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MORPHOLOGY OF FLOWERING PLANTS

Chapter: - 5th



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Chapter: 5th

Morphology of Flowering Plants



Introduction: Morphology is the study of the external structure and form of organisms. In the context of flowering plants, morphology focuses on understanding the various parts of a plant and their functions. This chapter explores the morphology of flowering plants, including their root system, stem, leaf, inflorescence, flower, and fruit.

Section 5.1: The Root

Introduction to the Root:

The root is an essential part of the plant's anatomy, typically found below the ground. It is the primary organ responsible for anchoring the plant, absorbing water and minerals, and storing nutrients. Roots exhibit various adaptations and modifications to suit the needs of different plant species and environments.

Definition and Functions of Roots:

A root is a subterranean (underground) part of a plant that typically lacks leaves, nodes, and buds. It originates from the radicle, which is the embryonic root found in the seed. The main functions of roots include:

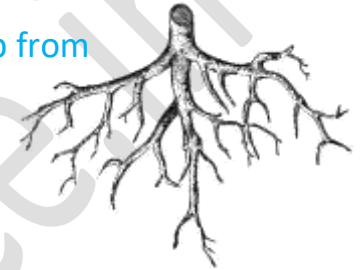
1. **Anchorage:** Roots anchor the plant firmly into the soil, providing stability and support against wind and other forces.
2. **Absorption:** Roots absorb water and essential minerals from the soil through specialized structures called root hairs. These structures increase the surface area for absorption.
3. **Conduction:** Roots transport water, minerals, and other nutrients from the soil to the rest of the plant through the vascular tissues, such as xylem and phloem.
4. **Storage:** Some plants store excess nutrients, carbohydrates, and water in their roots for future use. These stored reserves can be utilized during periods of drought, flowering, or fruit production.

Types of Roots: Taproot and Adventitious Roots:

1. **Taproot:** A taproot system consists of a large, primary root called the taproot, which grows vertically into the soil. It develops from the radicle and serves as the central axis from which smaller lateral roots, known as secondary roots, branch out. Taproots are typically found in dicotyledonous plants, such as carrots, radishes, and trees. They provide excellent anchorage and efficient nutrient absorption due to their deep penetration into the soil.



2. **Adventitious Roots:** Adventitious roots are roots that develop from non-root plant organs, such as stems, leaves, or even other roots. They can arise from various plant parts, depending on the species and environmental conditions. Adventitious roots are commonly found in monocotyledonous plants, such as grasses, orchids, and some tropical plants. They may serve functions such as support, absorption, and reproduction (e.g., in the case of vegetative propagation).



Modifications of Roots: Storage Roots, Prop Roots, and Pneumatophores:

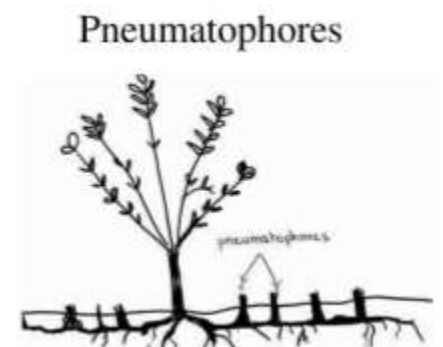
1. **Storage Roots:** Some plants have modified roots that are specialized for storing water and nutrients. These storage roots can be thickened and swollen, providing a reservoir of energy reserves for the plant. Examples of plants with storage roots include carrots, sweet potatoes, and beets.



2. **Prop Roots:** Prop roots are adventitious roots that develop from the lower nodes of the stem and grow downwards into the soil. They provide additional support to the plant by anchoring it firmly in the ground. Prop roots are commonly found in certain tree species, such as banyan trees and corn.



3. **Pneumatophores:** Pneumatophores, also known as air roots or aerial roots, are specialized roots found in certain plant species that grow in oxygen-deficient or waterlogged environments. These roots grow vertically above the ground or water surface and help in obtaining oxygen for the plant's root system.



Mangroves are well-known examples of plants with pneumatophores.

These various types and modifications of roots allow plants to adapt to different ecological conditions, optimize nutrient uptake, and ensure their survival and growth.

