HORT-5601

Plant Parts, Their Functions and Modifications

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Plant Parts

- Flowering plants have two basic parts

Root: The part of plant that is underground.

Shoot: The part of plant that is aboveground.

- The plant body is made up of microscopic components called cells, although they are essentially similar, may be structurally and functionally different.
- Masses of cells in various combinations and arrangements build up the various morphological structures of the plant.

Cytology: The study of cell, its concerned with their organization, structure and function. The cell is the basic unit of higher organisms. The complex multicellular organism is an integrated collection of living and non-living cells.

- The most prominent components visible under the light microscope are the densely staining nucleus and more or less rigid cell wall that enclosed the cytoplasm.
- The cytoplasm contains a number of structural bodies or organelles such as plastids, mitochondria and vacuoles, and various other entities such as crystals, starch grains and oil droplets.

- The main parts of cell are as under

Cell Wall:

- Only present in plant cells
- Made up of cellulose
- Surround and protect the cell wall
- Make the cell stiff and strong

Cell Membrane:

- Hold and protect cell
- Controls the movement of materials in and out of cell

Ctyoplasm:

- A watery gel-like material in which cell parts move.

Mitochondria:

- This is called the power house of cell.
- Produce and supply most of energy to the cell

Chloroplast:

Contains chlorophyll

Capture energy of sunlight and use it to produce food (carbohydrates) for cell.

Vacuole:

This store water, food and chemicals.

Nucleus:

Acts as brain of the cell

Regulate and controls all activities of cell.

Nuclear Membrane:

- Exist in nucleus
- Surround and protect nucleus
- Controls movement of materials in and out of the nucleus

Chromosomes:

Direct cell activities

Exist in nucleus

Plastids:

- These are specialized disk shaped bodies in the cytoplasm
- They are peculiar to the plant cells

They are classified on the basis of presence or absence of pigments.

I. Leucoplast…….Colorless
II. Chlorpolast…….. Colored, involved in photosynthesis
III. Amyloplast…….Storage

Endoplasmic reticulum:

- Moves materials around in cell
- Smooth type lack ribosomes
- Rough type ribosomes embedded on surface

Ribosomes:

- Each cell contains thousands of ribosomes
- Prepare proteins
- Found on endoplasmic reticulum and floating through the surface

Golgi Bodies:

- Protein packing plant
- Moves materials within the cell
- Moves materials out of cell

Lysosomes:

- Digestive plant for protein, fat and carbohydrates
- Transport undigested materials to cell membrane for removal
- Cell breaks down if lysosomes exploded

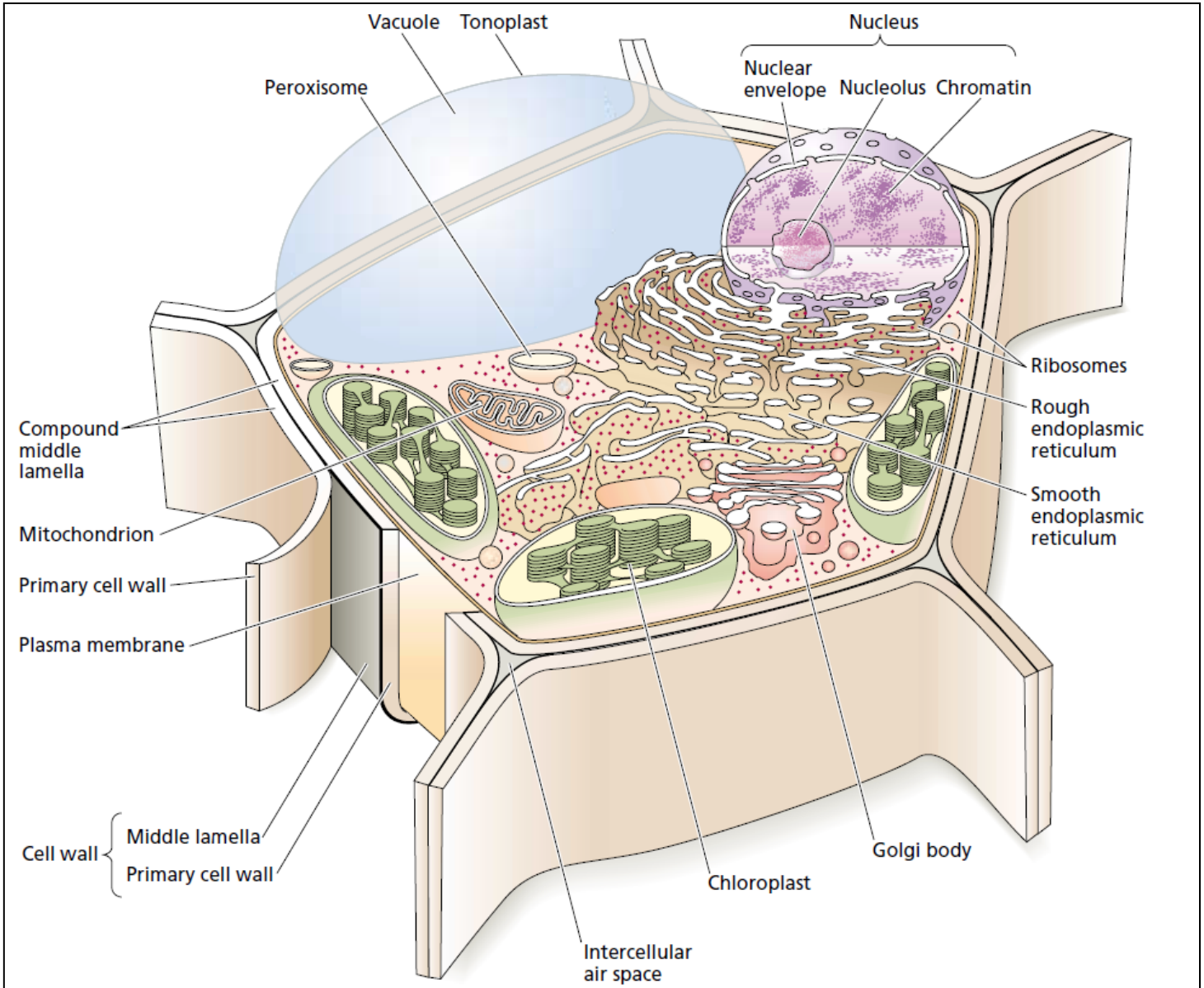


FIGURE 1.4 Diagrammatic representation of a plant cell. Various intracellular compartments are defined by their respective membranes, such as the tonoplast, the nuclear envelope, and the membranes of the other organelles. The two adjacent primary walls, along with the middle lamella, form a composite structure called the compound middle lamella.

Lignin: Chemically related compounds, these are polymers of phenolic acids

Pectin: Acid Polysaccharides, water soluble polymers of galacturonic acid

Tissue: Organized masses of similar cells are known as tissues.

