MORPHOLOGY OF FLOWERING PLANTS

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CLASS: XI **BIOLOGY**

THE ROOT

What are adventitious roots? Give examples.

In some plants, like grass, Monstera and the banyan tree, roots arise from parts of the plant other than the radicle and are called adventitious roots.

Enumerate the functions of roots.

- The main functions of the root system are
- Absorption of water and minerals from the soil.
- Providing anchorage to the plant parts.
- Storing reserve food material and synthesis of plant growth regulators.

What is the thimble like structure in root called? What is its function?

The root is covered at the apex by a thimble-like structure called the **root cap**.It protects the tender apex of the root as it makes its way through the soil.

Name the modified roots which store food?

Tap roots of carrot, turnips and adventitious roots of sweet potato, get swollen and store food.

Differentiate between fibrous roots and adventitious roots.

	Fibrous root	Adventitious root
1	In monocots, the primary root which develops from the radicle of the seed is short-lived and is replaced by a large number of roots arising from the base of the stem.	These roots arise from any part of the plant other than the radicle of seeds.
2	It is found in wheat and other cereals.	It is found in banyan, *Monstera*, and other plants.

Explain the regions of the root and their functions.

Region of meristematic activity

A few millimetres above the root cap is the region of meristematic activity. The cells of this region are very small, thin-walled and with dense protoplasm. They divide repeatedly.

Region of Elongation:

The cells proximal to this region undergo rapid elongation and enlargement and are responsible for the growth of the root in length. This region is called the region of elongation.

Region of maturation:

The cells of the elongation zone gradually **differentiate and mature**. Hence, this zone, proximal to region of elongation, is called the region of maturation. From this region some of the epidermal cells form very fine and delicate, thread-like structures called root hairs. These **root hairs** absorb water and minerals from the soil.

What are modified roots? Why do they modify?

Roots in some plants change their shape and structure and become modified to perform functions other than absorption and conduction of water and minerals. Such roots are called modified roots.

They are modified for **support, storage of food and respiration**

What are the various types of modifications of roots found in the following?

(a) Banyan tree

(b) Maize

(c) Mangrove trees

Prop roots: The banyan tree has pillar-like adventitious roots arising from the aerial part of the stem. These roots grow towards the ground and provide support to the tree. Such roots are called prop roots.

Stilt roots:

The stems of maize and sugarcane have supporting roots coming out of the **lower nodes of the stem**. These are called **stilt roots**.

Pneumatophores:

In some plants such as **Rhizophora** growing in swampy areas, many roots come out of the ground and grow vertically upwards. Such roots, called **pneumatophores**, help to get oxygen for respiration.

THE STEM

What are the features of a stem?

- The stem is the ascending part of the axis bearing branches, leaves, flowers and fruits. It develops from the plumule of the embryo of a germinating seed.
- The stem bears **nodes** and **internodes**. The regions of the stem where leaves are born are called nodes while internodes are the portions between two nodes.
- The stem bears buds, which maybe terminal or axillary.
- Stem is generally green when young and later often become woody and dark brown.

What are the functions of stems?

The main function of the stem is spreading out branches bearing leaves, flowers and fruits.

It conducts water, minerals and foods.

Some stems perform the function of storage of food, support, protection and of vegetative propagation.

Describe modifications of stem with suitable examples.

Underground stems:

They are modified to perform different functions. Underground stems of potato, ginger, turmeric, zaminkand, Colocasia are modified to store food in them.

They also act as organs of perenation to tide over conditions unfavourable for growth.

Stem tendrils:

Stem tendrils which develop from axillary buds, are slender and spirally coiled and help plants to climb such as in gourds (cucumber, pumpkins, watermelon) and grape vines.

Thorns

Axillary buds of stems may also get modified into woody, straight and pointed **thorns.** Thorns are found in many plants such as Citrus, Bougainvillea.

They protect plants from browsing animals. Some plants of arid regions modify their stems into flattened (Opuntia), or fleshy cylindrical (Euphorbia) structures. They contain chlorophyll and carryout photosynthesis.

THE LEAF

What is leaf? Name the parts of a leaf.

The leaf is a lateral, flattened structure borne on the stem. It develops at the node and bears a bud in its axil. A typical leaf consists of three main parts: **leaf base, petiole and lamina.** Leaves originate from shoot apical meristems and are arranged in an acropetal order.

What develops into a branch?

The **axillary bud** later develops into a branch.

What is a stipule?

The leaf is attached to the stem by the **leaf base** and may bear two lateral small leaf-like structures called stipules.

In monocotyledons, the leaf base expands into a sheath covering the stem partially or wholly.

What is pulvinous?

