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Chapter - 01

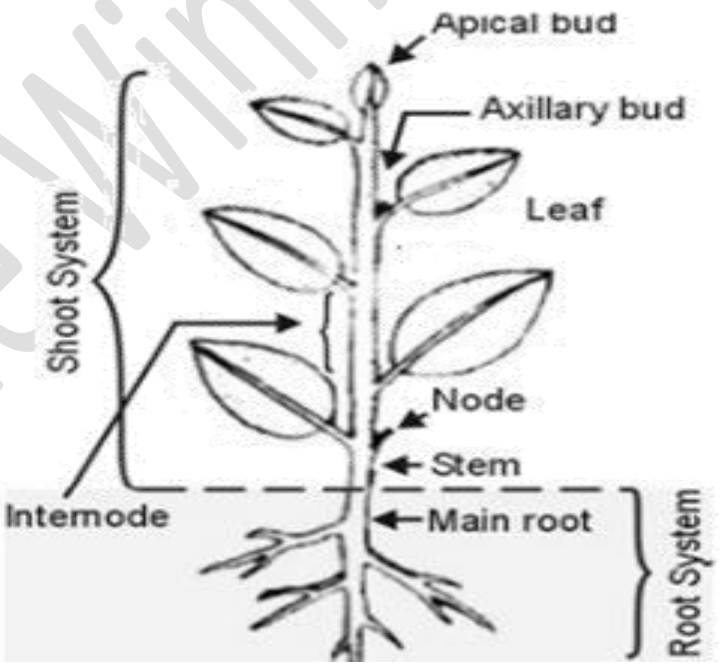
Basic structural organization – Plants

All plants have different parts that we call structures.

Parts of a plant

We depend on nature for all our basic needs. Plants are one of big groups of nature. They are autotrophic which means they can make their own food. We obtain many things from plants such as cereals, pulses, vegetables, fruits, wood, fiber, rubber, gum, tea, coffee etc. Plants include trees, herbs, bushes, grasses, vines, ferns, mosses and green algae. The scientific study of plants is known as Botany. Fungi and non-green algae are not considered as plants. Basic parts of plants are roots, stems, leaves, flowers, fruits and seeds. Each part of a plant has a very important function. The typical plant body consists of two systems:

A. The Root System (usually underground)
B. The Shoot System (usually above the ground)

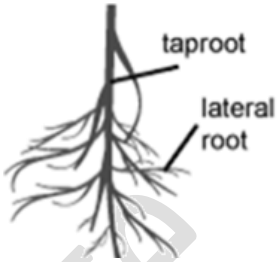


A. The root system

The root system can be studied under the following heads:

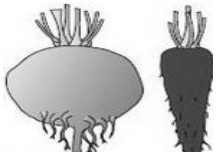
Roots: Root is the underground part of the plant's body and grows towards the force of gravity. It develops from the radical of germinating seed. It fixes the plant within the soil, transports water and mineral nutrients from the soil. It also stores excess food.

There are two types of roots:



1. Tap Roots - It consists of one main root growing downwards from which lateral roots develop which may initially grow horizontally then turn downward. Tap roots are important adaptations to search for water and minerals from deep within the soil.
Examples: Beet root, radish, coriander, carrot etc.

2. Fibrous Roots - It consists of a dense mass of slender roots that arise from the stem. The roots grow downward and outward from the stem, branching repeatedly to form a mass of fine roots.
Examples: Lilies, grass, palm, wheat, rice, corn etc.



Modified Roots - In some plants the roots are modified to do special tasks.
Storage roots - These consist of thickened roots due to the accumulation of high-energy storage compounds, usually starch.
Example: Carrot, sweet potato, radish.

Aerial roots- These fibrous roots remain aerial, i.e. they do not enter the soil. It performs special functions such as water retention, photosynthesis and support. (Also called prop roots)
Example: Mangroves and old banyan trees have aerial roots hanging down, these provide support to the tree.

