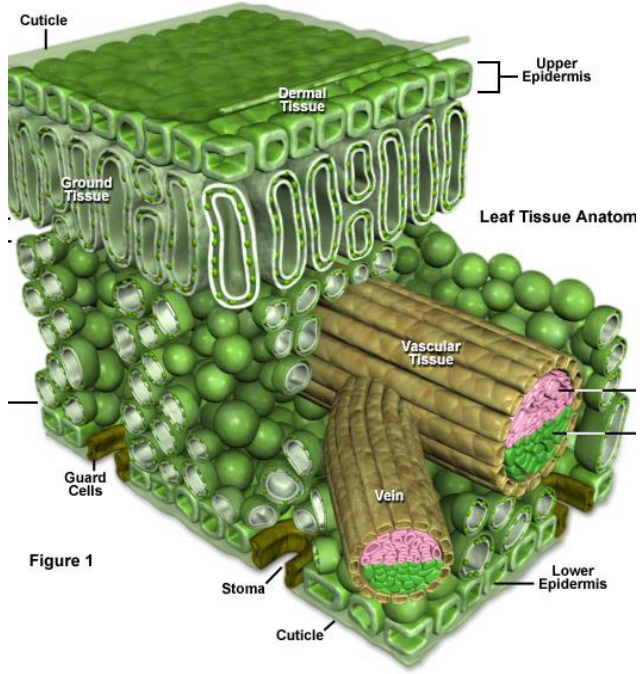
PLANTS ANATOMY

BIO 203

WHAT IS PLANT ANATOMY?

PLANTS ANATOMY: Branch of biology concerned with the study of internal structure of plant and their parts.



PLANT ANATOMY

Plant anatomy plays an important role in the understanding of plant biology.

A realistic interpretation of morphology, physiology, and phylogeny must be based on a thorough knowledge of the structure of cells and tissues.

Furthermore, the knowledge of plant structure is also essential to solve many important everyday problems such as the identification of unknowns, food contaminants, and forensic problems.

APPLICATION OF PLANT ANATOMY

1. Enables to Identify Fragmentary Plant Materials.
2. Enables to Detect Adulterants in Crude Drugs
3. Enables to Identify Wood
4. Enables to Identify Archaeological Plant Remains
5. Applied Aspects of Meristem Culture
6. Provides Evidences in Forensic Investigation
7. Provides Characters of Taxonomic Significance

Overview of Plant Structure

Plants are Earth's Primary Producers

Harvest Energy from sunlight by converting ***light*** energy into ***chemical*** energy

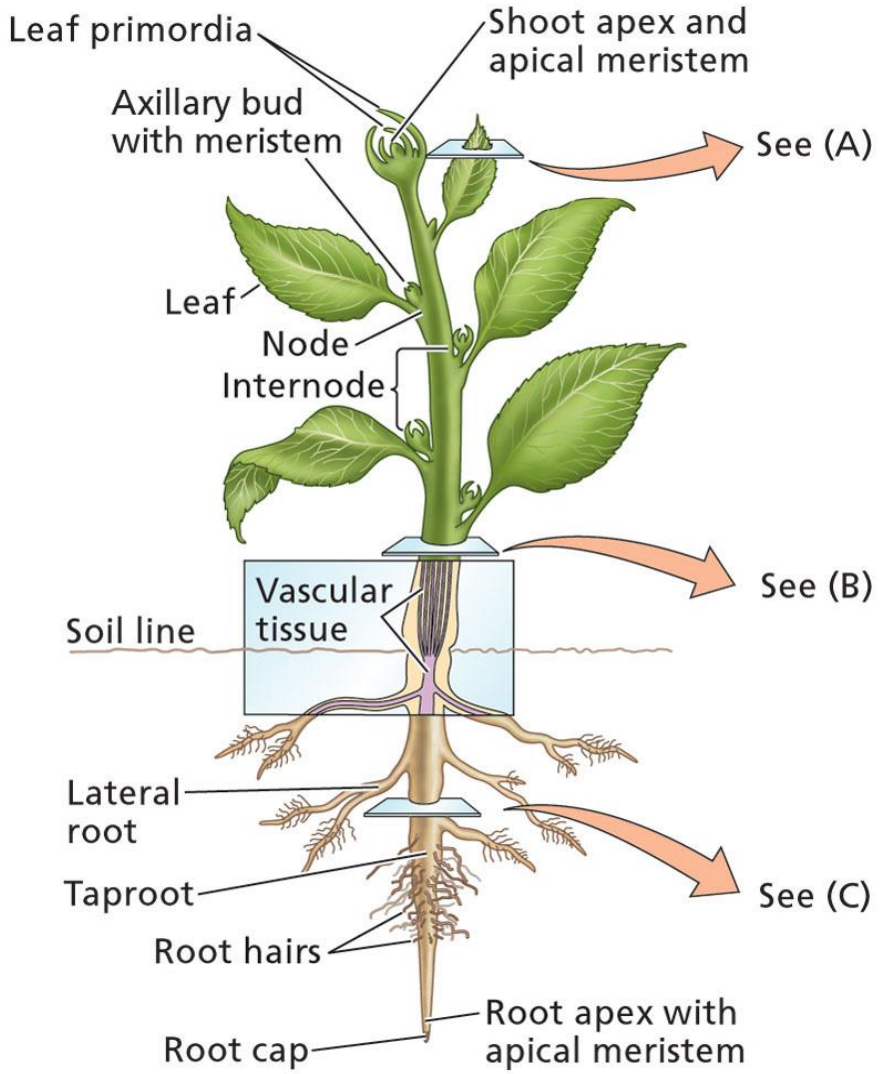
They store this Chemical Energy in bonds formed when the synthesize ***Carbohydrates*** from Carbon Dioxide and Water.

Non- motile

Have evolved to grow towards resources throughout their life span.

Overview of Plant Structure

- The vegetative body consists of:
- **Leaf**: ***Photosynthesis***
- **Stem**: ***Support***
- **Roots**: ***anchorage*** and absorption of ***water*** & ***minerals***.
- **Nodes**: leaf attached to stem.
- **Internode**: Region of stem between two nodes



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Overview of Plant Structure

- Two general types of plants:
- ***Angiosperms***:
  - More advanced type of plant
    - About 250,000 species known
    - Major innovation is the Flower
      - So these are also known as flowering plants!
- ***Gymnosperms***:
  - Less advanced than angiosperms
    - About 700 species known
    - Largest group is the conifer (cone bearer)
      - ie, pine, fir, spruce, and redwood

Table 2.5: Difference between Gymnosperms and Angiosperms		
S.No	**Gymnosperms**	**Angiosperms**
1.	Vessels are absent [except Gnetales]	Vessels are present
2.	Phloem lacks companion cells	Companion cells are present
3.	Ovules are naked	Ovules are enclosed within the ovary
4.	Wind pollination only	Insects, wind, water, animals etc., act as pollinating agents
5.	Double fertilization is absent	Double fertilization is present
6.	Endosperm is haploid	Endosperm is triploid
7.	Fruit formation is absent	Fruit formation is present
8.	Flowers absent	Flowers present

UNIFYING THEMES OF PLANTS

- Plant studies have revealed that plants share several important features

An understanding of these themes will enable you understand plants better

These themes will form the bedrock of what you will study each time you study about plants in your course