Meristematic Tissues: Actively dividing undifferentiated cells

Permanent Tissues: Non-dividing differentiated cells

Simple Tissues: Composed of one type of cells

Parenchyma:

- Simple thin walled cells
- Makes fleshy portion of fruits and vegetables, roots, tubers

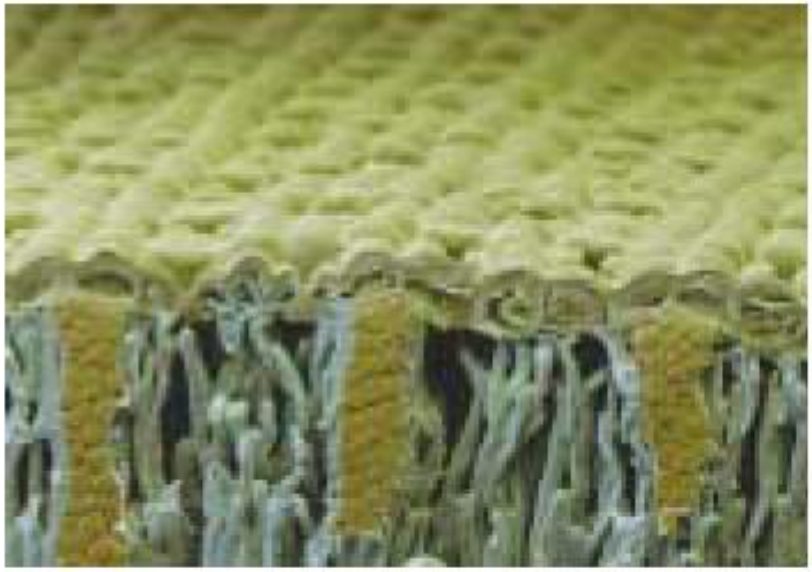
Collenchyma:

- Thicker walled parenchyma
- Elongated cells, thickened primary cell walls (cellulose and pectic substances).
- Provide mechanical support in early growth.

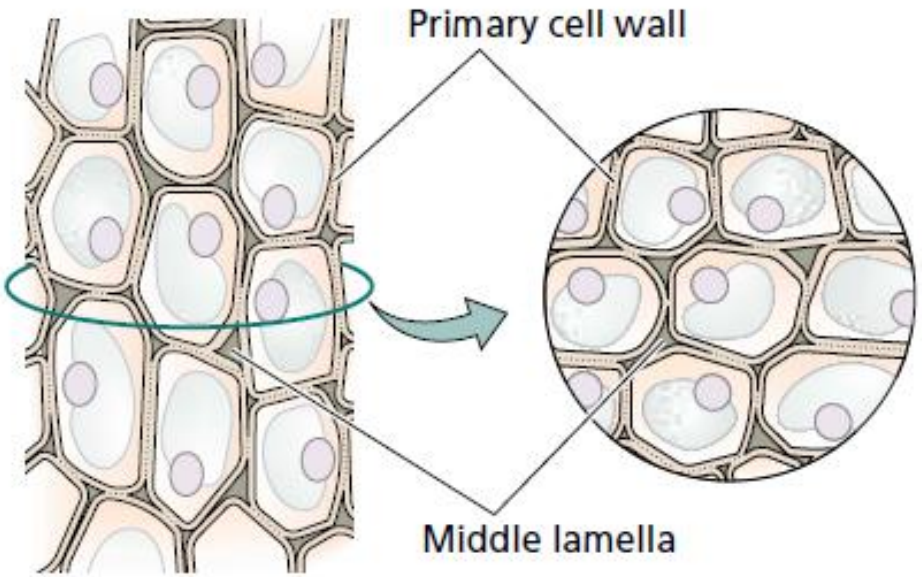
Sclerenchyma:

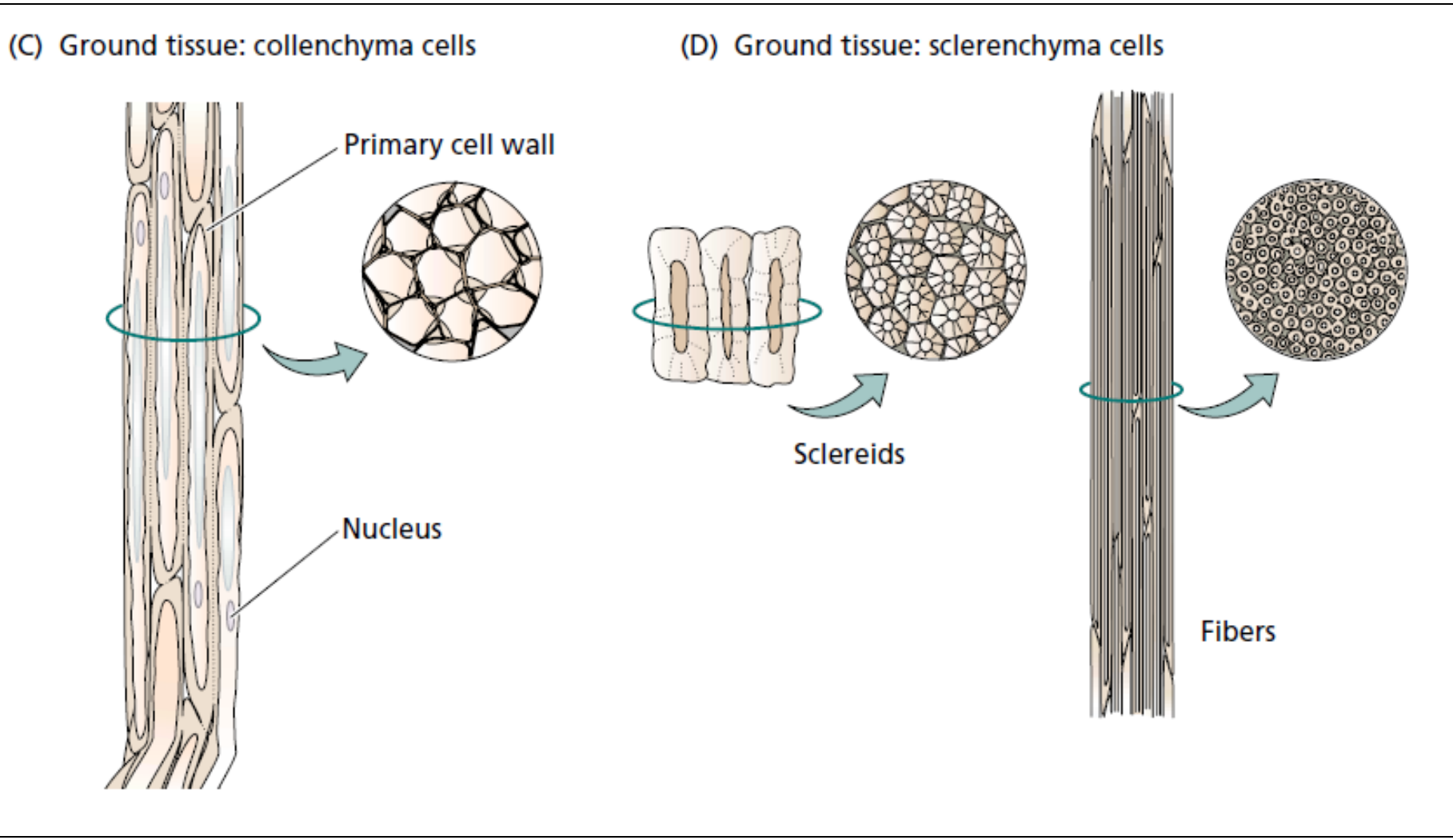
- Thick walled supporting cells
- Thick walled cells, often lignified.
- Fibers……..Long and tapered
- Scleroid….gritty texture of pear, walnut shells, and peach and cherry pits are made of these cells.