Aquatic Roots - These are specialized roots in some plants that grow in watery places and function mainly for water and nutrient absorption. Its root system consists of long fibrous roots.
Example: Water lily

B. The shoot system

It is the aerial part of the plant body and enables a plant to grow taller to gain access to energy-giving light and helps plant to prepare food. It is composed of erect stems on which are attached leaves, flowers, branches and buds. Leaves are attached to the stem at regions called nodes. The various parts are discussed as follows:

a) **Stem -** It supports the upper parts of plants. It carries the water and nutrients needed for plants to grow from roots to leaves besides, food produced by the leaves to other part of plants. Stems also store food for the plant. Typical stems are located above ground, but there are **modified stems** that can be found either above or below ground.

b) **Tendrils** - In various climbing plants, such as the grapes, some parts of stems are modified into coil-like structures called tendrils. They are weak, so they take the support of other structures to help the plants to climb up and grow.

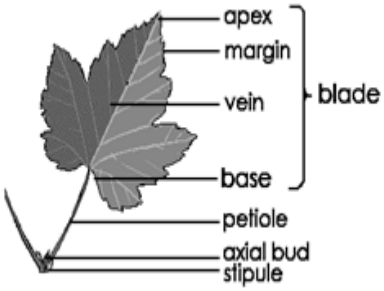
c) **Runners or Stolons** - Stems that grow in a creeping fashion horizontally above the surface of the soil are called runners, or 'Stolons'. Nodes of these stem if touches soil, give rise to new plant.
Examples: Strawberries, Mint, Spider grass etc.

d) **Water storing stem -** Some cacti and a few other kinds of plants have stems that look like leaves. They are green thus manufacture and store food.

e) **Underground modified stem** - Potato, garlic, onion and ginger are example of underground stem.

Ginger Potato

The leaves



These are the parts of the plant where food is made by the process of photosynthesis. That's why leaves are called the food making factories of green plants. Chlorophyll (green pigment) present in the leaves uses the energy in sunlight to turn water (H_2O) and carbon dioxide gas (CO_2) into sugar and oxygen gas (O_2). Leaves are of different shapes and sizes.

The outer surface of the leaf has a waxy coating which protects the leaf. The flat surface of the leaf is called a leaf blade or lamina. It has veins running across within the leaf. Tiny openings on the surface of the leaves called stomata helps in the exchange of gases. The veins carry the food the leaf makes to the rest of the plant. Some of the few categories of leaves can be classified in the following paragraphs:

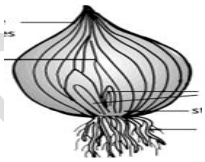
a) **Modified Leaves**

I. **Spines**- Spines are modified leaves in cacti that serve as a protective adaptation. Due to the scarcity of water in deserts, the leaves of some plants are modified to form spines.

II. **Tendrils**- Tendrils are spring-like structures that coil spirally. They are modified leaves that provide support; when they come into contact with any structure, they coil around it for stability.

Examples: Pea, grapes, and members of the melon family.

III. **Storage organs**: In plants like onions, the leaves are modified into storage organs. These modified leaves protect the stem at the base of the onion.



Example: Onions.

IV. **Needle Leaves**- The most significant modification of leaves is related to the plant's need for water conservation. Needle like leaf modification is seen in plants like:

