Biology

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This is the grouping together of animals with similar characteristics. Animals can be classed as either vertebrates or invertebrates.

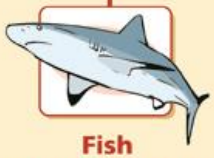
ANIMALS

VERTEBRATES

These are animals that have a backbone.

Reptiles

Have dry scaly skin.
Lay eggs on dry land.
Are cold blooded.
(Snake, Crocodile)



Fish

Have scales on their bodies.
Have gills for breathing.
Are cold blooded.
(Shark, Tuna)

Amphibians

Have moist slimy skin.
Lay eggs in water.
Are cold blooded.
(Frog, Newt)

Birds

Have feathers and wings.
Have beaks and lay eggs.
Are warm blooded.
(Wren, Swan)

Mammals

Have fur or hair.
Feed young on milk.
Are warm blooded.
(Cow, Human)

INVERTEBRATES

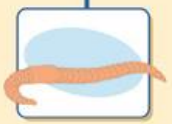
These are animals that do not have a backbone.

Protozoa

Single cell organisms all microscopic.

Flatworms

Simple and soft bodied.
(Tape worm, Flukes)



Annelid Worms

Segmented bodies.
(Earthworm, Leech)

Echinoderms

Spiny sea creatures.
(Starfish, Sea urchin)

Coelenterates

Soft bodies, stinging cells.
(Jellyfish, Sea anemone)

Arthropods

Hard external skeleton and jointed limbs.

Molluscs

Soft bodied, most have shells.
(Snails, Limpet)

Arachnids

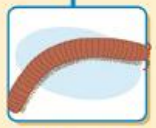
Eight legs, two body parts, no antennae.
(Spider, Scorpion)

Crustaceans

Mostly sea creatures.
Many legs and two sets of antennae.
(Crab, Lobster)

Insects

Wings, six legs, three body parts, one pair of antennae.
(Bee, Ladybird)



Myriapods

Many legs and body segments.
(Centipede, Millipede)

Plants Classification

The past taxonomic literature described three types of systems of classification:

1. Artificial Classification: Based on few easily observable character like Linnaeus System, i.e. trees, shrubs, herbs, etc. or floral characters (particularly the number of stamens and carpels).

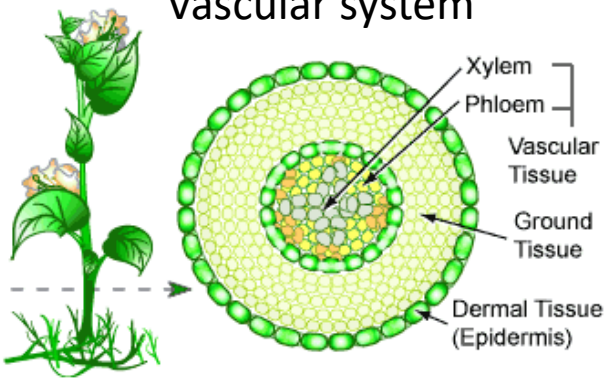
2. Natural Classification: These systems of classifications are based upon overall resemblances, mostly in gross morphology, thus, utilizing as many taxonomic characters as possible, to group taxa. Thus, the closely related plants should naturally be grouped together. Based on wide array of characters like Bentham and Hooker System (Dicot, Monocot and gymnosperm)

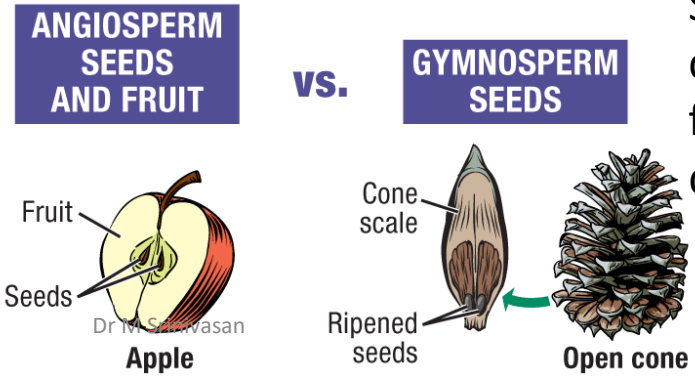
3. Phylogenetic Classification: Based on many taxonomic characters as possible in addition to the evolutionary interpretations like Engler and Prantle's system of classification

Thalophytes
Algae
Sea weeds

- Plants
  - Non-plant bodies (Thalophytes)
  - Differentiated Plant bodies
    - Vascular
      - Seed
        - Angiosperm
          - Flowering Plant
            - Monocots
            - Dicots
        - Gymnosperm
          - Non-flowering plants
            - Cycas
            - Cycad, ginkgo
            - Conifers
            - Pine
      - Spore
        - Pteridophyta
          - Spikemosses, clubmosses, ferns, quillworts
    - Non-vascular
      - Bryophyta
        - Liverwort
        - Moss

Vascular system



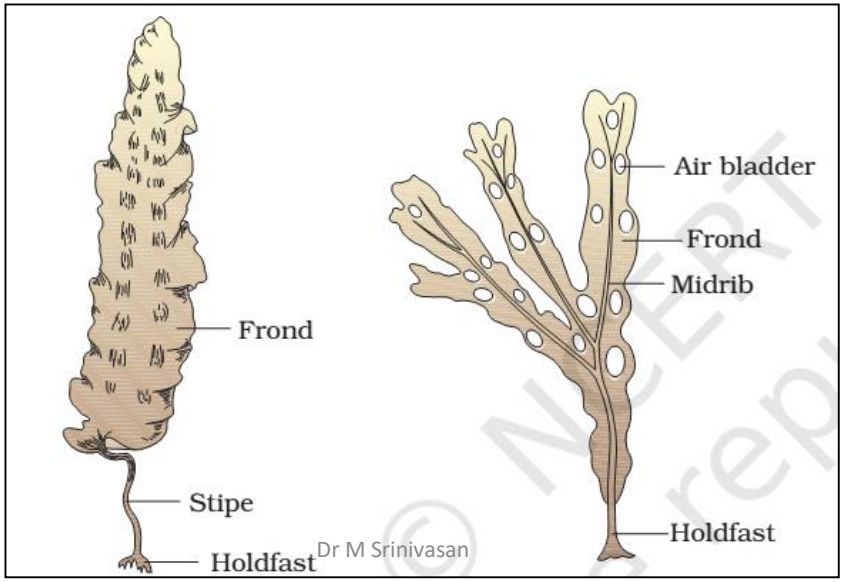


Plant Classification - Thallophytes

- This is a group of non-mobile organisms traditionally described as "thalloid plants", "relatively simple plants" or "lower plants“
- The thallophytes are defined as having undifferentiated bodies (thalli) Eg Algae

