NATURE AND COMPOSITION OF PLANTS

ALE REVIEW 2018

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BSA- Crop Science

The plant CELLS: Parts and Function

DEFINITION OF A CELL

- The smallest structure in the universe capable of growing and reproduction.
- The basic unit of every living organism
- An autonomous living system capable of independent existence and propagation.
- Fundamental morphological unit of plant body.

Differences between plant and animal cells

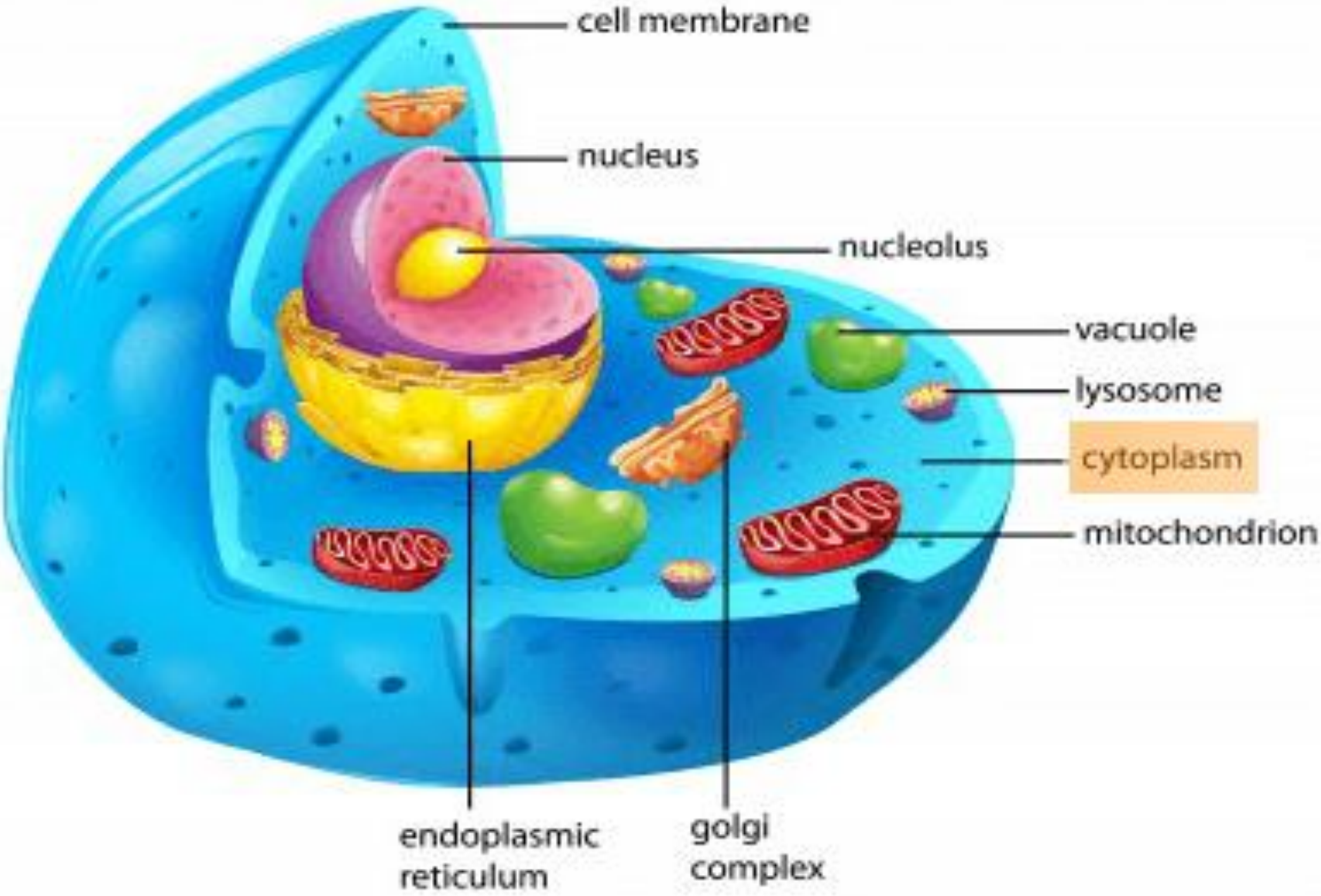
- Plant cells contain chloroplast(s) that carry out photosynthesis
- Plant cell is surrounded by a rigid cell wall. Each walled cell and its adjacent wall are cemented together by middle lamella.
- Plant cells develop a large central vacuole
- Animal cells contain centrioles and lysosomes that involved in cell division and digestion, respectively. Embryonic cell can migrate from one location to another.

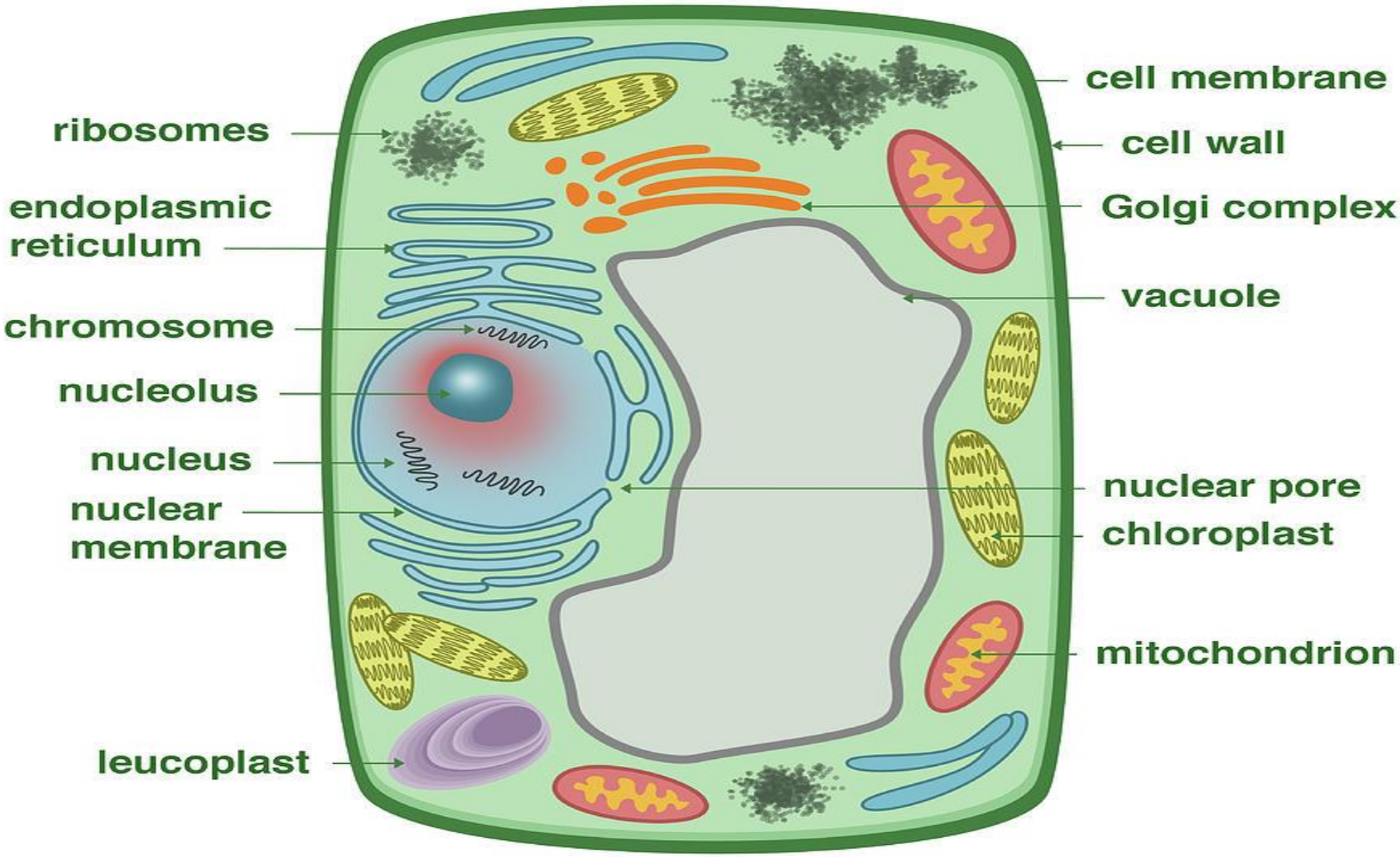
PLANT CELL: Three (3) main components

Cell Wall

Cytoplasm

Nucleus


cell membrane
nucleus
nucleolus
vacuole
lysosome
cytoplasm
mitochondrion
endoplasmic reticulum
golgi complex


ribosomes
endoplasmic reticulum
chromosome
nucleolus
nucleus
nuclear membrane
leucoplast
cell membrane
cell wall
Golgi complex
vacuole
nuclear pore
chloroplast
mitochondrion

PLANT CELL

PLANT CELL: Three (3) main components

CELL WALL

- Provides mechanical protection and rigidity to the plant cell
- Consist of cellulose that overcome pressure due to elastic property
- Composed of cellulose, hemicellulose, pectic susbtances, organic and inorganic substances, lignin, enzymes, protein and water.

PLANT CELL: Three (3) main components

CELL WALL

Three layers of cell wall

1. **Middle lamella** (where pectin cements adjacent cells together)
2. **Primary wall** (thin, not rigid, stretched as the cell grows, layer formed before and during growth of the plant cell consists of cellulose microfibril, have primary pit fields, thin areas that transversed by numerous protoplasmic strands called **plasmodesmata.**
3. **Secondary wall** (rigid, thick, formed after cell completes growth)