Root Hairs and Their Functions:

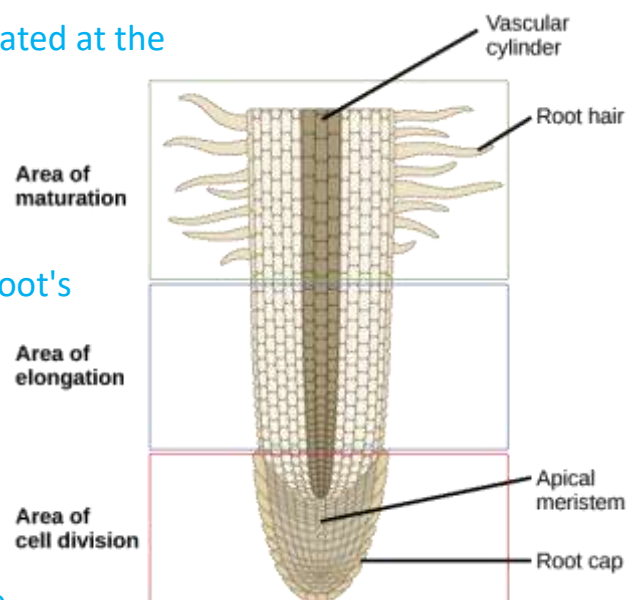
Root hairs are tiny, elongated outgrowths that develop from the epidermal cells of the root. They significantly increase the root's surface area, allowing for more efficient absorption of water and minerals from the soil. The functions of root hairs include:

1. **Absorption:** Root hairs greatly enhance the root's capacity to absorb water and nutrients by providing a larger surface area for interaction with the soil particles.
2. **Adhesion:** The root hairs adhere to the soil particles, aiding in anchoring the root firmly in place and preventing soil erosion.
3. **Exchange:** Root hairs facilitate the exchange of gases, such as oxygen and carbon dioxide, between the root and the soil environment.

Region of Cell Division, Elongation, and Maturation in the Root:

The root can be divided into three distinct regions based on the different stages of cell development:

1. **Region of Cell Division:** This region is located at the tip of the root and contains the apical meristem. The apical meristem is a group of actively dividing cells responsible for root growth and the production of new cells. It is where the root's length is primarily increased.
2. **Region of Elongation:** Just above the region of cell division, the region of elongation is present. In this region, the newly formed cells from the apical meristem start elongating, leading to the elongation of the root. The cells in this region increase in length, pushing the root tip further into the soil.



- 3. Region of Maturation:** The region of maturation, also known as the differentiation zone, is the uppermost part of the root. Here, the elongated cells differentiate into specific cell types, such as those forming the epidermis, cortex, endodermis, pericycle, xylem, and phloem. Root hairs also develop in this region.

These distinct regions of the root contribute to its growth, development, and specialized functions.

Section 5.2: The Stem

Introduction to the Stem:

The stem is a vital plant organ that serves as a structural support system, connecting the roots and leaves. It is responsible for various essential functions, such as transporting water, minerals, and nutrients, providing mechanical support, and housing reproductive structures. Stems exhibit diverse forms and adaptations to suit the needs of different plant species and environments.

Definition and Functions of Stems:

The stem is the main aerial or above-ground part of a plant that typically bears leaves, branches, flowers, and fruits. It arises from the shoot apical meristem, which is responsible for the growth and development of new stem tissues. The main functions of stems include:

- 1. Support:** Stems provide structural support to the plant, keeping it upright and allowing it to withstand the forces of gravity, wind, and other external factors.
- 2. Transportation:** Stems contain vascular tissues, such as xylem and phloem, which transport water, minerals, and nutrients between the roots and leaves. The xylem carries water and minerals from the roots to the aerial parts, while the phloem transports sugars and other organic compounds produced in the leaves to other parts of the plant.
- 3. Storage:** Some stems have specialized tissues for storing nutrients, carbohydrates, and water. These storage stems allow plants to store reserves for periods of dormancy, regrowth after disturbances, or reproductive processes.

4. **Reproduction:** Stems often bear reproductive structures such as flowers and fruits, facilitating the production and dispersal of seeds or asexual reproduction through vegetative propagation.

Types of Stems: Herbaceous and Woody Stems:

1. **Herbaceous Stems:** Herbaceous stems are soft, green, and flexible. They are typically found in herbaceous plants, which are non-woody and often annual or perennial. Herbaceous stems do not undergo secondary growth and do not have a woody structure. Examples include stems of grasses, dandelions, and most garden flowers.
2. **Woody Stems:** Woody stems are hard, rigid, and composed of lignified tissues. They are characteristic of woody plants, such as trees and shrubs. Woody stems undergo secondary growth, resulting in an increase in girth and the development of wood and bark. The wood provides strength and support to the plant, while the bark protects the underlying tissues. Examples of woody stems include tree trunks and branches.