Plants consist of organized parts

Plants exchange energy with their environment

Plants respond and adapt to their environment

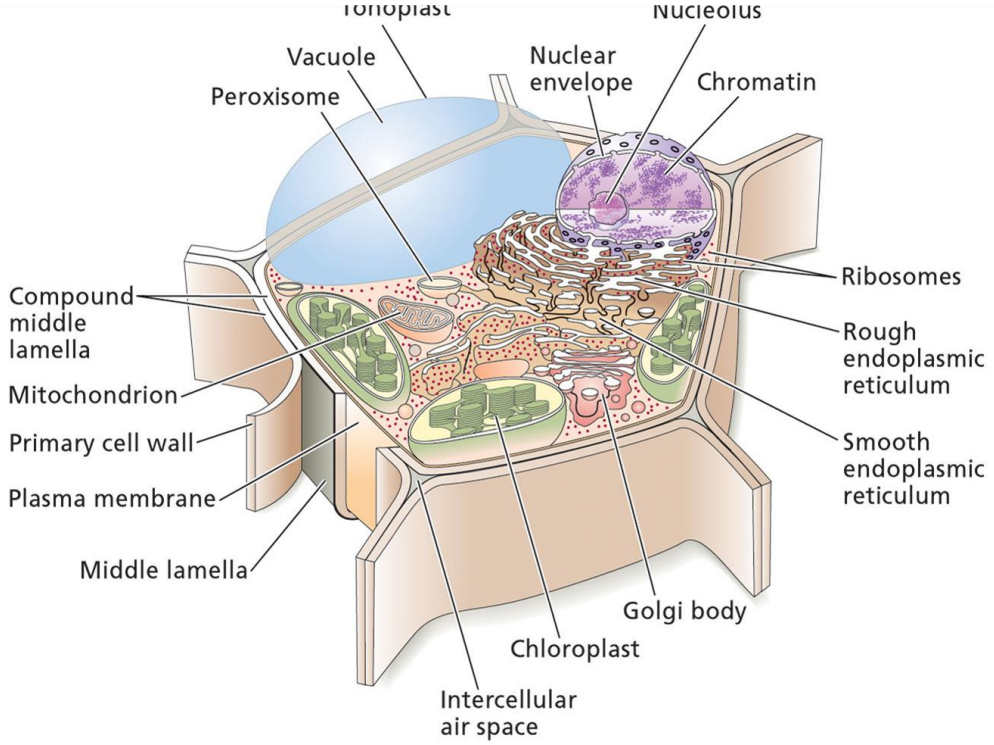
Plants reproduce

Plants share parts of a common ancestry

The Plant Cell

Cell, is the basic membrane-bound unit that contains the fundamental molecules of life and of which all living things are composed.

Its microscopic in size, cells are the smallest structural units of living matter and compose all living things.



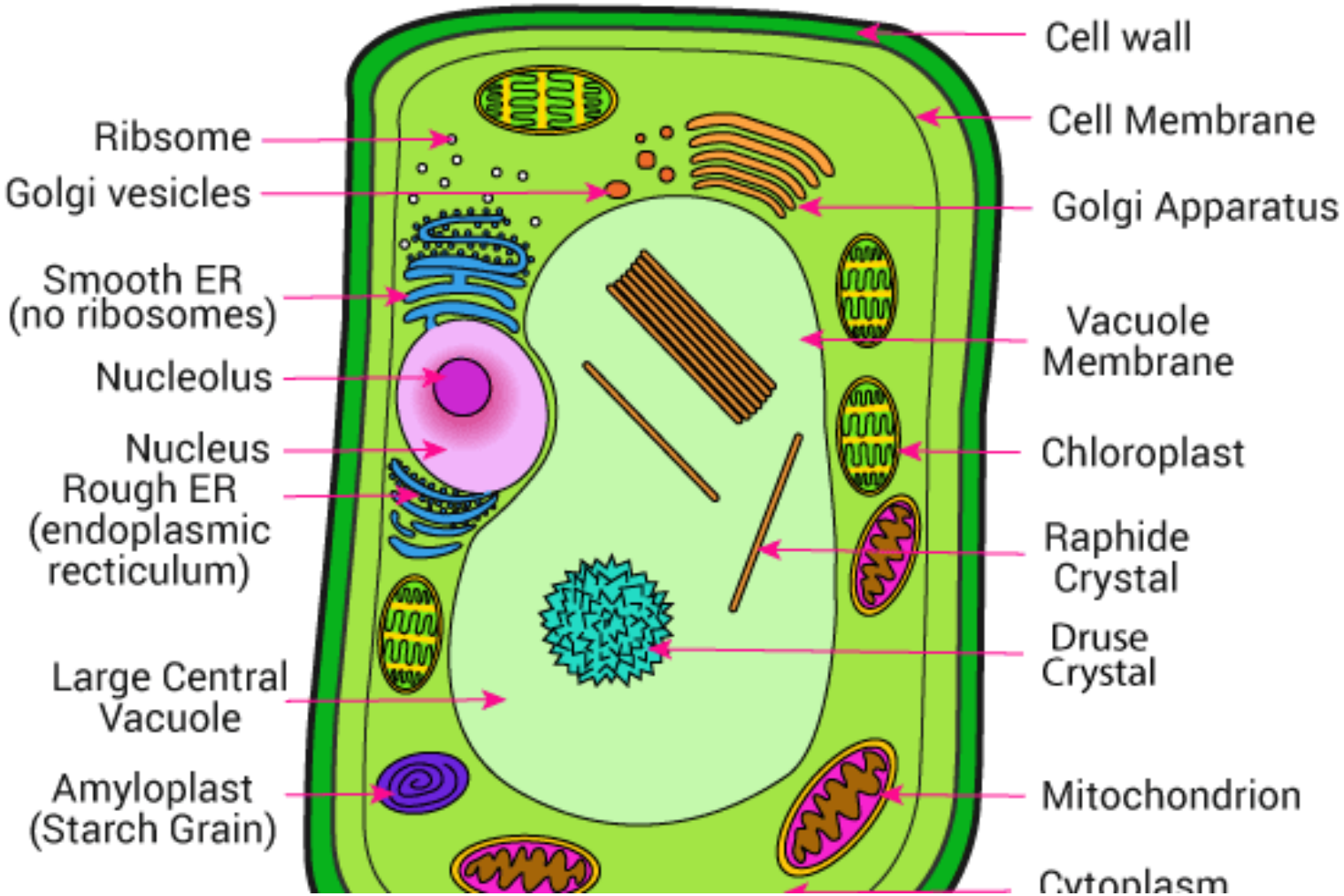
"A cell is defined as the smallest, basic unit of life that is responsible for all of life's processes."

The Plant Cell

- Plant cells at maturity when they become specialized, plant cells may differ greatly from one another in their structures and functions
  - ***Even those physically next to each other.***
  - ***Even the nucleus can be lost in some plant cells***

- Contains many organelles with specific functions

- Enclosed by a membrane which defines their boundaries


Cell wall
Cell Membrane
Golgi Apparatus
Vacuole Membrane
Chloroplast
Raphide Crystal
Druse Crystal
Mitochondrion
Cytoplasm
Ribsome
Golgi vesicles
Smooth ER (no ribosomes)
Nucleolus
Nucleus
Rough ER (endoplasmic recticulum)
Large Central Vacuole
Amyloplast (Starch Grain)