(A) Dermal tissue: epidermal cells



(B) Ground tissue: parenchyma cells




(C) Ground tissue: collenchyma cells
Primary cell wall
Nucleus
(D) Ground tissue: sclerenchyma cells
Sclereids
Fibers

Complex Tissues: Composed on more than one type of cells

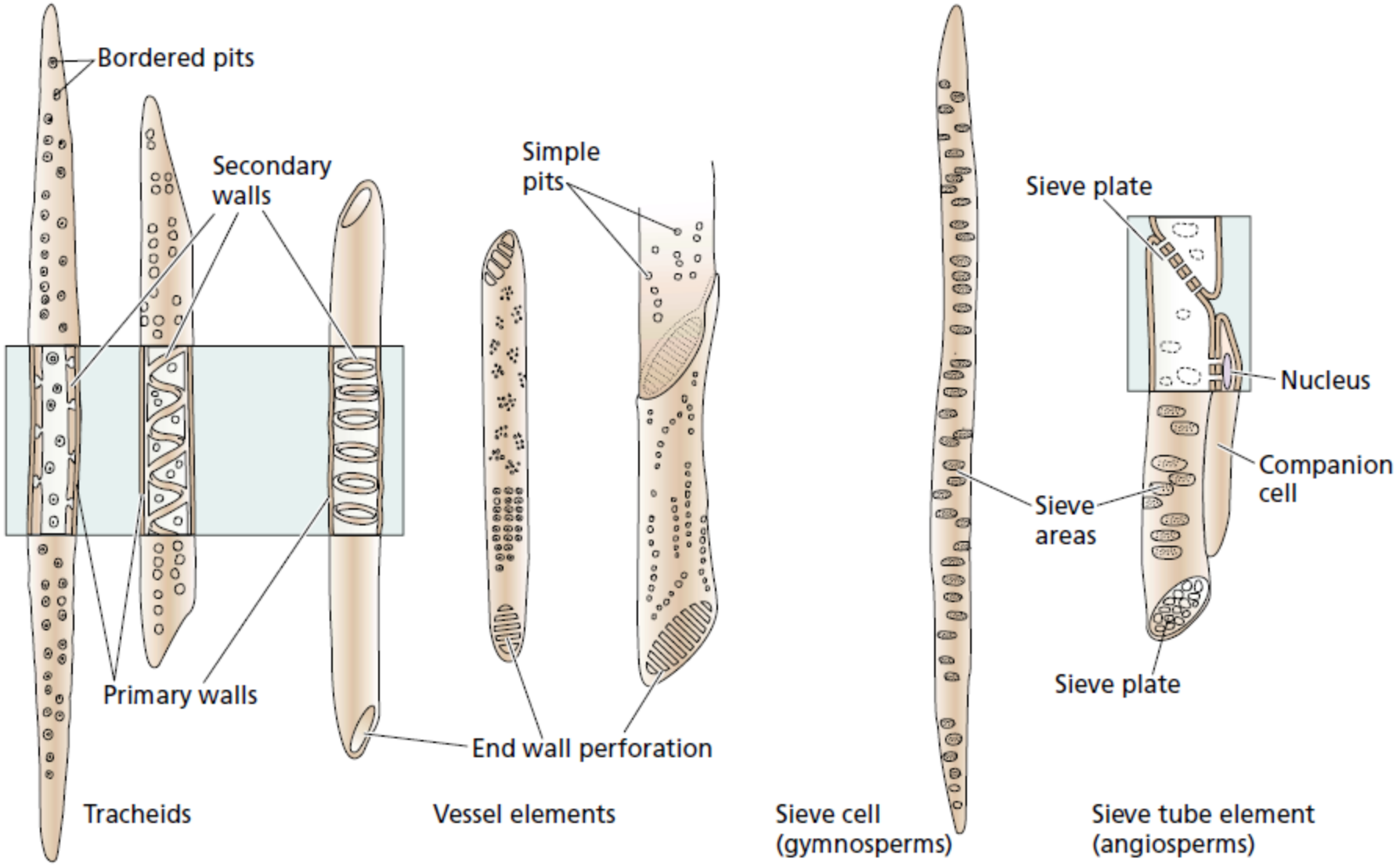
Xylem: Water conducting tissues

Phloem: Food conducting tissues

Xylem:

- Principal water conducting tissue
- Consists of living and nonliving cells
- Wood is largely xylem
- Tracheids…..Non living specialized cells responsible for water conduction
- Xylem typically includes fibers and parenchyma cells

(E) Vascular tisssue: xylem and phloem



Phloem:

- It is principal food conducting tissue
- Sieve elements and companion cells help in conduction
- The fibers of flax and hemp are derived from phloem tissues