Brown Algae ***Laminaria*** ***Fucus***

Algae



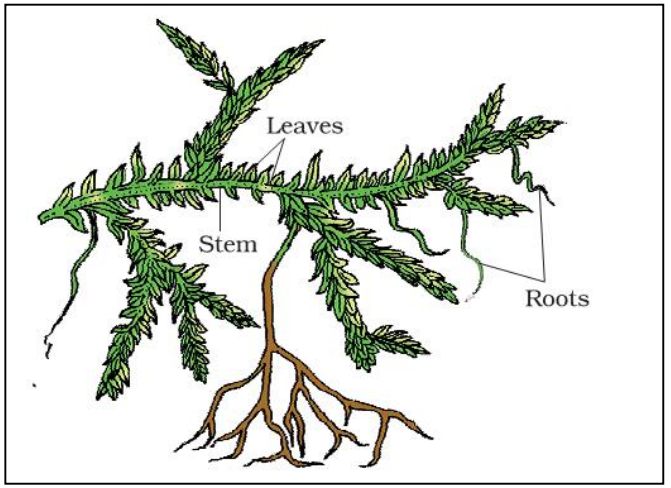
Lichens

Plant Classification - **Bryophytes**

- They do not have true vascular tissue and are therefore called "non-vascular plants
- This group is a collective term for mosses, hornworts, and liverworts
- They produce neither flowers nor seeds and reproduce via spores
- They are also called as amphibians of the plant kingdom because these plants can live in soil but are dependent on water for sexual reproduction

Plant Classification - Pteridophytes

- These are vascular plants (plants with xylem and phloem) that reproduce and disperse via spores
- The group includes ferns, mostly found in shaded areas of the hills

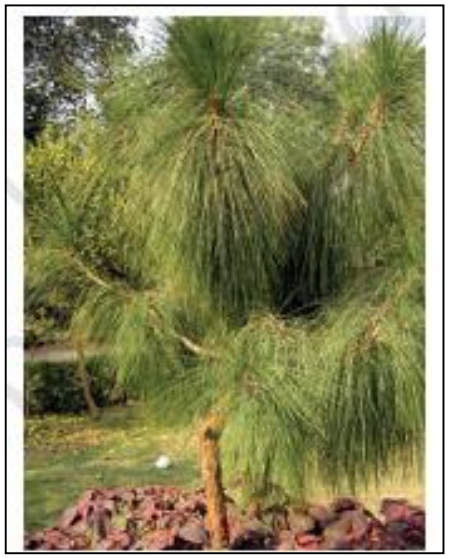


Selaginella

Plant Classification - Gymnosperm

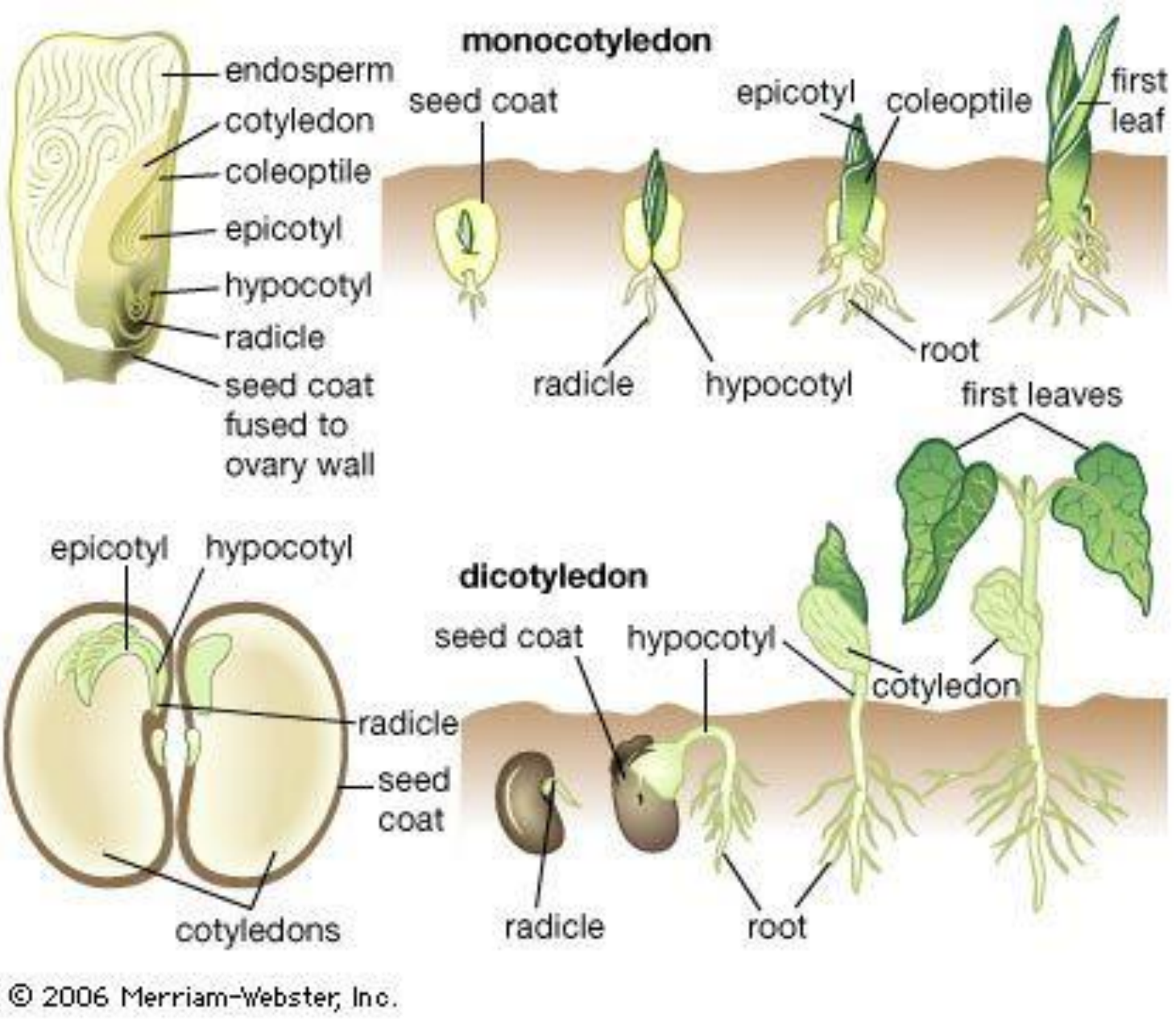
- These are the plants in which seeds are naked means they are not covered with seed envelop or covering
- They include medium-sized or tall trees
- One of the gymnosperms, the giant redwood tree *Sequoia* is one of the tallest tree species
- The leaves in gymnosperms are well-adapted to withstand extremes of temperature, humidity and wind
- Leaves have thick covering known as cuticle and sunken stomata that help to reduce water loss