The Plasma Membrane

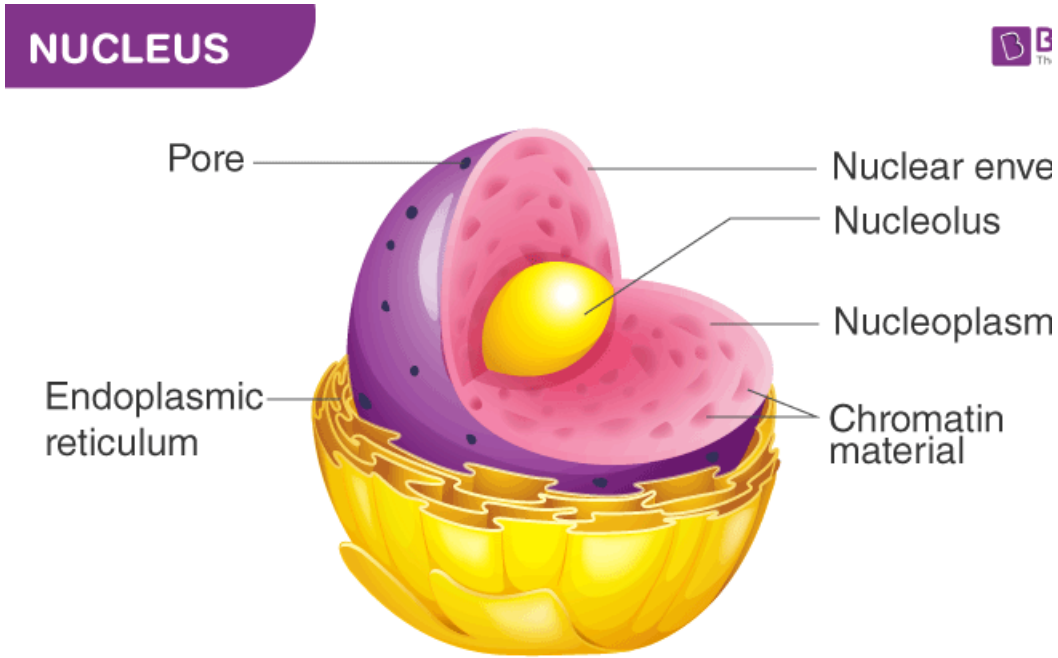
It is the semi-permeable membrane that is present within the cell wall. It is composed of a thin layer of protein and fat.

The plasma membrane plays an important role in regulating the entry and exit of specific substances within the cell.

For instance, cell membrane keeps toxins from entering inside, while nutrients and essential minerals are transported across.

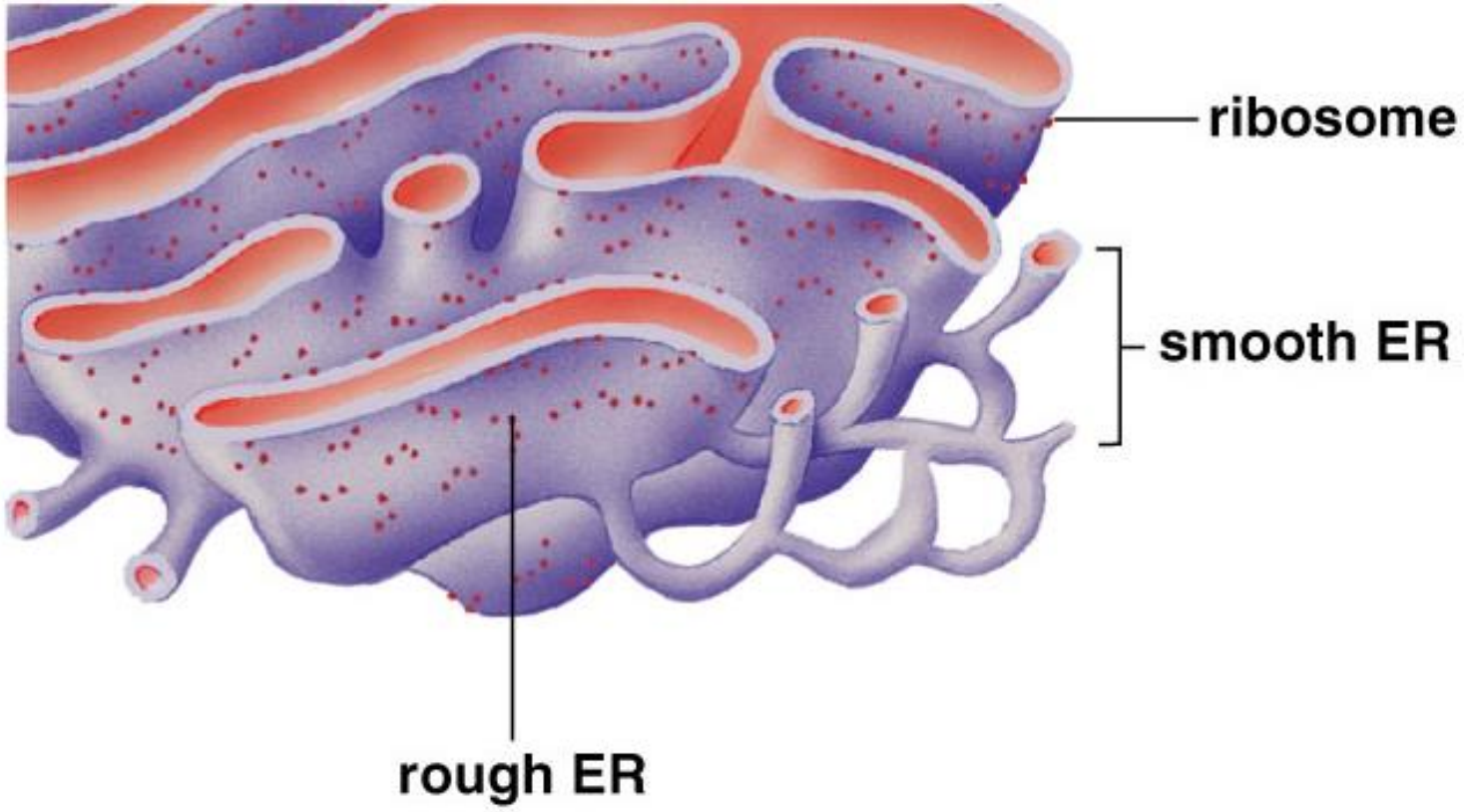
The nucleus

The nucleus is a membrane-bound structure that is present only in eukaryotic cells. The vital function of a nucleus is to store DNA or hereditary information required for cell division, metabolism and growth.



Nucleolus: It manufactures cell's protein-producing structures and ribosomes

Nucleopore: Nuclear membrane is perforated with holes called nucleopore that allows proteins and nucleic acids to pass through



