2	Q.5	2	Q.6	2	Q.7	1
Q.8	2	Q.9	3	Q.10	2	Q.11	4	Q.12	3	Q.13	2	Q.14	4
Q.15	2	Q.16	3	Q.17	2	Q.18	2	Q.19	1	Q.20	4	Q.21	3
Q.22	4	Q.23	3	Q.24	3	Q.25	3	Q.26	3	Q.27	2	Q.28	1
Q.29	2	Q.30	4	Q.31	1	Q.32	2	Q.33	4	Q.34	4	Q.35	2
Q.36	4	Q.37	2	Q.38	3	Q.39	2	Q.40	3	Q.41	1	Q.42	3

Q.43 2 Q.44 4 Q.45 2 Q.46 2 Q.47 4 Q.48 2 Q.49 4
Q.50 1 Q.51 3

Questions

Bacteria found in root nodules of legumes are **[DPMT 2002]**

(1) Nitrobacter (2) Nitrosomonas (3) Rhizobium (4) Azotobacter

Root cap is absent in **[BHU 1994, 2000]**

(1) Hydrophytes (2) Lithophytes (3) Xerophytes (4) Mesophytes

Regions of root from base to root tip are **[AMU 2001]**

(1) Maturation zone - Cell division zone - Elongation zone

(2) Maturation zone - Elongation zone - Cell division zone

(3) Cell division zone - Elongation zone - Maturation zone

(4) Elongation zone - Cell division zone - Maturation zone

A plant with epidermis specialised to absorb moisture from air is **[APMEE 2002]**

(1) Avicennia (2) Vanda (3) Rhizophora (4) Jussiaea

A root is adventitious when it is **[CPMT 2002]**

(1) Swollen (2) Growing in marshy places

(3) Formed from plumule (4) Modified for storage

Phylloclade is found in **[AMU 2001]**

(1) Chrysanthemum (2) Asparagus (3) Ruscus (4) Opuntia

Green leaf-like one internode long stem branches are called **[KCET 2003]**

(1) Phylloclades (2) Phyllodes (3) Bulbils (4) Cladodes

Leaves develop from **[AFMC 2003]**

(1) Nodes (2) Internodes (3) Epidermis (4) Endodermis

Phyllode is found in **[CET Chd. 2003]**

(1) Clematis (2) Gloriosa (3) Acacia (4) Dischidia

Santalum album/Sandal-wood Tree is **[Orissa 2007]**

(1) Partial root parasite (2) Partial stem parasite

(3) Total stem parasite (4) Total root parasite

A rootless aquatic plant in which a portion of leaf is modified to form a blade for catching small aquatic animals is **[DPMT 2009]**

(1) Dionaea (2) Drosera (3) Utricularia (4) Nepenthes

Total root parasite is **[MPPMT 2009]**

(1) Rafflesia (2) Cassytha (3) Viscum (4) Loranthus

The tallest plant belongs to **[AFMC 2004]**

(1) Cedrus deodara (2) Eucalyptus ragnans

(3) Sequoia sempervirens (4) Pinus roxburghii.

Insects

captured by carnivorous plants partially meet their requirement of **[B.H.U 2008]**

