
The Stem

In botany, the plant axis that bears buds and shoots with leaves and, at its basal end, roots. The stem is the stalk of a plant or the main trunk of a tree.

The plant stem is a component of the shoot system, the portion of the plant body of the angiosperms having phototropic response. Besides the stem, the plant shoot also consists of the leaves and the reproductive organs. The plant stem has been described as a “central axis” to which all other parts are attached. In most plants the stems are conspicuous aboveground, but in some species they are hidden below the ground.

The first stem that develops from a seed arises from the *epicotyl*, an embryonic shoot within the seed. They usually end in a bud and bear leaves, lateral buds and reproductive organs. Lateral branches arise in the axils of leaves (the angle between leaf and stem).

Characteristics of a stem

- i) Generally it is above ground
- ii) Bears node, internode, leaves and flower
- iii) Supply nutrients or assimilates from root to leaves and leaves to roots
- iv) Store nutrients for supplying other plant parts

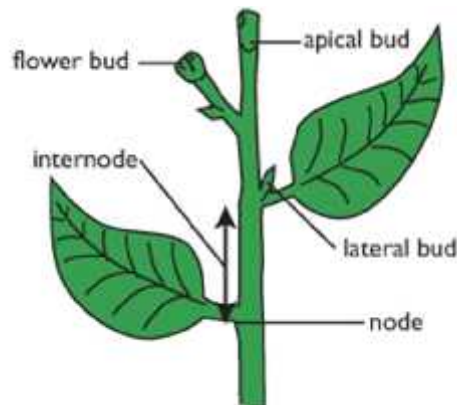


External Structures of a Stem

Bud: It is a stem's primary two types they can be either leaf

growing point. Buds are of buds which are vegetative or

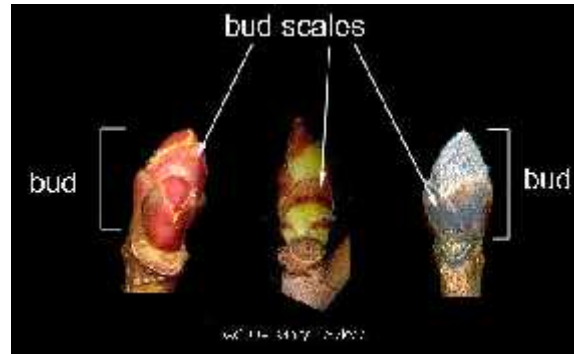
flower buds which are reproductive. The flower buds tend to be plumper than leaf buds, apart from this characteristic the two buds tend to be very similar in appearance.



Terminal bud: The tip of a stem shows the terminal bud which releases the plant hormone known as auxin in many plants. This hormone suppresses development of lateral buds, thereby focusing the growth of the plant in upward rather than outward direction.

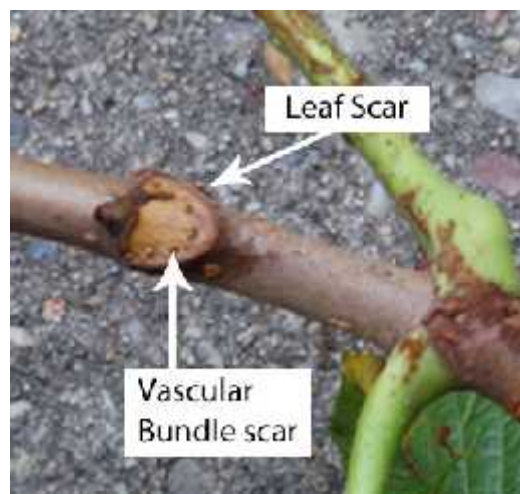
Lateral buds: These buds grow from the leaf axils on the side of a stem.

Bud scales: It is a modified leaf protecting and covering a bud.



Leaf scar: When the leaf falls down it leaves a mark on the stem.

Bundle scar: This is used in the identification of the woody plants and it is a mark left in the leaf scar from the vascular tissue attachment.



Lenticel: They are the pores that allow for gas exchange.



Node: It is a segment of stem where leaves and lateral buds are attached.

Internode: It is the section of a stem between two nodes.

Bark: It forms the protective outer tissue which helps in the woody plant identification and develops with age.