Modifications of Stems: Underground Stems, Aerial Stems, and Thorns:

1. **Underground Stems:** Some plants have modified stems that grow below the ground. These underground stems serve various functions, such as storage, vegetative propagation, and survival in adverse conditions. Examples of underground stems include bulbs (e.g., onions), rhizomes (e.g., ginger), and tubers (e.g., potatoes).
2. **Aerial Stems:** Aerial stems refer to stems that grow above the ground and perform specialized functions. These modified stems may have unique shapes, sizes, or functions. For example, stolons or runners are horizontal aerial stems that allow plants to spread and reproduce



vegetatively (e.g., strawberry plants). Climbing stems possess adaptations, such as tendrils or thorns, enabling the plant to climb and anchor itself for support (e.g., grapevines).

- 3. Thorns:** Thorns are modified stems that arise from axillary buds and are typically found in woody plants. Thorns serve as defensive structures, deterring herbivores and protecting the plant from potential damage. Examples of plants with thorns include roses, blackberries, and cacti.



These various types and modifications of stems demonstrate the versatility and adaptability of plants, enabling them to thrive in different ecological niches and fulfill their respective functions.

Introduction to the Leaf:

Leaves are the primary organs of photosynthesis in plants. They are flat, green structures attached to the stem of a plant, and they play a vital role in the plant's overall growth and survival. Leaves are responsible for capturing sunlight and converting it into chemical energy through the process of photosynthesis.

Definition and Functions of Leaves: Leaves are the principal sites for photosynthesis, which is the process by which plants convert sunlight, carbon dioxide, and water into glucose (a form of sugar) and oxygen. The main functions of leaves include:

- 1. Photosynthesis:** Leaves contain chlorophyll, a green pigment that absorbs light energy. This pigment allows leaves to capture sunlight and convert it into chemical energy through photosynthesis. The energy generated is used by the plant for growth, reproduction, and other metabolic processes.
- 2. Gas Exchange:** Leaves have tiny pores called stomata, primarily located on the underside of the leaf surface. Stomata allow the exchange of gases, such as carbon dioxide and oxygen, between the plant and its surroundings. Carbon dioxide enters the leaf through stomata for use in photosynthesis, while oxygen exits the leaf as a byproduct.

- 3. Transpiration:** Transpiration is the process of water loss through the stomata. As water evaporates from the leaf's surface, it creates a pulling force, known as transpiration pull, which helps in drawing water and nutrients from the roots up to the leaves. Transpiration also helps in regulating temperature and maintaining hydration in the plant.

Types of Leaves: Simple and Compound Leaves: Leaves can be categorized into two main types: simple leaves and compound leaves.

- 1. Simple Leaves:** Simple leaves are those that consist of a single leaf blade attached to the stem by a petiole (leaf stalk). They have a single, undivided structure. Examples of plants with simple leaves include maple, oak, and sunflower.



- 2. Compound Leaves:** Compound leaves are composed of multiple leaflets, each attached to a common stalk called a rachis. The leaflets may be arranged in different patterns, such as pinnate (arranged on opposite sides of the rachis, resembling a feather) or palmate (radiating from a central point like the fingers of a hand). Examples of plants with compound leaves include rose, clover, and mimosa.

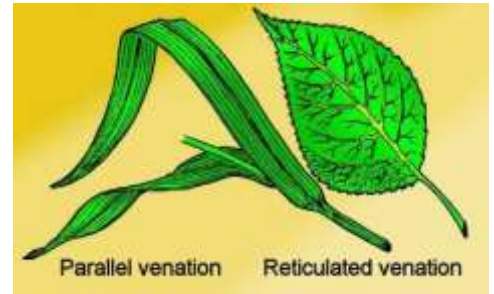


Leaf Arrangements and Venation Patterns: Leaf arrangements refer to how the leaves are positioned along the stem. The three main types of leaf arrangements are:

- 1. Alternate:** In alternate leaf arrangement, a single leaf is attached at each node along the stem, alternating sides. Examples include mango and rose.
- 2. Opposite:** In opposite leaf arrangement, two leaves are attached at each node along the stem, directly across from each other. Examples include maple and mint.
- 3. Whorled:** In whorled leaf arrangement, three or more leaves are attached at each node along the stem, forming a circular arrangement. Examples include oleander and catalpa.

Venation patterns refer to the arrangement of veins within a leaf. The two primary types of venation patterns are:

- 1. Parallel Venation:** In parallel venation, the veins run parallel to each other from the base of the leaf to the tip. This pattern is commonly found in monocot plants like grasses, lilies, and banana plants.
- 2. Netted Venation:** In netted venation (also called reticulate venation), the veins form a branching network throughout the leaf blade. This pattern is typical in dicot plants like roses, oaks, and maples.



Understanding the different types of leaves, their functions, arrangements, and venation patterns provides insights into the diverse adaptations and characteristics of plants in the natural world.