Pinus



Plant Classification - Angiosperm

- These are the flowering plants where seeds are covered with fruit
- These are exceptionally large group of plants occurring in wide range of habitats
- They provide us with food, fodder, fuel, medicines and several other commercially important products
- They are divided into two classes: the dicotyledons (Dicots) and the monocotyledons (Monocots)
- The dicotyledons are characterized by having two cotyledons in their seeds while the monocolyledons have only one


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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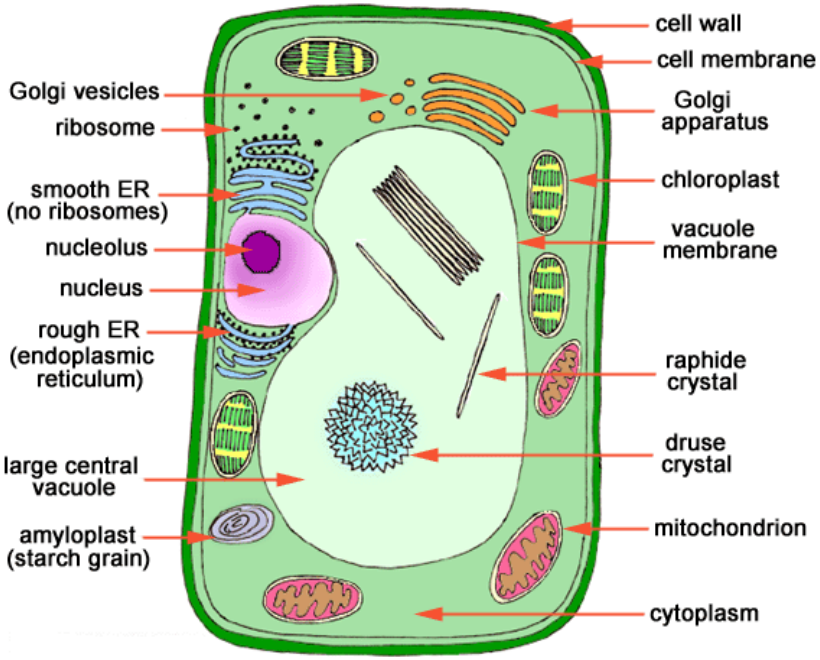
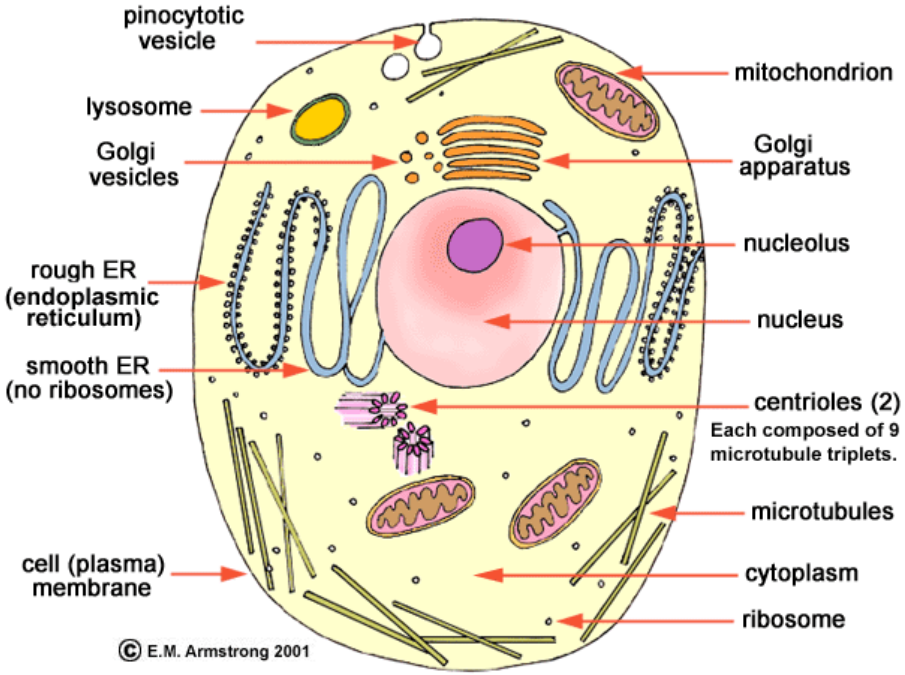
Eukaryotic cell – Origin

- The set of ideas most favored by biologists to explain how eukaryotic cells first came about is called the endosymbiotic theory
- The eukaryotic cell evolved from a symbiotic community of prokaryotic cells
- Specifically, the mitochondria and the chloroplasts are what remains of ancient symbiotic oxygen-breathing bacteria and cyanobacteria, respectively, whereas the rest of the cell seems to be derived from an ancestral archaean cell
- The origin of the eukaryotic cell was a milestone in the evolution of life
- Although eukaryotes use the same genetic code and metabolic processes as prokaryotes, their higher level of organizational complexity has permitted the development of truly multicellular organisms