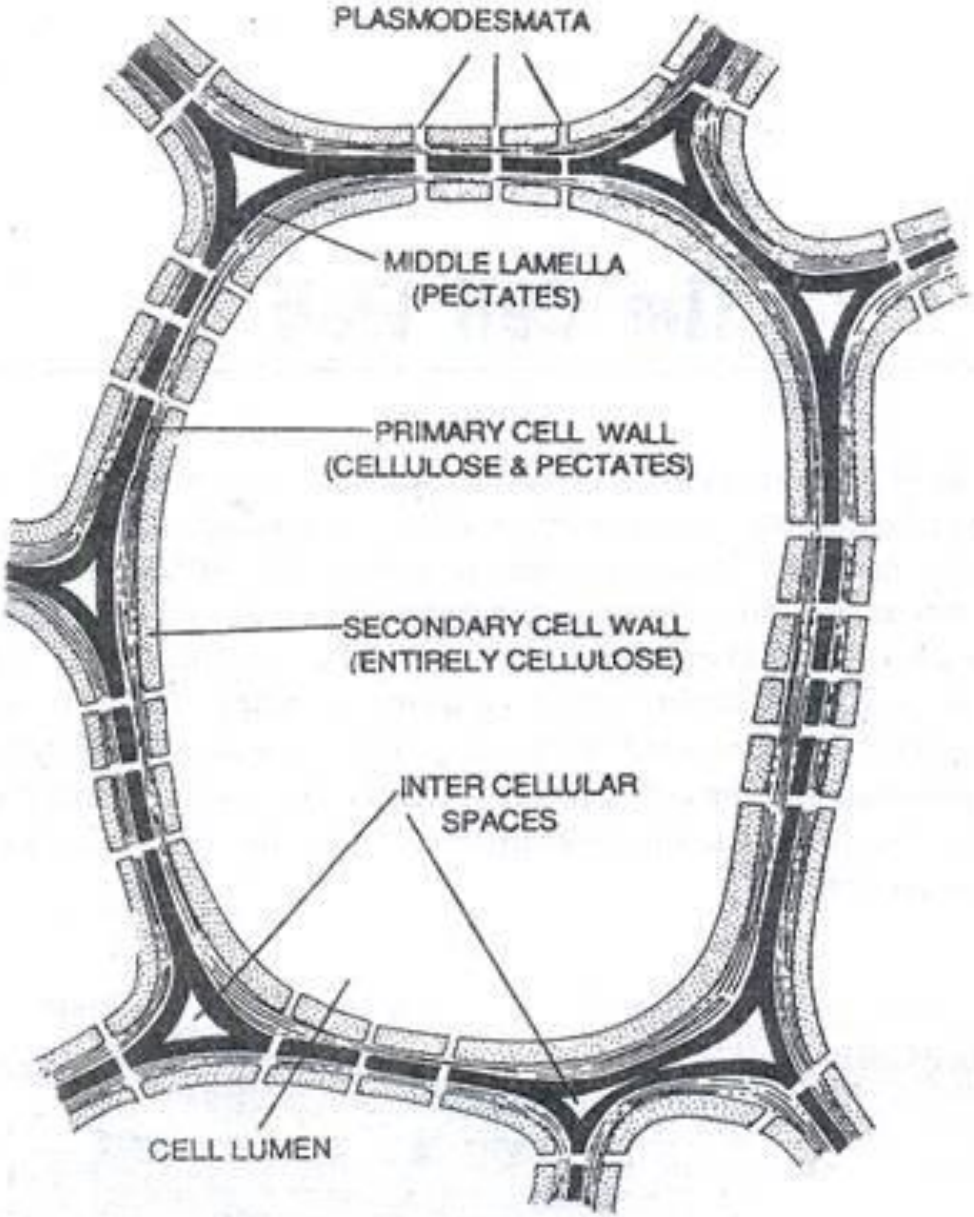
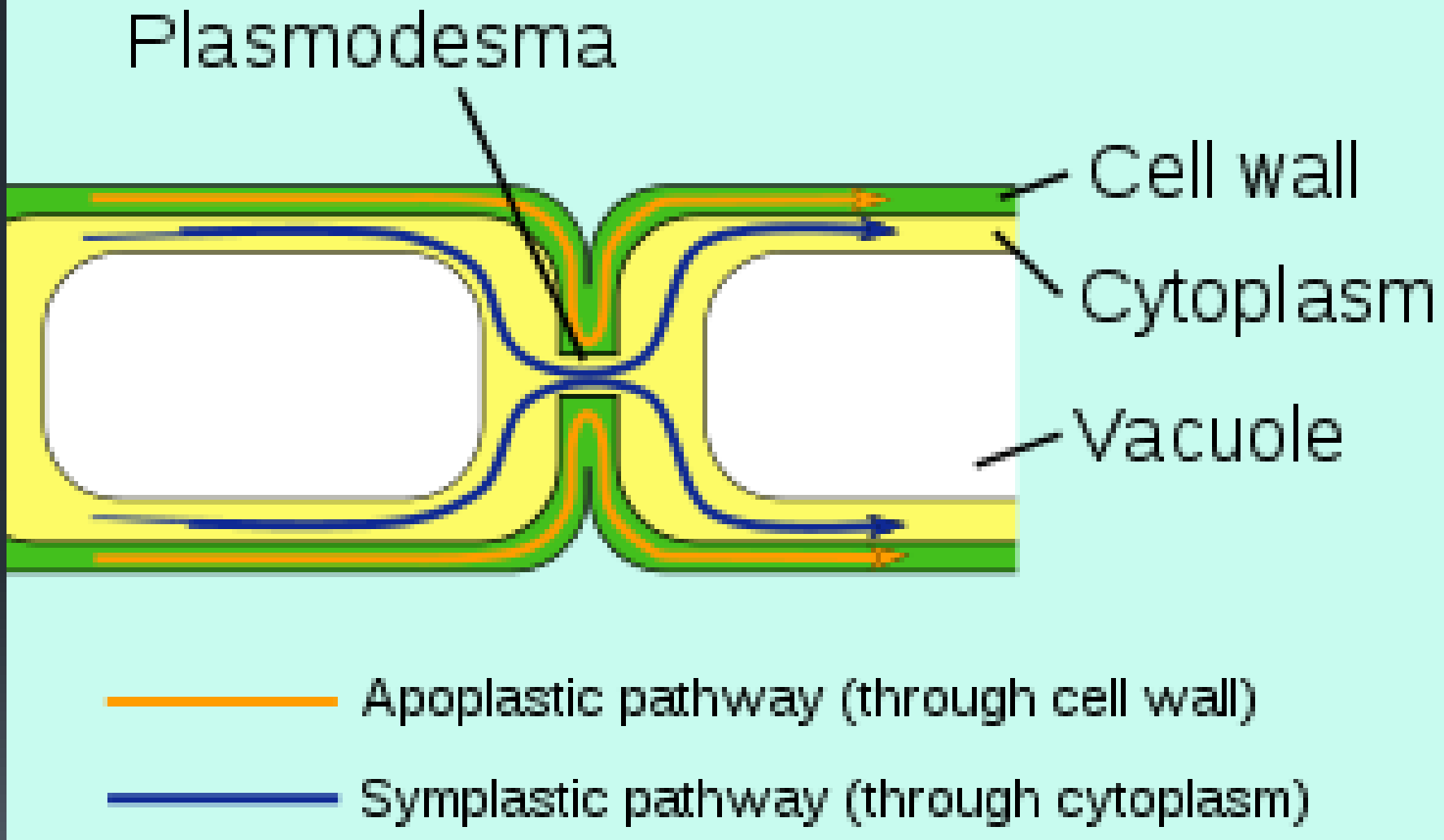
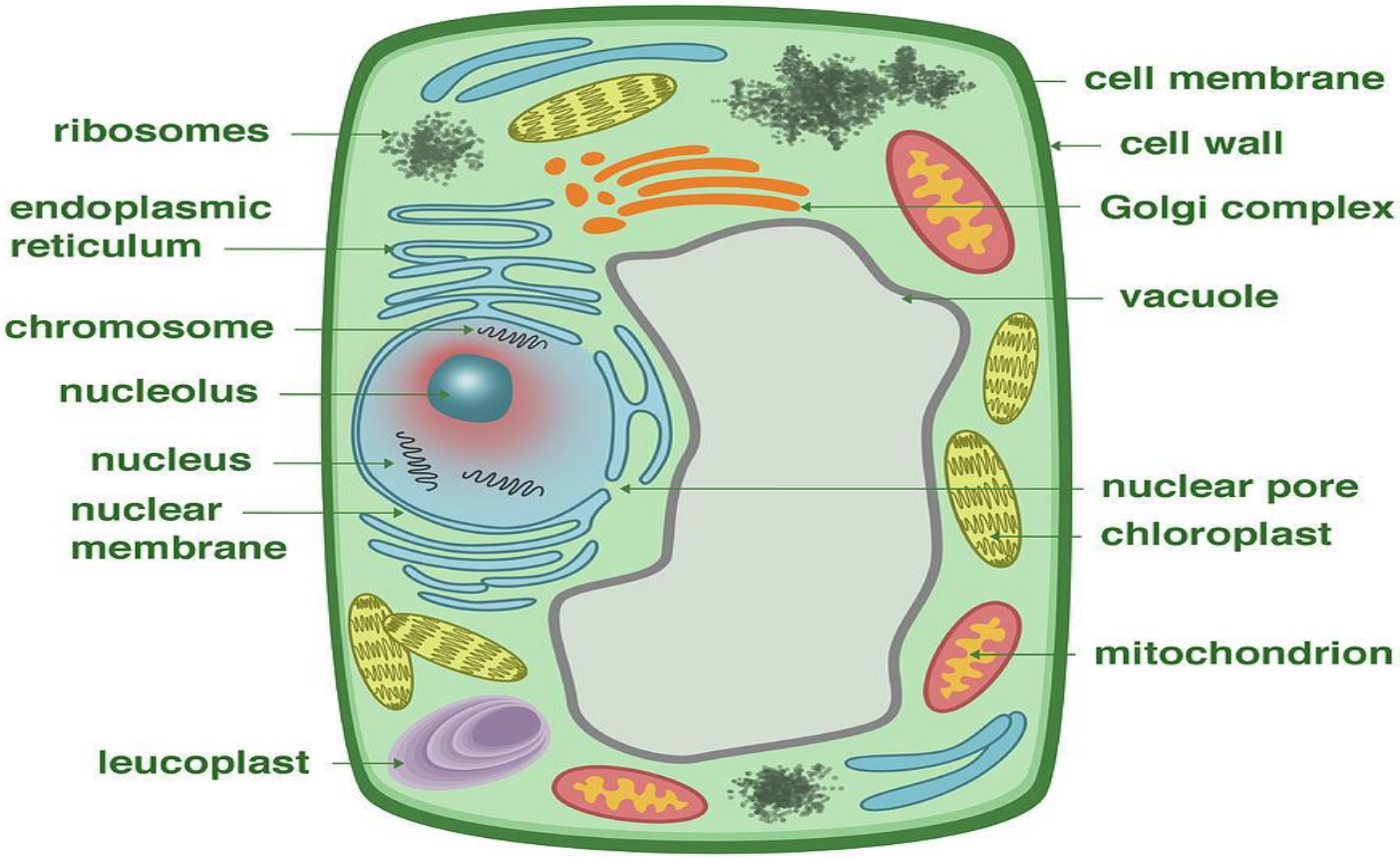


Fig. 34.2. The cell wall. Schematic representation of structure and composition of plant cell walls.


Plasmodesma
Cell wall
Cytoplasm
Vacuole
Apoplastic pathway (through cell wall)
Symplastic pathway (through cytoplasm)

PLANT CELL: Three (3) main components

CYTOPLASM



WHAT IS CYTOPLASM??

- All living matter of the cell apart from the nucleus
- Gel-like material of fluid in which the cell's organelles and internal membrane system are suspended
- Distributes substances absorbed from outside and released by the nucleus and other organelles (through cytoplasmic streaming/cyclosis-flowing movement of cytoplasm)

Cytoplasm consist of the following:

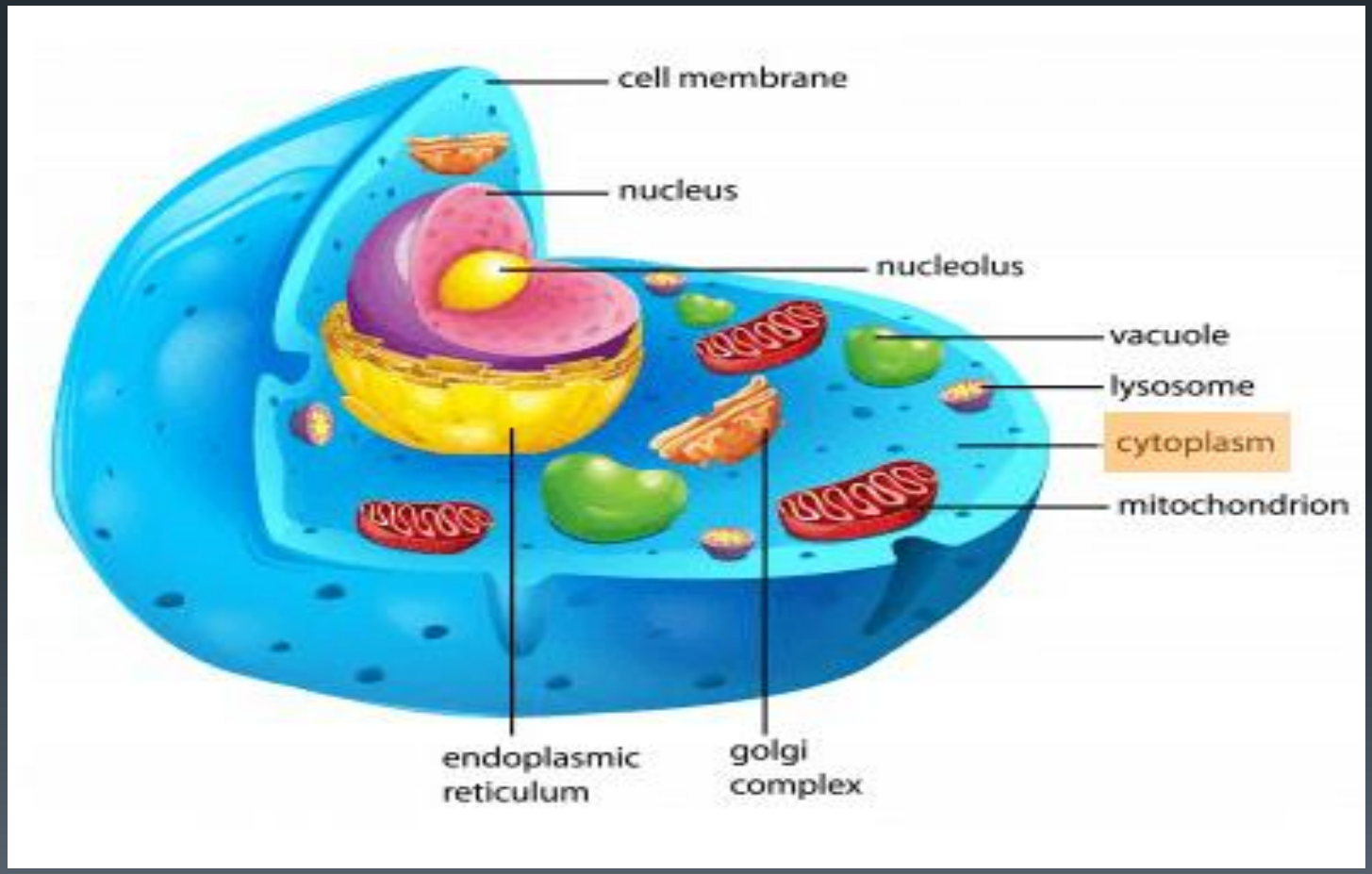
- **Plasmalemma/ plasma membrane/ cell membrane-** has selective permeability.