(1) Organic matter (2) Enzymes (3) Water (4) Nitrogen

Which one of the following is a partial root parasite **[D.PMT 2002]**

(1) Balanophora (2) Santalum (3) Viscum (4) Cuscuta

Haustoria or sucking roots occur in **[Kerala 2006]**

(1) Betel (2) Orchids (3) Cuscuta (4) Tinospora

Velamen is present in **[Manipur 2007]**

(1) Tuberous roots (2) Epiphytic roots (3) Breathing roots (4) Parasitic roots

Roots originating from parts other than radicle are **[Har. PMT 2005]**

(1) Stilt roots (2) Adventitious roots (3) Tap roots (4) Fibrous roots

Which of the following has succulent root? **[Pb. PMT 2005]**

(1) Opuntia (2) Agave (3) Aloe (4) Asparagus

Velamen occurs in **[B.H.U. 2008]**

(1) Epiphytes (2) Mesophytes (3) Hydrophytes (4) Xerophytes

Select the correct code,

Primary root is -

1. Positively geotropic
2. Positivily hydrotropic
3. Negatively geotropic
4. Negatively hydrotropic **[BHU 2008]**

(1) 1, 2, 3 correct (2) 1, 2 correct (3) 2, 4 correct (4) 1, 3 correct

A fibrous root system is efficient in **[DPMT 2009]**

(1) Food storage (2) Nitrogen fixation

(3) Good anchorage (4) Absorption from deep soil layers

Primary root continues to grow and form root system called **[DPMT2009]**

(1) Tap (2) Stilt (3) Secondary (4) Fibrous

Rhizophora possesses **[AMU 2009]**

(1) Pneumatophores (2) Prop roots (3) Stilt roots (4) Modified roots

Which is incorrect match? **[AMU 2010]**

(1) Tap root – Carrot (2) Prop root – Banyan Tree

(3) Adventitious root – Sweet potato (4) Stilt root – Turnip

In Amorphophallus, vegetative multiplication occurs through **[Pb. PMT 2005]**

(1) Bulbils (2) Rhizome (3) Corm (4) Offset

Thick undergound stem growing parallel to soil surface is **[DPMT2009]**

(1) Stolon (2) Rhizome (3) Sucker (4) Offset

A rhizome which grows vertically upwards is **[AFMC 2005]**

(1) Corm (2) Stolon (3) Bulbil (4) Rootstock

Stem may function in **[AMU 2008]**

(1) Protection

(2) Spread of branches

(3) Storage, support and vegetative propagation

(4) All of these

Petiole is modified into green leafy structure called **[CET Chd. 2009]**

(1) Phyllode (2) Phylloclade (3) Cladode (4) Foliaceous petiole

In Nepenthes the pitcher is modified **[DPMT 2005, Orissa 2010]**

(1) Whole leaf (2) Leaf apex (3) Lamina (4) Petiole (5) Leaf base

Venation in monocots is **[Orissa 2005, AMU 2005]**

(1) Pinnate reticulate (2) Palmate reticulate (3) Pinnate parallel (4) Parallel

Phyllotaxy in Calotropis is **[AMU 2005]**

(1) Alternate (2) Opposite (3) Whorled (4) None of these

Find the correct match **[AMU 2010]**

(1) Mustard – Leaves opposite (2) Mustard – Leaves alternate

(3) Guava – Leaves alternate (4) Guava – Leaves whorled

The flowers of a raceme are arranged **[Pb.PMT 2010]**

(1) Acropetally (2) Basipetally (3) Centripetally (4) Centrifugally

Capitulum inflorescence is found in **[MPPMT 2010]**

(1) Malvance (2) Papilionaceae (3) Liliaceae (4) Compositae

Inflorescence of Jowar is **[Wardha 2010]**

(1) Spike of spikelets (2) Panicle of spikelts (3) capitulum (4) Verticillaster

Raceme inflorescence occurs in **[JIPMER 2003]**

(1) Cucurbita (2) Delonix (3) Euphorbia (4) Begonia

Which is nearest to corymb **[CMC 2003]**

(1) Umbel (2) Capitulum (3) Cyathium (4) Hypanthodium

Edible part of Cauliflower is **[AFMC 2005]**

(1) Cotyledons (2) Mesocarp (3) Endocarp (4) Inflorescense

In an inflorescence two types of centripetally arranged sessile flowers with hair like sepals occurs. Which one is not associated with them

(a) Nectar glands at base of corolla (b) Axile placentation

(c) Superior ovary (d) Scaly bracts **[EAMCET 2008]**

(1) b and c (2) c and d (3) a and b (4) a and d

A plant with both male and female flowers/sex organs borne over it is **[DPMT 2009]**