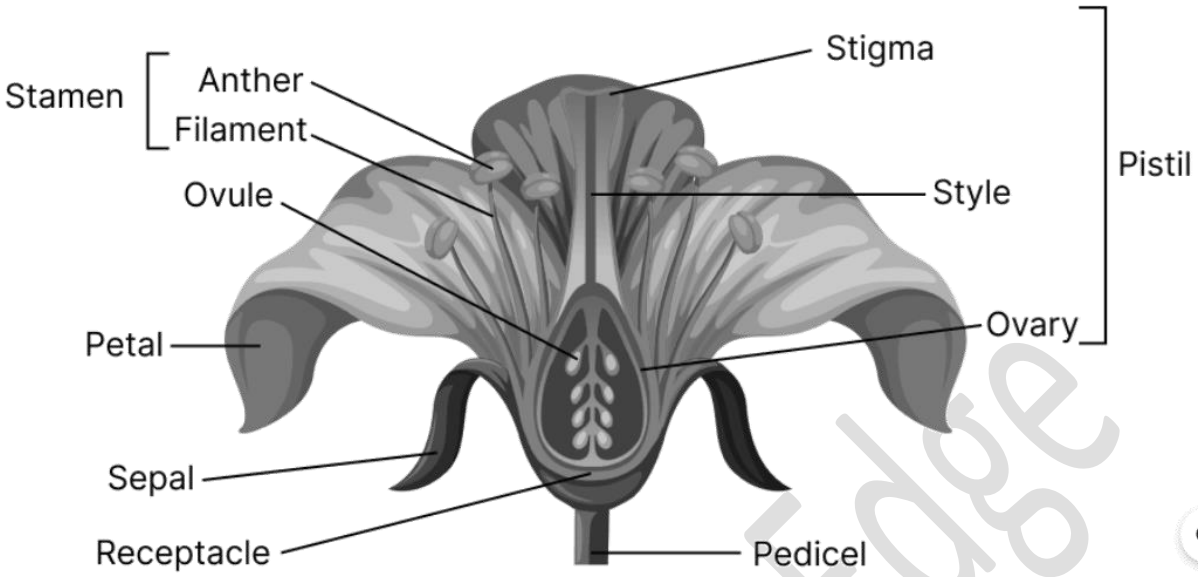
i. Pines
ii. Firs
iii. Spruces
iv. Cedars
v. Venus fly trap*

* The Venus flytrap is not typically classified under needle-like leaves; it has specialized leaves designed to capture and digest insects. Venus fly trap plants are designed to capture and digest insects between the folds of their **specialized leaves**.

Bougainvillea is a plant with flower-like spring leaves near its flowers.

The flowers

Flowers are the most attractive part of a plant. Each type of flower has a different physical structure, color, and scent compared to other flower types. The petals and fragrance of the flowers attract insects and bees for pollination. After pollination, the petals fall off, and seeds develop in the part of the flower called the ovary.



Parts of the Flower

The ovary itself usually becomes the fruit. Pollination is the process by which pollen is transferred from the anther to the stigma of the plant. Some of the agents of pollination are insects, wind, birds, mammals and water. Some parts of the flower are mentioned in the following paragraphs:

A. Petals - The parts of a flower that are often brightly colored or unusually shaped to attract pollinators. They are the most attractive part of the plant.

B. Sepals - These are small and green in color composing the outermost part of a flower. It encloses and protects the bud and may remain after the fruit forms.

C. Pistils - The pistil usually is based in the center of the flower and consists of three parts: stigma, style and ovary.

- **i. Stigma** - It is the waxy, sticky bulb in the center and receives the pollens.
- **ii. Style** - It is a long, slender stalk that connects the stigma and the ovary.
- **iii. Ovary** - The ovary is located at the bottom of the style.

D. Stamen - The pollen-producing part of a flower and consists of:

- ❖ **Anthers** – It is pollen producing structure. These are generally yellow in color.
- ❖ **Filament** – It is a thread-like structure which holds anthers.

The fruit and the seed

The fruit is a fleshy or dry ripened (mature) ovary of a plant, enclosing the seed or seeds. Most plants grow from seeds. A seed (mature ovule) is a miniature plant with a protective outer covering called the seed coat, usually with some stored food.

Seeds are dispersed by wind, water, or animals. When provided with air, water, and sunlight, seeds grow into baby plants. Most plants grow in the ground, with stems above and roots below.