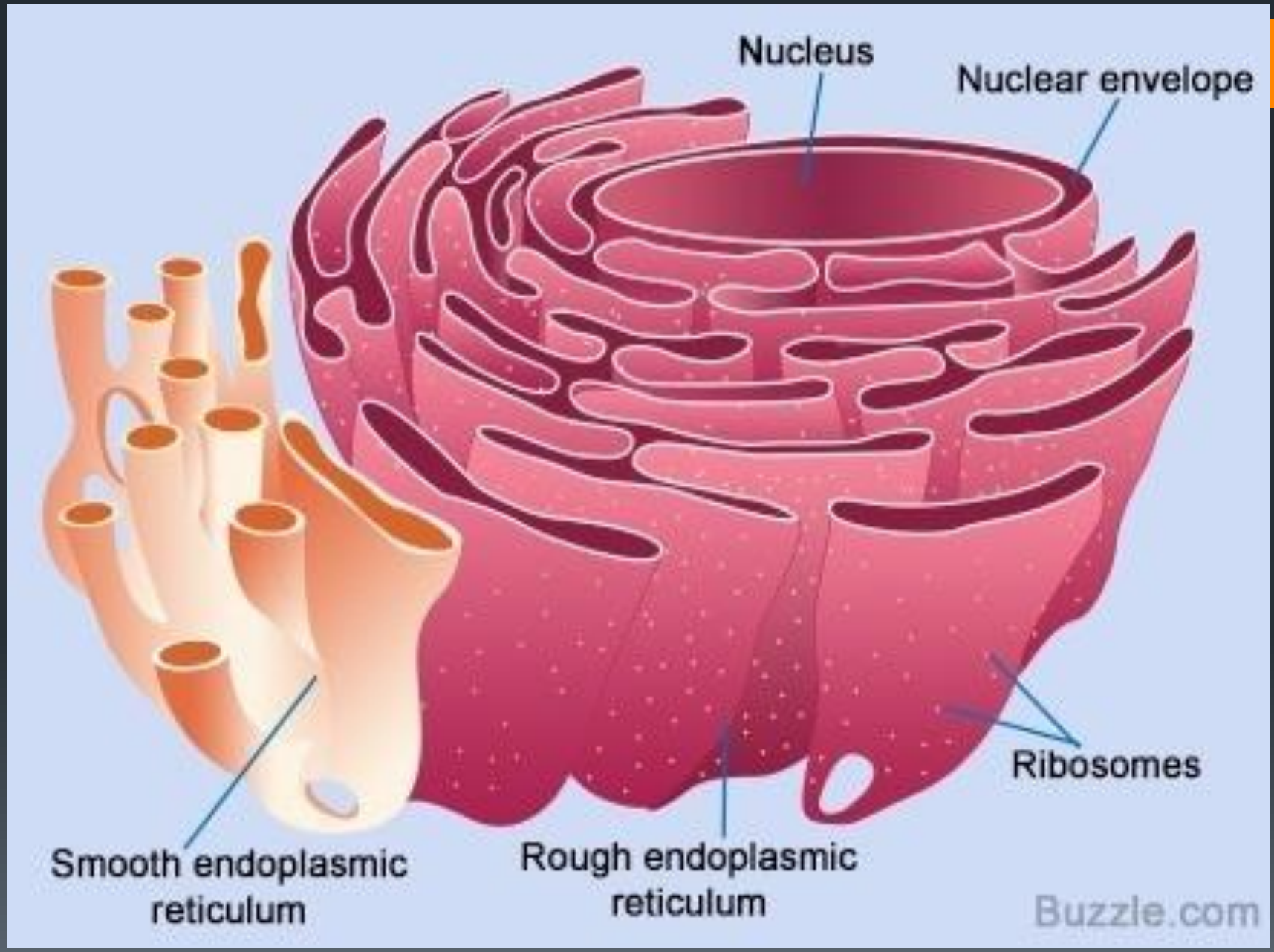
Functions:

- Allow some substances to cross easily and completely block substances
- Accumulates the ions or the molecules in the cytosol through the action of transport proteins that consumes metabolic energy
- Coordinates the formation of cell wall microfibris

Cytoplasm consist of the following:

- **Endoplasmic Reticulum-** flattened disks or tubular sacs.




Nucleus
Nuclear envelope
Ribosomes
Smooth endoplasmic reticulum
Rough endoplasmic reticulum
Buzzle.com

Types:

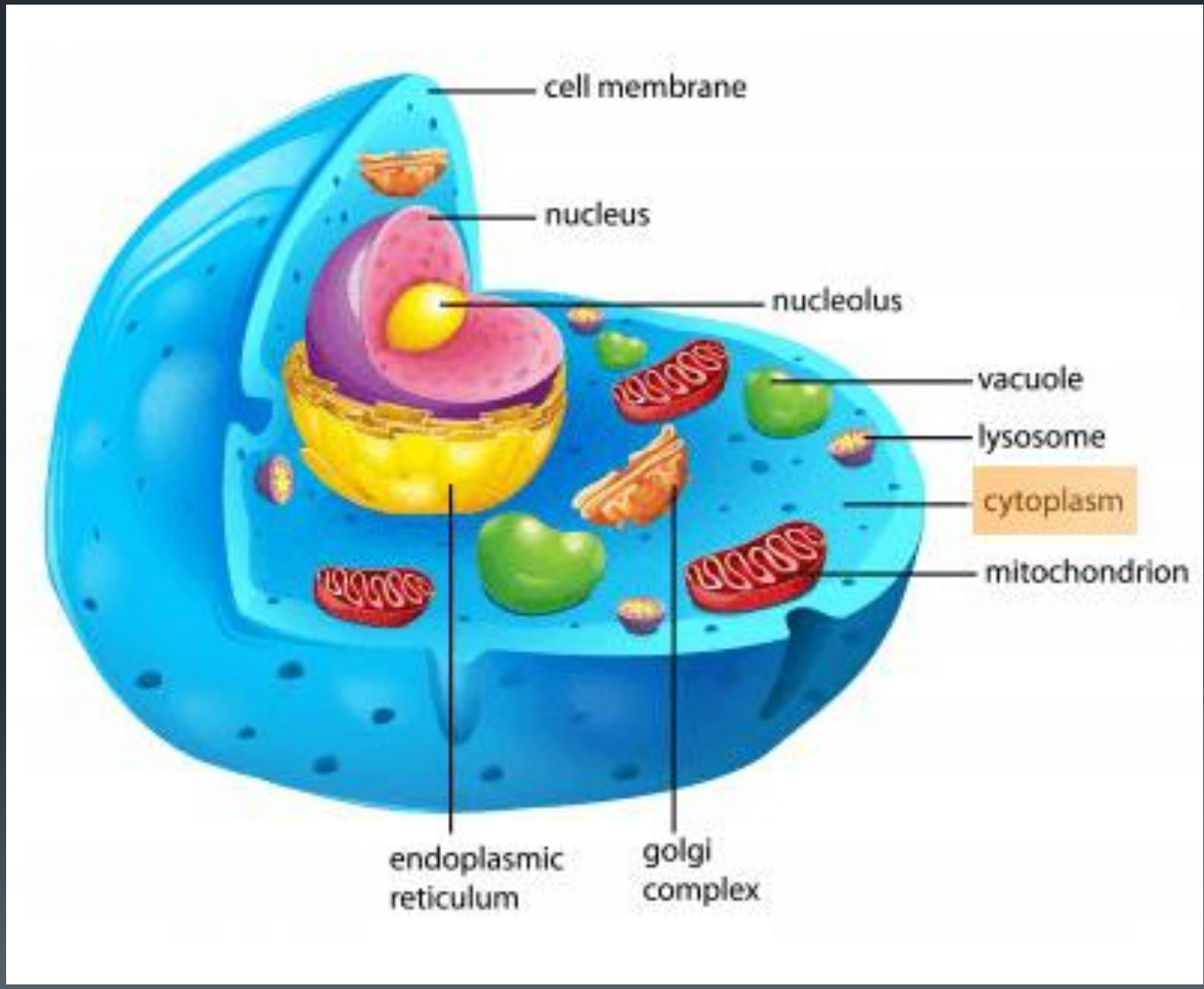
- Rough endoplasmic reticulum (with numerous ribosomes)- involved in the synthesis of lipids
- Smooth endoplasmic reticulum (lack ribosomes)- involved in the synthesis of membrane proteins and secretory proteins.

Cytoplasm consist of the following:

- **Golgi apparatus-** collective term for all dictyomes (consist of stack of flattened hollow disks called cisternae) or golgi bodies.

Functions:

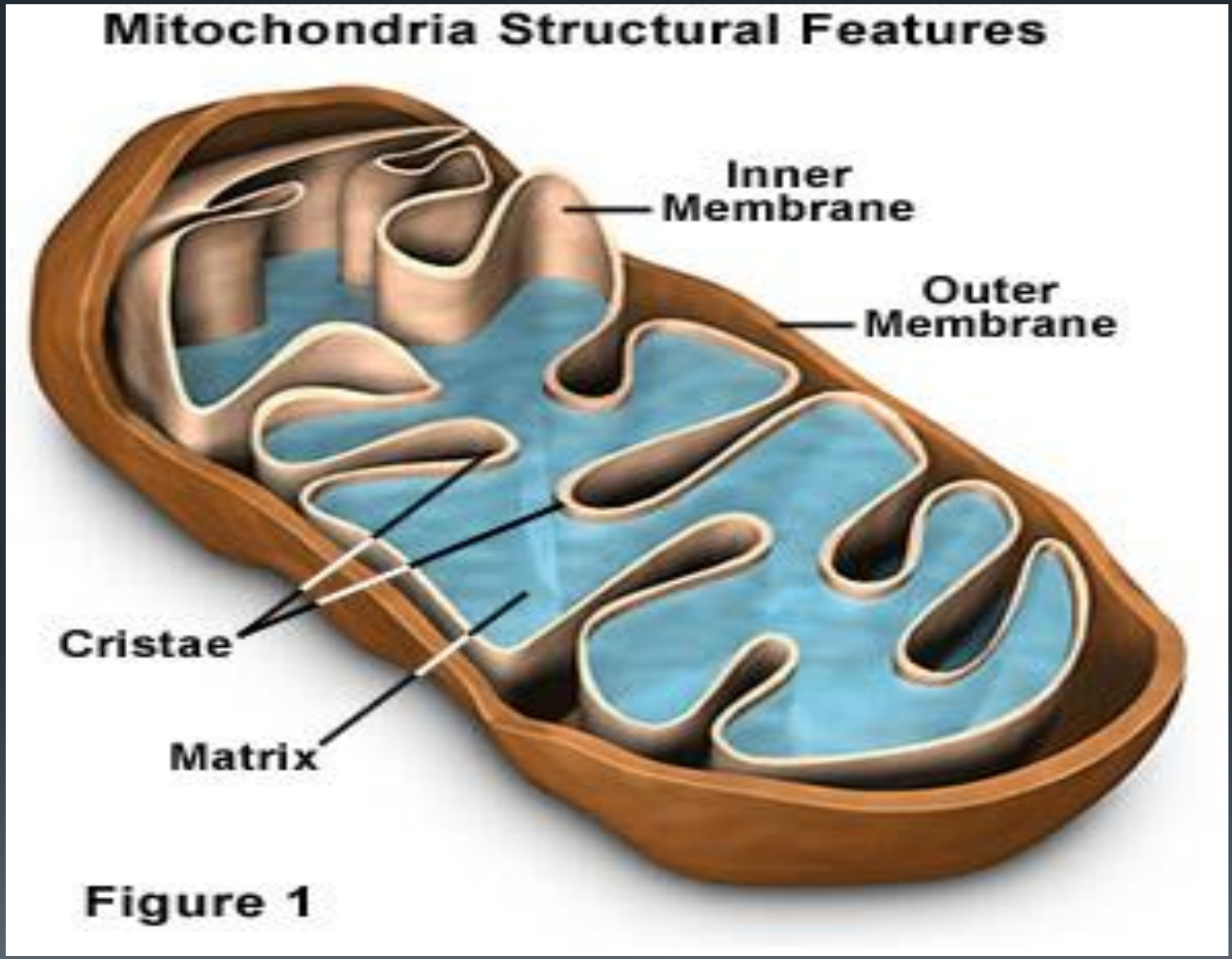
- Involved in the synthesis of polyssacharides and glucose units for cell wall formation.
- Secretes protein and carbohydrates from the cell to the exterior part (Example: nectar coming out from the flower)


cell membrane
nucleus
nucleolus
vacuole
lysosome
cytoplasm
mitochondrion
endoplasmic reticulum
golgi complex

Cytoplasm consist of the following:

- **Mitochondria**- small cylindrical organelles enclosed by two unit membranes.
  - **Outer membrane-** permeable for smaller particles, contains the respiratory chain component and enzymes for the synthesis of ATP.
  - **Inner membrane-** impermeable and folded into numerous cristae

Functions: site of respiration (energy source for plants body maintenance, growth and development).