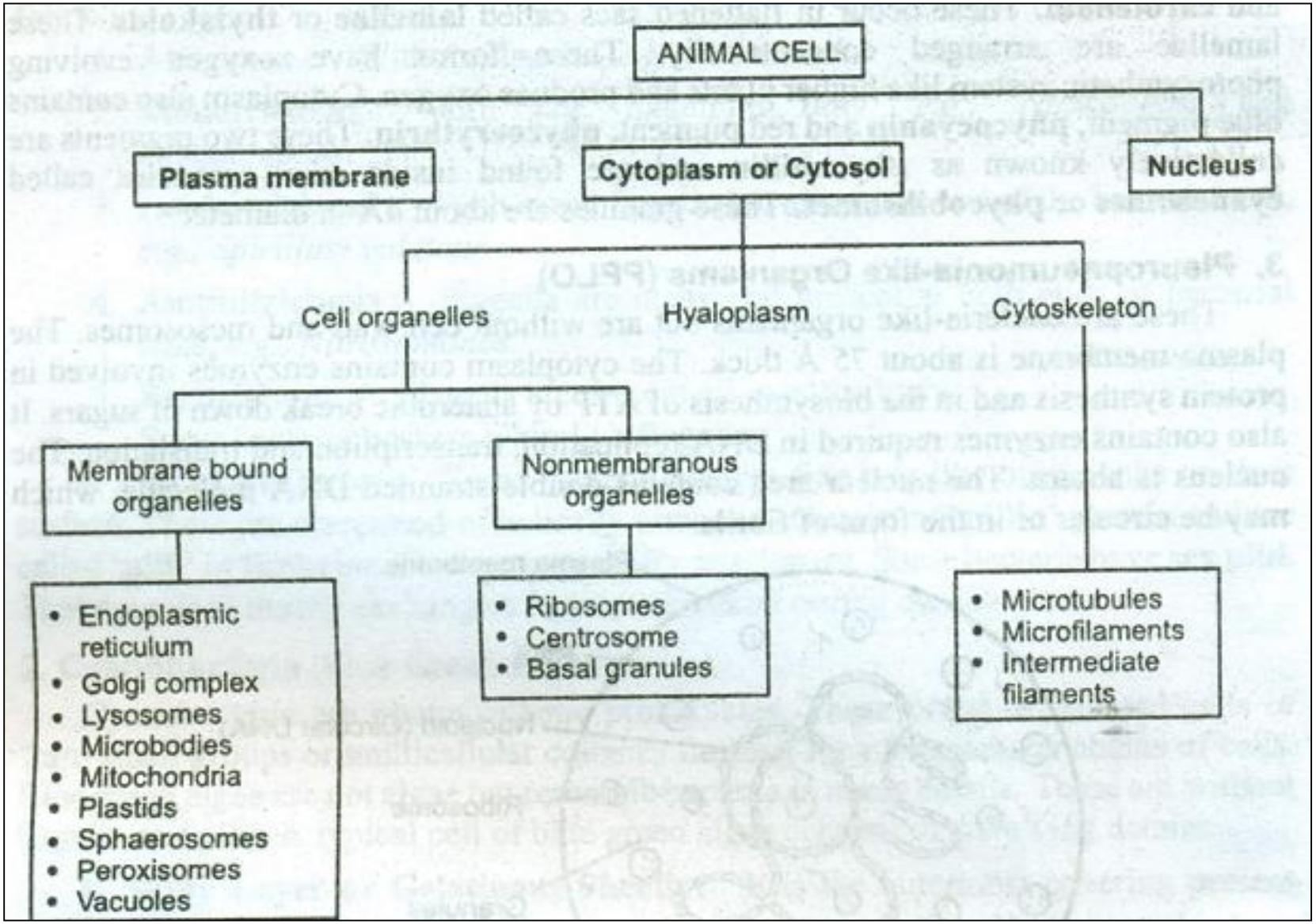
Eukaryotic cell





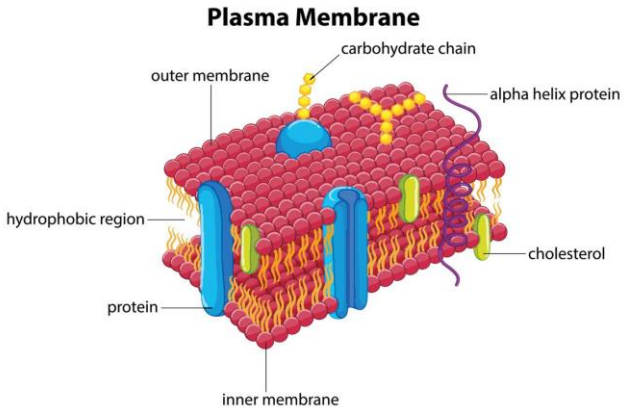
Eukaryotic cell – Animal cell

- All animal cells are multicellular
- Animal cells are surrounded by plasma membrane and it contains the nucleus and organelles that are membrane bound
- Animal cells are of various sizes and have irregular shapes
- Most of the cells size range between 10 and 100 micrometers and are visible only with help of microscope
- Trillions of cells are found in the human body
- There are many different types of cells, approximately 210 distinct cell types in adult human body
- Animal cells lack cell wall, a large vacuole and plastids

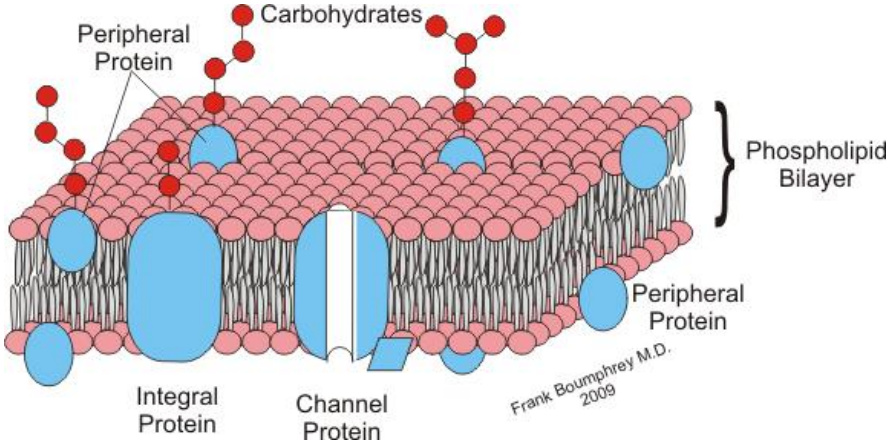

ANIMAL CELL
Plasma membrane
Cytoplasm or Cytosol
Nucleus
Cell organelles
Hyaloplasm
Cytoskeleton
Membrane bound organelles
Nonmembranous organelles
• Endoplasmic reticulum
• Golgi complex
• Lysosomes
• Microbodies
• Mitochondria
• Plastids
• Sphaerosomes
• Peroxisomes
• Vacuoles
• Ribosomes
• Centrosome
• Basal granules
• Microtubules
• Microfilaments
• Intermediate filaments

Plasma Membrane

- It is a semi-permeable barrier, allowing only a few molecules to move across it
- Electron microscopic studies of cell membrane shows the lipid bi-layer model of the plasma membrane, it also known as the fluid mosaic model (Singer and Nicolson Model, 1972)
- The cell membrane is made up of phospholipids which has polar (hydrophillic) heads and non-polar (hydrophobic) tails