(1) Monoecious (2) Dioecious (3) Unisexual (4) Bisexual

Pappus is modification of **[BHU 2005]**

(1) Bracts (2) Bracteoles (3) Corolla (4) Sunflower

Diadelphous (9) + 1 stamens occur in **[AIIMS 2001]**

(1) Gramineae (2) Cucurbitaceae (3) Papilionate (4) Malvaceae

Filament attachd along the whole length of anther is the condition called **[AIIMS 2002]**

(1) Adnate (2) Dorsifixed (3) Basifixed (4) Versatile

Tetradynamous condition is characteristic of family **[CBSC 2001]**

(1) Papilionaceae/Pea (2) Cruciferae/Mustard

(3) Solanaceae/Tamato (4) Malvaceae/Cotton

Butterfly shaped flower with one standard, two wing-like and two keeled petals belong to **[AIIMS 2000]**

(1) Compositae (2) Rubiaceae (3) Malvaceae (4) Papilionaceae

Anthers represents **[BHU 2001]**

(1) Male gametophytes (2) Male sporophylls
(3) Spermatogonia (4) Female gametophytes

Bicarpellary gynoecium with oblique ovary occurs in **[CBSE 2001]**

(1) Banana (2) Brinjal (3) Pisum (4) Mustard

In Bentham and Hooker's system of classification the arrangement of three series of polypetalae reflects evolution from **[EAMCET 2002]**

(1) Bisexuality to unisexuality
(2) Dichlamydeous to monochlamydeous condition
(3) Hypogyny to epigyny (4) Apocarpy to syncarpy

Union of stamens with carpels from a complex called **[CMC 2003]**

(1) Gynandrous (2) Syngenesious (3) Gynandrium (4) Synandrous

An ovule bent to come at right angles to funicle is **[CBSE 2004]**

(1) Anatropous (2) Orthotropous (3) Campylotropous (4) Hemitropous

Trimerous unisexual flowers occur in **[KCET 2004]**

(1) Tamarind (2) Cocos (3) Pea (4) Hibiscus

Gynoecium having three fused carpels with a single ovule containing chamber is **[JIPMER 2004]**

(1) Tricarpellary, syncarpous, unilocular (2) Tricarpellary, polycarpellary unilocular
(3) Tricarpellary, syncarpous, trilocular (4) Tricarpellary, polycarpellary, trilocular

When pistillate and bisexual flowers develop on different plants. The condition is **[BV 2006]**

(1) Gynodioecious (2) Gymnomonoecius (3) Polygamodiecius (4) Polygamonoecius

Synandrous condition is found in **[WB 2008]**

(1) Sunflower (2) Gourd (3) Pea (4) Lemon

Replum occurs in the ovary of **[CBSE 2008]**

(1) Mustard (2) Pea (3) Sunflower (4) Lemon

Ovules occur along the ventral suture over a ridge in two rows in placentation **[AMU 2009]**

(1) Marginal (2) Parietal (3) Axile (4) Free central

An example of axile placentation is **[CBSE 2009]**

(1) Marigold (2) Dianthus (3) Lemon (4) Argemone

Which one is monoecious **[CBSE 2009]**

(1) Marchantia (2) Pinus (3) Cycas (4) Papaya

The expression 'gynoecium is apocarpous' implies that **[DPMT 2010]**

(1) Gynoecium compries only one pistil which is fused with the stamens
(2) Gynoecium compries more than one carpel which are free

(3) Gynoecium compries more than one carpel which are fused

(4) Gynocium compries only one carpel which is free

In unilocular ovary with a single ovule the placentation is **[CBSE 2010]**

(1) Basal (2) Free central (3) Axile (4) Marginal

The technical term used for the androecium in a flower of China Rose (Hibiscus rosa - sinensis) is **[CBSE 2010]**