Mitochondria Structural Features
Inner Membrane
Outer Membrane
Cristae
Matrix
Figure 1

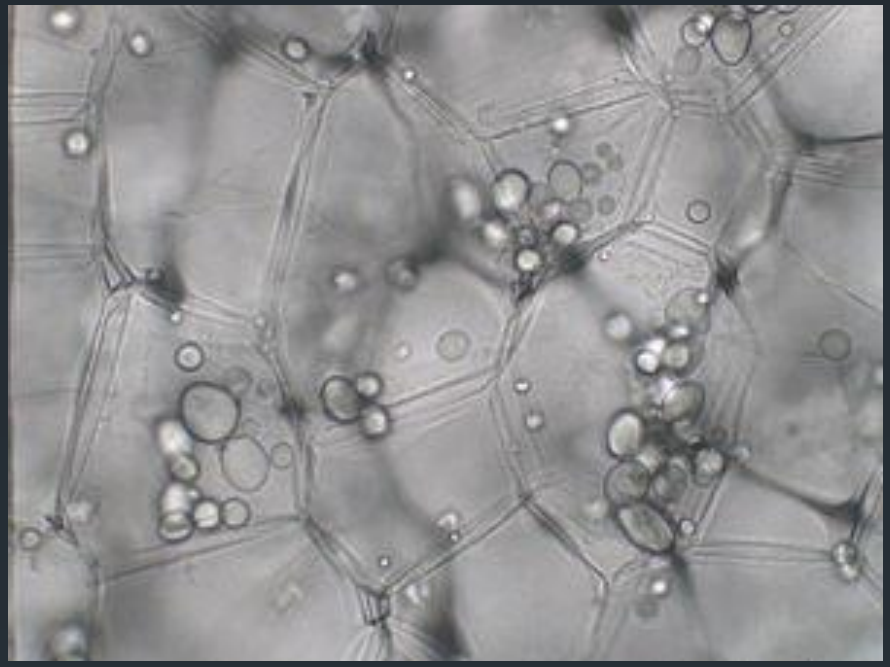
Cytoplasm consist of the following:

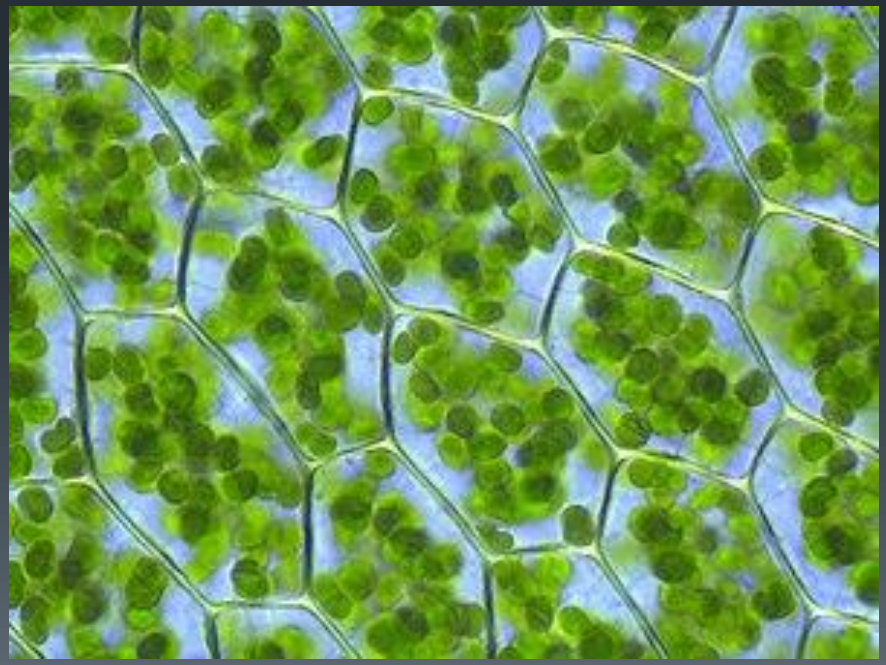
- **Plastids-** differentiated into system of membrane (2 units) and ground substance, the stroma.

Types:

- **Chloroplast-** site of photosynthesis, involved in amino acid and fatty acid synthesis, provides space for temporary storage of starch.
- **Chromoplast**- responsible for the yellow, orange or red colors of many flowers and other parts of the plants. It also attracts insects and other animals.
- **Leucoplast-** non-pigmented plastids but once exposed to light, it may develop into chloroplast.

-**Amyloplasts** (starch), **proteinplasts** (proteins), **elaioplast** (fats and oils)





Cytoplasm consist of the following:

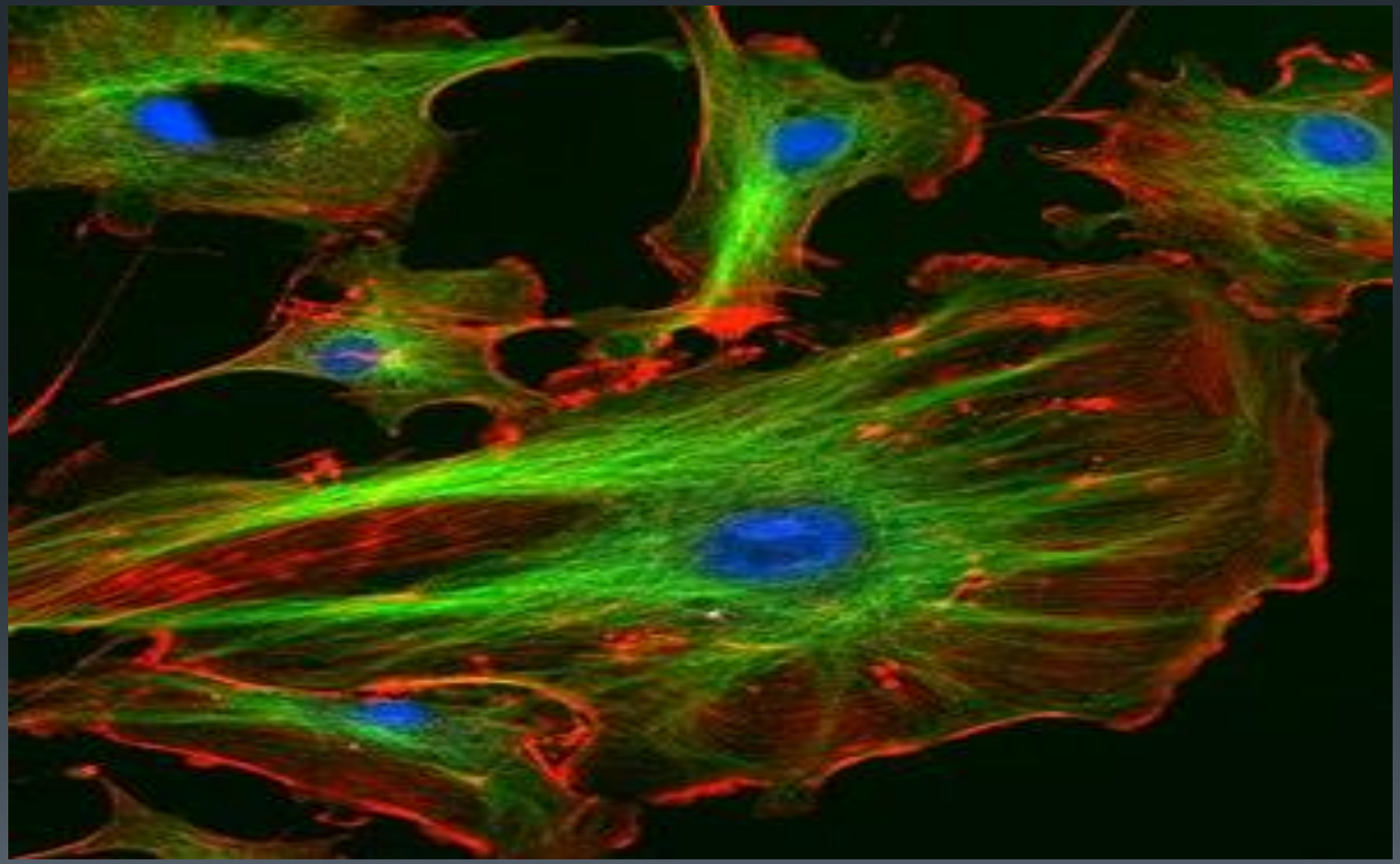
- **Microbodies-** spherical organelles bounded only by one membrane, about 0.5 to 1.5 micrometer in diameter.

Function:

- **Peroxisomes** (other term for microbodies) play an important role in glycolytic acid metabolism associated with photorespiration.
- **Lyoxisomes** (other microbodies) contain enzymes needed for the conversion of fats into carbohydrates during germination in many seeds.

Cytoplasm consist of the following:

- **Cytoskeleton-** an organized cytosol into a three dimensional network of fibrous protein.



Types of cytoskeleton

1. Microtubules (green in color) long, thin, cylindrical structures of varying lengths.

- Each is made up of sub-units of the protein called tubulin.

Functions:

- ✓ Involved in the orderly growth of the cell wall, especially the control of cellulose microfibrils alignment
- ✓ Formation of cell plate
- ✓ Involved in the movement of flagella and celia in which microtubules are important components of it.

Cytoplasm consist of the following:

- **Cytoskeleton-** an organized cytosol into a three dimensional network of fibrous protein.

Types:

2. Microfilaments or actin filaments (shown in red)- consist of two actin chain (similar to that of muscle tissue) that maintains in a helical fashion.

Function: play a causative role in cytoplasmic streaming.

Cytoplasm consist of the following:

- **Ribosomes-** small particles about 17-23 nm in diameter containing an equal polyribosomes or polysomes.
- **Vacuoles-** enclosed by a unit membrane called tonoplast; dumping house of the cell, contains water and other susbtances

Functions: absorbs toxin products, stores various metabolites, breakdown macromolecules and the recycling of their components within the cell.

PLANT CELL: Three (3) main components

NUCLEUS

Definition of Nucleus

- Nucleus contain the genetic information indispensable for the cell life and metabolic function.

Function: Control the activities of the cell by determining which protein molecules are produced and when they are produced, stores the genetic information.

THE ANATOMICAL REGIONS OF A PLANT BODY

- The plant part is composed of three organs: leaf (photosynthesis), stem (support), and root (anchorage and absorption of water and minerals).
- The flowering plants (angiosperms=250,000 species) cover almost the Earth's vegetation.
- The seed contains embryo and cotyledon (endosperm) which are protected with a seed coat.
- The seed grows under favorable condition (moisture, temperature, oxygen, and sometimes light).

THE ANATOMICAL REGIONS OF A PLANT BODY

- From the embryo, the root and shoot develop.
- The seedling grows due to cell division in the meristematic tissues.
- After juvenile stage, plant produces flowers and fruits (after pollination and fertilization)
- Fruits contain seeds thus completing the life cycle of the plant.

THE ANATOMICAL REGIONS OF A PLANT BODY

TISSUES

- composed of cell usually similar in structure and function. It is simple if it contains cell type.
- it is more complex it is made up of several types of cells.

ORGAN

- composed of several tissues with distinct structures and functions.

SYSTEM

-composed of interacting organs that coordinate as a functional complex in the life of the organs.

PLANT TISSUES AND TISSUE SYSTEMS

1. **MERISTEMATIC TISSUES-** part of plant where cell division (mitosis) or production of new cell occurs.

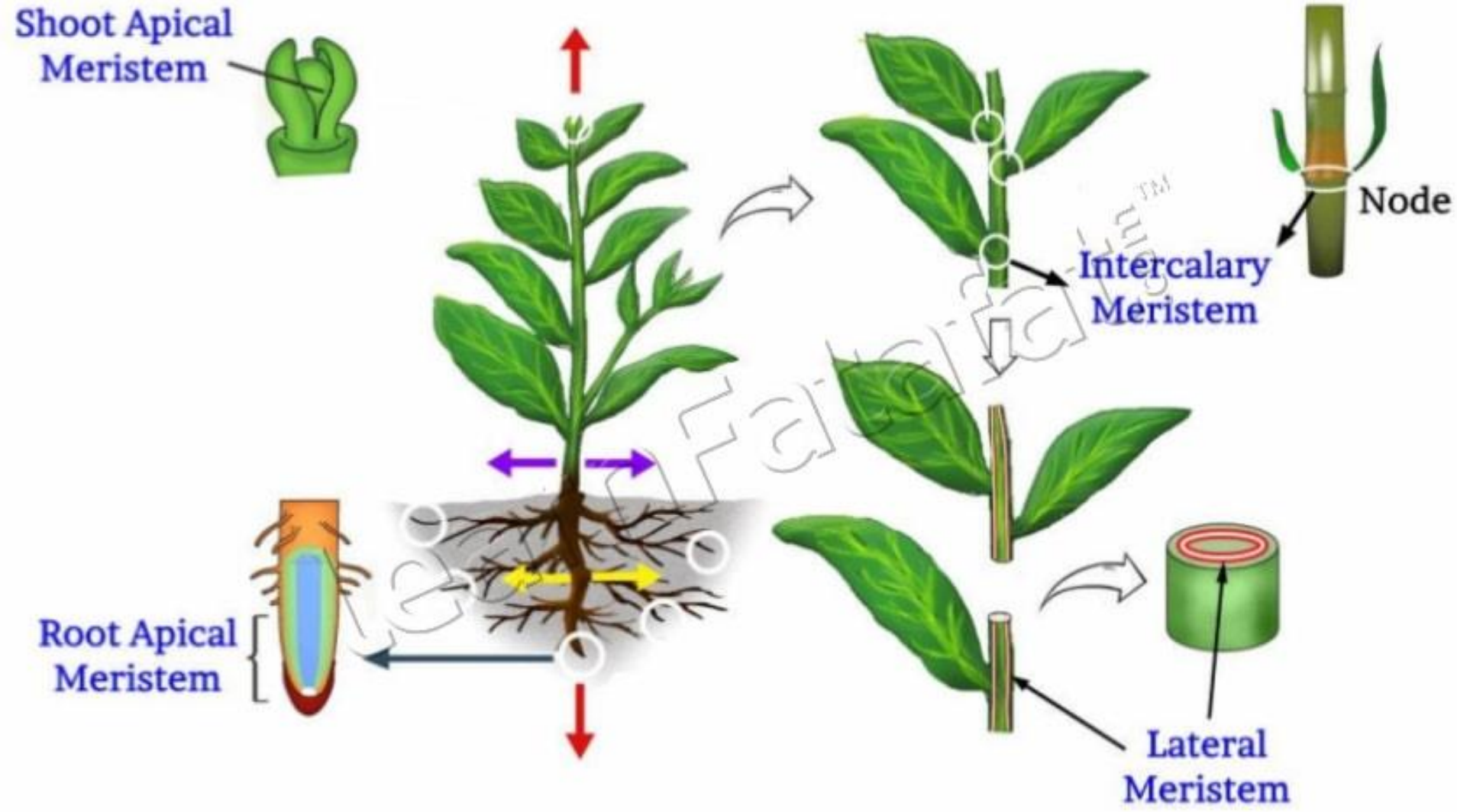
a. **Apical meristem-** tip of stem and roots (shoot or root apical meristem); give rise to primary meristem.

b. **Lateral meristem-** stem and roots (vascular cambium and phellogen)

c. **Intercallary meristem-** internodes and bases of young leaves.