Classification of Plants based on growth habit

a) **Herbs** - Herbs are short plants with soft, green, delicate stems that lack woody tissue. They complete their life cycle within one or two seasons. Generally, they have few branches or may be branchless. Herbs can be easily uprooted from the soil and contain sufficient nutritional benefits, including vitamins and minerals, to be part of a healthy balanced diet.
Example: Tomato, Wheat, Paddy, Grass and Bananas.

b) **Shrub** - Shrubs are medium-sized, woody plants that are taller than herbs but shorter than trees. Their height usually ranges between 1 to 6 meters. Their features include bushy, hard, woody stems with many branches. Although the stems are hard, they are flexible but not fragile. The lifespan of shrubs usually depends on the species. Example: Rose, jasmine, lemon, Tulsi and Henna.

c) **Trees** - The Trees are big and tall plants. They have very thick, woody and hard stems called the trunk. This single main stem or the trunk gives rise to many branches that bear leaves, flowers and fruits. Some trees are branchless like coconut tree, i.e., they have only one main stem which bears leaves, flowers and fruits all by itself. The lifespan of trees is typically very long, often lasting several decades or even centuries.
Example: Banyan, Mango, Neem, Cashew, Teak and Oak.

d) **Creepers** - Creepers, as the name suggests, are plants that creep on the ground. They have very fragile, long, thin stems that can neither stand erect nor support all its weight. Example: Watermelon, Strawberry, Pumpkin and Sweet Potatoes.

e) **Climbers** - Climbers are much more advanced than creepers. These have a very thin, long and weak stem which cannot stand upright. They use external support to grow vertically and carry their weight. These types of plants use special structures called tendrils to climb. Example: Pea plant, Grapevine, Sweet-gourd, money-plant, Runner Beans, Green Peas.

Exercise

1. The scientific study of plants is known as _____

a) Botany b) Zoology c) History d) Anatomy

2. The ovary is located at the bottom of the_____.

a) Stamina b) Style c) Leaves d) Stigma

3. _____ are attached to the stem at regions called nodes.

a) Petals b) Leaves c) Sepals d) Flower

4. _____ is the process by which pollen is transferred.

a) Reproduction b) Transportation c) Hibernation d) Pollination

5. _____ are the most attractive part of the plant.

a) Ovary b) Petals c) Sepals d) Anther

6. Leaves are modified as _____ in cactus for protection.

a) Herbs b) Spines c) History d) Anatomy

7. The flat surface of the leaf is called *leaf blade or*_____.

a) Lamina b) Spines c) Nodes d) Antinodes

8. The typical plant body consists of two systems_____.

a) Growth system and Nutrients system b) The root and Shoot system

c) Underground and Above ground system d) None of the above

9. _____ and non-green algae are not considered as plants

a) Algae b) Wheat c) Herb d) Fungi

10. _____ develops from the radicle of germinating seed

a) Leaf b) Root c) Stem d) Flowers

11. _____is an example of herb.

a) Tomato b) Tulsi c) Henna d) Mango

12. _____ is an example of shrub.

a) Wheat b) Paddy c) Tulsi d) Rosemary

13. _____is an example of trees.

a) Teak b) Ginger c) Henna d) Basil

14. _____ is an example of creepers.

a) Money Plant b) Corn c) Beans d) Sweet Potato

15. _____ is an example of climbers.

a) Jasmine b) Onion c) Wheat d) Pumpkin

16. _____ is not an example of taproots

a) Carrot b) Beetroot c) Radish d) Ginger

17. _____ is not an example of fibrous roots

a) Ginger b) Wheat c) Rice d) Corn

18. _____ is not an example of underground modified stems.

a) Tomato b) Potato c) Garlic d) Onion

19. _____ is an example of tendril leaves.

a) Pea b) Spruces c) Firs d) Pines

20. _____ is an example of needle shaped leaves.