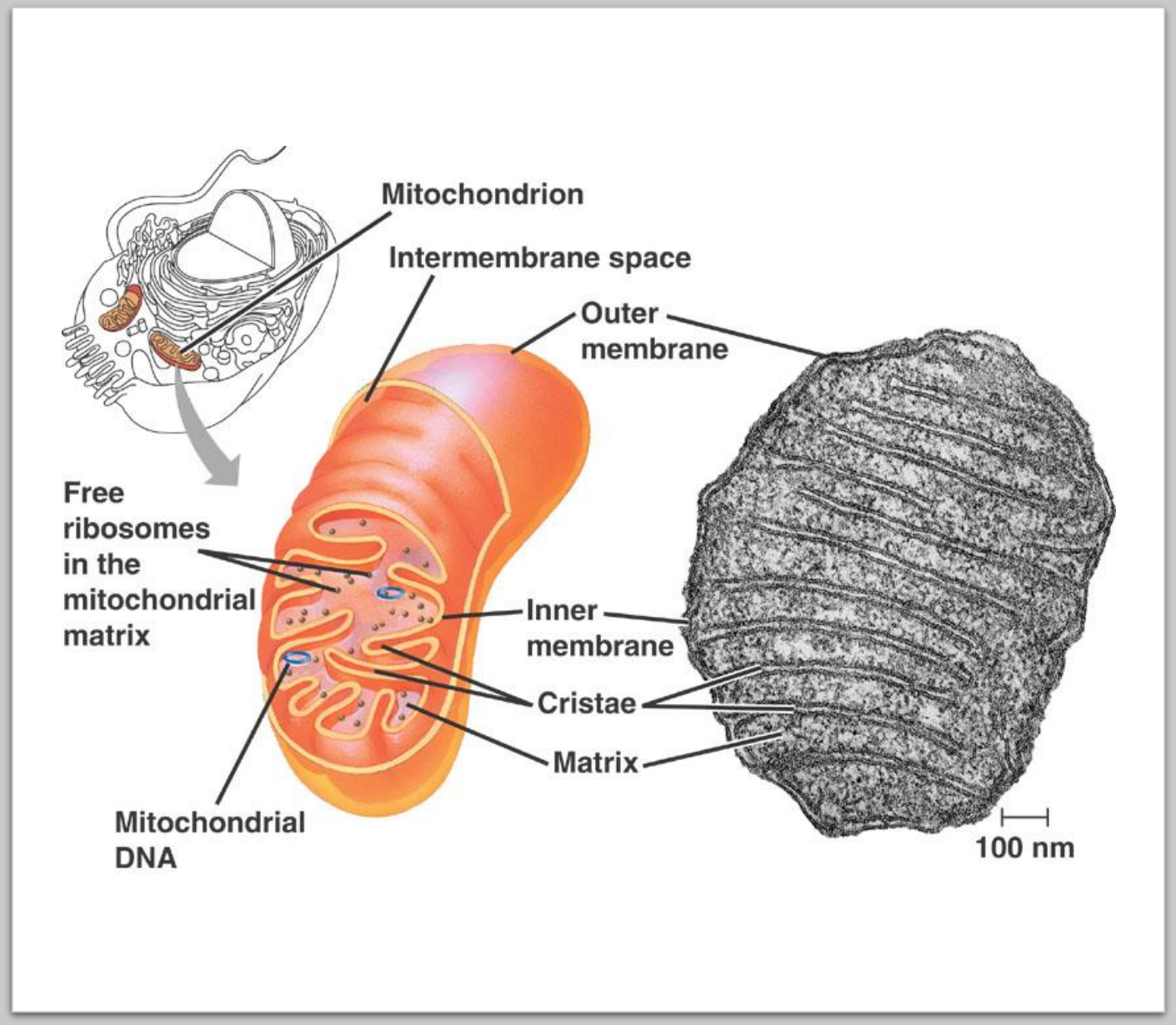
The Endoplasmic reticulum

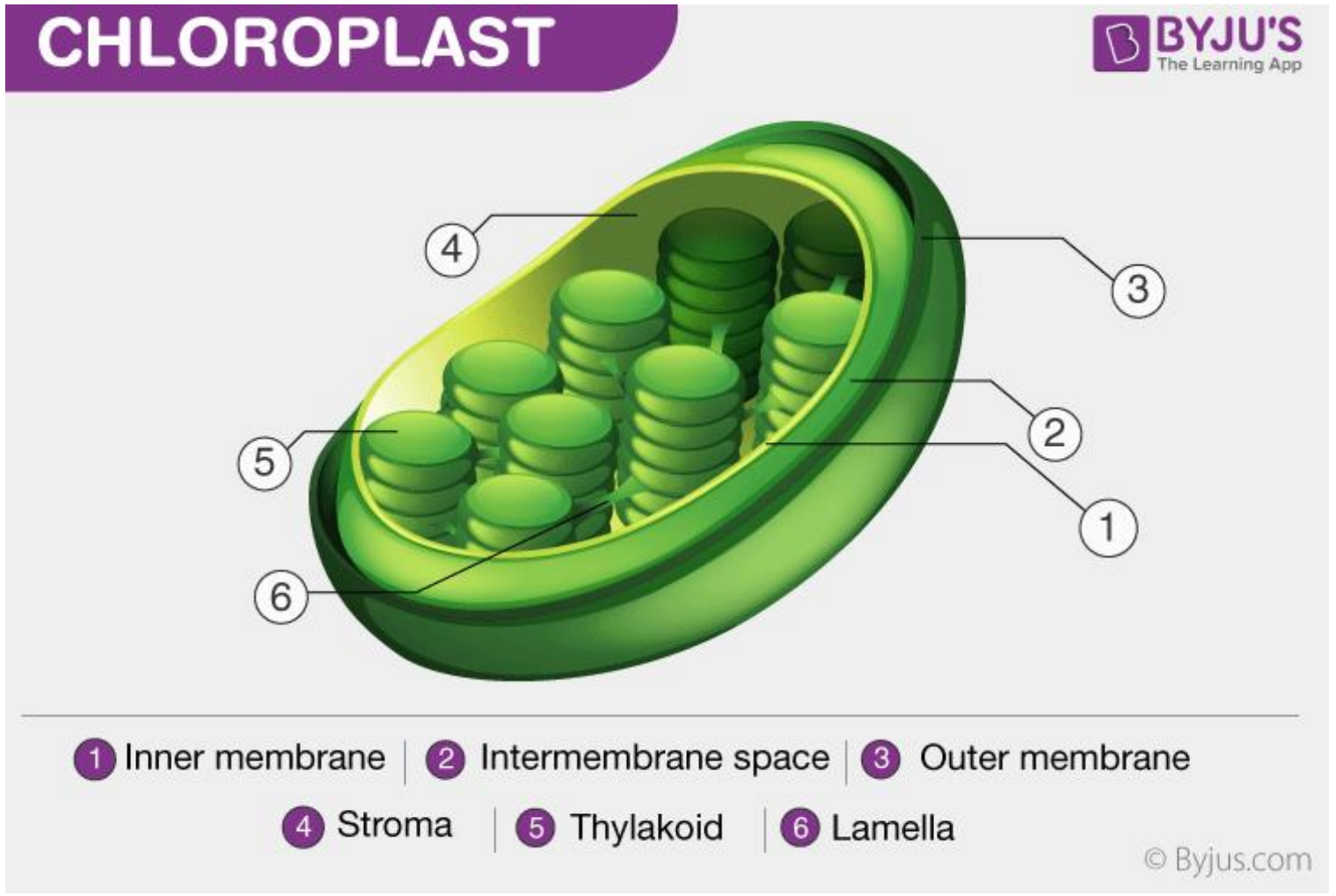
- The endoplasmic reticulum is a network of sacs that manufactures, processes, and transports chemical compounds for use inside and outside of the cell.
- It is connected to the double-layered nuclear envelope, providing a pipeline between the nucleus and the cytoplasm.
- ***Rough ER***: Synthesize, process, and sort proteins targeted to membranes, vacuoles, or the secretory pathway.
- ***Smooth ER:*** Synthesize lipids and oils.

The Mitochondria

- Mitochondria are oblong shaped organelles found in the cytoplasm of all eukaryotic cells. In plant cells, they break down carbohydrate and sugar molecules to provide energy, particularly when light isn't available for the chloroplasts to produce energy.

- Contain their own DNA and protein-synthesizing machinery





The Chloroplast

CHLOROPLAST

Chloroplasts are found in all higher plants. It is oval or biconvex, found within the mesophyll of the **plant cell.**

The size of the chloroplast usually varies between 4-6 µm in diameter and 1-3 µm in thickness.

They are double-membrane organelle with the presence of outer, inner and intermembrane space.

There are two distinct regions present inside a chloroplast known as the grana and stroma.

Stroma: It is a colourless, alkaline, aqueous, protein-rich fluid present within the inner membrane of the chloroplast present surrounding the grana.