Leaf Modifications: -

- a) Tendrils:** Tendrils are modified leaf structures that help the plant to climb or support itself. These leaf modifications are commonly found in plants like peas and grapes. Tendrils are slender, coiling structures that emerge from the leaf axils. They coil around a support, such as a pole or another plant, enabling the plant to climb and reach sunlight.
- b) Spines:** Spines are modified leaves that are sharp and pointed, often found in plants growing in arid or desert regions. These leaf modifications reduce water loss through transpiration and protect the plant from herbivores. Examples of plants with spines include cacti and thorny bushes like Acacia.
- c) Phyllodes:** Phyllodes are flattened leaf stalks that resemble leaf blades. In certain plants, such as Acacia and Australian wattles, the leaf blades are either absent or greatly reduced, and the leaf stalk takes over the photosynthetic function. Phyllodes help reduce water loss and protect the plant from herbivores.
- d) Bracts:** Bracts are modified leaves that are usually located below the flower. They are often brightly colored and can attract pollinators. Bracts can also provide protection to the flower bud. Poinsettias are an example of plants with showy bracts.



e) **Storage Leaves:** Some plants store food and water in modified leaves known as storage leaves. These leaves are thick and fleshy and often have reduced surface area to minimize water loss. Examples of plants with storage leaves include succulents like aloe vera and certain species of agave.



f) **Floral Leaves:** In certain plants, leaves can undergo modifications to perform functions other than photosynthesis. In some plants, leaves can be modified to form petals, sepals, or other floral parts. These modifications help attract pollinators and protect the reproductive organs. For example, in lilies, the outermost whorl of leaves is modified to form colorful petals.



g) **Insect-Trapping Leaves:** Some plants have modified leaves that are adapted to trap and digest insects. These leaves are usually modified into specialized structures, such as pitchers or sticky traps. The pitcher plant is a classic example of a plant with insect-trapping leaves.



h) **Window Leaves:** Window leaves are modified leaves found in plants growing in dry environments. These leaves have a translucent window-like structure that allows sunlight to penetrate deep into the leaf, reducing the risk of damage from intense sunlight.



i) **Floating Leaves:** Floating leaves are adapted to grow on the surface of water bodies. These leaves are often circular or heart-shaped, with a waxy surface to prevent waterlogging. They also have air spaces in the leaf tissues to provide buoyancy. Water lilies are an example of plants with floating leaves.

j) **Needle-like Leaves:** Needle-like leaves are modified to minimize water loss and withstand harsh environmental conditions, such as in coniferous trees. These leaves are long, narrow, and often have a waxy coating to reduce water loss through transpiration.



k) **Succulent Leaves:** Succulent leaves are thick and fleshy, enabling plants to store water in arid environments. These leaves have a high water-holding capacity and reduced surface area to minimize water loss. Plants like jade plant and certain species of cacti have succulent leaves



External Features of a Typical Leaf:

- 1. Lamina:** Also known as the leaf blade, the lamina is the broad, flattened part of the leaf where most of the photosynthesis takes place. It is typically thin and has a large surface area to maximize light absorption.
- 2. Petiole:** The petiole is a slender stalk that connects the lamina to the stem. It provides support and allows the leaf to orient itself to capture sunlight efficiently. Not all leaves have a petiole; some are directly attached to the stem and are called sessile leaves.
- 3. Stipules:** Stipules are small, leaf-like structures found at the base of the petiole. They are not present on all leaves and can vary in size and shape. Stipules serve various functions, including leaf protection and defense against herbivores.
- 4. Leaf Base:** The leaf base is the part of the leaf where it attaches to the stem. It may have specialized structures, such as swollen bases in bulbs or tendrils for climbing plants.

Adaptations of Leaves: Leaves exhibit various adaptations to suit different environmental conditions and fulfill specific functions. Here are a few common adaptations:

- 1. Modifications for Photosynthesis:** Some leaves may have specific adaptations to maximize photosynthetic efficiency, such as larger surface area, increased chlorophyll content, or specialized structures like spines in cacti or water storage cells in succulents.
- 2. Water Conservation:** Leaves of certain plants in arid environments have adaptations to minimize water loss, such as reduced leaf surface area, thick cuticles, sunken stomata, or specialized water-storing tissues like succulent leaves.

3. **Climbing Adaptations:** Certain leaves have modifications to help plants climb or attach to supports. Examples include tendrils in peas and grapes, or adhesive pads in ivy.
4. **Insect Trapping:** Some plants, like carnivorous plants, have leaves with adaptations to trap and digest insects. These leaves may have modified structures like pitcher-shaped leaves in pitcher plants or sticky hairs in sundews.