Plasma Membrane



- Outer limit of cells
- Thickness of 8nm
- Dynamic structure with distinct inside and outside faces
- Presence of cholesterol is specific to animal cells
- Transportation – Passive and active transport
- Bulk transportation – endocytosis and exocytosis
- Cell recognition – glycoprotein and glycolipids
- Intercellular junctions

Nucleus

- Contains DNA
- In resting phase cells diffusive DNA is seen
- In M Phase, chromosome structure appears
- Histone proteins are involved in packing DNA
- Nuclear pore – Small pore in nuclear envelope that allow movement of molecules

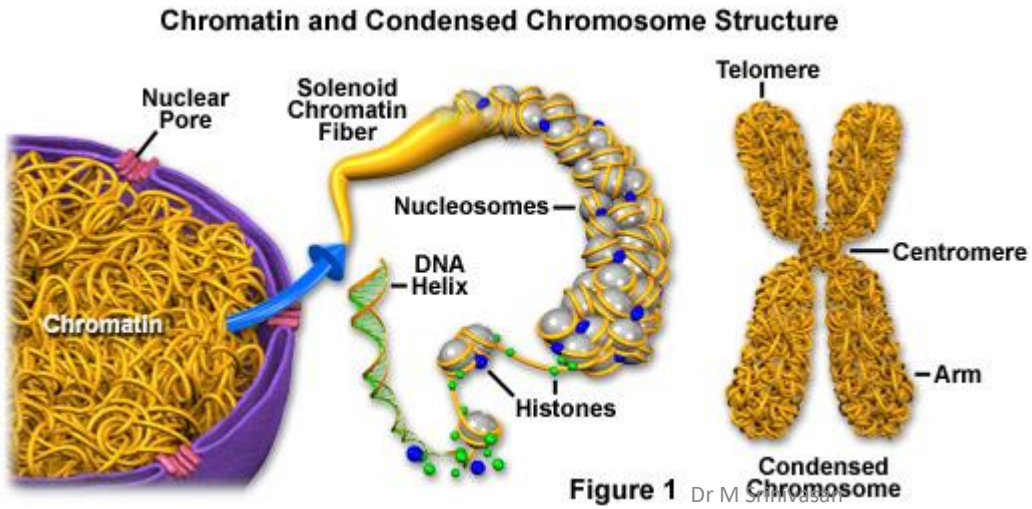
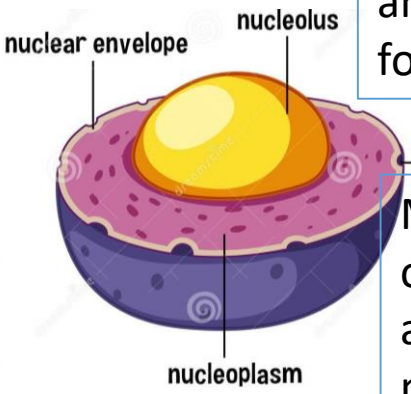


Figure 1



Ribosome and rRNA formation

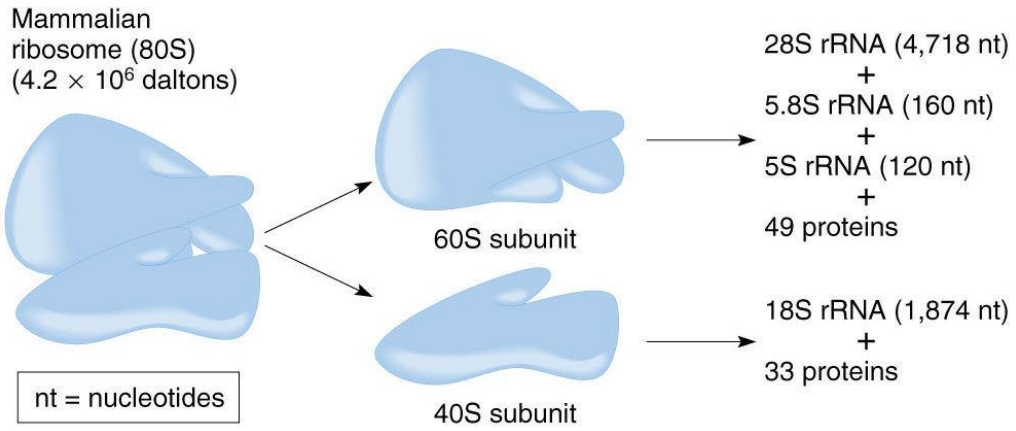
Movement of protein and other molecules

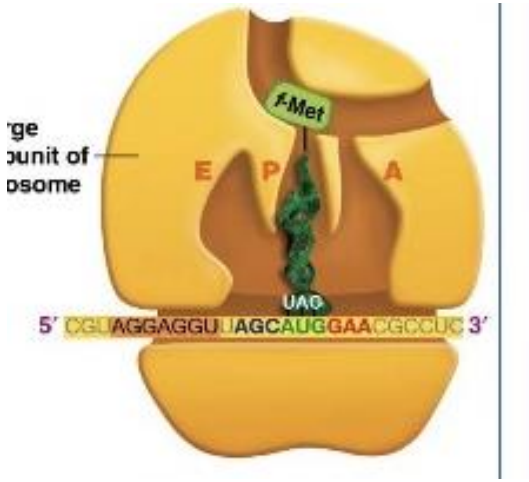
Cytoplasm

- The fluid matrix that fills the cell is the cytoplasm
- Colorless, slimy, thick and transparent colloidal
- 90% water and solutes (sugar, amino acids, enzymes, nucleotides, ATP and dissolved gases)
- Site for biochemical reactions
- Microtubules and microfilaments
- The cellular organelles are suspended in this matrix of the cytoplasm
- This matrix maintains the pressure of the cell, ensures the cell doesn't shrink or burst

Ribosome

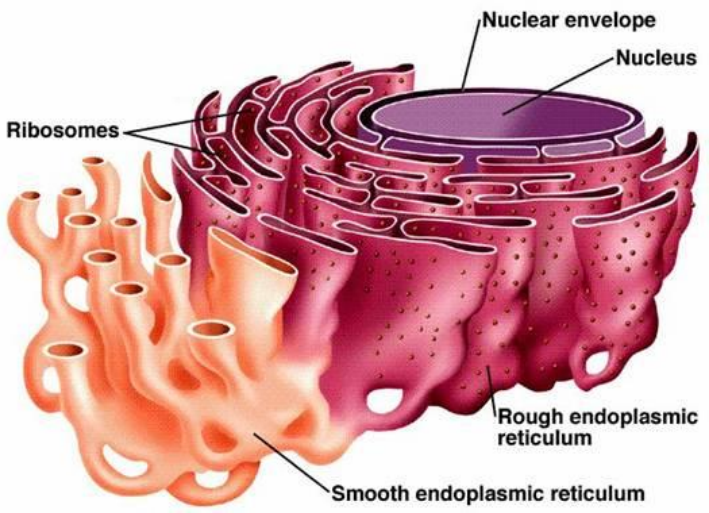
- Free floating or attached to endoplasmic reticulum
- Site for protein synthesis