(1) Diadelphous (2) Polyandrous (3) Polyadelphous (4) Monadelphous

Edible part in the fruit of Litchi is **[CBSE 2005]**

(1) Mesocarp (2) Aril (3) Fleshy thalamus (4) Cotyledons

Which one of the following is a nut **[BHU 2005, 2008]**

(1) Walnut (2) Cashewnut (3) Groundnut/Areca (4) Both 1 and 2

Coir of commerce is obtained from **[AMU 2005, CPMT 2009]**

(1) Endocarp of Coconut (2) Mesocarp of Coconut
(3) Stem of Jute (4) Leaves of Coconut

Fruit growing from hypanthodium/fruit of Fig is **[CPMT 2001, CBSE 2009]**

(1) Sorosis (2) Siliqua (3) Syconus (4) Samara

The fruit of Annona squamosa (Custard Apple) is **[AFMC 2004]**

(1) Etaerio of berries (2) Etaerio of drupes (3) Hypanthodium (4) Etaerio of achenes

The edible part of Apple/Pear is **[BHU 2008, AMU 2005]**

(1) Cotyledons (2) Thalamus/Receptacle
(3) Mesocarp (4) Endocarp

Edible part of Mango is **[AFMC 2010, CBSE 2004]**

(1) Pericarp (2) Mesocarp (3) Pome (4) Epicarp

Dry indehiscent single seeded fruit formed from bicarpellary syncarpous inferior ovary is **[CBSE 2008]**

(1) Cremocarp (2) Caryopsis (3) Cypsela (4) Berry

Aril represents edible part in **[CBSE 2006, AFMC 2009]**

(1) Litchi (2) Apple (3) Mango (4) Banana

Syconus fruit develops from **[AMUPMDC 2006]**

(1) Catkin (2) Varticillaster (3) Hypanthodium (4) Cyathium

Which is correct match for edible part **[CBSC 2001]**

(1) Tomato – Thalamus (2) Maize – Cotyledons
(3) Guava – Mesocarp (4) Date – Mesocarp

Edible part of Banana is **[CBSE 2001]**

(1) Epicarp (2) Epicarp and mesocarp
(3) Mesocarp and less developed endocarp (4) Endocarp and less developed mesocarp

Aril is **[JIPMER 2002]**

(1) Outgrowth of integument

(2) Persistent nucellus

(3) Outgrowth of funicle which grows around the ovule

(4) Outgrowth from micropyle

Juicy hair like structures observed in lemon fruit develop from **[CBSE 2003]**

(1) Exocarp (2) Mesocarp (3) Endocarp (4) Mesocarp and endocarp

Fruits have fructose for **[AMU 2003]**

(1) Attracting animals for seed dispersal (2) Fruit ripening
(3) Maturation of seeds (4) Nourishment of embryo

In sorosis type of composite fruits, the edible part is **[BHU 2005]**

(1) Cotyledons (2) Fleshy thalamus
(3) Perianth and peduncle (4) Endosperm

Which one is a true fruit? **[AMU 2005]**

(1) Walnut (2) Areca nut (3) Cashew nut (4) Ground nut

Edible part in sorosis fruit is **[AMU 2005]**

(1) Perianth (2) Parianth + sepals (3) Placenta (4) Perianth + Placenta

Pineapple (Ananas) fruit develops from **[CBSE 2006, DPMT 2009]**

(1) Cluster of flowers borne compactly on a common axis
(2) Multilocular monocarpellary flower
(3) Unilocular polycarpelley flower
(4) Mulitpistillate syncarpous flower

Lomentum is **[BHU 2007]**

(1) Achenial fruit (2) Schizocarpic fruit (3) Composite fruit (4) Syconus fruit

Geocarpic fruits are formed in **[AMFC 2007]**

(1) Watermelon (2) Onion (3) Carrot (4) Groundnut

The fruit is chambered, developed from inferior ovary and has seeds with succculent testa is **[CBSE 2008]**