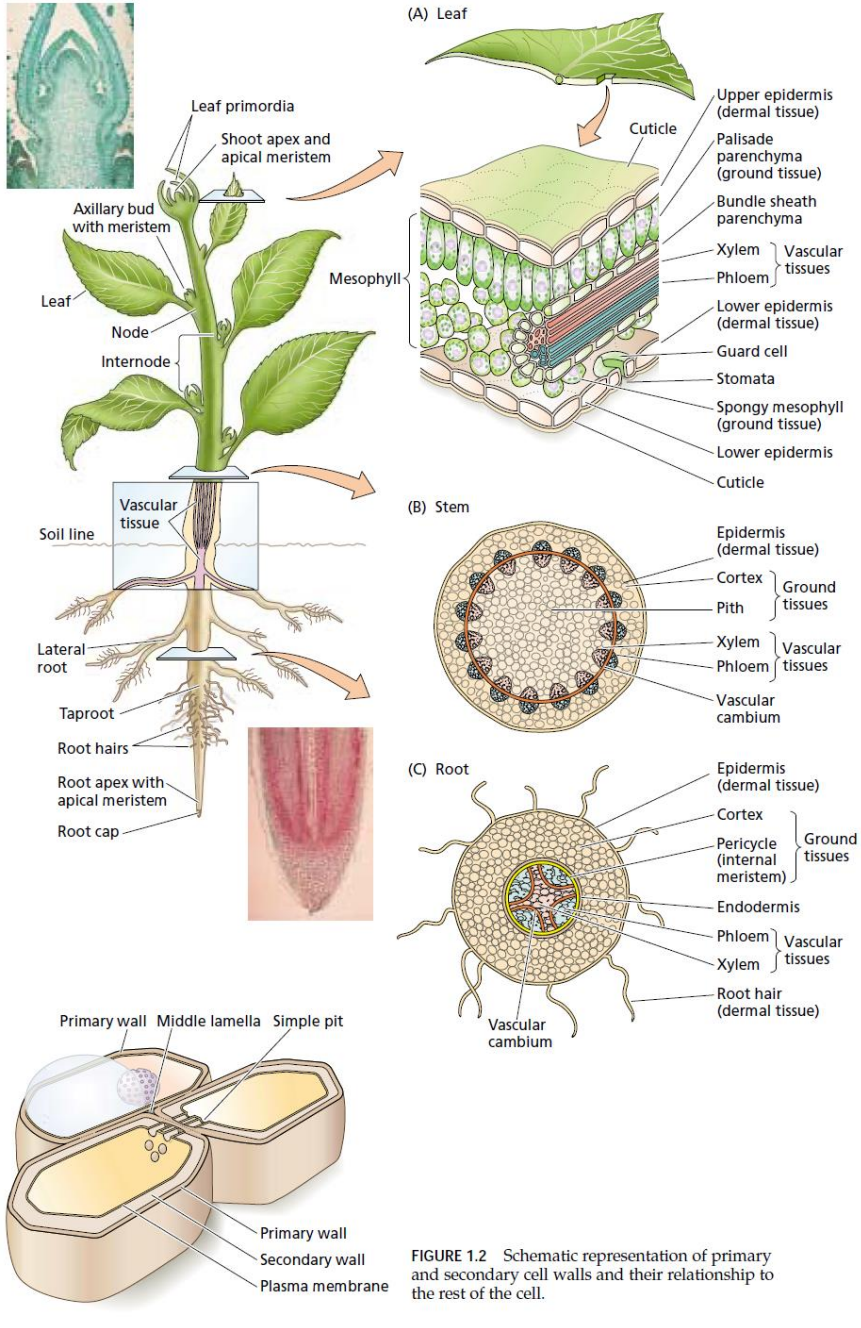


FIGURE 1.2 Schematic representation of primary and secondary cell walls and their relationship to the rest of the cell.

Root

- Major component of plant
- It may consist of more than half of the dry weight of plant body

Functions

- Absorption of water and nutrients (by root hairs)
- Transportation of water and nutrients to stem
- Provide anchorage and support to the shoot portion (food producing leaves)
- Roots also acts as storage organ (Carrot, sweet potato)

Root systems

Tap root System: When primary root becomes the main root of the plant, the network is referred to as a tap root system e. g. Walnut, Carrot, beet and turnip

Fibrous Root System:

In many plants primary root ceases growth when plant is still young, and root system is taken by new roots that grow adventitiously out of the stem, forming a fibrous root system. e.g. grasses, maize, wheat, datepalm

- However, some plants (having tap root system) form an upper network of feeder roots to ensure the water and nutrient supply/availability.
- Fiberous root system may be established by destroying the tap root, used as a standard horticultural practice for transplanting of shrubs and tress.

Root Modification

- Root becomes swollen and fleshy, with stored food in the form of starch and sugar (carrot, turnip, radish, sweet potato)
- In some plants roots have stored food, with the ability to form adventitious shoot buds and are used in propagation (Sweet potato, Dahlia)
- *Adventitious-happening by accident, not planned

Root Structure

- Epidermis: Outer most layer of cells, like skin of root
- Cortex: Tissues inside the epidermis that stores starch and other substances for the growth of the root.
- Root Cap: Provides protection for the root tip.
- Root Hairs: Site of absorption

The shoot

- The shoot has been described as “Central axix with appendages”. The central axis (stem) supports the food producing leaves and connect them with nutrient gathering roots. The stem is also a storage organ and in many plants it is modified for this function.
- Young green stems have role in food production because of the chlorophyll they contain.
- Stem has extremely varied forms, from single upright (date plam) to prostrate branched “creepers”

- Trees-Central leader present
- Shrubs-Central leader absent, many stems
- Slender and flexible stem that cannot support themselves in erect position are vines. Vines may be herbaceous (pea, cucurbits) or woody (Bougain Villea)

Buds

- Stem, is divided into mature region and actively dividing region in which growth and differentiation takes place.
- An embryonic stem is called a bud.
- All buds do not grow actively, many exhibit arrested development or dormancy but are nevertheless potential source of further growth.

Types of Buds

- Some buds may be ***inconcpious*** (embedded in the stem tissues) or ***conspicuous*** structures.
- The form, structure and arrangement of buds are used t describe the plants when leaves are absent.

- The plant growth may originate from a signal ***terminal bud*** or from a ***lateral buds*** that occur in leaf axil.
- Buds may be formed in the internodal region of the stem, leaves or root often as a result of injury, these are called ***adventitious buds***.
- Buds produce leaves, flower or both and thus termed as ***leaf buds, flower buds*** **or** ***mixed buds,*** respectively.
- When more than one buds is present at leaf axil, all but the central or basal bud are called ***accessory buds.***

- Arrangement of buds depends on leaf arrangement.
- When two leaves are opposed to each other at the same level, the leaves and bud arrangement is said to be ***opposite or whorled.***
- When leaves and buds are at different levels, they are arranged in a spiral are said to be ***alternate.***
- The spiral pattern of leaf arrangement is called ***phyllotaxy*** and expressed as fraction (1/3, 2/5, 3/8). Herein, numerator is the number of turns to get to a leaf directly above another and denominator is the number of buds passed. Phyllotaxy has taxonomic significance and is often same throughout a genus or a family. Phyllotaxy of mango is 3/8.

Stem Modifications

- The stem may be greatly modified from a basically cylindrical structure. Stem modifications may be divided into ***above ground forms*** and ***below ground forms***.
- Stem modifications contain large amount of stored food, may be used for propagation or for food.