Endoplasmic reticulum

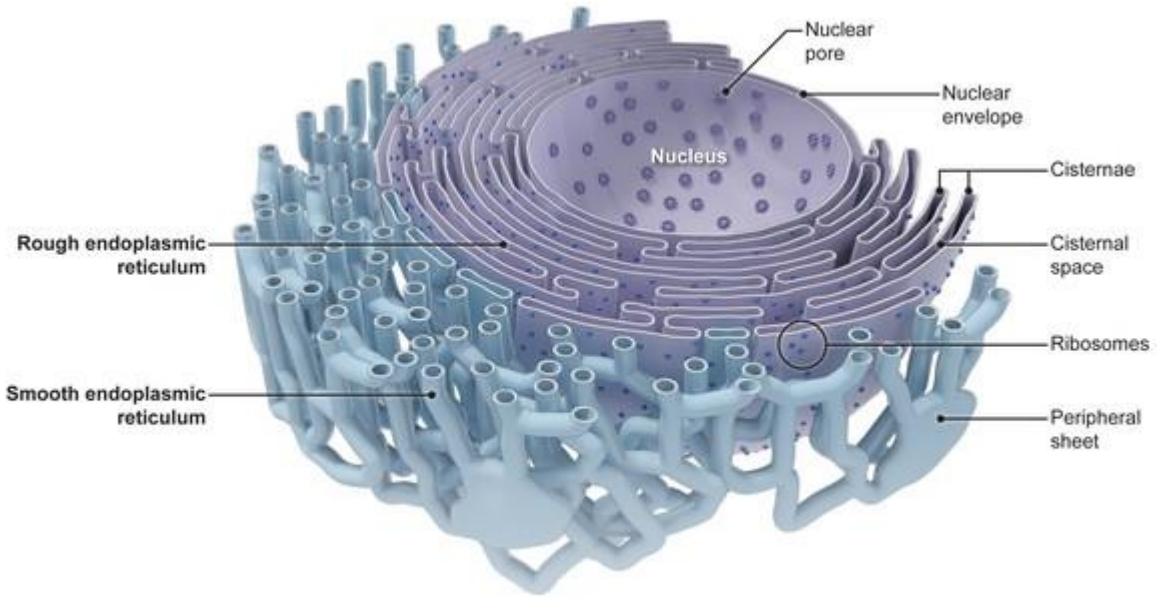
- ER is the transport system of the cell
- Double membrane structure
- It transports molecules that need certain changes and also molecules to their destination
- ER is of two types, rough and smooth
- ER bound to the ribosomes appear rough and is the rough endoplasmic reticulum; while the smooth ER do not have the ribosomes



Endoplasmic reticulum

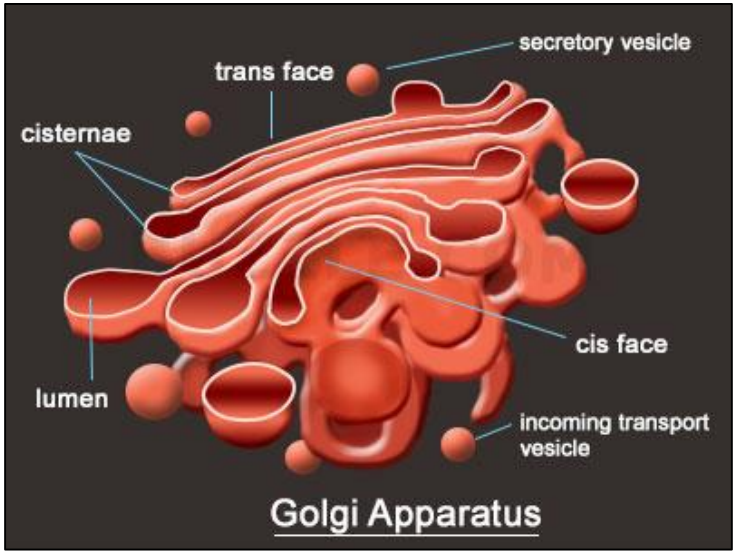
- The endoplasmic reticulum is a part of the endomembrane system which includes the nuclear envelope, Golgi apparatus, vacuole, lysosome and plasma membrane.
- These membranous structures are very dynamic, and they form a network between nucleus, cytoplasm and plasma membrane.
- The vesicular structure and flattened sacs called cisterna and sheets, respectively.
- Cisterna forms the transport vesicles by pinching of the endoplasmic reticulum vesicles.
- Since the ribosomes synthesise protein, the rough endoplasmic reticulum actively produces protein required for the cells and aid in protein folding and they produce vesicles that help in trafficking protein to their destinations.
- In the smooth endoplasmic reticulum, lipid synthesis, carbohydrate metabolism, detoxification of drug and poison, and calcium ion storage occurs.
- An extensive network of smooth endoplasmic reticulum is seen in liver cells, which is related to the liver's ability to detoxify the drugs, similarly, as in the case of muscle cells which store calcium in the smooth endoplasmic reticulum.

Endoplasmic reticulum



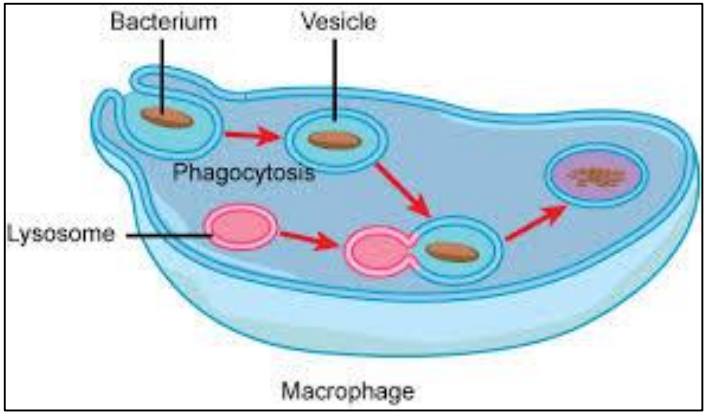
Golgi bodies

- Double membrane organelle
- They are flattened stacks of membrane-bound sacs (Cisternae)
- Golgi bodies are the packaging center of the cell
- The Golgi bodies modify the molecules from the rough ER by dividing them into smaller units with membrane known as vesicles
- Protein modification
- Lipid transportation and lysosome formation
- Carbohydrate modifications