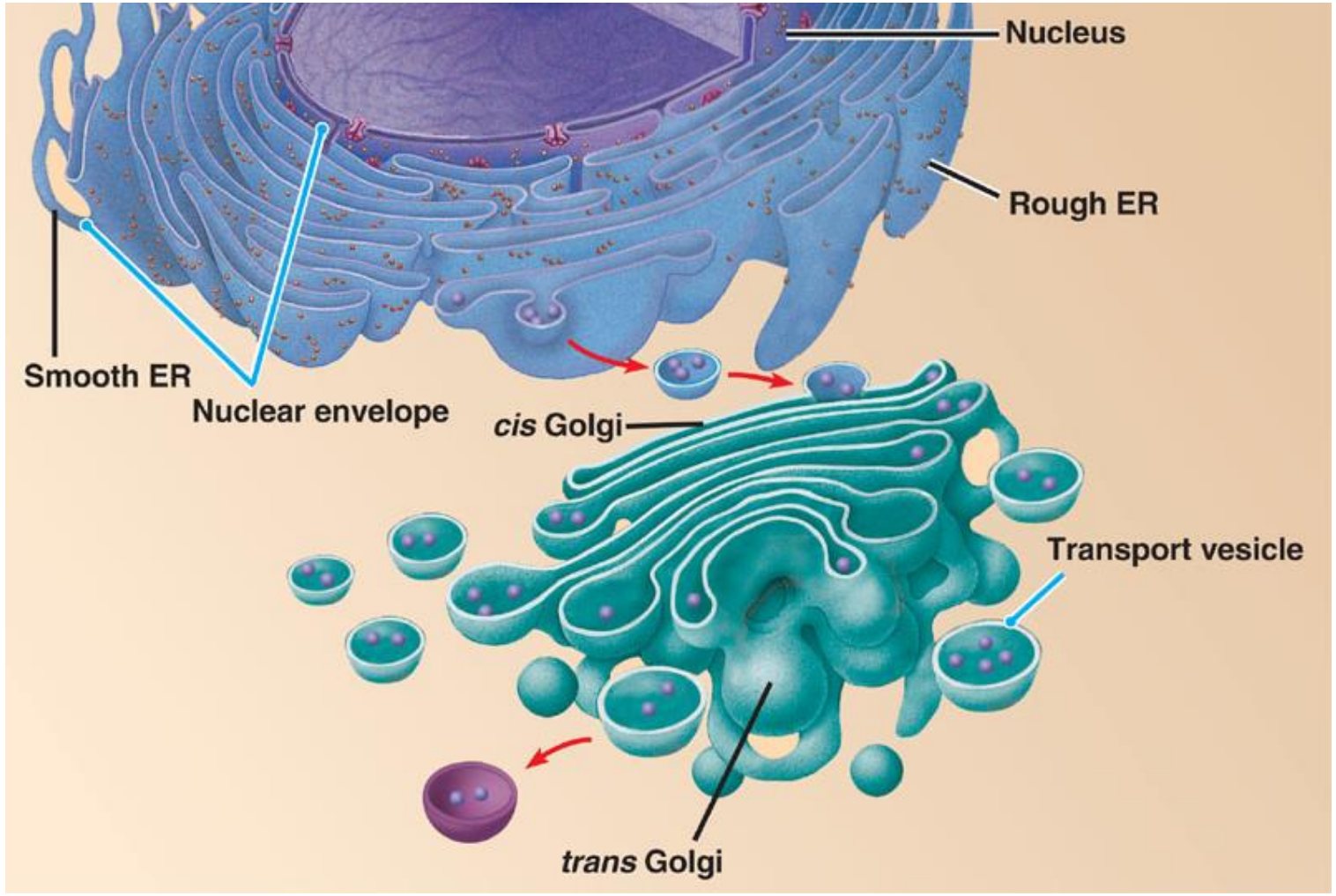
Grana: These are the sites of conversion of light energy into chemical energy.

The most important function of the chloroplast is to synthesize food by the process of photosynthesis.

Absorbs light energy and converts it into chemical energy

Chloroplast has a structure called chlorophyll which functions by trapping the solar energy and used for the synthesis of food in all green plants.

The carbon dioxide (CO2) obtained from the air is used to generate carbon and sugar during the Calvin Cycle or dark reaction of photosynthesis.



GOLGI APPARATUS

GOLGI APPARATUS

The Golgi apparatus has multiple names such as Golgi complex or Golgi body.

The name is given on the name of the scientist, who discovered the organelle, i.e. Camillo Golgi.

Its main function is the packaging and secretion of proteins

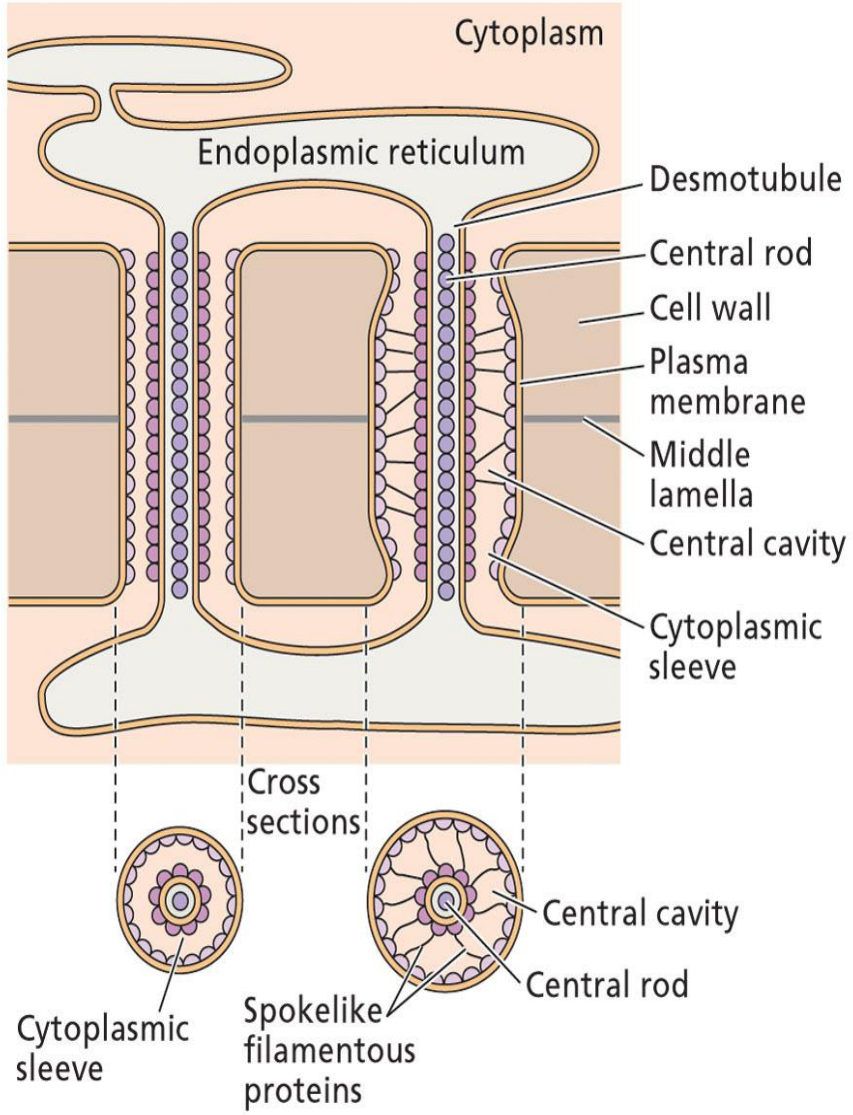
Golgi apparatus is the site for the synthesis of various glycolipids, sphingomyelin

The Vacuole

- Can be 80 – 90% of the plant cell
- Contained within a vacuolar membrane (***Tonoplast***)
- Contains:
  - Water, inorganic ions, organic acids, sugars, enzymes, and secondary metabolites.
- Required for plant cell enlargement
- The turgor pressure generated by vacuoles provides the structural rigidity needed to keep herbaceous plants upright.

Plamodesmarta

- Each contains a tube called a ***Desmotubule***, which is part of the ER.
- This is what connects adjacent cell and allow chemical communication and transport of material throughout the whole plant.
- The restriction acts to control the size of the molecules which pass through.