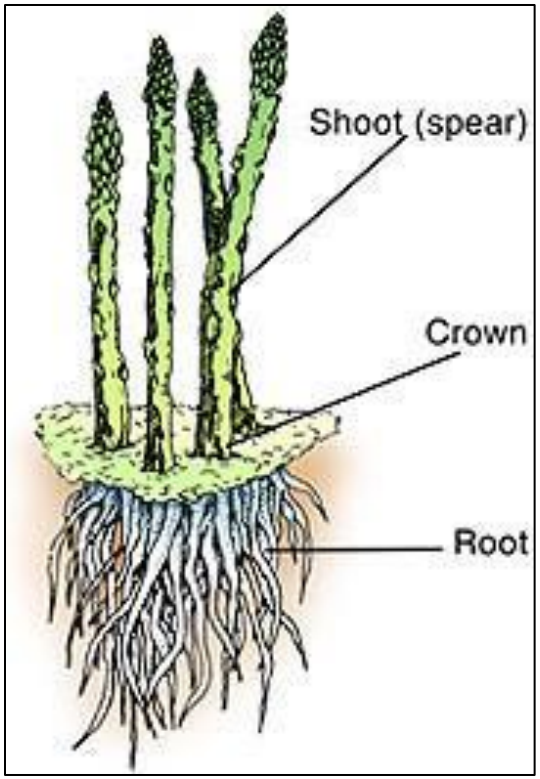
Above Ground Stem Modifications

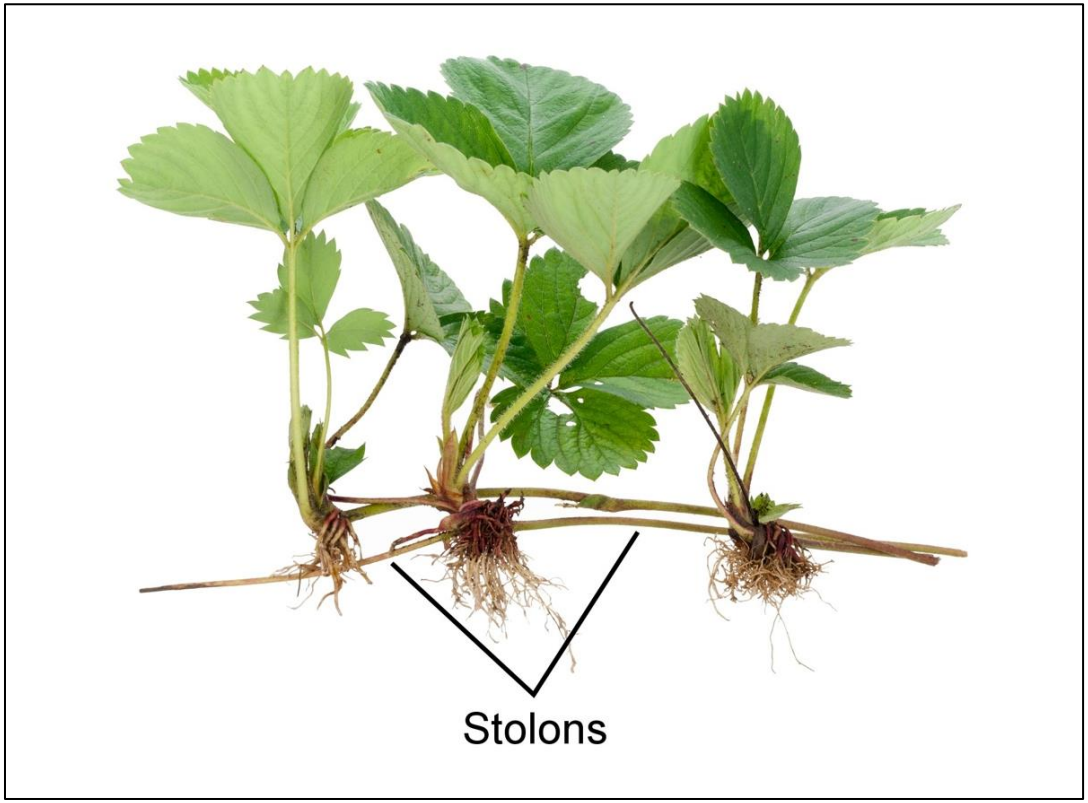
Crown: A crown is a compressed stem. Crown of the plant is part of plant just above and just below the ground level e.g. Asparagus

Stolons:

The stem that grows horizontally along the ground e.g. Strawberry.

Spurs: These are the stems of woody plants whose growth is restricted. They have shortened internodes and are usually attached to a normal branch e.g. Apple, Pear, Quince.





Strawberry Plants

Pear and apple flower buds can be found at the tips of short shoots and spurs.

Below Ground Modifications

Bulb: A bulb is made up of short stem and fleshy leaves. Bulb is essentially a compressed modification of the shoot. It consists of short, flattened or disk shaped stem surrounded by fleshy leaf like structures called scales which may enclose shoot or flower buds. These are found in monocot plants e.g. Onion, Tulip

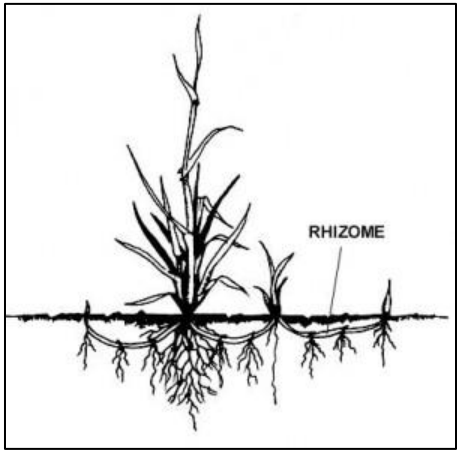
Corms: These are short, fleshy, underground stems having few nodes. Corms grow vertically found in monocots. The gladiolus and crocus are propagated by corms.

Rhizome: The rhizomes are horizontal underground stems. They may be compressed and fleshy as in Iris or slender with elongated internodes as in turf grass. Normally roots and shoots develop from nodal regions.

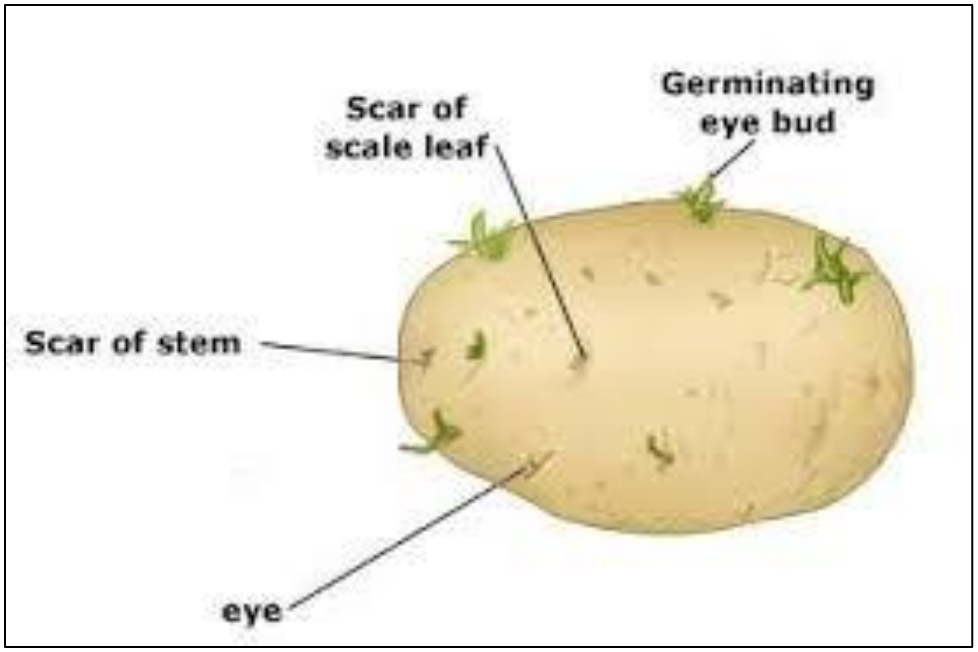
Tubers: These are greatly enlarges fleshy portion of underground stems. They are non-cylindrical. The edible portion of potato is a tuber. The “eyes” arranged in a spiral around the tuber as buds. Each eye consists of rudimentary leaf scar and a cluster of buds.