These are just a few examples of the diverse leaf adaptations found in the plant kingdom, highlighting the remarkable range of forms and functions that leaves can exhibit based on the environmental challenges they face.

Placentation: -

Placentation refers to the arrangement of ovules within the ovary of a flower. It plays a crucial role in seed development and the formation of fruits. Various types of placentation can be observed in different plant species. Let's explore some common types of placentation:

- a) **Marginal Placentation:** In this type of placentation, the ovules are attached to the inner wall or margin of a simple or compound ovary. The ovules are arranged in a single row along the ventral suture of the ovary. Examples of plants with marginal placentation include pea and tomato.
- b) **Axile Placentation:** Axile placentation occurs when the ovules are attached to the central axis (referred to as the placenta) within a compound ovary. The ovules are arranged in multiple rows along the placenta. Examples of plants with axile placentation include tomato and lemon.
- c) **Parietal Placentation:** Parietal placentation is characterized by the attachment of ovules to the inner walls of a compound ovary. The ovules are borne on the walls or partitions (referred to as the placentae) that divide the ovary. Examples of plants with parietal placentation include rose and mustard.
- d) **Free Central Placentation:** Free central placentation occurs when the ovules are



Marginal placentation



Axile placentation



Parietal placentation



Free central placentation



Basal placentation

attached to a central column (referred to as the central placenta) within a compound ovary. The ovules are not attached to the walls of the ovary. Examples of plants with free central placentation include Dianthus and primrose.

e) **Basal Placentation:** Basal placentation is characterized by the attachment of a single ovule at the base or bottom of a simple ovary. The ovule is situated at the basal part of the ovary. Examples of plants with basal placentation include marigold and sunflower.

f) **Superficial Placentation:** Superficial placentation occurs when the ovules are attached to the inner surface of a hollow ovary that lacks distinct septa or partitions. The ovules are attached directly to the walls of the ovary. Examples of plants with superficial placentation include poppy and pomegranate.

g) **Half-Inferior Placentation:** Half-inferior placentation is a type of placentation where the ovary is partially superior (above the attachment of other floral parts) and partially inferior (below the attachment of other floral parts). The ovules are attached to the lower part of the ovary. Examples of plants with half-inferior placentation include apple and pear.



It's important to note that these placentation types are general examples, and some plants may exhibit variations or combinations of different placentation types.

Understanding placentation is crucial in botanical studies as it helps in identifying plant families and understanding their reproductive mechanisms.

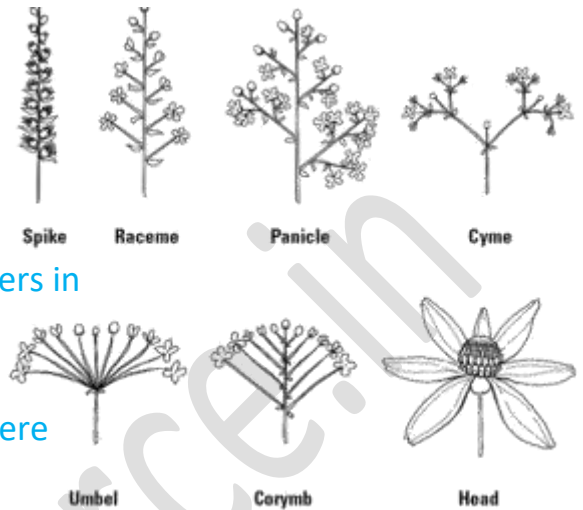
Introduction to the Inflorescence:

An inflorescence refers to the arrangement and grouping of flowers on a plant. It is the reproductive structure that produces and displays flowers, allowing for pollination and subsequent seed production. Inflorescences can vary in their forms, types, and patterns, providing a diverse range of strategies for plant reproduction.

Definition and Types of Inflorescences: Racemose and Cymose:

1. **Racemose Inflorescence:** Racemose inflorescences are characterized by an indeterminate growth pattern, meaning that the main axis continues to grow even after the flowers have bloomed. This results in the presence of a terminal flower and the potential for additional flowers to develop along the axis. Racemose inflorescences can be further classified into different subtypes:

- **Raceme:** In a raceme, the main axis produces flowers on pedicels (individual flower stalks) of approximately equal length. The oldest flowers are found at the base, while the youngest flowers are located towards the top. Examples include the snapdragon and delphinium.
- **Spike:** A spike is similar to a raceme but lacks pedicels. Instead, the flowers are directly attached to the main axis. The flowers in a spike are usually sessile (without stalks). Examples include wheat and rye.
- **Panicle:** A panicle is a branched raceme where the main axis produces secondary axes, which then bear flowers. The secondary axes can also give rise to tertiary axes, resulting in a highly branched structure. Examples include oat and lilac.
- **Catkin:** A catkin, also known as an ament, is a type of spike with unisexual flowers. The flowers are small and usually lack petals. Catkins are commonly found in wind-pollinated plants, such as willows and birches.