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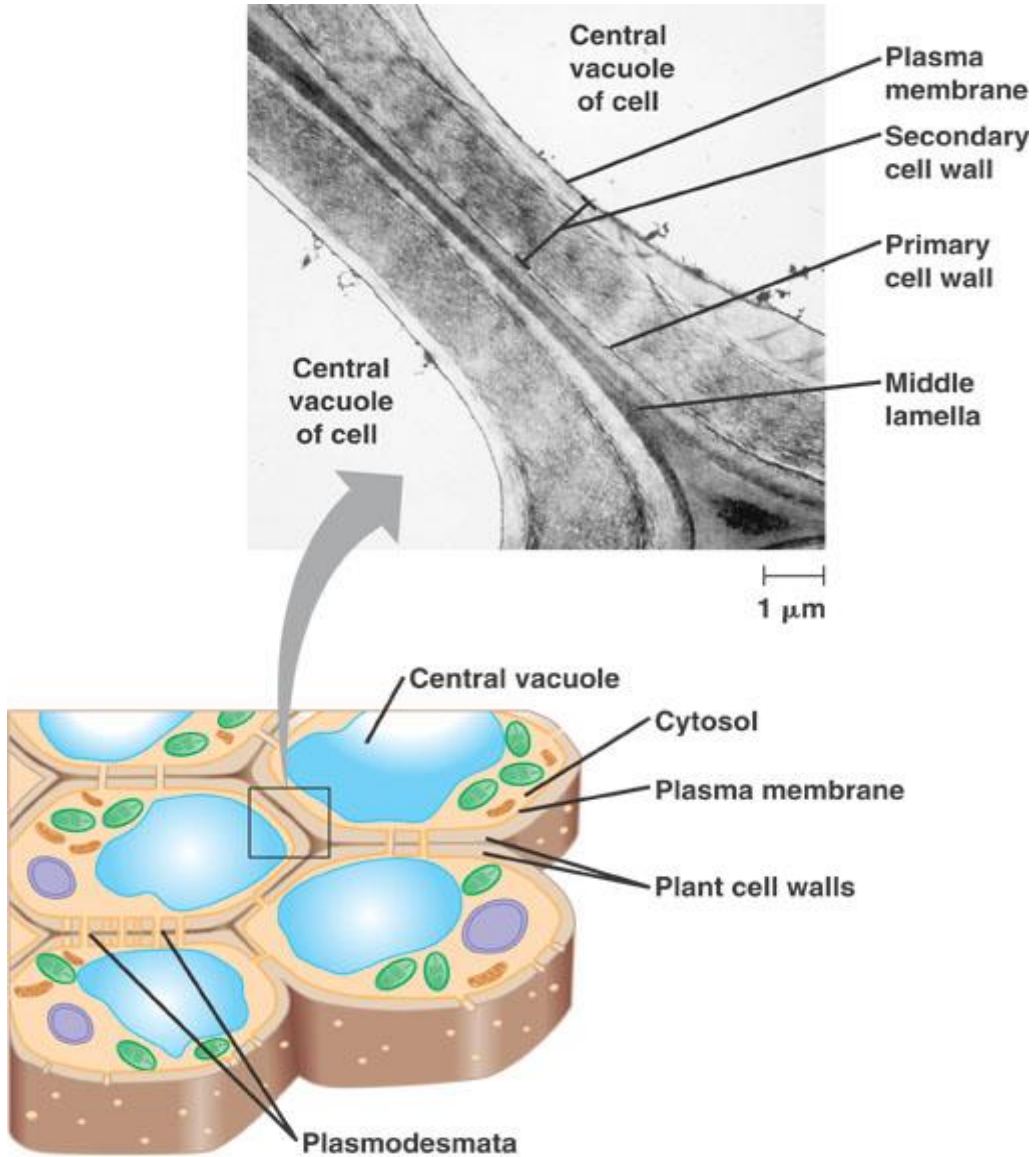
The Plant Cell wall



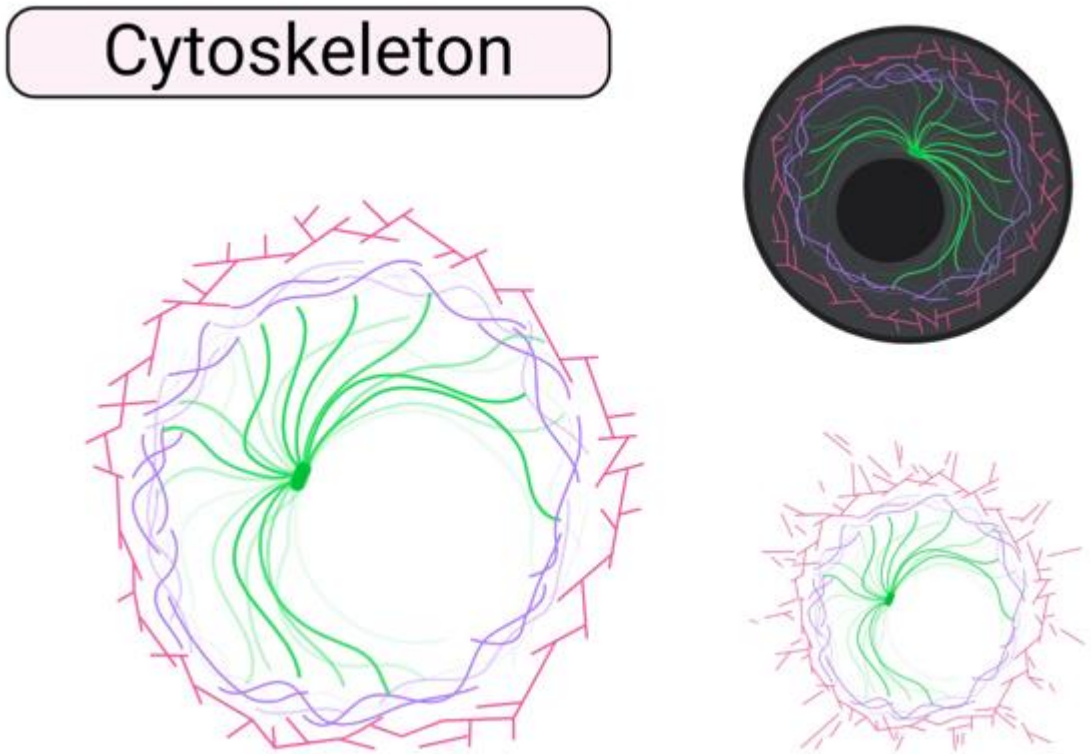
The Plant Cell wall

It is a rigid layer which is composed of cellulose, glycoproteins, lignin, pectin and hemicellulose. It is located outside the cell membrane. It comprises proteins, polysaccharides and cellulose.

The primary function of the cell wall is to protect and provide structural support to the cell. The plant cell wall is also involved in protecting the cell against mechanical stress and to provide form and structure to the cell. It also filters the molecules passing in and out of the cell.

The formation of the cell wall is guided by microtubules. It consists of three layers, namely, primary, secondary and the middle lamella. The primary cell wall is formed by cellulose laid down by enzymes.