Onion Bulbs

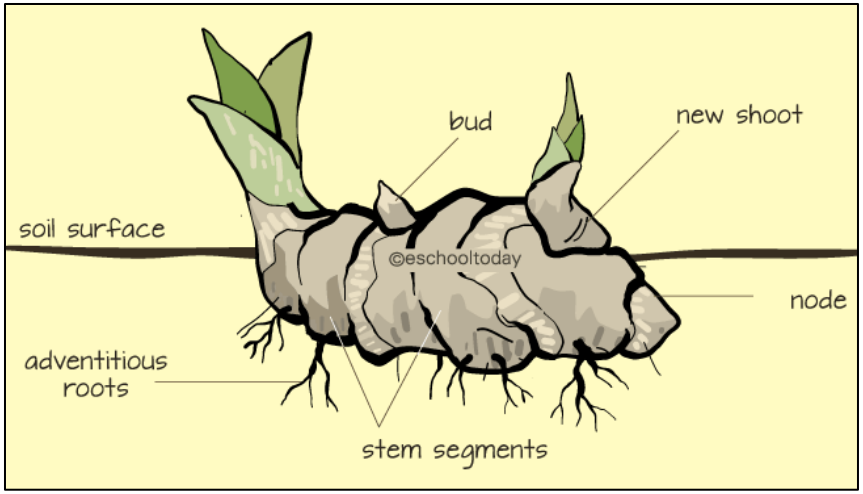
Gladiolus Corms



Rhizome



Potato tuber



Rhizome

Leaf

Leaves are photosynthetic organ upon which higher plants depend for the formation of their food. Leaf is basically flat appendage of the stem arranged in such a way to present large surface for light absorption.

Parts of Leaves

Leaf Blade: Wide flattened are of leaf for light absorption

Petiole: Short stem that attaches leaf to the main stem or branch

Veins: Vascular bundles with in the leaf for transport

External Leaf Structure

Petiole: Leaf stalk

Leaf Blade: Check last slide

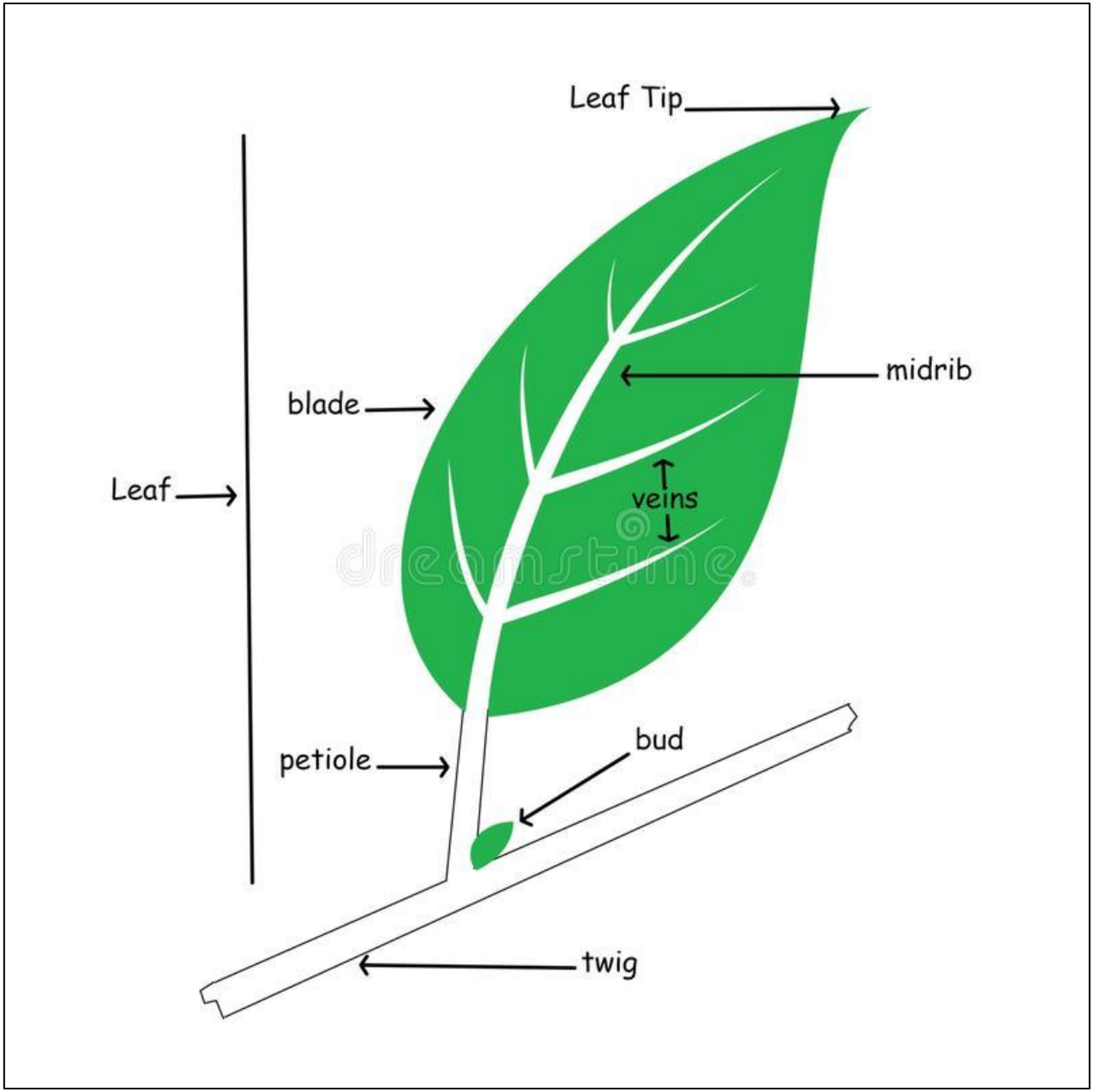
Mid Rib: Large central vein from which other veins extend

Margins: Edges of leaf, assist in plant identification

Internal Leaf Structure

Epidermis (Lower and upper)