2. **Cymose Inflorescence:** Cymose inflorescences have a determinate growth pattern, meaning that the growth of the main axis terminates with the formation of a terminal flower. This results in a predictable and limited number of flowers. Cymose inflorescences can be classified into different subtypes:
 - **Cyme:** In a cyme, the main axis produces a terminal flower, and subsequent lateral branches arise from the base of the flower. Each lateral branch follows the same pattern, forming a cluster of flowers. Examples include the forget-me-not and hydrangea.
 - **Umbel:** An umbel is a type of cyme where the lateral branches arise from a common point, resembling the spokes of an umbrella. The flowers in an umbel are generally pedicellate and of approximately equal length. Examples include dill and wild carrot.
 - **Corymb:** A corymb is similar to an umbel but with unequal pedicels, resulting in a flat or slightly convex upper surface. The oldest flowers are found at the outer

edge, while the youngest flowers are towards the center. Examples include hawthorn and yarrow.

- **Head:** A head, also known as a capitulum, is a dense, compact inflorescence where multiple flowers are clustered together on a flattened or rounded receptacle. Each individual flower in the head is often small and inconspicuous. Examples of plants with heads include sunflowers and daisies.

Flowering Patterns and Arrangements in Inflorescences:

Inflorescences can exhibit different flowering patterns and arrangements within their structures. Some common patterns include:

1. **Indeterminate:** In indeterminate inflorescences, the flowers mature from the base towards the tip of the axis. This results in a continuous flowering sequence, with older flowers at the bottom and younger flowers towards the top. Racemose inflorescences, such as racemes and panicles, typically display indeterminate flowering patterns.
2. **Determinate:** In determinate inflorescences, the terminal flower blooms first, followed by the lower, lateral flowers. This leads to a predictable and limited number of flowers. Cymose inflorescences, such as cymes and umbels, often exhibit determinate flowering patterns.
3. **Mixed:** Some inflorescences may combine both determinate and indeterminate patterns, were certain.

Introduction to the Flower:

A flower is the reproductive structure found in flowering plants (angiosperms). It is a complex and diverse structure that plays a vital role in sexual reproduction. Flowers are responsible for the formation of seeds, which contain the plant's genetic information and allow for the next generation to develop. In addition to reproduction, flowers also serve various other functions, such as attracting pollinators and protecting the reproductive organs.

Functions of Flowers:

- 1. Reproduction:** The primary function of flowers is sexual reproduction. Flowers produce male and female gametes (pollen and ovules) and provide a platform for their fertilization, leading to the formation of seeds.
- 2. Attraction:** Flowers often have vibrant colors, pleasant fragrances, and nectar to attract pollinators such as insects, birds, and bats. These pollinators help in the transfer of pollen between flowers, facilitating cross-pollination and increasing genetic diversity.
- 3. Protection:** Flowers may have structures like sepals and petals that protect the reproductive organs from physical damage, extreme temperatures, and excessive moisture loss.

Parts of a Typical Flower:

A typical flower consists of four main parts: sepals, petals, stamens, and carpels. These parts are arranged in concentric circles, with the innermost circle containing the reproductive organs. Here is a brief description of each part:

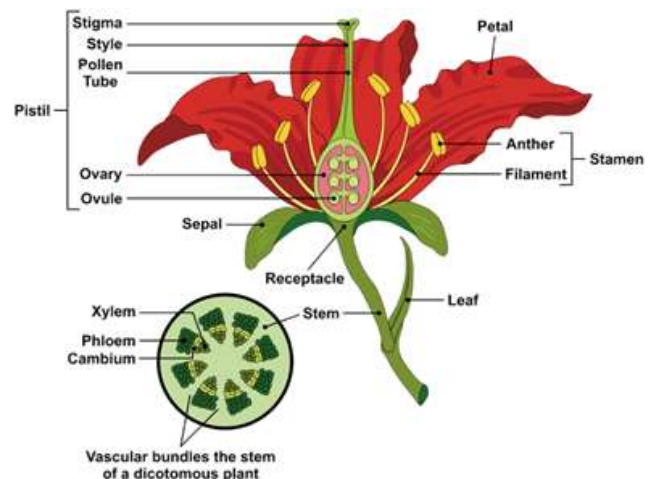
- 1. Sepals:** Sepals are the outermost whorl of modified leaves that enclose and protect the developing flower bud. They are usually green and collectively referred to as the calyx.