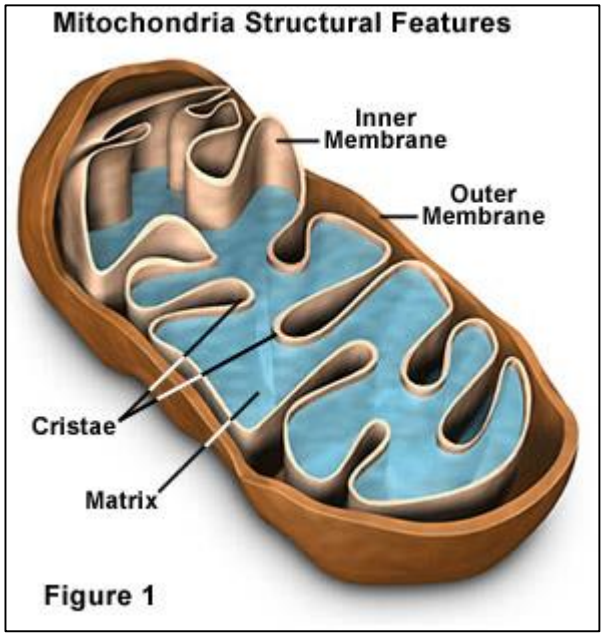
Lysosome

- It is the digestive system of the cell, with a acidic pH in their lumen, size - 0.1 µm to 1.2 µm
- They have digestive (hydrolytic) enzymes helps in breakdown the waste molecules and help in detoxification of the cell
- If the lysosomes were not membrane bound the cell could not have used the destructive enzymes
- Autophagy
- Breakdown of biomolecules
- Recycling cellular waste



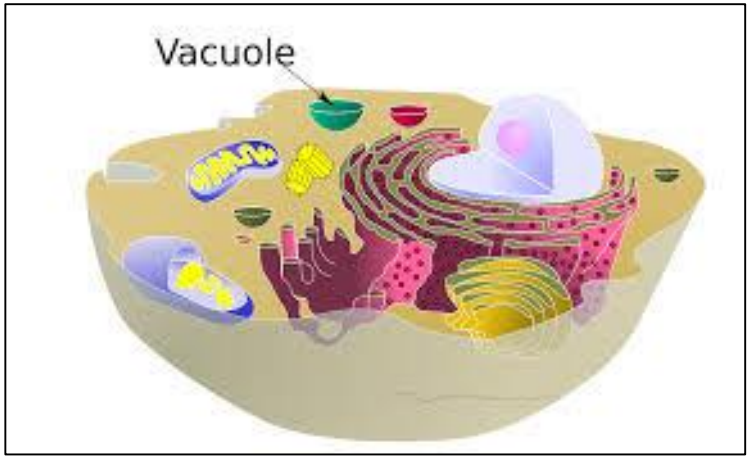
Mitochondria

- It is spherical or rod-shaped organelle within the size range of 0.5 t0 10μm
- Mitochondria is the main energy source of the cell
- They are called the power-house of the cell because energy(ATP) is created here
- Mitochondria consists of inner and outer membrane
- It is an organelle which is independent as it has its own hereditary material.
- TCA cycle and Electro transport chain occurs in mitochondria



Vacuoles

- They are bound by single membrane and small organelles
- In many organisms vacuoles are storage organelles
- Vesicles are smaller vacuoles which function for transport in/out of the cell



Peroxisomes

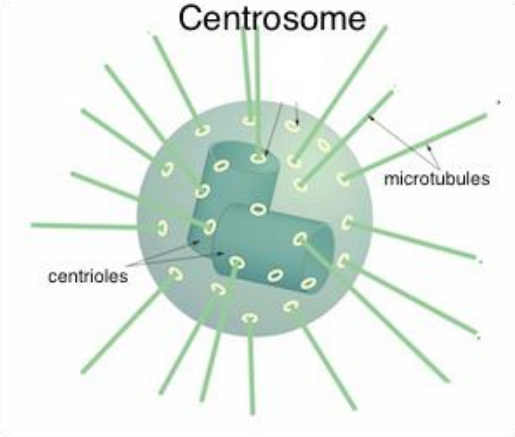
- Peroxisomes are single membrane bound organelle that contain oxidative enzymes that are digestive in function

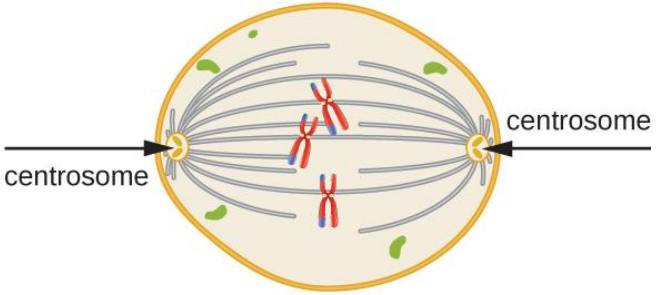
- They help in digesting long chains of fatty acids and amino acids and help in synthesis of cholesterol

Centrosome

It is located near the nucleus of the cell and is known as the 'microtubule organizing center' of the cell

- Two centrioles are present in a centrosome
- Microtubules are made in the centrosome
- During mitosis the centrosome aids in dividing of the cell and moving of the chromosome to the opposite sides of the cell

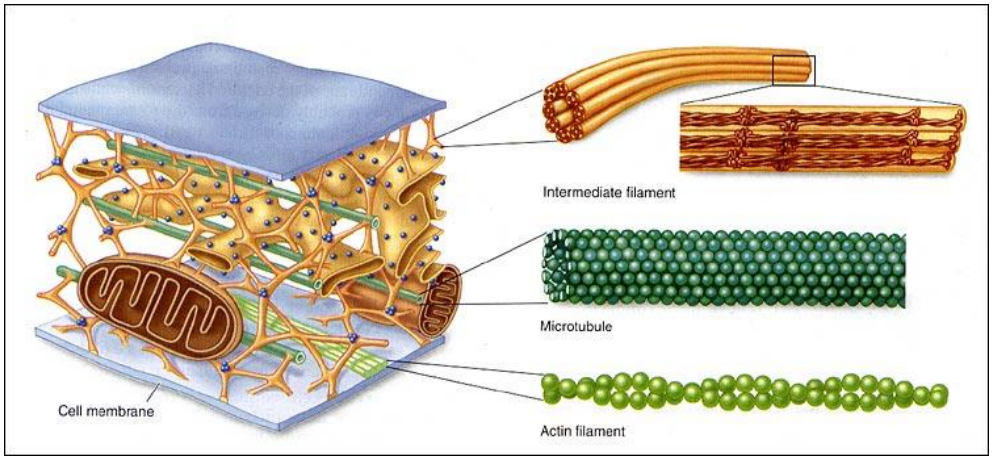




(b)