- Skin of leaf
- Single layer of cells
- Protect leaf from loss of moisture



Parts of a leaf

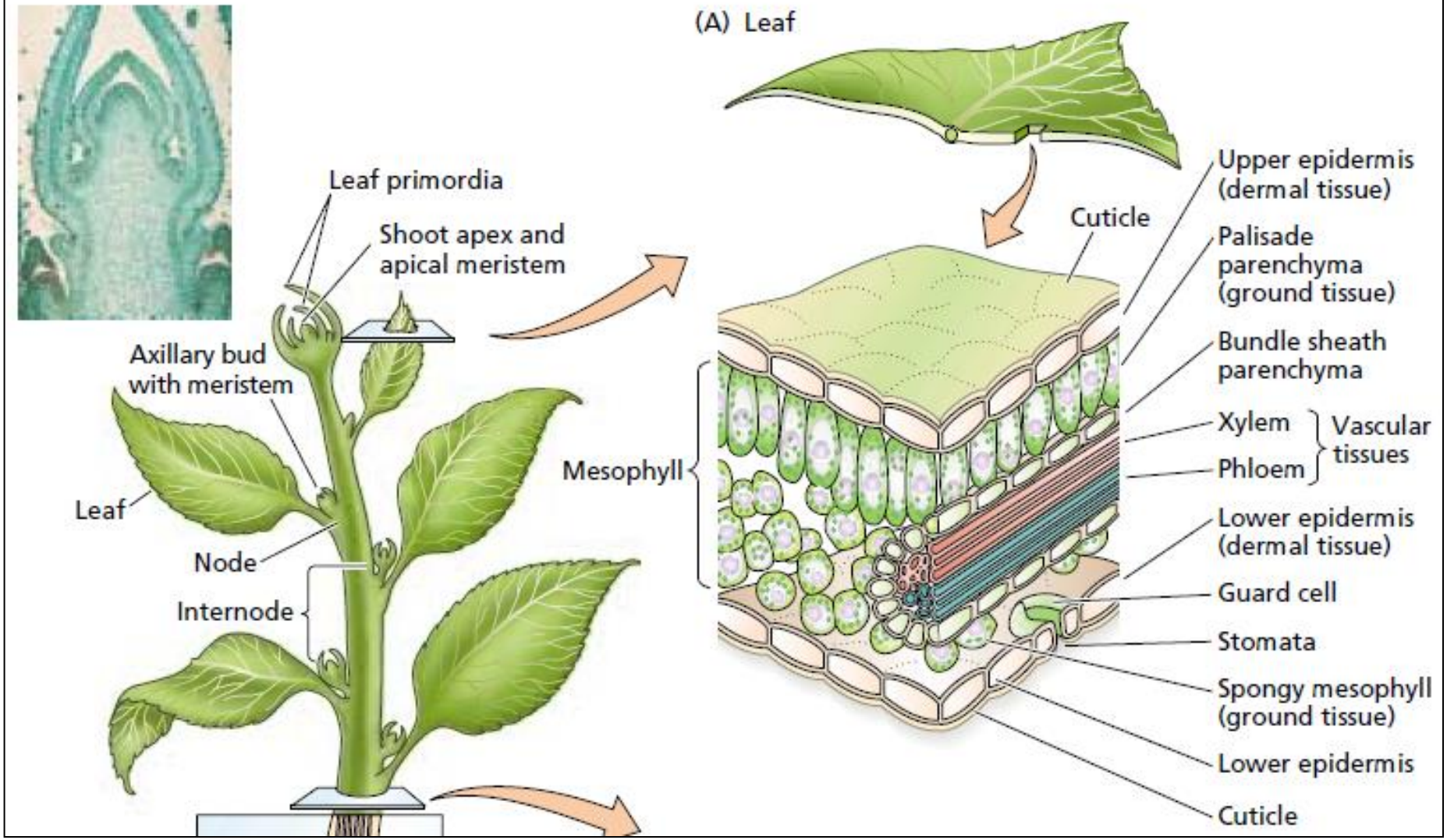
Stomates (Stomata)

Openings present on the lower side of leaves. They allow gaseous exchange and water vapors.

Guard Cells: Open and close the stomata.

Chloroplast

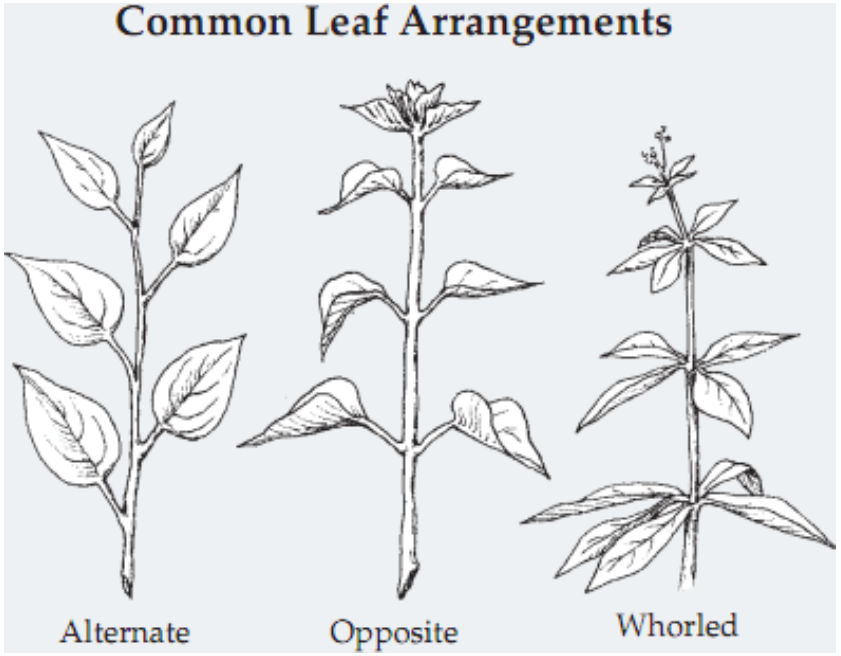
- Contains chlorophyll
- **Palisade parenchyma**-series of elongated closely packed “palisade”. These are rich in chloroplast.
- **Spongy parenchyma-** irregularly arranged cells beneath the palisade cells produce a sponge like region.

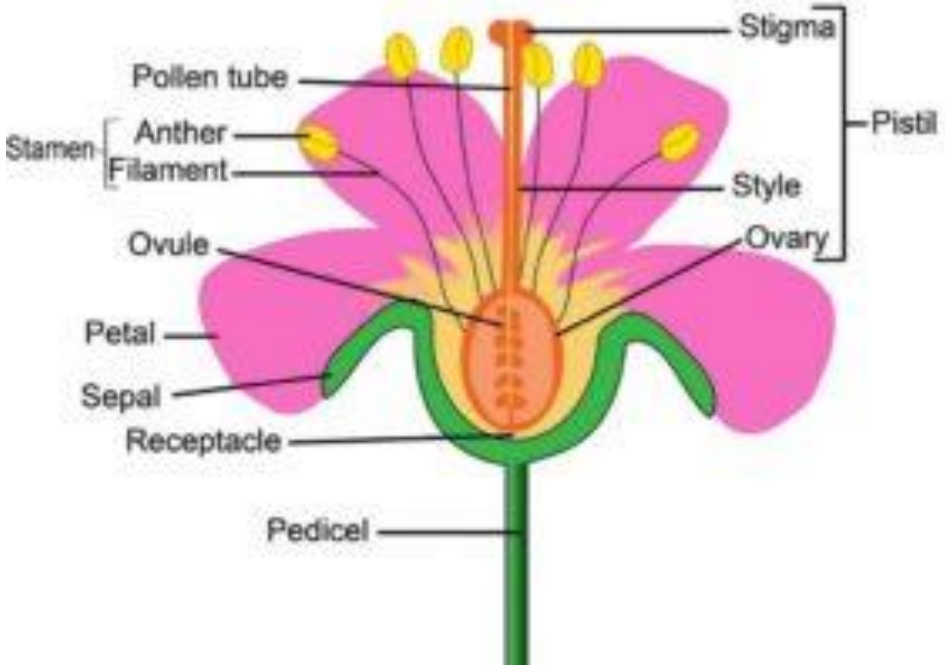


Internal Leaf Structure

Leaf arrangement

- Opposite
- Alternate
- Whorled





Flower

Sepals (Calyx)

- **Enclose flower in the bud**
- **These are small, green in color and below the petals.**

Petals (Corolla)

- Conspicuous portion of the most flowers
- They are pigmented (colored)
- Contains perfumed gland, nectar gland, vicious sugary substance.