a) Pines b) Beans c) Melons d) Mango

21. Leaves are attached to the stem at

a) Internodes b) Nodes c) Apical meristem d) Axillary meristem

22. Anther is a part of

a) stigma b) stamen c) ovary d) petal

23. Pollen grains are collected by

a) Anther b) Carpel c) Stigma d) Sepal

24. The part of flower that becomes seeds is

a) Ovule b) Ovary c) Anther d) Stigma

25. The male reproductive part of a flower

a) Stamen b) Pistil c) Stigma d) Style

26. Which root modification does not store food?

a) Stilt b) Conical c) Napiform d) Tuberous

27. Outer seed coat is

a) Testa b) Tegmen c) Hilum d) Funiculus

28. Sweet potato is a modification of

a) Leaf b) Primary root c) Adventitious root d) Underground root

29. Which is a shrub among the following?

a) Spinach b) Mango tree c) Lemon d) Pipal

30. Plants with thick, hard and woody stem

a) Climber b) Shrub c) Herb d) Creepers

31. What is the role of the lamina in a leaf?

a) To attach the leaf to the stem b) To store water

c) To perform photsynthesis d) To produce seeds

32. What is the role of the axillary bud in the shoot system?

a) To produce roots b) To store food

c) To produce leaves d) To develop new branches

33. Which part of the plant develops from the plumule of the embryo?

a) Root b) Shoot system c) Leaf d) Flower

34. What is the function of the stem in the shoot system?

a) To absorb water b) To store food

c) To support the plant d) To reproduce

35. What is the node in the shoot system?

a) A part of the root b) A part of the leaf

c) A point where a leaf is attached d) A type of flower

36. What is an internode in the shoot system?

a) A part of the root b) A part of the leaf

c) The area between two nodes d) A type of flower

37. Which of the following is NOT a part of the shoot system?

a) Stem b) Leaf c) Flower d) Root

38. What is the main site of photosynthesis in the shoot system?

a) Stem b) Leaf c) Flower d) Fruit

39. What is the function of leaves in the shoot system?

a) To store water b) To support the plant

c) To perform photosynthesis d) To reproduce

40. What is the mature ovary of a flower that contains seeds?

a) Leaf b) Stem c) Fruit d) Root

41. Which of the following plants has a fibrous root system but is part of the shoot system?

a) Mango b) Wheat c) Banana d) Tulsi

42. What is the process by which pollen grains are transferred from one flower to another?

a) Respiration b) Photosynthesis c) Pollination d) Transpiration

43. Which part of the shoot system provides additional support and space for leaves and flowers?

a) Stem b) Branches c) Leaves d) Flowers

44. Which type of modified leaf is used for climbing in plants like cucumbers?

a) Spine b) Tendril c) Bract d) Storage leaf

45. What is the main purpose of bracts in plants like Bougainvillea?

a) To store water b) To protect from herbivores

c) To attract pollinators d) To perform photosynthesis

46. Which type of plant uses modified leaves to trap insects?

a) Succulent plants b) Carnivorous plants

c) Climbing plants d) Desert plants

47. What is the function of succulent leaves in plants like aloe?

a) To attract pollinators b) To protect from herbivores

c) To store water d) To perform photosynthesis

48. What is the function of needle-like leaf modifications in coniferous plants?

a) To store water b) To attract pollinators

c) To reduce water loss d) To perform photosynthesis

49. What is the term for the modified leaf that forms a protective covering around a flower bud?

a) Bract b) Sepal c) Petal d) Tendril

50. In which type of plants are storage leaves commonly found?

a) Cacti b) Carnivorous plants c) Succulent plants d) Climbing plants

Answer key

1 Botany	**2** Style	**3** Leaves	**4** Pollination	**5** Petals
6 Spines	**7** Lamina	**8** The root and shoot system	**9** Fungi	**10** Root
11 Tomato	**12** Tulsi	**13** Teak	**14** Sweet potato	**15** Jasmine
16 Ginger	**17** Ginger	**18** Tomato	**19** Pea	**20** Pines
21 Nodes	**22** Stamen	**23** Stigma	**24** Ovule	**25** Stamen
26 Stilt	**27** Testa	**28** Adventitious root	**29** Lemon	**30** Shrub
31 To perform photosynthesis	**32** To develop new branches	**33** Shoot system	**34** To support the plant	**35** A point where leaf is attached
36 The area between two nodes	**37** Root	**38** Leaf	**39** To perform photosynthesis	**40** Fruit
41 Banana	**42** Pollination	**43** Branches	**44** Tendril	**45** To attract pollinators
46 Carnivorous plants	**47** To store water	**48** To reduce water loss	**49** Sepal	**50** Succulent Plants