Stems have five main functions which are:

1. Support and elevation of leaves, flowers and fruits. The stems keep the leaves in the light and provide a place for the plant to keep its flowers and fruits. It supports the leaves, flowers and fruits and connects them with the roots. In trees and shrubs, the main stem or trunk provides a strong columnar structure from which branches are attached, raising the leaves upward to be exposed more fully to the sun.
2. Transport of fluids between the roots and the shoots in the xylem and phloem. It conducts water, nutrients and the products of photosynthesis to and from roots and leaves. It accommodates the transport system which is necessary for the vertical and lateral movement of water and sap within the plant body
3. Storage of nutrients, products of photosynthesis and water.
4. The production of new living tissue. The normal life span of plant cells is one to three years. Stems have cells called meristems that annually generate new living tissue.
5. Young green stem also performs a minor role in the production of food through the process of photosynthesis, but in some species (e.g. cactus) the stem is the chief photosynthesizing organ.

As to texture, plant stems are classified as:

- **Herbaceous stems**, as in banana, have no permanent woody tissue, with a short life span, and die soon after flowering.

- **Suffrutescent** stems, as in eggplant and jute, are more or less woody or half-woody, usually at the basal part.
- **Woody** stems, as in all shrubs and trees, form permanent woody tissue which persist indefinitely. The woody portion of the stem is made of secondary xylem.



As to direction, plant stems are:

- Stems are **erect** when they grow vertically upward in a direction that is perpendicular from the base;
- **ascending** when rising obliquely or in slanting direction;
- **decumbent** when more or less reclining on the ground at or near the base;
- **prostrate** when lying flat on the ground; creeping when growing flat on the ground and rooting on the nodes;
- **climbing** or **scandent** when rising by clinging to other objects by means of tendrils, rootlets, or other specialized organs;
- **twining** when rising by coiling around other stems or objects.

Generally, the stems are aerial and grow above the soil surface. Plants with no obvious stem above ground, but bear only leaves and flower stalks, are called *stemless* or *acaulescent*. In grass plants like rice, corn and bamboo which belong to the botanical family *Poaceae*, the main stem is specially called culm which are hollow with pronounced solid nodes.

The stem is basically cylindrical. However, there are many modified forms to perform special functions like perennation, vegetative propagation and food storage.

The modified stems may be grouped under three heads viz, underground, subaerial and aerial.

Underground Stem Modifications

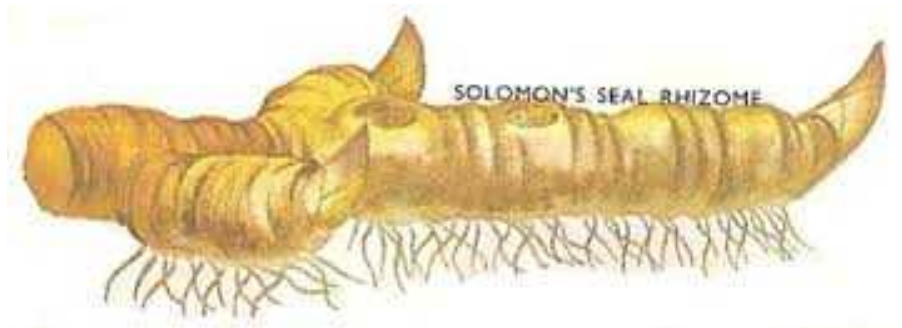
The underground stems, situated below the surface of the soil, protect themselves against unfavorable conditions of weather and the attack of animals, and serve as store houses for reserve food, and in vegetative propagation. Their stem nature can be distinguished by the presence of nodes and internodes, scale leaves at the nodes, axillary buds in axils of scale leaves and a terminal bud. Further, the anatomy of the underground stem resembles that of an aerial stem.

The underground stems are of four types namely

- Rhizome
- Tuber
- Bulb
- Corm

Rhizome

A rhizome is a thick horizontally growing stem which usually stores food material. It has nodes and internodes, scale leaves, axillary buds, adventitious roots and a terminal bud. Scale leaves enclosing the axillary buds are seen arising from the nodal points of the stem. Some of the axillary buds develop into branches which grow upwards into the air and then produce normal green foliage leaves. Usually the growing points of the rhizome continue to remain underground causing an elongation of the rhizome. Roots develop from the lower surface of the rhizome. e.g. Ginger, Turmeric.