(1) Orange (2) Cucumber (3) Pomegranate (4) Guava

Fleshy receptacle of syconus of Fig encloses a number of **[CBSE 2008]**

(1) Berries (2) Achenes (3) Mericarps (4) Samras

Find out the correct statements **[BHU 2008]**

(1) Seeds of Pea are exalbuminous (2) Fruit of Peach is drupe
(3) Seeds of Tamoto are albuminous (4) Fruit of Coconut is berry
(1) 1, 2, 3, correct (2) 1, 2 correct (3) 2, 4 correct (4) 1, 3 correct

In which plant the fruit is a drupe, seed coat is thin, embryo is inconspicuos and endosperm is edible? **[DPMT 2009]**

(1) Groundnut (2) Apple (3) Wheat (4) Coconut

In drupe of Coconut, mesocarp is **[AMU 2009]**

(1) Stony (2) Fleshy (3) Fibrous (4) Watery

Cotyledons and testa are respectively edible in **[CBSE 2009]**

(1) Walnut and Tamarind (2) French Bean and Coconut
(3) Cashew Nut and Litchi (4) Groudnut and Pomegranate

What is correct answer to assertion (a) and reason (r).

Assertion : In syconus type fruit, the achenes formed are fewer the total number of flowers in the inflorescence.

Reason : Upper and middle flowers do not develop into fruits **[EAMCET 2009]**

(1) Both a and r are correct with r being correct explanation of a.

(2) Both a and r are correct with r is not correct explanation of a.

(3) a is true but r is false.

(4) a is false but r is true.

Which of the following fruit is parthenocarpic **[CET Chd. 2010]**

(1) Mango (2) Lemon (3) Banana (4) Apple

Scientific name of Banana is **[AFMC 2010]**

(1) Musa paradisica (2) Musa superba (3) Musa textilis (4) Hibiscus mutabilis

Mechanical injuring of seed coat to break dormancy is called **[DPMT 1999, 2003]**

(1) Scarification (2) Stratification (3) Impaction (4) Compaction

A seed which does not require oxygen for germination is **[BHU 2008]**

(1) Pea (2) Rice (3) Typha (4) Both B and C

Micropyle occurs in **[BHU 2008]**

(1) Ovary (2) Seeds (3) Ovule (4) Both B and C

Shield – shaped cotyledon/scutellum occurs in **[BHU 2008]**

(1) Maize/Sorghum (2) Gram (3) Pea (4) Cucumber

Embryo of Sunflower has **[BHU 2002]**

(1) One cotyledon (2) Two cotyledon (3) Many cotyledons (4) No cotyledon

Aleurone layer of maize grain is specially rich in **[CBSE 2003]**

(1) Proteins (2) Starch (3) Lipid (4) Auxins

Dry fruit 'Chilgoza' is **[BHU 2005]**

(1) Fruit of Cycas (2) Seed of Cycas

(3) Fruit of Pinus gerardiana (4) Seed of Pinus gerardiana

Why is vivipary an undesirable character for annual crop plants? **[CBSE 2005]**

(1) It reduces vigour of the plant

(2) It adversely affects the fertility of the plant

(3) The seeds exhibit long dormancy

(4) The seeds cannot be stored under normal conditions for next season.

A dicot plant lacking cotyledons is **[AMU 2005]**

(1) Cuscuta (2) Santalum (3) Lodoicea (4) None of the above

Seed of Castor is **[AMU 2005]**

(1) Nonendospermic exalbuminous (2) Endospermic ablbuminous

(3) Endospermic exalbuminous (4) Nonendospermic ablbuminous

In cereal grain, single cotyledon is represented by **[CBSE 2006]**

(1) Coleoptile (2) Coleorhiza (3) Scutellum (4) Prophyll

Scutellum of Maize is **[CBSE 2010]**

(1) Cotyledon (2) Endosperm (3) Tegmen (4) Testa

Find the correct answers : Seeds have separate endosperm **[BHU 2008]**

(a) Mazie (b) Onion (c) Rice (d) Bean

(1) a, b and c (2) a and b (3) b and d (4) a and c

Find the correct answer : For germination of angiospermic seeds **[BHU 2008]**

(a) On hydraytion the seed germinates showing increased enzyme activily

(b) Respiration rate of germinating seed increases alongwith increase enzymatic activity