Explanation

1. **BOTANY:** Botany is the branch of biology that deals with the scientific study of plants, including their structure, physiology, ecology, and genetics. It involves understanding the life processes, classification, and interactions of plants with their environment.
2. **OVARY**: This is the part of a flower where seeds develop. It's divided into three main parts: the ovary itself, the style, and the stigma.
3. **LEAVES**: Leaves are plant organs primarily responsible for photosynthesis. They consist of a lamina (the flat part of the leaf), a petiole (the stalk that attaches the leaf to the stem), and nodes (points where leaves or branches attach to the stem). Internodes are the segments of stem between nodes.
4. **POLLINATION**: Pollination is the process by which pollen is transferred from the male structures of a plant (anthers) to the female structure (stigma), enabling fertilization and seed production. This process involves petals, which attract pollinators like bees and butterflies.
5. **PETALS**: Petals are the colorful parts of a flower that attract pollinators. They are often arranged in a specific pattern around the reproductive parts of the flower.
6. **SPINES**: Spines are modified leaves or branches that serve as protective structures for plants, often found in arid environments where water conservation is crucial.
7. **LAMINA**: The flat and expanded portion of the leaf in its entirety is known as the lamina.
8. **THE ROOT and SHOOT SYSTEM**: The root system, consisting of roots, absorbs water and nutrients from the soil. The shoot system, comprising stems, leaves, and flowers, grows above ground and is responsible for photosynthesis and reproduction.
9. **FUNGI**: Fungi are simple organisms, or living things, that are neither plant nor animal. These organisms can form symbiotic relationships with plant roots, helping them absorb nutrients.

10. **Root**: Root is an underground part of a plant. It keeps the plant upright. It takes water and food from the soil and stores food for the plant. There are two main kinds of roots: taproots and fibrous roots.
11. **Herbs**: These are small, non-woody plants that typically die after one growing season. Examples include basil, mint, and coriander.
12. **Shrubs**: These are small to medium-sized woody plants that are usually smaller than trees. Examples include rose bushes and lavender.
13. **Trees**: Large, woody plants with a single main stem called a trunk. Examples include oak and pine trees.
14. **Creepers**: These are plants that grow along the ground or on other surfaces without climbing. Examples include strawberry plants and ivy.
15. **Climbers**: Plants that use other structures for support to grow upwards. Examples include grapevines and peas.
16. **Taproots**: These are large, single roots that grow straight down into the soil. Examples include carrots and beets.
17. **Fibrous Roots:** These are a network of small roots that spread out in all directions. Examples include grass and wheat.
18. **Underground Modified Stems**:
    1. Rhizomes: These are underground stems that grow horizontally and produce new plants at their nodes. Examples include ginger and turmeric.
    2. Bulbs: These are underground stems with fleshy leaves that store food. Examples include onions and garlic.
    3. Tubers: These are swollen underground stems that store food. Examples include potatoes
19. **Tendril Leaves**: These are modified leaves that act as tendrils for climbing. Examples include peas and cucumbers.
20. **Needle-Shaped Leaves**: These are long, thin leaves that reduce water loss. Examples include pine trees and cacti.
21. **Nodes:** These are the points on a stem where leaves, branches, or flowers are attached. Internodes: These are the segments of a stem between two nodes. **Internodes** are responsible for increasing the length of the stem.
22. **Anther**: This is the pollen-producing part of a flower, located at the tip of the stamen. Example: In sunflowers, the anthers are the yellow parts that produce pollen.
23. **Stigma**: This is the pollen-collecting part of a flower, located at the top of the pistil.