CYTOSKELETON



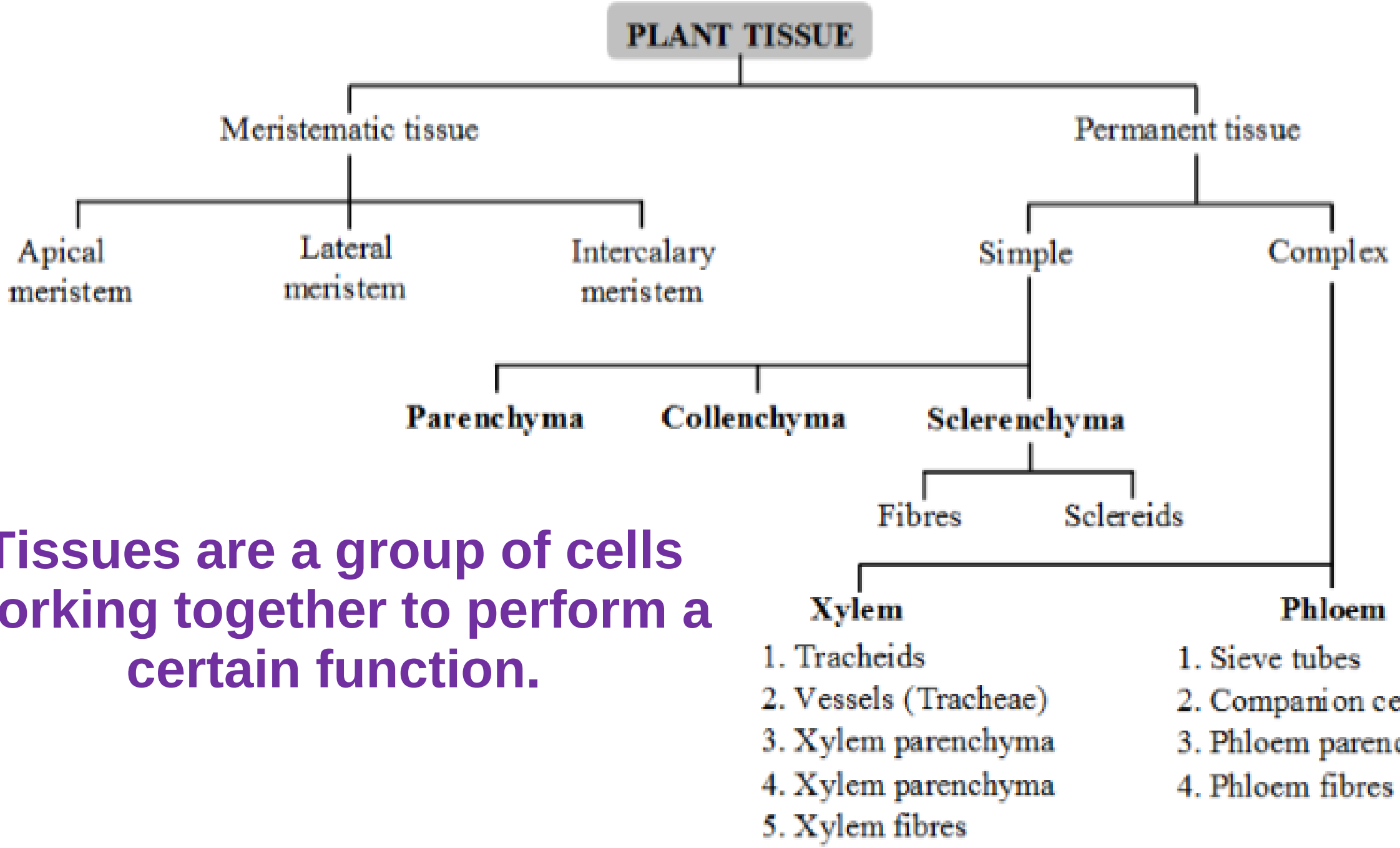
CYTOSKELETON

This is a network of microtubules and filaments that plays a primary role in maintaining the plant cell shape and giving the cell cytoplasm support and maintaining its structural organization.

Its also involved in the transportation of cellular molecules, cell division, and cell signalling activities.

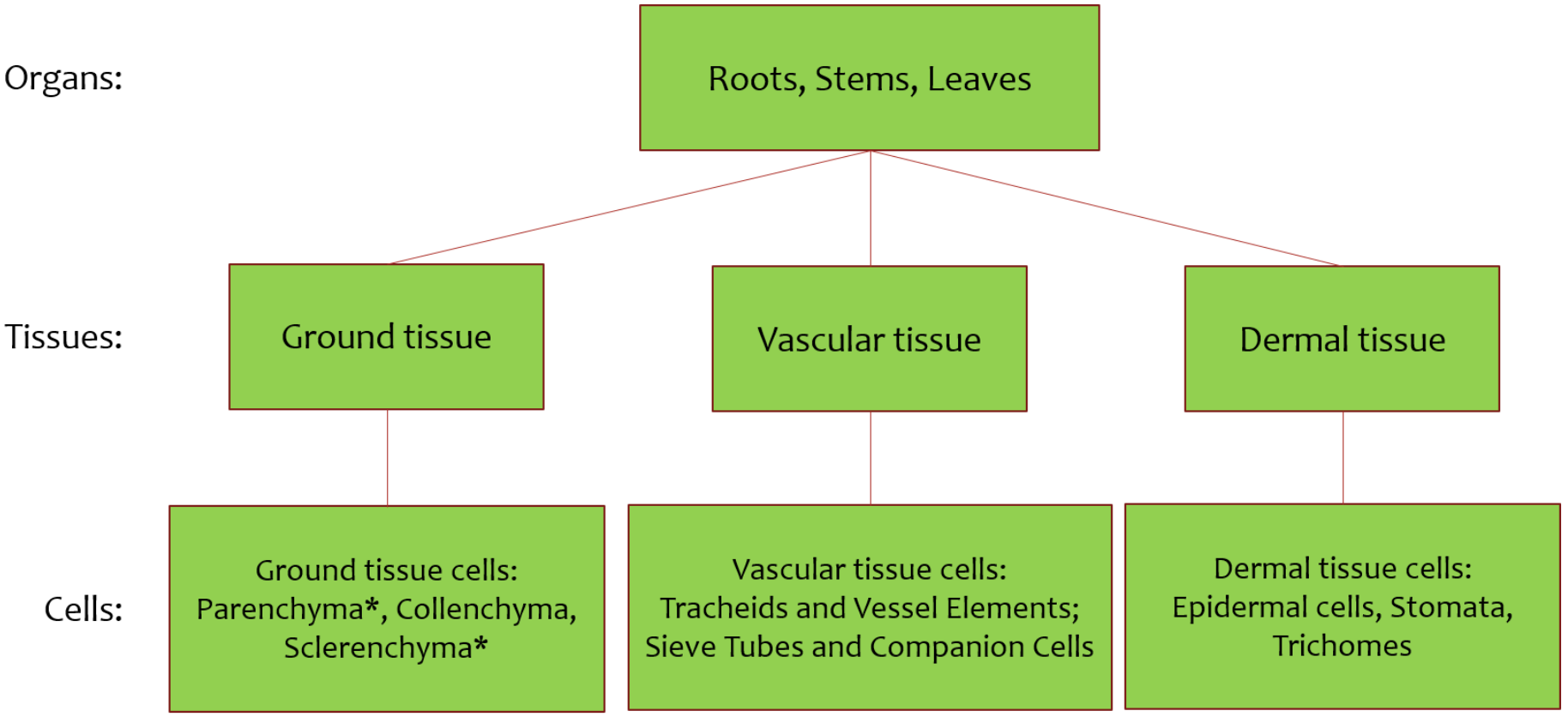
They also participate in cytoplasmic streaming, a process of cytosol flow all over the cell, transporting nutrients and cell organelles.

They play a primary role is a division of the cell cytoplasm by a mechanism known as cytokinesis, forming two daughter cells.