(c) Increase in respiratory rate continue still senescence

(d) Rate of enzymatic activity increases

(1) 1, 2, 3 (2) 1 and 2 (3) 2, 4 (4) 1 and 3

Q.108 Endosperm is consumed by the developing embryo in **[CBSE 2008]**

(1) Coconut (2) Pea (3) Maize (4) Castor

Q.109 Embryo axis above the cotyledon is known as **[Orissa 2009]**

(1) Hypocotyl (2) Funicle (3) Epicotyl (4) Raphe

Q.110 An example of a seed with endosperm, perisperm and caruncle is **[CBSE 2009]**

(1) Castor (2) Coffee (3) Lily (4) Cotton

Match the follwing **[EAMCET 2009]**

	Column I		Column II
a	Coleorhiza	i	Development of sporophyte directly from gametophyte without intervention of gametes
b	Apogamy	ii	Development of gametophyte directly from sporophyte without the involvement of reduction division
c	Indusium	iii	An unbranched columnar stem with a crown of leaves
d	Caudex	iv	Protective covering of radicle
		v	Protective structure of a sorus

(1) a – v, b – ii, c – iv, d – i (2) a – iii, b – v, c – ii, d – iv

(3) a – iv, b – i, c – v, d – iii (4) a – ii, b – iii, c – i, d – v

Residual perisistent nucellus is known as **[AMU 2010]**

(1) Perisperm (2) Integument (3) Pericarp (4) None of the above

Non – endospermic seeds are found in **[Orissa 2010]**

(1) Barley (2) Castor (3) Bean (4) Wheat

In hypogeal germination plumule comes out of ground due to elongation of **[Orissa 2010]**

(1) Hypocotyl (2) Epicotyl (3) Cotyledons (4) Both A and B

Keel is characteristic of the flower of **[CBSC 2010]**

(1) Cassia (2) Calotropis (3) Bean (4) Gulmohur

Clematis and Narvelia are dispersed by air with the help of **[BHU 2008]**

(1) Persistent inflated calyx (2) Perisistent hairy styles

(3) Hair (4) Wings

Censer mechanism of seed dispersal is found in **[CPMT 2000, BHU 2007]**

(1) Papaveraceae (2) Liliaceae (3) Leguminosae (4) Rosaceae

Birds disseminate seeds by **[AMU 2003]**

(1) Eating fruit and passing the seeds unharmed through excreta at places

(2) Their feathers

(3) Carrying seeds in their beaks

(4) Eating fruits and digesting fruit contents in their alimentary canal.

Which one of the following statements is correct? **[CPMT 2011]**

(1) In tomato, fruit is a capsule (2) Seeds of orchids have oil-rich endosperm

(3) Placentation in primose is basal (4) Flower of tulip is a modified shoot

The correct floral formula of chilli is **[CPMT 2011]**

(1) ⊕♀$K_{(5)}C_5A_5G_{(2)}$ (2) ⊕♀ $K_{(5)}C_{(5)}A_5G_{(2)}$ (3) ⊕♀$K_{(5)}C_{(5)}A_{(5)}G_2$ (4) ⊕ ♀$_{(5)}C_5A_{(5)}G_2$

Q.121 The ovary is half inferior in flower of **[CPMT 2011]**

(1) Peach (2) Cucumber (3) Cotton (4) Guava

Q.122 A drupe develops in **[CPMT 2011]**

(1) Mango (2) Wheat (3) Pea (4) Tomato

Placentation in tomato and lemon is : **[AIPMT Pre 2012]**

(1) Free central (2) Marginal (3) Axile (4) Parietal

How many plants in the list given below have composite fruits that develop form an inflorescence ? **[AIPMT Pre 2012]**