24. **Ovule**: This is the part of a flower where fertilization occurs, leading to seed development. Ovules are found within the ovary. Example: In apples, the ovules are the tiny structures inside the core that develop into seeds.
25. **Stamen**: This is the male reproductive part of a flower, consisting of the anther and filament.
26. **Stilt Roots**: These are roots that grow from the base of a stem and provide additional support to the plant. Some types of corn develop stilt roots for support.
27. **Testa**: The testa is the outer layer of the seed coat, which is typically thick and hard. **Tegmen**: The tegmen is the inner layer of the seed coat, which is thinner than the testa. The **hilum** is a scar on the seed coat where the seed was attached to the plant via the funiculus. The **funiculus** is the stalk that attaches the ovule (which develops into a seed) to the placenta in the ovary of a flower. It provides nutrients and support to the developing seed.
28. **Primary Root**: This is the main root that develops from the radicle of a seedling. It grows straight down into the soil. Example: Carrots have a large primary root. **Adventitious Roots:** These are roots that develop from parts of the plant other than the primary root, such as stems or leaves. Example: Ivy plants develop adventitious roots from their stems. **Underground Roots:** These are roots that grow beneath the soil surface, including both primary and adventitious roots.
29. **Shrub:** A shrub is a small to medium-sized woody plant that is typically smaller than a tree. Rose, Hibiscus, Jasmine, Tulsi, China Rose, Lemon plant etc., are popular shrubs used in gardens for their beauty.
30. **Shrub:** A shrub is a small to medium-sized woody plant that is typically smaller than a tree.
31. **Lamina**: The broad, flat part of a leaf where photosynthesis occurs. It contains veins for nutrient transport.
32. **Axillary Bud**: A small bud located in the axil (the angle between a leaf and the stem). It can grow into a new branch or flower.
33. **Embryo:** An embryo is the early stage of development in plants that grows inside a seed. It is formed after the fertilization of an ovule by pollen. The main parts of a plant embryo are: Radicle, Plumule, Cotyledons.
34. **Shoot System**: The part of a plant that grows above the ground, including stems, leaves, flowers, and fruits. Its main function is to support the plant, transport nutrients, and facilitate photosynthesis.
35. **Node**: A point on the stem where a leaf or branch is attached.
36. **Internode**: The segment of a stem between two nodes.

37. **Shoot System:** The part of a plant that grows above the ground, including stems, leaves, flowers, and fruits.
38. **Photosynthesis**: The process by which plants convert sunlight, carbon dioxide, and water into glucose and oxygen. It occurs mainly in leaves.
39. **Leaf**: The main function of a leaf is to produce food for the plant by photosynthesis.
40. **Fruit**: The mature ovary of a flower that contains seeds. Fruits like apples and mangoes develop from flowers.
41. **Banana Plant:** A type of plant with a false stem. It produces large leaves and edible fruits.
42. **Pollination**: The transfer of pollen from the male part of a flower (anther) to the female part (stigma), allowing fertilization to occur.
43. **Branches**: Extensions of the stem that support leaves and flowers.
44. **Tendril**: A modified leaf or stem that helps climbing plants like cucumbers and peas to attach themselves to supports.
45. **Pollinators**: Animals like bees, butterflies, and birds that help transfer pollen between flowers, facilitating pollination.
46. **Carnivorous Plants**: Plants that obtain nutrients by capturing and digesting insects, often found in nutrient-poor soil.
47. **Succulent Plants**: Plants that store water in their leaves, stems, or roots, often found in dry environments like deserts.
48. **Needle-like Leaves:** Modified leaves found in coniferous plants that reduce water loss by minimizing surface area.
49. **Sepals**: Green, leaf-like structures that protect the flower bud before it opens.
50. **Storage Leaves**: Modified leaves that store water or nutrients, often found in succulent plants like aloe.