Stamen (Androecium)

- Male part of flower
- Contain pollen bearing anther supported by filament

Pistils (Gynoecium) Female part of the flower

Pistils (Gynoecium)

- Female part of the flower
- Consists of ovule bearing base (ovary) supporting and elongating region (style) whose expanded tip is called stigma.
- Ovule give rise to seed.
- The mature ovary (with or without seed) becomes fruit.

Flower Types

Complete Flower: Contains all four parts, sepal, petal, stamen and pistils

Incomplete Flower: Lack one or more of these parts

Pistillate or female flower: lack stamens

Staminate or male flower: lack pistils

Perfect or bisexual or hermaphrodite flowers

Those contains both male and female parts

Monoecious Plants: Contains separate male and female flower but on the same plant e.g. maize

Dioecious Plants: Contains male and female flower on different plants e.g. Papaya, date palm

Andromonoecious: Having perfect and staminate flowers on the same plant e.g muskmelon

Gynomonoecious: Having perfect and pistillate flowers on the same plant e. g. *Aulonemia aristulata* (a bamboo species)

Inflorescence

When flowers are arranged in a cluster it is called inflorescence e.g. Mango

Fruit

- Ripened ovary is called fruit.
- Botanically term fruit refers to mature ovary and other flower parts associated with it.

Types

Simple fruits: Fruits composed of single fruit.

Aggregate fruit: Fruit derived from a flower having many psitils on a common receptacle e.g. Blackberry, Strawberry

Multiple fruit: Fruit derived from many separate but closely clustered flowers e.g. Pineapple, Fig, Mulberry

Fruit

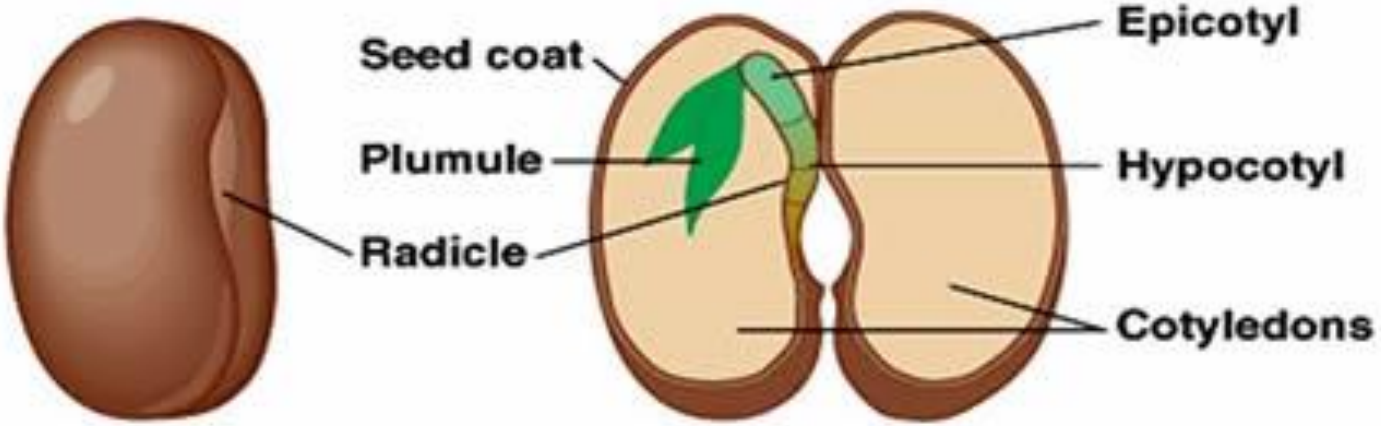
True fruit: edible portion develops from ovary

False fruits: edible portion develops from parts other than ovary

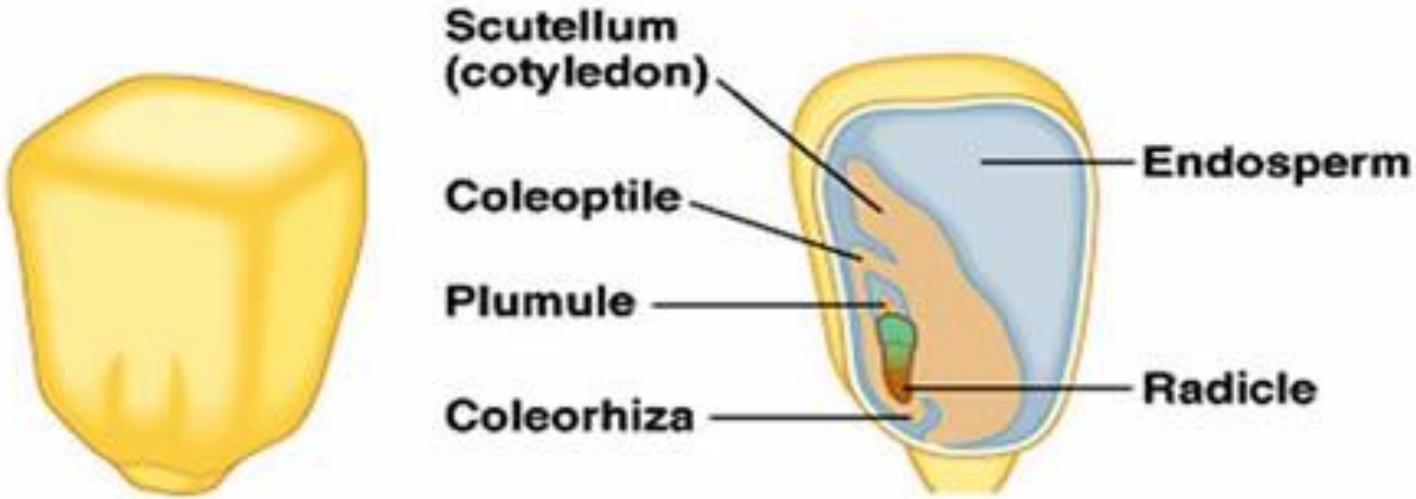
Ovary wall is called pericarp. It has three layers calssed Exocarp, Mesocarp and Endocarp

Seed

- Mature or ripened ovule is called seed. Seed is a miniature plant in arrested state of development.
- Seed contains **Plumule** (rudimentary shoot) and **Radicle** (rudimentary root) and one or two specialized seed leaves (cotyledonds) and a transition zone between the rudimetary root and rudimentary shoot called **Hypocotyl**.
- The stored food is present in seed as carbohydrates, fats, and proteins. Seeds are thus rich source of seed as well as fats and oils for industrial purpose. The stored food may be derived from tissue called **endosperm**, which is formed as a result of fertilization process.
- Seeds greatly vary in size and shape.



Common bean



Corn

The End