Meristematic Tissue

- Apical Meristem
- Intercalary Meristem
- Lateral Meristem



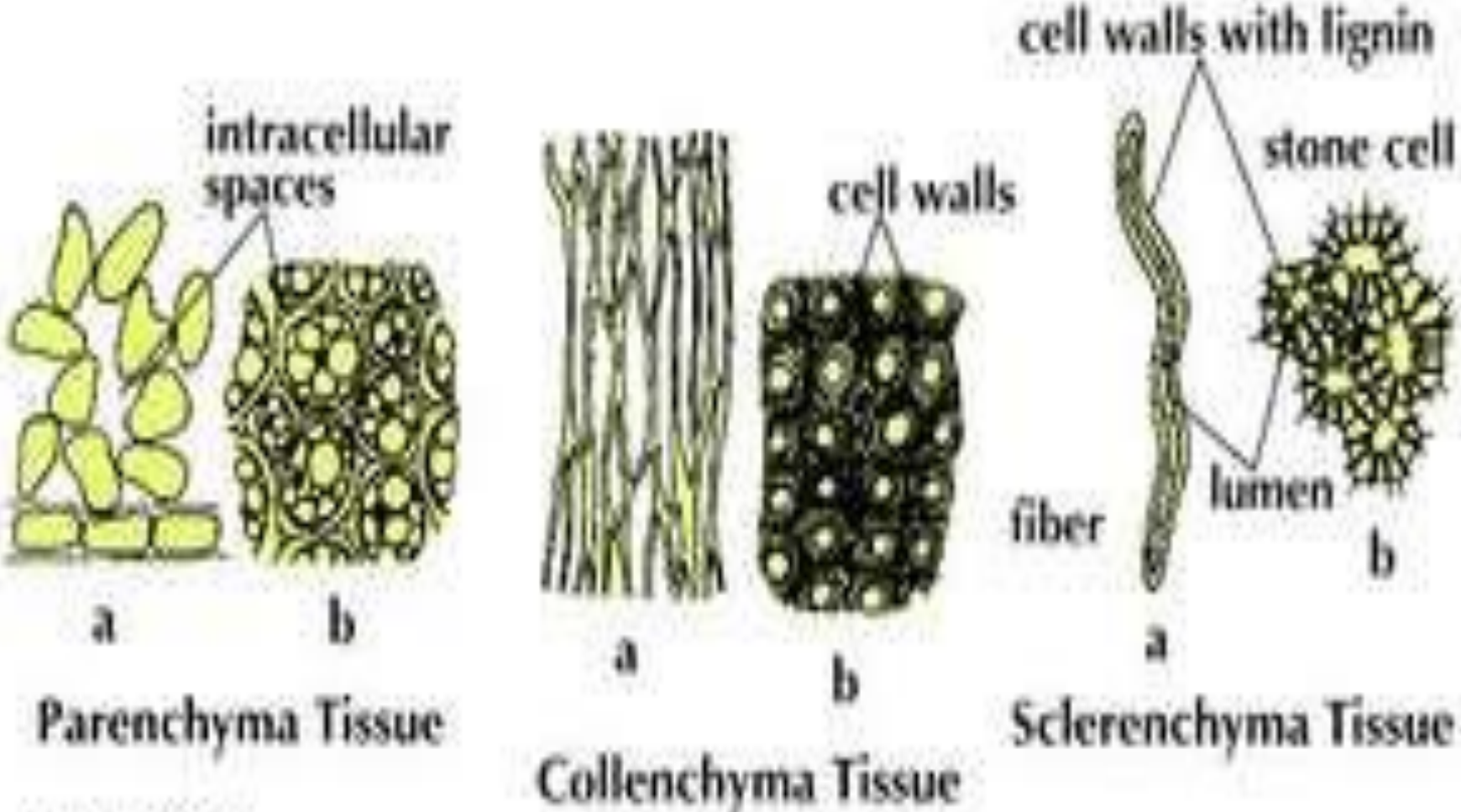
PLANT TISSUES AND TISSUE SYSTEMS

2. PERMANENT TISSUES- derived from meristems which have attained maturity thus perform specific function or functions.

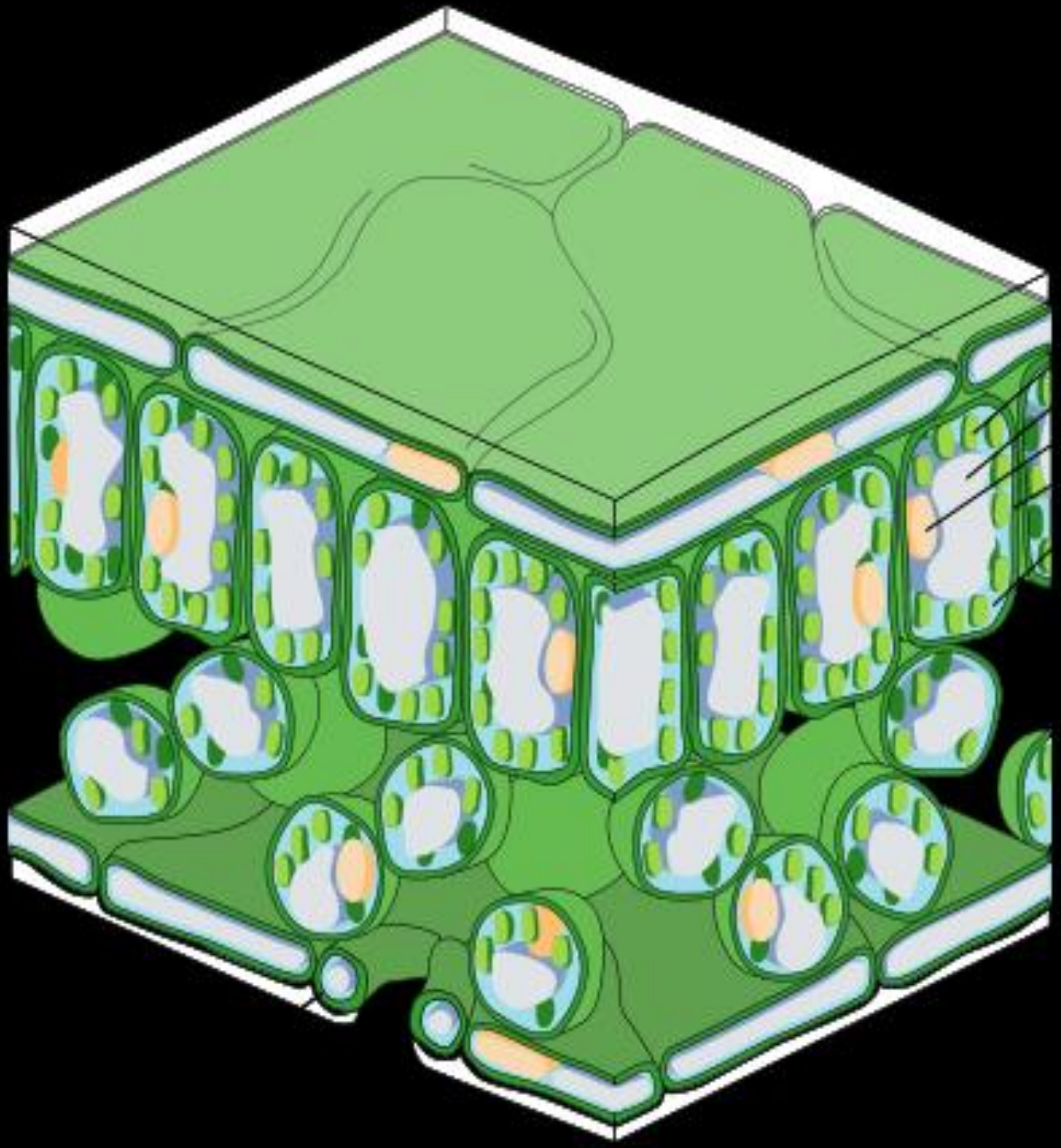
a. **Epidermis-** outermost layer of cells of the primary plant body. It contain stomata and trichomes (appendage).

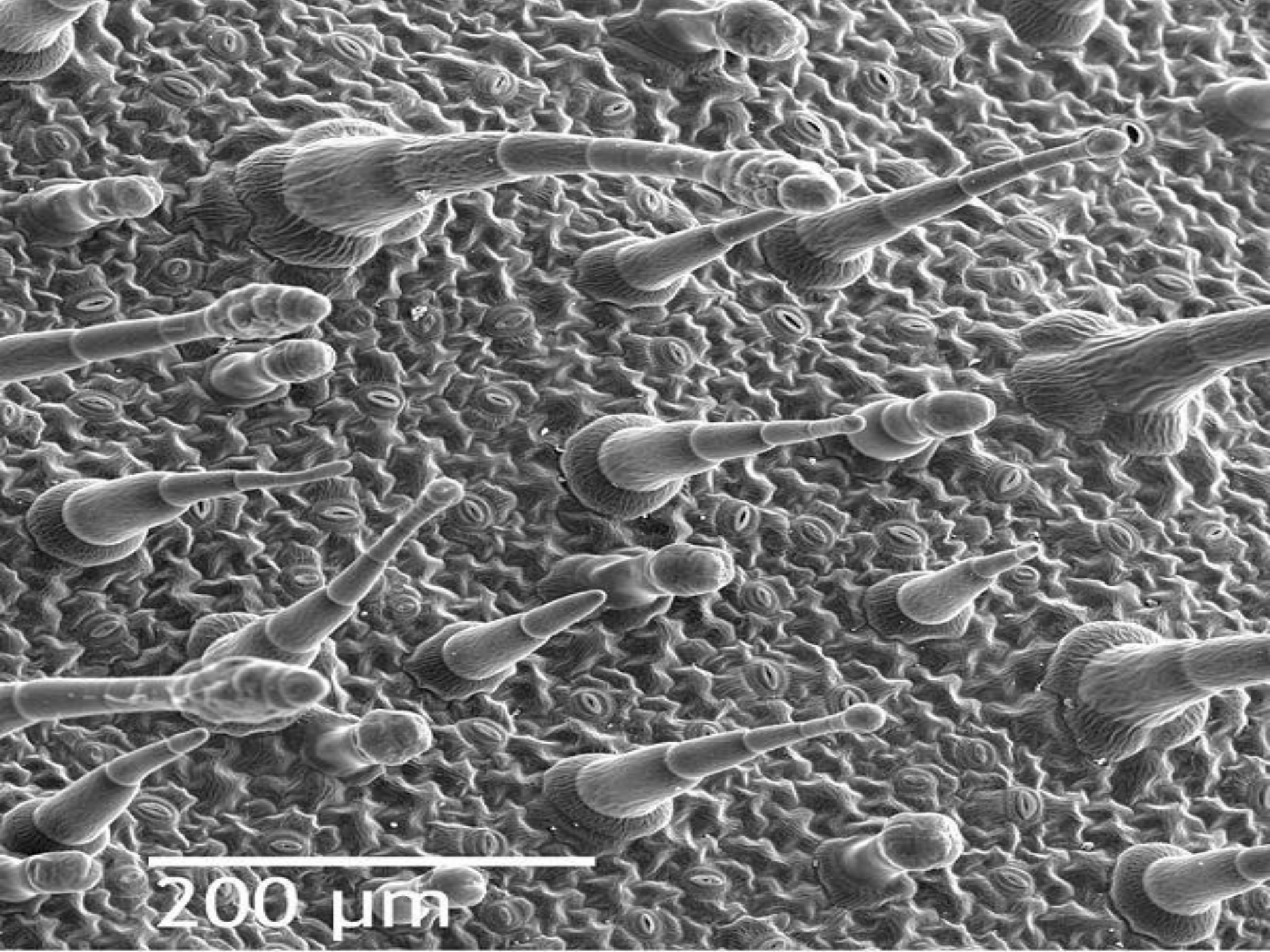
b. **Parenchyma-** found in the cortical regions of stems and roots and in the mesophyll of the leaves.

THE THREE BASIC TYPES OF PLANT TISSUE



a lengthwise
b cross section




200 µm

Parenchyma cells…

- These are living cells that have diverse functions ranging from storage and support to photosynthesis and phloem loading.
- Apart from the xylem and phloem in its vascular bundles, leaves are composed mainly of parenchyma cells.
- Some parenchyma cells, as the epidermis, are specialized for light penetration and focusing or regulation of gas exchange.

PLANT TISSUES AND TISSUE SYSTEMS

C. COLLENCHYMA

- Thickened tissue found in the cortex of the stem and petioles or along the veins of the leaves.
- Collenchyma cells are alive at maturity and have only a primary wall.
- These cells mature from meristem derivatives that initially resemble parenchyma, but differences quickly become apparent.