Tuber

Tuber is a swollen end of an underground branch which arises from the axil of a lower leaf. These underground branches grow horizontally outwards in the soil. Each tuber is irregular in shape due to the deposition of food materials (starch). On the surface of each tuber many leaf scars are seen. These leaf scars are the impressions of fallen scale leaves. Each such leaf scar encloses an axillary bud. A leaf scar with an axillary bud is called an eye. These eyes of potato are capable of producing new plants by vegetative propagation. e.g. potato.



Bulb

The stem is reduced and represented by a short disc. The lower surface of the stem produces many adventitious roots. e.g., onion, garlic.

In bulbs of onion, garlic, etc. the inner leaves are fleshy while the outer ones are dry. This is called as tunicated bulb since the concentric leaf bases form a complete covering or tunic. The apical bud of the bulb produces the shoot. The axillary buds sometimes produce daughter bulbs, as in garlic.



Corm

A corm is a greatly swollen underground basal portion of an erect stem. The swelling is due to the storage of reserve food material. It bears scale leaves and axillary buds. At the end of the growing season, the aerial parts die. With the return of favorable conditions usually one axillary bud (rarely more than one) near the apex develops into a new shoot utilising the food reserve material in the old corm. The new plant produces a new corm at its base. The earlier corm shrivels off. e.g. *Amorphophallus*, *Colocasia*.

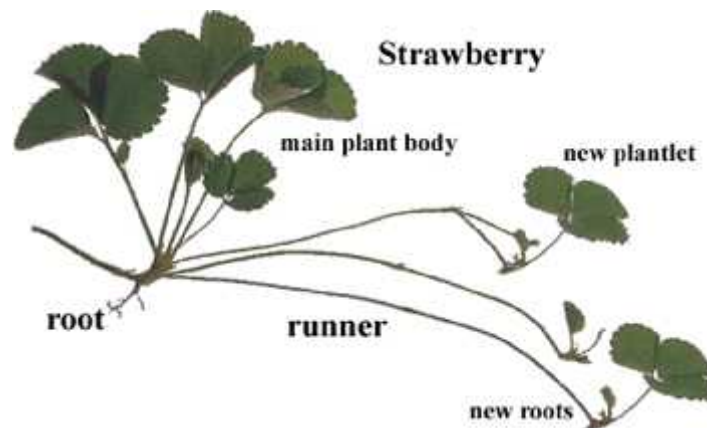


Sub-aerial Stem Modifications

In some plants, the sub-aerial stems are modified for the purpose of vegetative reproduction. They are of the following types:

Runner

The runner arises from the base of the stem as a lateral branch and runs along the surface of the soil. It develops distinct nodes and internodes. At each node, the runner produces roots below and leaves above. In this way many runners are often produced by the mother plant and they spread out on the ground on all sides. If any accidental injury results in the separation of a runner, the severed parts are capable of leading an independent existence. e.g., *Oxalis*, *Fragaria*, *Centella asiatica*.

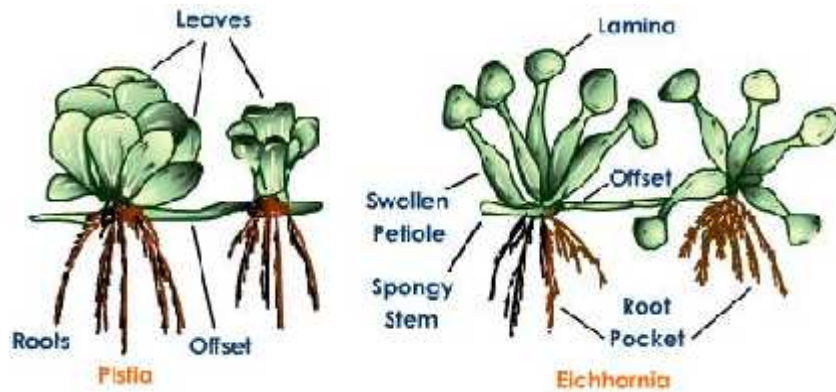


Offset

An offset is a short thick runner like branch which produces a new plant at its tip. The offsets grow in all directions from the main stem of the parent plant. If any accidental injury results in the separation of these units, each is capable of leading an independent existence. e.g., *Pistia*, *Eichhornia*.