(1) Five (2) Two (3) Three (4) Four

Phyllode is present in : **[AIPMT Pre 2012]**

(1) Euphorbia (2) Australian Acacia (3) Opuntia (4) Asparagus

The coconut water and the edible part of coconut are equivalent to : **[AIPMT Pre 2012]**

(1) Endocarp (2) Mesocarp (3) Embryo (4) Endosperm

Cymose inflorescence is present in : **[AIPMT Pre 2012]**

(1) Sesbania (2) Trifolium (3) Brassica (4) Solanum

Vixillary aestivation is characteristic of the family: **[AIPMT Pre 2012]**

(1) Asteraceae (2) Solanaceae (3) Brassicaceae (4) Fabaceae

The gynoecium consists of many free pistils in flowers of : **[AIPMT Pre 2012]**

(1) Tomato (2) Papaver (3) Michelia (4) Aloe

How many plants in the list given below have marginal placentation ?

Mustard, Gram, Tulip, Asparagus, Arhar, Sun hemp, Chilli, Colchicine, Onion, Moong, Pea, Tobacco, Lupin **[AIPMT Mains 2012]**

(1) Four (2) Five (3) Six (4) Three

Cuscuta is an example of : **[AIPMT Mains 2012]**

(1) Ectoparasitism (2) Brood parasitism (3) Predation (4) Endoparasitism

When the margins of sepals or petals overlap one another without any particular direction, the condition is termed as : **[AIPMT 2014]**

(1) Twisted (2) Valvate (3) Vexillary (4) Imbricate

Which one of the following statements is correct? **[AIPMT 2014]**

(1) A proteinaceous aleurone layer is present in maize grain.

(2) A sterile pistil is called a staminode.

(3) The seed in grasses is not endospermic.

(4) Mango is a parthenocarpic fruit.

An example of edible underground stem is : **[AIPMT 2014]**

(1) Sweet potato (2) Potato (3) Carrot (4) Groundnut

An aggregate fruit is one which develops from: **[AIPMT 2014]**

(1) Complete inflorescence (2) Multicarpellary superior ovary

(3) Multicarpellary syncarpous gynoecium (4) Multicarpellary apocarpus gynoecium

Placenta and pericarp are both edible portions in : **[AIPMT 2014]**

(1) Tomato (2) Potato (3) Apple (4) Banana

Answer Key

Q.1	3	Q.2	1	Q.3	2	Q.4	2	Q.5	3	Q.6	4	Q.7	4
Q.8	1	Q.9	3	Q.10	1	Q.11	3	Q.12	1	Q.13	2	Q.14	4
Q.15	2	Q.16	3	Q.17	4	Q.18	2	Q.19	4	Q.20	1	Q.21	2
Q.22	3	Q.23	1	Q.24	2	Q.25	4	Q.26	3	Q.27	2	Q.28	4
Q.29	4	Q.30	1	Q.31	3	Q.32	4	Q.33	2	Q.34	2	Q.35	1
Q.36	4	Q.37	2	Q.38	2	Q.39	1	Q.40	4	Q.41	1	Q.42	1
Q.43	4	Q.44	3	Q.45	1	Q.46	2	Q.47	4	Q.48	2	Q.49	2
Q.50	3	Q.51	1	Q.52	4	Q.53	2	Q.54	1	Q.55	1	Q.56	2
Q.57	1	Q.58	1	Q.59	3	Q.60	2	Q.61	2	Q.62	1	Q.63	4
Q.64	2	Q.65	4	Q.66	1	Q.67	3	Q.68	1	Q.69	2	Q.70	2
Q.71	3	Q.72	1	Q.73	3	Q.74	4	Q.75	3	Q.76	3	Q.77	3
Q.78	1	Q.79	3	Q.80	3	Q.81	4	Q.82	1	Q.83	2	Q.84	4
Q.85	3	Q.86	2	Q.87	2	Q.88	4	Q.89	3	Q.90	4	Q.91	1
Q.92	3	Q.93	1	Q.94	1	Q.95	4	Q.96	4	Q.97	1	Q.98	2
Q.99	1	Q.100	4	Q.101	4	Q.102	1	Q.103	2	Q.104	3	Q.105	1
Q.106	1	Q.107	2	Q.108	2	Q.109	3	Q.110	1	Q.111	3	Q.112	1
Q.113	3	Q.114	2	Q.115	3	Q.116	2	Q.117	1	Q.118	1	Q.119	4
Q.120	2	Q.121	1	Q.122	1	Q.123	3	Q.124	3	Q.125	2	Q.126	4
Q.127	4	Q.128	4	Q.129	3	Q.130	3	Q.131	1	Q.132	4	Q.133	1
Q.134	2	Q.135	4	Q.136	1								