In some leguminous plants the leaf base may become swollen, which is called the **pulvinus**.

What is the function of petiole?

The **petiole** helps to hold the blade to light. Long thin flexible petioles allow leaf blades to flutter in wind, thereby cooling the leaf and bringing fresh air to leaf surface.

Define the following?

(a) Lamina (b) Midrib

The lamina or the leaf blade is the green expanded part of the leaf with veins and veinlets.

There is, usually, a middle prominent vein, which is known as the midrib.

What are the functions of veins?

Veins provide rigidity to the leaf blade and act as channels of transport for water, minerals and food materials.

The shape, margin, apex, surface and extent of incision of lamina varies in different leaves.

What is venation? What are the two types of venation?

The arrangement of veins and the veinlets in the lamina of leaf is termed as **venation.**

When the veinlets form a network, the venation is termed as **reticulate**. Eg., Dicot leaves

When the veins run parallel to each other within a lamina, the venation is termed as **parallel.** Eg., Monocot leaves

Types of Leaves

How is pinnately compound leaf different from palmately compound leaf?

Pinnately compound leaf	Palmately compound leaf
The leaflets are attached to the common axis, called rachis which represents the midrib.	The leaflets are attached at a common point i.e., at the tip of petiole.
Examples include *neem* and *Cassia fistula*	Examples include silk cotton and *Cannabis.*

What is a simple leaf?

A leaf is said to be **simple**, when its lamina is entire or when incised, the incisions do not touch the midrib.

What is a compound leaf?

When the incisions of the lamina reach up to the midrib breaking it into a number of leaflets, the leaf is called **compound.**

A bud is present in the axil of petiole in both simple and compound leaves, but not in the axil of leaflets of the compound leaf.

Explain with suitable examples the different types of phyllotaxy?

Phyllotaxy is the pattern of arrangement of leaves on the stem or branch. This is usually of three types - alternate, opposite and whorled.

Alternate Phyllotaxy:

In **alternate** type of phyllotaxy, a single leaf arises at each node in alternate manner.

Eg. China rose, mustard and sun flower plants.

Opposite Phyllotaxy:

In **opposite** type, a pair of leaves arise at each node and lie opposite to each other. Eg. Calotropis and guava plants.

Whorled Phllotaxy:

If more than two leaves arise at a node and form a whorl, it is called **whorled**. Eg. Alstonia.

Explain the modifications of Leaves with examples.

- Leaves are often modified to perform functions other than photosynthesis.
- They are converted into **tendrils** for climbing as in peas or into **spines** for defence as in cacti
- The fleshy leaves of onion and garlic store food
- In some plants such as Australian acacia, the leaves are small and short-lived. The petioles in these plants expand, become green and synthesise food.
- Leaves of certain insectivorous plants such as pitcher plant, venus-fly trap are also modified leaves.

	Name of the plant	Modification of leaf	Function
1	Peas	Tendrils	Climbing
2	Cacti	Spines	Defence
3	Onion and garlic	Fleshy leaves	Store food
4	Australian acacia	Petioles expands and becomes green	Synthesise food
5	Pitcher plant and Venus-fly trap	Pitcher or Fly trap	Captures insect

THE INFLORESCENCE

What is inflorescence? What are the two types of inflorescence?

The arrangement of flowers on the floral axis is termed as **inflorescence.**

Depending on whether the apex gets converted into a flower or continues to grow, there are two major types of inflorescences - racemose and cymose.

Differentiate between racemose and cymose inflorescences.

Racemose inflorescence	Cymose inflorescence
The main axis in racemose inflorescence continues to grow and produce flowers laterally	The main axis in cymose inflorescence has limited growth, which later terminates into a flower.
The flowers are arranged in a acropetal order	The flowers are arranged in a basipetal order

THE FLOWER

What is a flower?

A flower is a modified shoot wherein the shoot apical meristem changes to floral meristem.

What are the four different kinds of whorls of a flower? How are they classified?

A typical flower has four different kinds of whorls arranged successively on the swollen end of the stalk or pedicel, called thalamus or receptacle.

They are calyx, corolla, androecium and gynoecium. They are classified into accessory organs and reproductive organs. Calyx and corolla are accessory organs, while androecium and gynoecium are reproductive organs.

Define the term perianth.

In some flowers like lily, the calyx and corolla are not distinct and are termed as perianth.

What are bisexual and unisexual flowers?

A flower having both androecium and gynoecium is a **bisexual flower**. A flower having either only stamens or only carpels is **unisexual flower.**

How are the flowers classified into various types based on the symmetry?

Based on symmetry, the flower may be actinomorphic (radial symmetry) or zygomorphic (bilateral symmetry) or asymmetric.