- 2. Petals:** Petals are the next whorl of modified leaves and are often brightly colored to attract pollinators. They are collectively known as the corolla and play a crucial role in attracting and guiding pollinators towards the reproductive organs.

- 3. Stamens:** Stamens are the male reproductive organs of the flower.

Each stamen consists of a filament and an anther. The filament is a slender stalk that holds the anther, which produces and releases pollen grains.

- 4. Carpels:** Carpels, also called pistils, are the female reproductive organs of the flower. Each carpel consists of three main parts: the stigma, style, and ovary. The



stigma is a sticky surface where pollen grains land and germinate. The style is a slender tube-like structure that connects the stigma to the ovary. The ovary contains one or more ovules, which develop into seeds after fertilization.

Structure of a Flower:

Arrangement and Fusion of Floral Parts: Floral parts can be arranged in different ways, and their fusion or separation can vary. Some common arrangements and fusions include:

1. Arrangement of Floral Parts:

- **Whorled:** Floral parts are arranged in a circular whorl, with multiple parts at each level. For example, a flower may have several sepals, petals, stamens, or carpels arranged in a whorled fashion.
- **Spiral:** Floral parts are arranged in a spiral pattern, with one part at each level. This arrangement can be seen in flowers where the parts are alternate and do not occur in distinct whorls.

2. Fusion of Floral Parts:

- **Connate:** Floral parts are fused or united together. For example, petals may be fused to form a tubular structure, or sepals may be fused to form a cup-like structure.
- **Free:** Floral parts are separate and not fused. Each part remains distinct and unattached to the neighboring parts.

Types of Symmetry in Flowers: The symmetry of a flower refers to the arrangement of its floral parts. Flowers can exhibit two main types of symmetry:

- 1. Actinomorphic (Radial) Symmetry:** In actinomorphic flowers, floral parts are arranged in a radial pattern, and the flower can be divided into similar halves by multiple planes passing through the central axis. Each whorl of floral parts is symmetrical. Examples of actinomorphic flowers include roses and lilies.
- 2. Zygomorphic (Bilateral) Symmetry:** In zygomorphic flowers, there is a single plane of symmetry dividing the flower into two mirror-image halves. The floral parts are arranged asymmetrically. Examples of zygomorphic flowers include orchids and snapdragons.

Floral Formula and Floral Diagrams: Floral formula and floral diagrams are graphical representations used to depict the structure and characteristics of a flower. They provide concise information about the number, arrangement, fusion, and other features of floral parts. Floral formulae use specific symbols and abbreviations, while floral diagrams use simplified illustrations to represent the flower's structure.

Introduction to the Fruit:

Fruits are mature ovaries of flowering plants (angiosperms) that develop after the fertilization of the ovules. They play a crucial role in plant reproduction by protecting and dispersing seeds. Fruits are typically formed from the enlargement and ripening of the ovary, often accompanied by changes in color, texture, and flavor. They exhibit a remarkable diversity in terms of size, shape, and structure.

Functions of Fruits:

1. **Seed Protection:** The primary function of fruits is to protect the seeds. Fruits provide a protective covering around the seeds, shielding them from mechanical damage, desiccation, and harsh environmental conditions.
2. **Seed Dispersal:** Fruits facilitate the dispersal of seeds away from the parent plant. This dispersal can be achieved through various mechanisms, including wind, water, animals, and explosive dehiscence. By dispersing seeds to new locations, fruits contribute to the plant's survival and colonization of different habitats.

Types of Fruits:

Fruits can be broadly categorized into two main types: fleshy fruits and dry fruits. Let's explore each type in more detail:

1. **Fleshy Fruits:** Fleshy fruits have a soft, fleshy pericarp (the fruit wall) surrounding the seeds. They are typically juicy and contain high water content. Examples of fleshy fruits include:
 - **Berry:** Berries are simple, fleshy fruits with a soft pericarp. They are often multiple-seeded and have a thin skin. Examples include tomatoes, grapes, and bananas.

- **Drupe**: Drupes, also known as stone fruits, have a fleshy mesocarp and a hard, stony endocarp surrounding the seed. Examples include peaches, plums, and cherries.
- **Pome**: Pomes are fleshy fruits with a leathery or papery outer layer (the exocarp) and a thick, fleshy inner layer (the mesocarp). The core of a pome contains the seeds. Examples include apples and pears.



The core of a pome contains the seeds.