Questions

INSTRUCTIONS FOR Q. NO. 66 TO 70

In the following questions (66 to 70), a statement of assertion (Al is followed by a statement of reason (R).

(1) If both Assertion & Reason are true and the reason is the correct explanation of the assertion, then mark (1).

(2) If both Assertion & Reason are true but the reason is not the correct explanation of the assertion, then mark (2) .

(3) If Assertion is true statement but Reason is false, then mark (3).

(4) If both Assertion and Reason are false statements, then mark (4).

A: In head inflorescence florets are arranged centrifugally.
R : There always occurs two types of florets in a head.

A : Staminal tube is present in Malvaceae.
R : It is due to monadelphous condition.

A : Nest of *Dischidia* is a modified structure of root.
R : Nest roots absorb water and food from humus rich soil collected in nest.

A : The storage region of maize grain is whitish or yellow.
R : It is rich in protein granules.

A : There are two alae in *Pisum sativum* flower.
R : Both alae are covered by largest petal.

A : In angiosperms, seeds are present inside fruit.
R : The ripended ovary forms fruit and ripened ovules form seeds.

A : The plants producing flowers and fruits single time in life are called monocarpic. R : Agave americana and Bambusa are monocarpic plants.

A : Onion is a tunicated bulb.
R : Characteristic smell of onion is due to presence of allyl sulphide.

A : Arrangement of main vein and its branches in leaf is called vernation. R : Parallel venation is characteristic of dicotyledons.

A : A specific outgrowth present over hilum in castor seed is called strophiole. R : Strophiole helps in gaseous exchange.

A : Roots of trapa are photosynthetic.
R : Trapa consist of spiny calyx.

A : Flower are arranged in acropetal Manner in cymose

inflorescence. R : All flower are at same level is cymose inflorescence.

A : Ovary is unilocular in parietal placentation.

R : Number of placenta is equal to number of ovaries.

A : Parietal placentation is found in cruciferae.

R : Ovary is bilocular in cruciferae.

A : Ovary of Brassicaceae is unilocular in the beginning but becomes bilocular. R : Ovary of Brassicaceae become bilocular due to formations of a false septum.

A : Custard apple is a aggregate fruit.

R : It is formed by many flowers.

A : It is possible to identify nodes on a stem.

R : Leaves arise from the nodes of a stem.

A : Radish is a fusiform fleshy root.

R : Base at radish root is hypocotyl.

A : Cladodes are stems of unlimited growth.

R : Only the main stems is modified as cladodes.

A : Lithci is an aril. R :

It is dry fruit.

Answers Key

Q.1	4	Q.2	1	Q.3	4	Q.4	3	Q.5	2	Q.6	2	Q.7	2
Q.8	2	Q.9	4	Q.10	3	Q.11	2	Q.12	4	Q.13	2	Q.14	1
Q.15	1	Q.16	3	Q.17	1	Q.18	2	Q.19	4	Q.20	2		