Actinomorphic

When a flower can be divided into two equal radial halves in **any radial plane** passing through the centre, it is said to be actinomorphic, e.g., mustard, datura, chilli.

Zygomorphic

When it can be divided into two similar halves **only in one particular vertical plane**, it is zygomorphic, e.g., pea, gulmohar, bean, Cassia.

Asymmetric

A flower is asymmetric (irregular) if it cannot be divided into two similar halves by any vertical plane passing through the centre, e.g., Canna.

Based on the position of calyx, corolla and androecium in respect of the ovary on thalamus, the flowers are described as hypogynous perigynous and epigynous. Explain with examples.

Hypogynous flower:

In the **hypogynous** flower the gynoecium occupies the highest position while the other parts are situated below it. The ovary in such flowers is said to be superior, e.g., Mustard, china rose and brinjal.

Perigynous flower:

In perigynous flower, the gynoecium is situated in the centre and other parts of the flower are located on the rim of the thalamus almost at the same level, it is called **perigynous.** The ovary here is said to be **half inferior**, e.g., Plum, rose, peach.

Epigynous flower:

In **epigynous flower**, the margin of thalamus grows upward enclosing the ovary completely and getting fused with it, the other parts of flower arise above the ovary. Hence, the ovary is said to be **inferior**. Eg., guava and Cucumber, and Ray florets of sunflower.

Aestivation

What is aestivation? Name the main types of aestivation.

The mode of arrangement of sepals or petals in floral bud with respect to the other members of the same whorl is known as aestivation.

The main types of aestivation are valvate, twisted, imbricate and vexillary

Describe the types of aestivation found in flowering plants with examples.

Valvate

When sepals or petals in a whorl just touch one another at the margin, without overlapping, as in **Calotropis**, it is said to be **valvate.**

Twisted

If one margin of the appendage overlaps that of the next one and so on as **in china rose, lady's finger and cotton**, it is called **twisted.**

Imbricate.

If the margins of sepals or petals overlap one another but not in any particular direction as in **Cassia and gulmohur**, the aestivation is called **imbricate.**

Vexillary

In pea and bean flowers, there are five petals, the largest (standard) overlaps the two lateral petals (wings) which in turn overlap the two smallest anterior petals (keel); this type of aestivation is known as **vexillary** or papilionaceous.

Differentiate between apocarpous and syncarpous ovary?

	Apocarpous ovary	Syncarpous ovary
1	In apocarpous ovary the carpels are free.	In syncarpous ovary the carpels are fused.
2	It is found in the flowers of lotus and rose.	It is found in the flowers of tomato and mustard.

What do the ovule and ovary become after fertilization?

After fertilization, the ovule develops into seed and the ovary matures into a fruit.

Placentation:

What is placentation? Name the different types of placentation.

The arrangement of ovules within the ovary is known as placentation. The placentations are of different types namely, marginal, axile, parietal, basal, central and free central

Describe the various types of placentation found in flowering plants.

Marginal

In **marginal** placentation the placenta forms a ridge along the ventral suture of the ovary and the ovules are borne on this ridge forming two rows, as in pea.

Axile placentation

In axile placentation the ovules are attached to the central axis in a multilocular ovary. Eg., China rose, tomato and lemon.

Parietal

In **parietal** placentation, the ovules develop on the inner wall of the ovary or on peripheral part. Ovary is one-chambered but it becomes two- chambered due to the formation of the false septum. E.g., mustard and Argemone.

Free central

In free central placentation, the ovules are borne on central axis and septa are absent. Eg., Dianthus and Primrose

Basal

In **basal** placentation, the placenta develops at the base of ovary and a single ovule is attached to it. Eg., Sunflower, marigold.

THE FRUIT

What is a fruit?

It is a mature or ripened ovary, developed after fertilisation.

What is a parthenocarpic fruit?

If a fruit is formed without fertilisation of the ovary, it is called a **parthenocarpic** fruit.

What are the two major parts of a fruit?

The two major parts of a fruit are **pericarp** or wall and seeds.

Name the three parts of a pericarp. Give an account of mango and coconut fruits.

Pericarp consists of three layers, the outer layer is **epicarp**, the middle layer is **mesocarp** and the inner layer is **endocarp.**

In mango and coconut, the fruit is known as a drupe. They develop from monocarpellary superior ovaries and are one seeded.

In mango the pericarp is well differentiated into an outer thin epicarp, a middle fleshy edible mesocarp and an inner stony hard endocarp. In coconut which is also a drupe, the mesocarp is fibrous.

THE SEED

The ovules after fertilisation, develop into seeds. A seed is made up of a seed coat and an embryo.