2. **Dry Fruits**: Dry fruits have a dry pericarp that does not contain much moisture. The pericarp can be either thin and papery or hard and woody. Dry fruits are further classified into two subtypes:

- **Dehiscent Fruits**: Dehiscent fruits split open at maturity, releasing the seeds. Examples include legumes (peas and beans), capsules (poppy and okra), and follicles (milkweed and larkspur).
- **Indehiscent Fruits**: Indehiscent fruits do not split open at maturity. The pericarp remains intact, enclosing the seeds. Examples include achenes (sunflower and buttercup), grains (wheat and corn), and nuts (acorn and hazelnut).



Modifications of Fruits:

Fruits can undergo modifications that alter their structure and function. Two common modifications of fruits are parthenocarpy and apomixis:

1. **Parthenocarpy**: Parthenocarpy refers to the development of fruits without fertilization. It occurs when fruits develop from unfertilized ovaries. The resulting fruits are seedless or contain underdeveloped seeds. Examples include seedless bananas and seedless grapes.
2. **Apomixis**: Apomixis is a form of asexual reproduction in plants where seeds are formed without the process of fertilization. The ovules develop into seeds without the fusion of male and female gametes. This results in offspring that are genetically identical to the parent plant. Examples of plants that reproduce through apomixis include some species of dandelions and certain grasses

Family: Fabaceae (Leguminosae)

Characteristics:

Also known as the legume or pea family.

- One of the largest families of flowering plants, with about 750 genera and over 19,000 species.
- Typically, herbaceous plants, but can also be shrubs, trees, or vines.
- Leaves are alternate, usually compound, with stipules.
- Flowers are bisexual and typically zygomorphic (bilaterally symmetrical).
- The flowers are usually arranged in racemes or spikes.
- Fruits are typically legumes (pods) that split open along two sides.
- Many species have root nodules that contain nitrogen-fixing bacteria.

Economic Importance:

- Many members of the Fabaceae family are important as food crops. Examples include common beans (*Phaseolus vulgaris*), lentils (*Lens culinaris*), chickpeas (*Cicer arietinum*), and peanuts (*Arachis hypogea*).
- Some legumes, such as soybeans (*Glycine max*) and alfalfa (*Medicago sativa*), are important forage crops for livestock.
- Fabaceae plants are often cultivated as ornamentals due to their attractive flowers and foliage. Examples include lupines (*Lupinus*), wisteria (*Wisteria*), and sweet peas (*Lathyrus odoratus*).
- Many leguminous plants are used in traditional medicine for their medicinal properties. For example, liquorice (*Glycyrrhiza glabra*) is used as an expectorant and anti-inflammatory agent.

Family: Solanaceae

Characteristics:

- Also known as the nightshade family.
- A large family of flowering plants with about 100 genera and over 2,500 species.
- Plants can be herbs, shrubs, trees, or vines.
- Leaves are alternate or rarely opposite, simple or compound, usually without stipules.
- Flowers are typically bisexual and actinomorphic (radially symmetrical).
- Flowers are usually solitary or arranged in cymes or racemes.
- Fruit types vary and can include berries, capsules, or dry dehiscent fruits.

Economic Importance:

- Many Solanaceae plants are cultivated as important food crops. Examples include tomato (*Solanum Lycopersicon*), potato (*Solanum tuberosum*), bell pepper (*Capsicum annuum*), and eggplant (*Solanum melongena*).
- Some Solanaceae species, such as tobacco (*Nicotiana tabacum*), have economic importance for their leaves, which are used in the production of cigarettes and other tobacco products.
- Certain Solanaceae plants have medicinal properties. For instance, belladonna (*Atropa belladonna*) contains alkaloids with medicinal uses, while *Datura* species are used in traditional medicine and as hallucinogens.
- Several ornamental plants belong to the Solanaceae family, including petunias (*Petunia*), angel's trumpet (*Brugmansia*), and ornamental peppers (*Capsicum annuum*).

Family: Liliaceae

Characteristics:

- Also known as the lily family.
- A family of flowering plants comprising about 15 genera and over 700 species.
- Plants are typically herbaceous perennials, but some can be shrubs or vines.
- Leaves are usually alternate or rarely whorled, simple, and often linear or lanceolate.
- Flowers are usually bisexual and actinomorphic, with three petals and three sepals.
- Flowers are typically arranged in racemes, panicles, or umbels.
- Fruit types vary and can include capsules, berries, or fleshy aggregates.

Economic Importance:

- Liliaceae plants are primarily valued for their ornamental qualities. Many species are cultivated for their beautiful flowers and are commonly used in gardens and landscaping.
- Some members of the family have been used in traditional medicine for their medicinal properties. For example, species like garlic and onion have been used for their health benefits.
- Some Liliaceae species, such as asparagus, are cultivated as food crops.
- The family includes several popular ornamental plants like lilies, tulips, and daylilies.