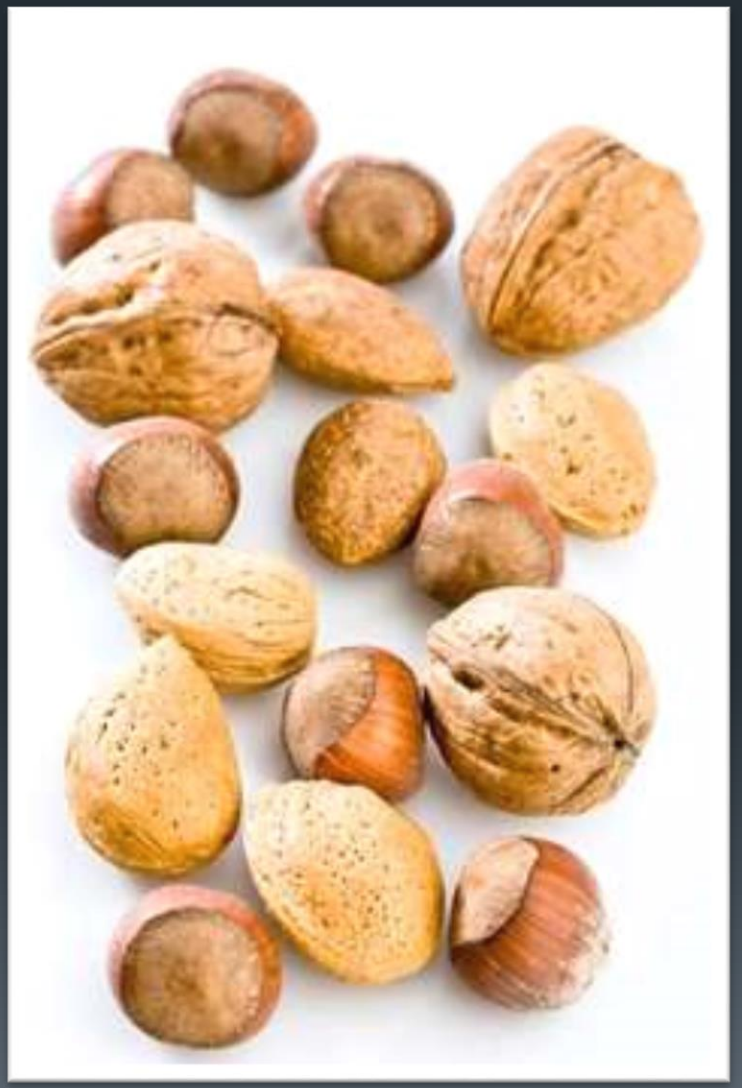
PLANT TISSUES AND TISSUE SYSTEMS

D. SCLERENCHYMA

- Sclerenchyma cells (from Greek *skleros*, hard) are hard and tough cells with a function of mechanical support.
- Scattered throughout the plant, found in both primary and secondary tissues.

Types

- Fibers- known as bast fibers; long thin cells with very thick walls often dead at maturity.
- Schleroids or stone cells- similar with fibers thick wall and lignified, maybe living or dead at maturity.



PLANT TISSUES AND TISSUE SYSTEMS

E. CORK

-Outermost tissue; impregnated with suberin (waxy substance)

COMPLEX PERMANENT TISSUE/TYPES OF VASCULAR TISSUE

❑ Xylem

- Conduct water and minerals salts upward the plant body.
- Consist of tracheids, vessel membrane, xylem fibers, and xylem parenchyma.

❑ Phloem

- Distributes the dissolved food materials between the source and sinks.
- Consists of a) sieve tube element b) companion cells c) phloem parenchyma d) phloem fibers.

MAJOR PLANT TISSUE SYSTEM

❑ GROUND

- This packing and supportive tissue accounts for much of the bulk of the young plants.
- It also functions in food manufacture and storage
- It contains three main cell types: parenchyma, collenchymas, and sclerenchyma.

❑ DERMAL TISSUE

- This is plant's protective outer covering in contact with the environment.
- It facilitates water and ion uptake in roots and regulates gas exchange in leaves and stems.

MAJOR PLANT TISSUE SYSTEM

❑ VASCULAR TISSUE

- Together the phloem and xylem form a continous vascular system throughout the plant.
- This tissue conducts water and solutes between organs and also provides mechanical support.

PLANT ORGANS

Roots

Stem

Leaf

Flower

Seed

Fruit

PLANT ORGANS- Roots

❑ REGIONS OF THE ROOTS

- ❖ **Root cap-** protects the tender apex (absent in aquatic plants)
- ❖ **Region of cell division-** 1 to few mm above the root cap; have small cells with thin walls, dense with protoplasm; undergo repeated cell division (meristematic region)
- ❖ **Region of elongation-** lies above meristematic region; extends to 1-5 mm; undergo rapid elongation and enlargement; responsible for growth in length of the root.
- ❖ **Region of maturation-** lies above meristematic region of elongation, this region produces root hairs.

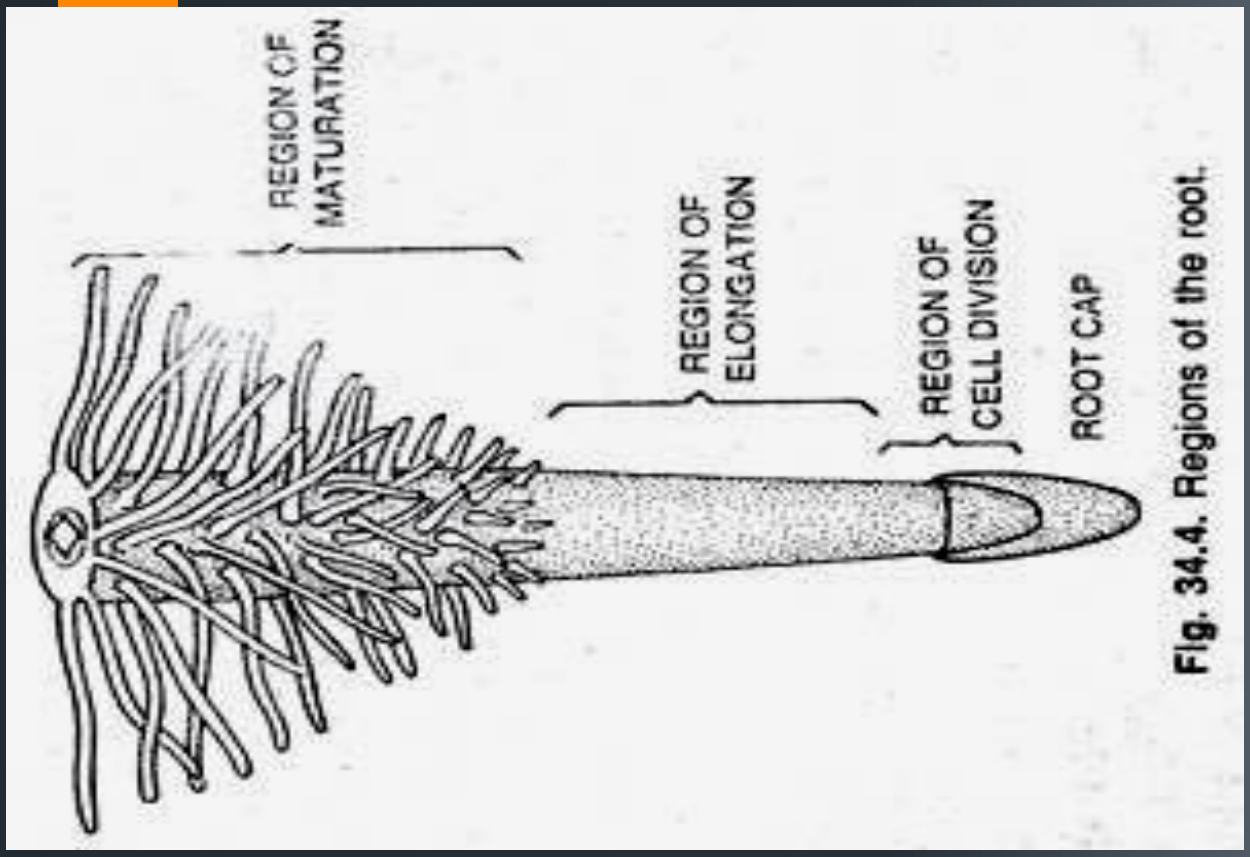


Fig. 34.4. Regions of the root.

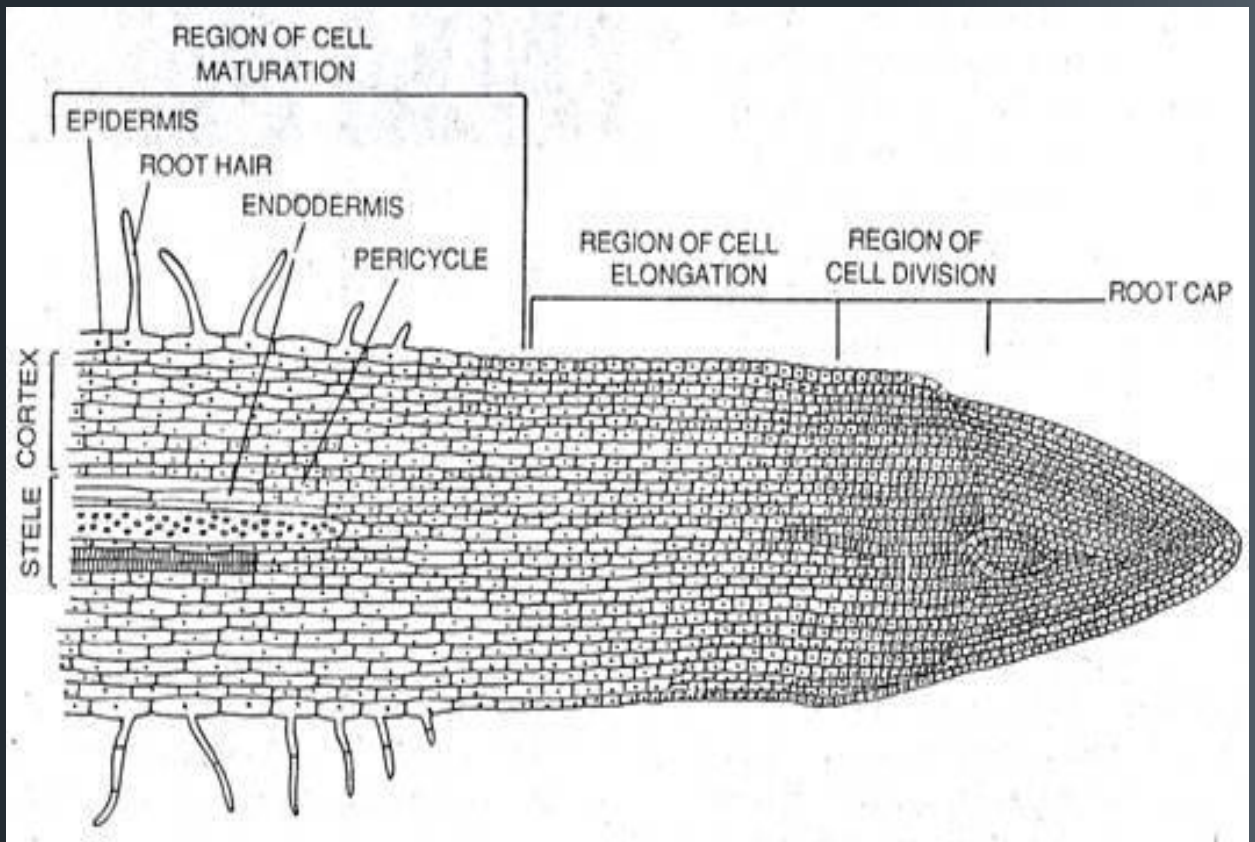


Fig. 34.3. Longitudinal section of root tip showing various regions of growth and root cap.

PLANT ORGANS- Roots

❑ TYPES OF ROOTS

1. Tap root system

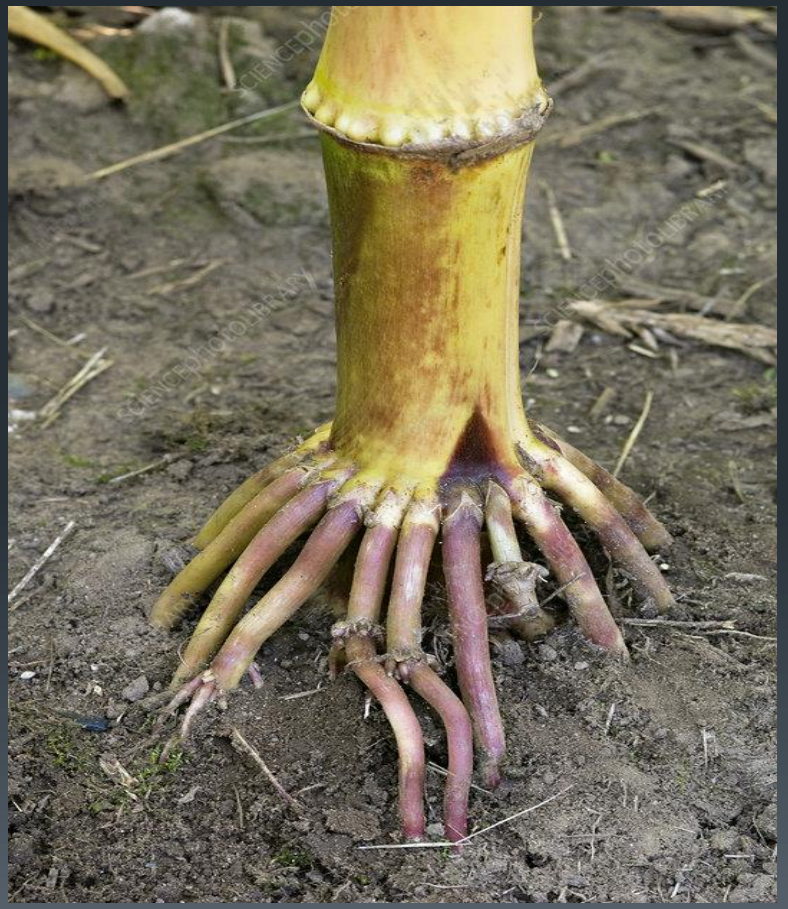
- Primary root grows vertical downward
- Branches grows downward or horizontally outwards

Functions

-absorbs water, mineral, salts from soil, anchorage.