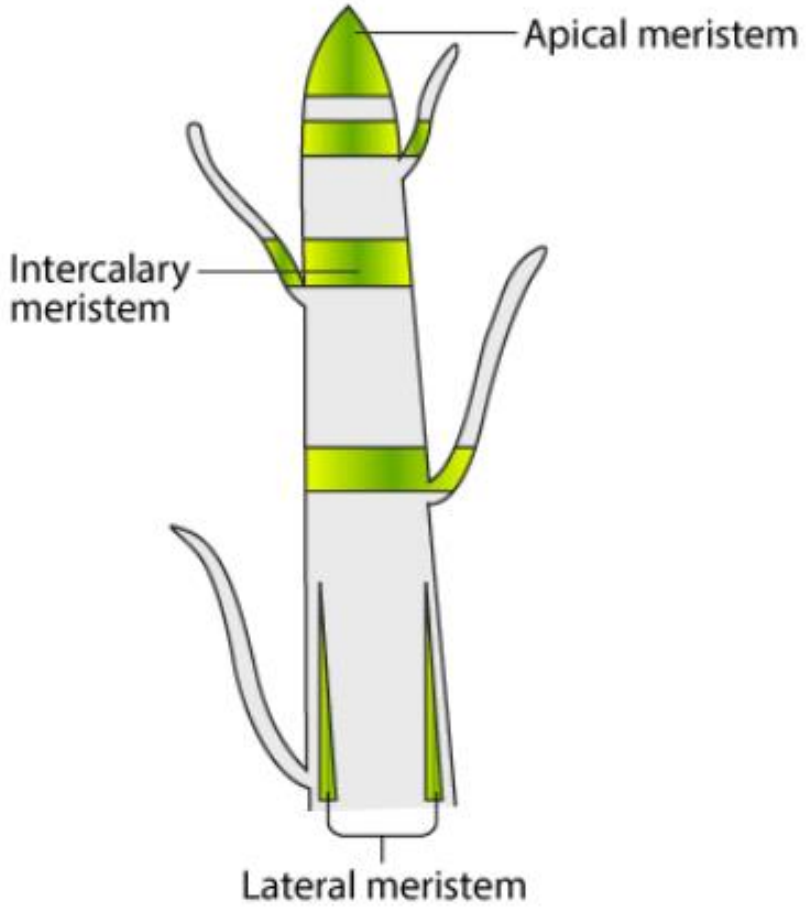


Tissues are a group of cells working together to perform a certain function.

LEVEL OF ORGANISATION



*Parenchyma and sclerenchyma are also associated with xylem and phloem (vascular tissue)


Apical meristem
Intercalary meristem
Lateral meristem

MERISTEMATIC TISSUE

The term “meristem.” was coined to meristematic tissue contains undifferentiated cells, which are the building blocks of the specialized plant structures.

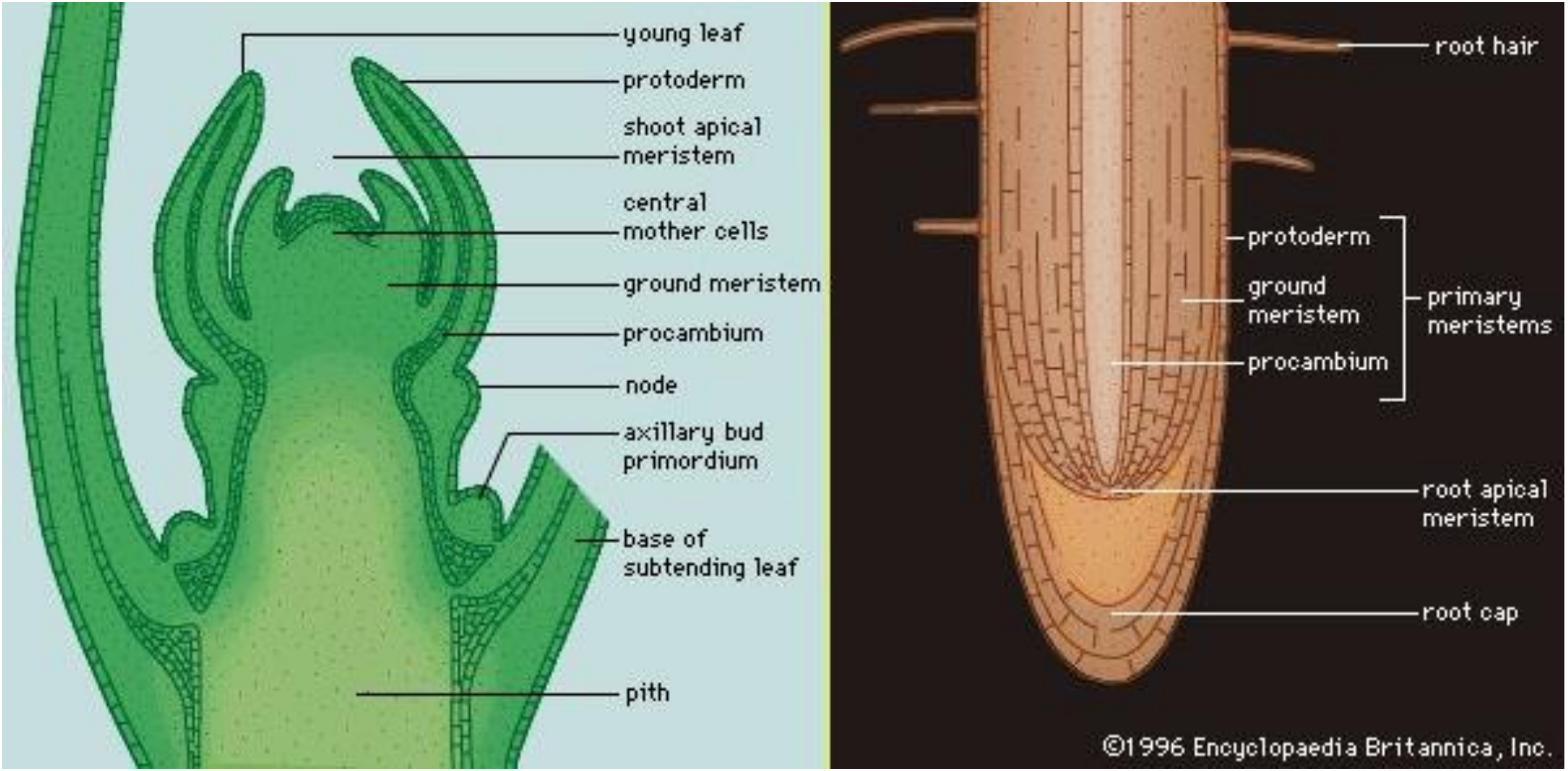
CHARACTERESTICS OF MERISTEMATIC TISSUE

- ✓ The cells of these tissues are commonly called meristems
- ✓ The meristematic tissue has the quality of self-renewal.
- ✓ Cell divides, remains identical to the parent cell.
- ✓ The others form specialized structures.
- ✓ They have very small and few vacuoles.

- ✓ The meristematic tissues heal the wounds of an injured plant.
- ✓ The cells of the meristematic tissue are young and immature.
- ✓ They do not store food
- ✓ They possess a single, large and prominent nucleus.

APICAL MERISTEM

- ✓ These are present at the tips of the roots and shoots and helps in the increase of the height of the plants.
- ✓ Various cell divisions facilitate the growth of the cells in the roots and shoots and help in cellular enlargement.
- ✓ Apical meristem is divided into-promeristem zone, which contains actively dividing cells, and the meristematic zone, which contains protoderm, procambium and ground meristem.


young leaf
protoderm
shoot apical meristem
central mother cells
ground meristem
procambium
node
axillary bud primordium
base of subtending leaf
pith
root hair
protoderm
ground meristem
procambium
primary meristems
root apical meristem
root cap
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INTERCALARY MERISTEM

- ✓ At internodes, or stem regions between the places at which leaves attach, and leaf bases.

- ✓ These help to increase the length of the internode.

- ✓ It is a part of apical meristem and adds to the height of the plant

LATERAL MERISTEM

- ✓ Lateral meristems are known as secondary meristems because they are responsible for secondary growth, or increase in stem girth and thickness.
- ✓ It is located in the stems and roots on the lateral side.
- ✓ It increases the thickness of the plant
- ✓ Vascular cambium and cork cambium are the two lateral meristems.

LATERAL MERISTEM

CLASSIFICATION OF MERISTEM BASED ON FUNCTIONS

PROTODERM: It is the outermost plant tissue and forms the epidermis. It protects the plants from any mechanical shocks.

PROCAMBIUM: It is the innermost tissue and gives rise to xylem and phloem. It helps in the transport of water and nutrients to different parts of the plant

Ground Meristem: The cells are large with thick wall. It forms the cortex, pericycle and pith

CLASSIFICATION OF MERISTEM BASED ON FUNCTIONS