Stolon

Here, lateral branches called stolon grow from the underground stem. stolon grow



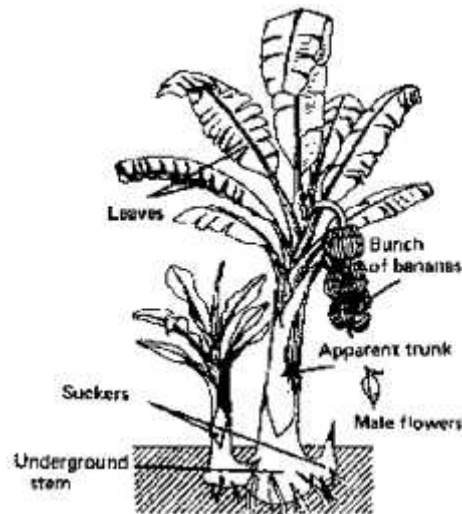
branches originate

The

horizontally outwards for a varying distance in the soil. Ultimately their end (terminal bud) emerges out of the ground and develops into a new plant. A runner, sucker or any basal branch which produces roots is called a stolon. e. g. *Colocasia*.

Sucker

A lateral branch arising close to the ground level, traveling underground for some distance, turning up at its end and producing a new plant is a sucker. e.g. *Chrysanthemum*



Aerial Stem Modifications

In some plants the aerial stem is modified to perform a variety of special functions. The aerial stem modifications are as follows:

Stem Tendril

Tendrils develop as modifications of the stem in certain plants. The terminal bud gives rise to a tendril in *Cissus quadrangularis* and the axillary bud becomes modified into a tendril in passion fruit.



Stem Thorn

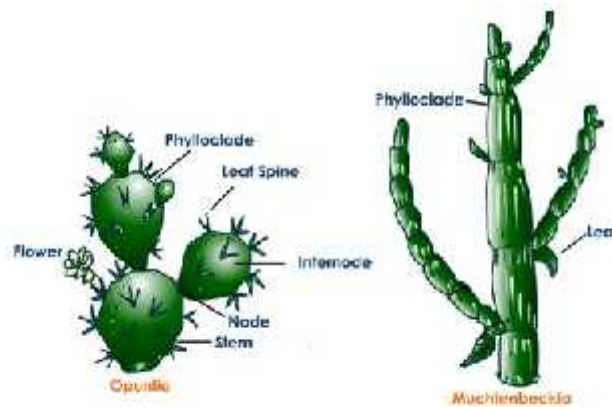
The thorn is a hard, straight, and pointed structure. The thorn sometimes bears leaves, flowers and fruits as seen in *Duranta* and *Pomegranate*. The thorns not only check the rate of transpiration but also protect the plants from herbivore grazing. e.g. *Carissa*, *Duranta*, *Citrus*.

Thorns are small, modified stems, spines are modified superficial leaves and prickles are sharp, pointed structures without vascular tissue, arising on stem, petioles and inflorescence.



Phylloclade

A phylloclade is a flattened stem of several internodes functioning as a leaf. In opuntia the stem is modified into a green flattened structure called phylloclade. On the surface of the phylloclade,



clusters of spines are formed. These spines are the modified leaves of the axillary bud. These spines not only check the rate of transpiration but also protect the plant from herbivores. The phylloclade has distinct nodes and internodes. e.g. Opuntia



Cladodes **and**

Cladophylls

A phylloclade of one or two internode is called as a cladode. There are no suitable examples of cladodes because, Asparagus, which is often considered as cladodes, is in reality, cladophylls. cladophyll is a flattened leaf like stem arising in the axils of a minute, bract-like, true leaf.



Bulbil

Bulbil is a special multicellular body essentially meant for reproduction. In *Agave* the floral buds are modified into bulbils. These bulbils get detached, come in contact with the soil and develop into new plants. In *Dioscorea* the axillary bud develops into a bulbil. This bulbil detaches from the mother plant and grows up into a new independent one.



Summary of Modifications

Stem

Underground	Sub aerial	Aerial
Rhizome	Runner	Tendrils
Tuber	Offset	Thorn
Corm	Stolon	Phylloclade
Bulb	Sucker	Cladodes and Cladophylls
		Bulbil