2. Adventitious root system

- Root that grow from any part of the plant or the plnat body other than radicle.



PLANT ORGANS- Roots

❑ TYPES OF ROOTS

3. Fibrous root system

- In monocots (with all adventitious roots)

4. Foliar root system

- From leaves mainly petiole or vein (spontaneous or due to injury)

PLANT ORGANS- Stem

- **DEFINITION-** supporting and conducting organ initially developed from the epicotyl

Major Parts: Bark, pith, and wood (composed of xylem made up of vessels, fibers, and parenchyma cells)

PLANT ORGANS- Stem

- **Types of stems**
  - ✓ **bulb-** short, erect, underground stem

PLANT ORGANS- Stem

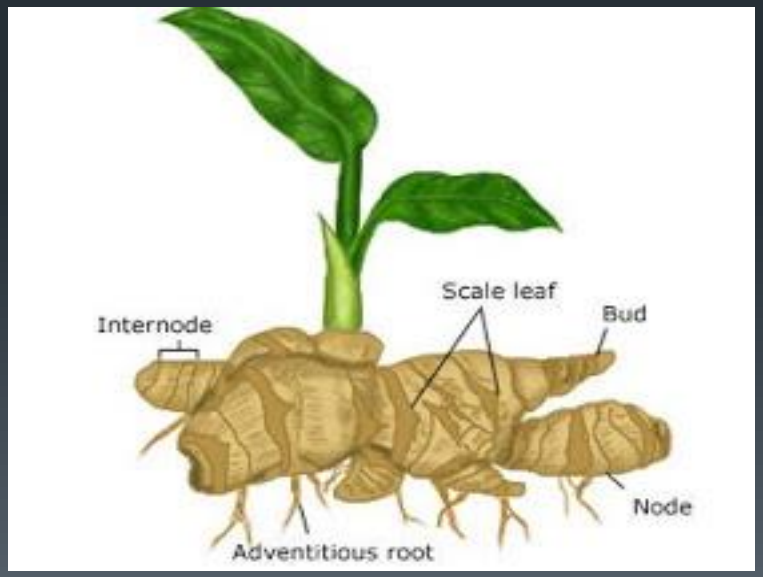
- **Types of stems**
  - ✓ **culm-** flowering stem of grasses and sedges

PLANT ORGANS- Stem

- **Types of stems**
  - ✓ **offset**- like runner originates from leaf axil as a short and thickened branch away from the mother plant.

PLANT ORGANS- Stem

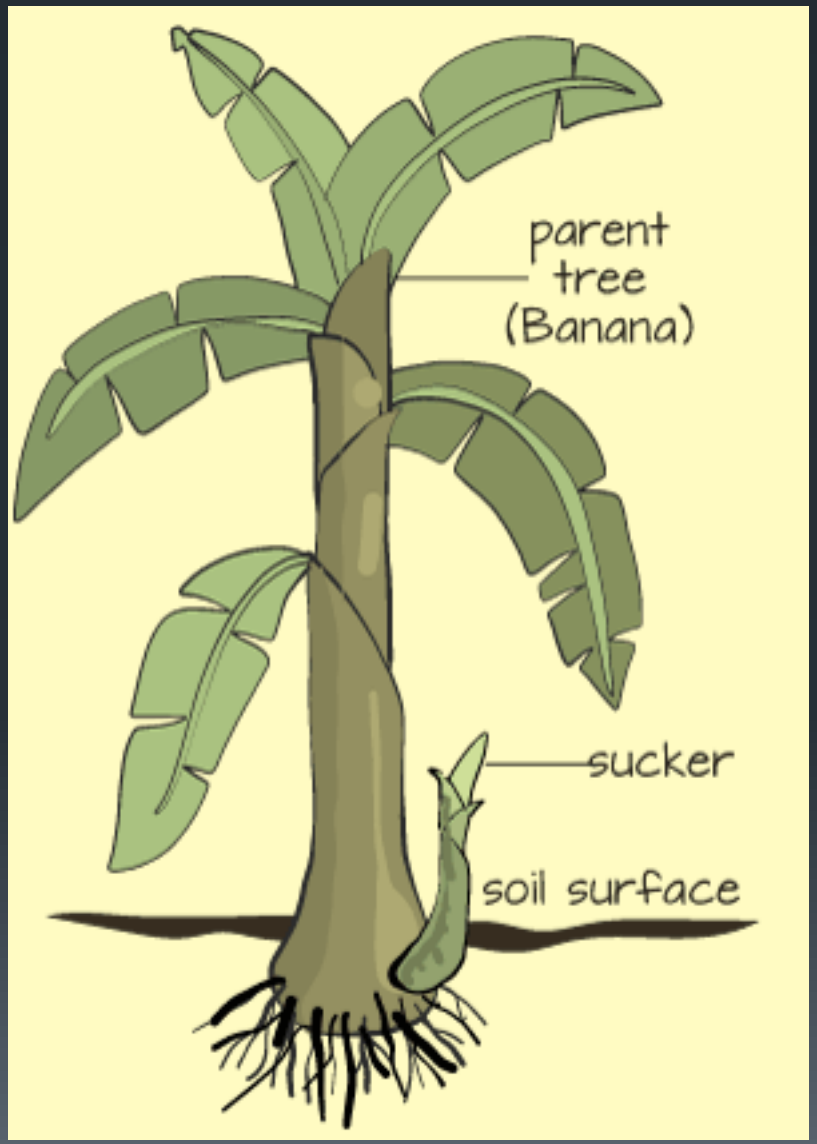
- **Types of stems**
  - ✓ **rhizome-** horizontal underground stem.



PLANT ORGANS- Stem

- **Types of stems**
  - ✓ **runner or stolon-** indeterminate aboveground stem with internodes and new plantlet at the tip.

PLANT ORGANS- Stem



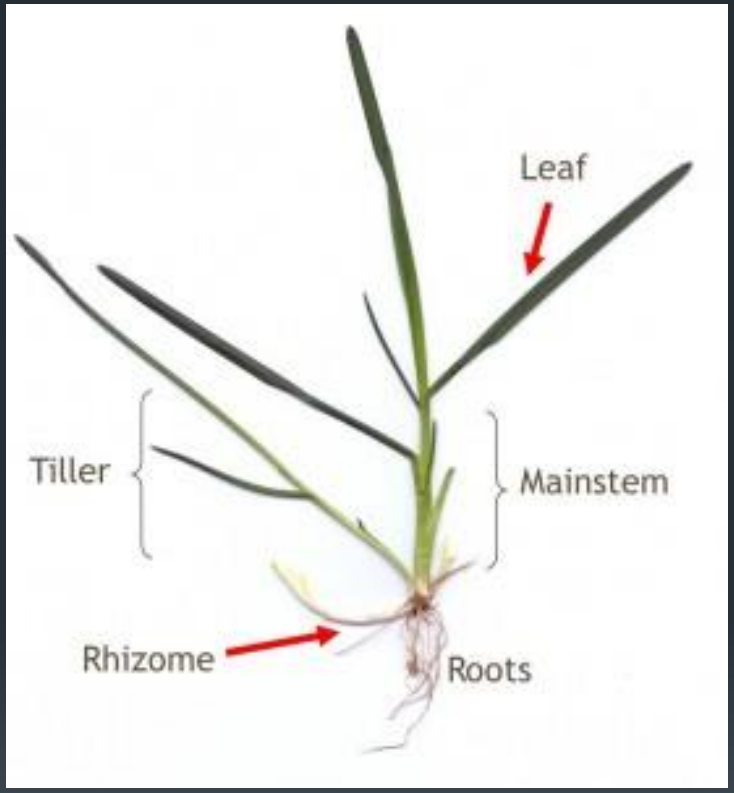
- **Types of stems**
  - ✓ **sucker-** shoot arising below the ground from old stem

PLANT ORGANS- Stem

- Types of stems
  - ✓ tendril- slender coiling branch for climbing

PLANT ORGANS- Stem

- **Types of stems**
  - ✓ **tiller-** shoot produced from the base of the stem or culm



PLANT ORGANS- Stem

- **Types of stems**
  - ✓ **tuber-** thick storage underground stem.

PLANT ORGANS- Stem

- **Types of stems**
  - ✓ **corm**- enlarged solid fleshy base

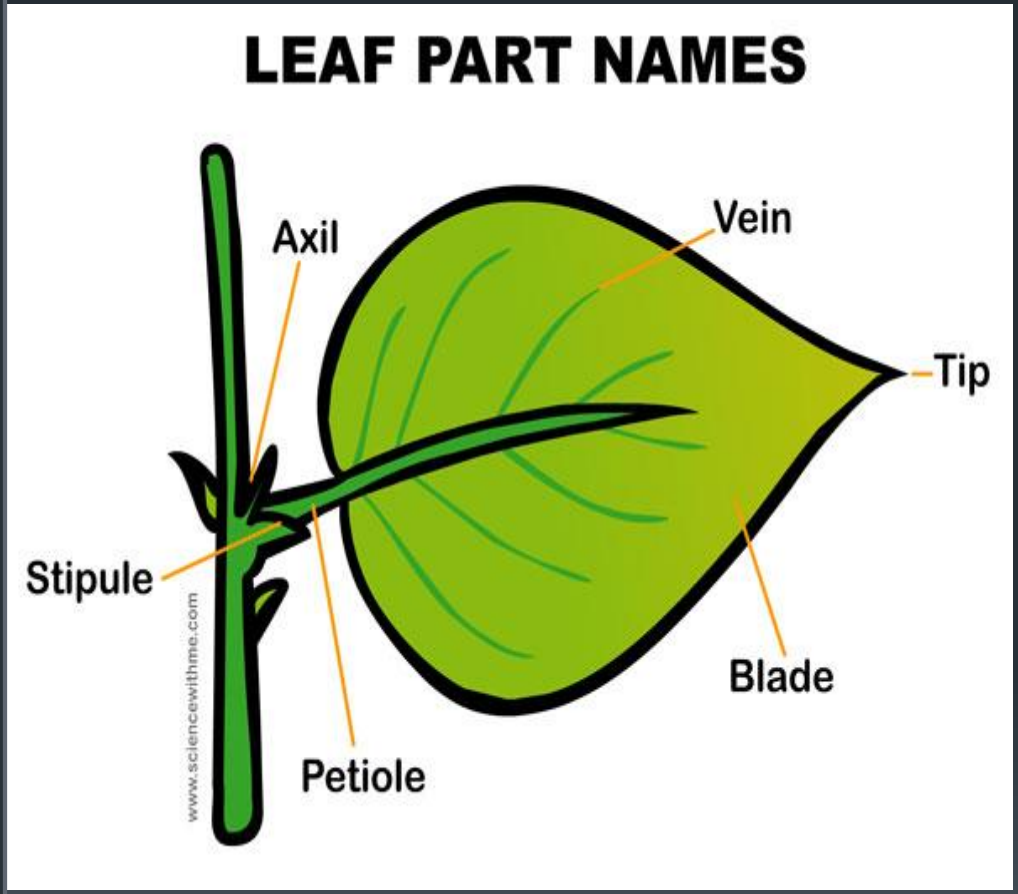
PLANT ORGANS- Leaf

FUNCTIONS:

- Food manufacture
- Exchange of gases
- Evaporative cooling

PARTS OF LEAF

- **Leaf base-** part attached to the stem
- **Petiole**- stalk or leaf
- **Leaf blade or lamina**