The embryo is made up of a radicle, an embryonal axis and one (as in wheat, maize) or two cotyledons (as in gram and pea).

Structure of a Dicotyledonous Seed

The outermost covering of a seed is the seed coat.

The seed coat has two layers, the outer **testa** and the inner **tegmen.**

The **hilum** is a scar on the seed coat through which the developing seeds were attached to the fruit.

Above the hilum is a small pore called the **micropyle**.

Within the seed embryo, consisting of an embryonal axis and two cotyledons.

The cotyledons are often fleshy and full of reserve food materials.

At the two ends of the embryonal axis are present the radicle and the plumule.

In some seeds such as castor the **endosperm** formed as a result of double fertilisation, is a food storing tissue.

In plants such as bean, gram and pea, the endosperm is not present in mature seeds and such seeds are called non-endospermous.

Structure of Monocotyledonous Seed

Generally, monocotyledonous seeds are endospermic but some as in orchids are non-endospermic.

In the seeds of cereals such as maize the seed coat is membranous and generally fused with the fruit wall.

The endosperm is bulky and stores food.

The outer covering of endosperm separates the embryo by a protenous layer called **aleurone layer.**

The embryo is small and situated in a groove at one end of the endosperm.

It consists of one large and shield shaped cotyledon known as **scutellum** and a short axis with a **plumule** and a **radicle**.

The plumule and radicle are enclosed in sheaths which are called **coleoptile** and **coleorhiza** respectively.

DESCRIPTION OF SOME IMPORTANT FAMILIES

Fabaceae

This family was earlier called Papilonoideae, a subfamily of family Leguminosae.

It is distributed all over the world.

Vegetative Characters

Trees, shrubs, herbs; root with root nodules

Stem:

Erect or climber

Leaves:

Alternate, pinnately compound or simple; leaf base, pulvinate; stipulate; venation reticulate.

Floral characters

Inflorescence: racemose

Flower: bisexual, zygomorphic

Calyx: sepals five, gamosepalous; imbricate aestivation

Corolla: petals five, polypetalous, papilionaceous, consisting of a posterior standard, two lateral wings, two anterior ones forming a keel (enclosing stamens and pistil), vexillary aestivation

Androecium: ten, diadelphous, anther dithecous

Gynoecium: ovary superior, mono carpellary, unilocular with many ovules, style single

Fruit: legume; seed: one to many, non-endospermic

Economic importance

Many plants belonging to the family are sources of pulses (gram, arhar, sem, moong, soyabean; edible oil (soyabean, groundnut); dye (indigofera); fibres (sunhemp); fodder (Sesbania, Trfolium), ornamentals (lupin, sweet pea); medicine (muliathi).

Solanaceae

It is a large family, commonly called as the ‘potato family’. It is widely distributed in tropics, subtropics and even temperate zones.

Vegetative Characters

Plants mostly, herbs, shrubs and small trees

Stem: herbaceous rarely woody, aerial; erect, cylindrical, branched, solid or hollow, hairy or glabrous, underground stem in potato (Solanumtuberosum)

Leaves: alternate, simple, rarely pinnately compound, exstipulate; venation reticulate

Floral Characters

Inflorescence: Solitary, axillary or cymose as in Solanum

Flower: bisexual, actinomorphic

Calyx: sepals five, united, persistent, valvate aestivation

Corolla: petals five, united; valvate aestivation

Androecium: stamens five, epipetalous

Gynoecium: bicarpellary, syncarpous; ovary superior, bilocular, placenta, swollen with many ovules

Fruits: berry or capsule

Seeds: many, endospermous

Economic Importance

Many plants belonging to this family are source of food (tomato, brinjal, potato), spice (chilli); medicine (belladonna, ashwagandha); fumigatory (tobacco); ornamentals (petunia).

Lilaceae

Commonly called the 'Lily family' is a characteristic representative of monocotyledonous plants.

It is distributed world wide.

Vegetative characters: Perennial herbs with underground bulbs/corms/ rhizomes

Leaves mostly basal, alternate, linear, exstipulate with parallel venation

Floral characters

Inflorescence: solitary / cymose; often umbellate clusters

Flower: bisexual; actinomorphic

Perianth tepal six (3+3), often united into tube; valvate aestivation

Androcium: stamen six, (3+3)

Gynoecium: tricarpellary, syncarpous, ovary superior, trilocular with many ovules; axile placentation

Fruit: capsule, rarely berry

Seed: endospermous

Economic Importance

Many plants belonging to this family are good ornamentals (tulip, Gloriosa), source of medicine (Aloe), vegetables (Asparagus), and colchicine (Colchicum autumnale).

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