PLANT ORGANS- Flower

❑ DEFINITION

Flower is a reproductive structure of flowering plants

❑ MAJOR PARTS

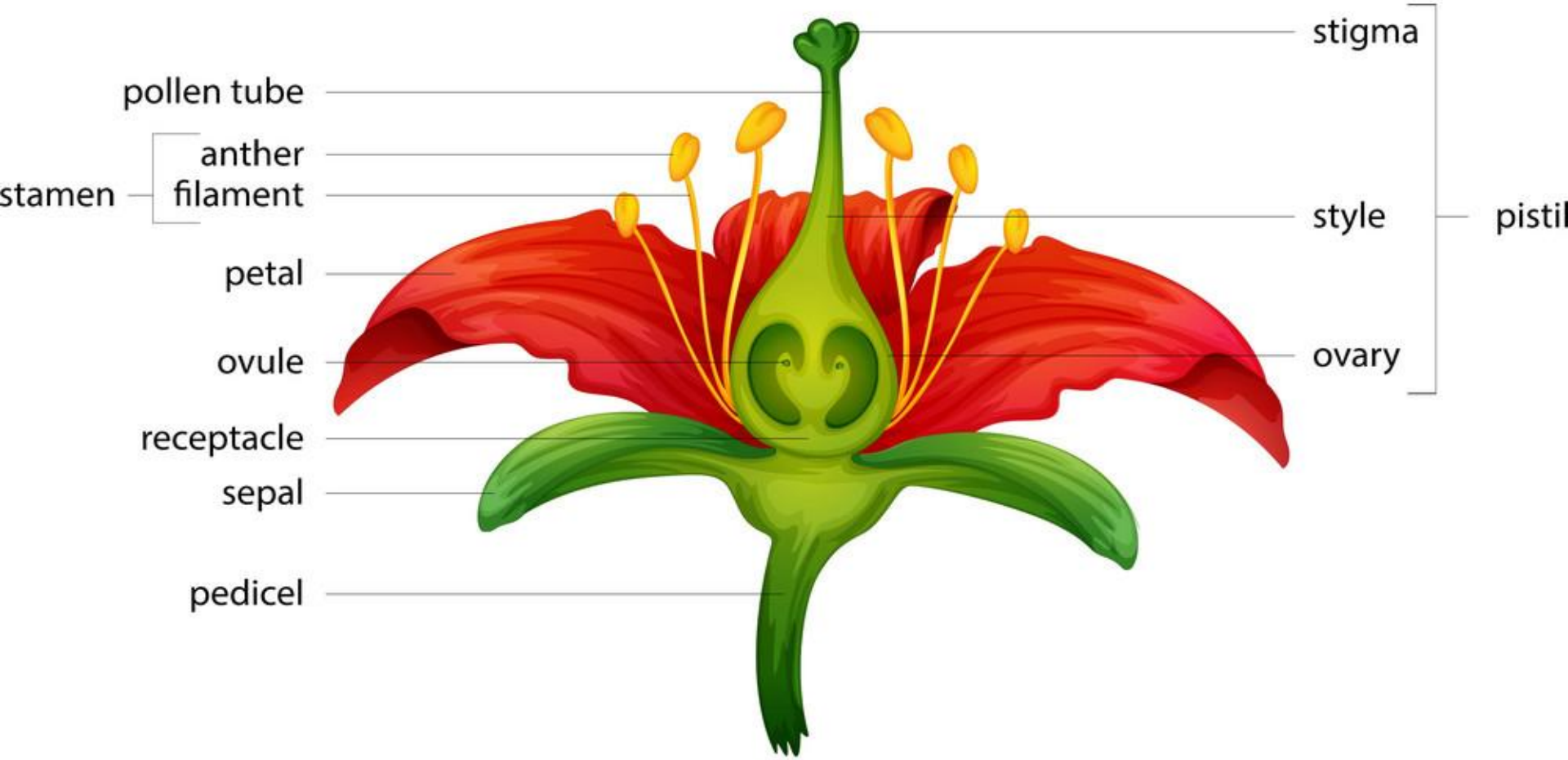
- ✓ **calyx-** lowermost whorl of modified leaves, also known as sepals
- ✓ **corolla-** whorl of petals above the sepals
- ✓ **gynoecium or pistil-** group of carpels in the center or at the top of the flower
- ✓ **gynophore-** stipe of a pistil or carpel

PLANT ORGANS- Flower

❑ MAJOR PARTS

- ✓ **pedicel-** stalk of a flower
- ✓ **perianth-** combined calyx and corolla
- ✓ **petal-** a unit of corolla
- ✓ **sepal-** a unit of calyx
- ✓ **stamen-** male sporophyll within the flower.

Parts of a Flower



PLANT ORGANS- Flower

- **Complete Flower-** has all four parts of the flower (sepals, petals, pistil, and stamen)
- **Incomplete Flower-** a flower lacking sepals, petals, pistil or stamen.
- **Perfect vs. Imperfect Flower**

PLANT ORGANS- Seed

❑ DEFINITION

Seed is a ripened ovule which when shed from the parent plant consist of embryo and stored food supply both of which are enclosed in a seed coat or covering.

- ❖ **Dicotyledon-** embryo lies within an axis of two cotyledon
- ❖ **Monocotyledon-** consist of seed coat, endosperm and embryo.

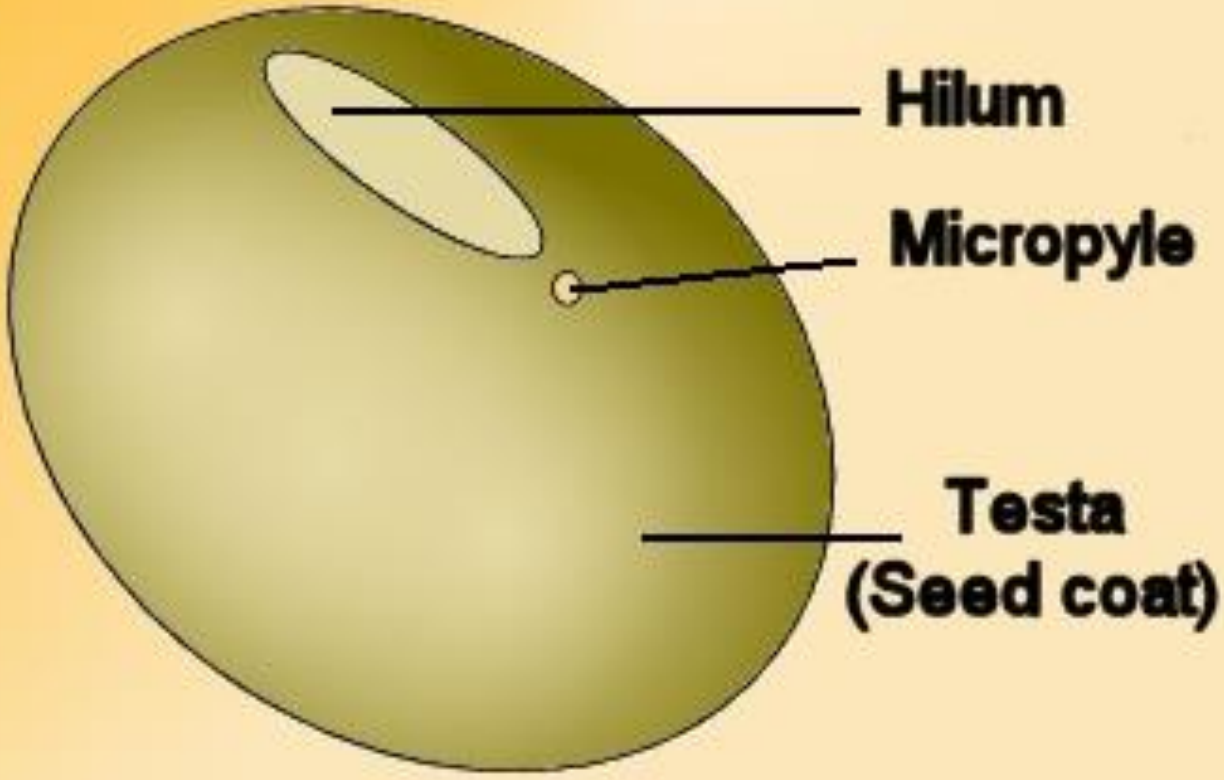
PLANT ORGANS- Seed

❑ PARTS OF A SEED

- ✓ **Embryo-** developing plant still inside the seed. The embryo has cotyledons (embryonic leaves), a root cap, a food source and a plumule (shoot).
- ✓ **Hilum-** the scar on a seed coat at the location where it was attached to the plant's stalk during development.
- ✓ **Micropyle-** the small pore in a seed that allows water absorption.

Seed

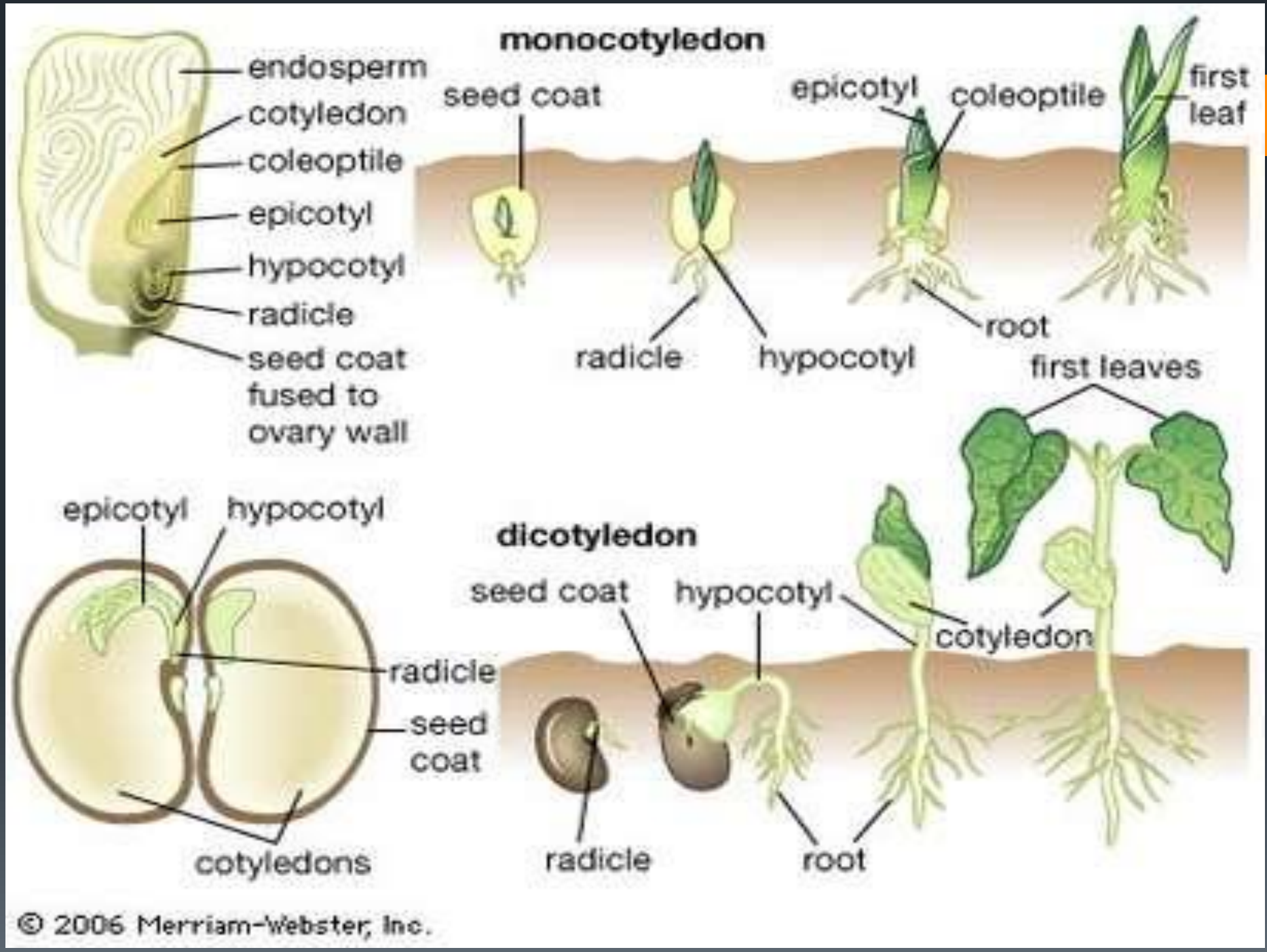
(Unopened)



PLANT ORGANS- Seed

❑ PARTS OF A SEED

- ✓ **Root (Hypocotyl)-** the part of the stem of a sprouting plant that is above
- ✓ **Seed coat (Testa)-** seed coat is the outer, protective layer covering the seed.
- ✓ **Seed leaf (cotyledon)-** the embryonic leaf within the seed
- ✓ **Plumule-** the shoot of an embryo.


endosperm
cotyledon
coleoptile
epicotyl
hypocotyl
radicle
seed coat fused to ovary wall
monocotyledon
seed coat
epicotyl
coleoptile
first leaf
radicle
hypocotyl
root
first leaves
epicotyl
hypocotyl
dicotyledon
seed coat
hypocotyl
cotyledon
radicle
seed coat
cotyledons
radicle
root
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PLANT ORGANS- Seed

❑ TYPES OF SEED- Orthodox

- ✓ Dries out naturally on mother plant to a low MC (less than or equal to 20%)
- ✓ Can be dried to low MC (less than 5%) without damage.
- ✓ Can be stored at low temperature
- ✓ Examples: Rice, Corn, Beans, Vegetable seeds, Pili, etc.

PLANT ORGANS- Seed

❑ TYPES OF SEED- Recalcitrant

- ✓ Do not dry out normally on mother plant, shed in moist condition (50-70% MC)
- ✓ Seed larger than orthodox-embryo is only 15% of the orthodox
- ✓ Killed if MC is reduced below critical values (12-30%)
- ✓ Susceptible to freezing (below 0 degree celcius) or chilling (10-15 degree celcius)
- ✓ Examples: large seeded species, jackfruit, cacao, rambutan, lanzones etc.

PLANT ORGANS- Seed

❑ TYPES OF SEED- Intermediate

- ✓ Can withstand dessication to about 10-12% MC and can be stored under hermetic condition
- ✓ Lose viability more rapidly at low temperature (<10 degree celsius) than at warm temperature (12-21 degree celsius)
- ✓ Examples: coffee, oil palm, papaya, citrus species, star apple, chico, etc.

THANK YOU FOR LISTENING!!!