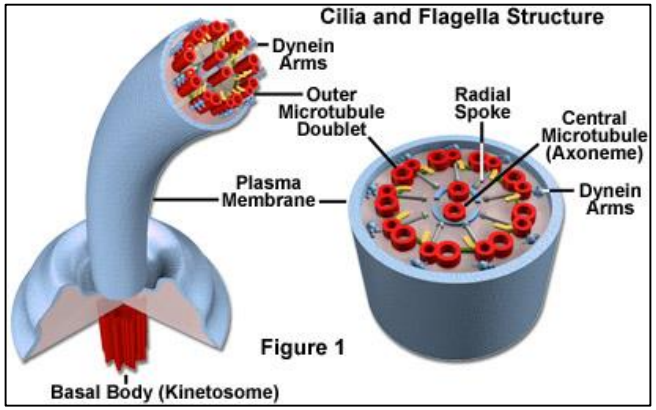
Cytoskeleton

- It is the network of intermediate filaments, microtubules and microfilament fibers
- They give structural support and maintain the shape of the cell
- Help in transportation of vesicles, cell migration, cell division and chromosomal segregation
- Intracellular transport, muscle contraction



Cilia and flagella

- Cilia and flagella are structurally identical structures
- They are different based on the function they perform and their length
- Cilia are short and are in large number per cell while flagella are longer and are fewer in number
- They are organelles of movement
- The flagellar motion is undulating and wave-like whereas the ciliary movement is power stroke and recovery stroke



Animal cell function

Cell membrane - forms the outer covering of the cell, and is semi-permeable

Cytoplasm - is a gel-like matrix where all the other cell organelles are suspended inside the cell

Nucleus - contains the hereditary material DNA and directs the activities of the cell

Centrioles - organize the microtubules assembly during cell division

Endoplasmic Reticulum - are a network of membranes composed of rough and smooth endoplasmic reticulum

Golgi *complex* - is responsible for storing, packaging of cellular products

Lysosomes - are enzyme sacs, that digest cellular wastes

Microtubules - are hollow rods, function primarily as support and shape to the cell

Mitochondria - is the site for cellular respiration and producers of energy

Ribosomes - are made of RNA and proteins, and are sites for protein synthesis

Nucleolus - is the structure within the nucleus and helps in synthesis of rRNA and ribosome

Eukaryotic cell – Plant cell

- **Plant cells are eukaryotic cells that differ in several key aspects from the cells of other eukaryotic organisms**

- **Their distinctive features include:**
  - **A large central vacuole, a water--filled volume enclosed by a membrane known as the Tonoplast that maintains the cell's turgor, controls movement of molecules in the cytosol, stores useful material and digests waste proteins and organelles**
  - **A cell wall composed of cellulose and hemicellulose, pectin and in many cases lignin is secreted by the protoplast on the outside of the cell membrane**
  - **This contrasts with the cell walls of fungi (which are made of chitin), and of bacteria, which are made of peptidoglycan**
  - **Specialized cell-to-cell communication pathways known as plasmodesmata, pores in the primary cell wall through which the plasmalemma and endoplasmic reticulum of adjacent cells are continuous**

- Plastids, the most notable being the chloroplast, which contains chlorophyll, a green-colored pigment that absorbs sunlight, and allows the plant to make its own food in the process known as photosynthesis

- Other types of plastids are the amyloplasts, specialized for starch storage, elaioplasts specialized for fat storage, and chromoplasts specialized for synthesis and storage of pigments

- As in mitochondria, which have a genome encoding 37 genes, plastids have their own genomes of about 100–120 unique genes and, it is presumed, arose as prokaryotic endosymbionts living in the cells of an early eukaryotic ancestor of the land plants and algae

- The sperm of bryophytes and pteridophytes, Cycads and Ginkgo have flagella/cilia similar to those in animals, but higher plants, (including Gymnosperms and flowering plants) lack the flagella and centrioles that are present in animal cells

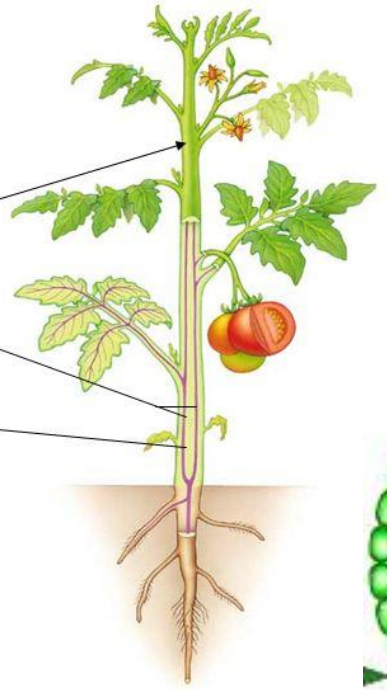
Plant tissue

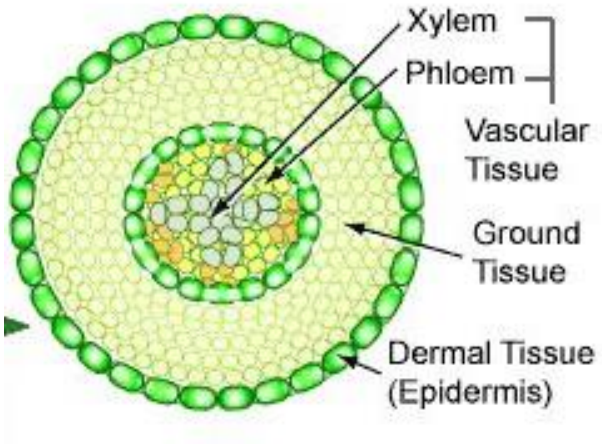
Three Types of Plant Tissues:

1) Dermal Tissue - covers and protects

2) Vascular Tissue - distribute H2O and solutes

3) Ground Tissue - makes up bulk of plant body

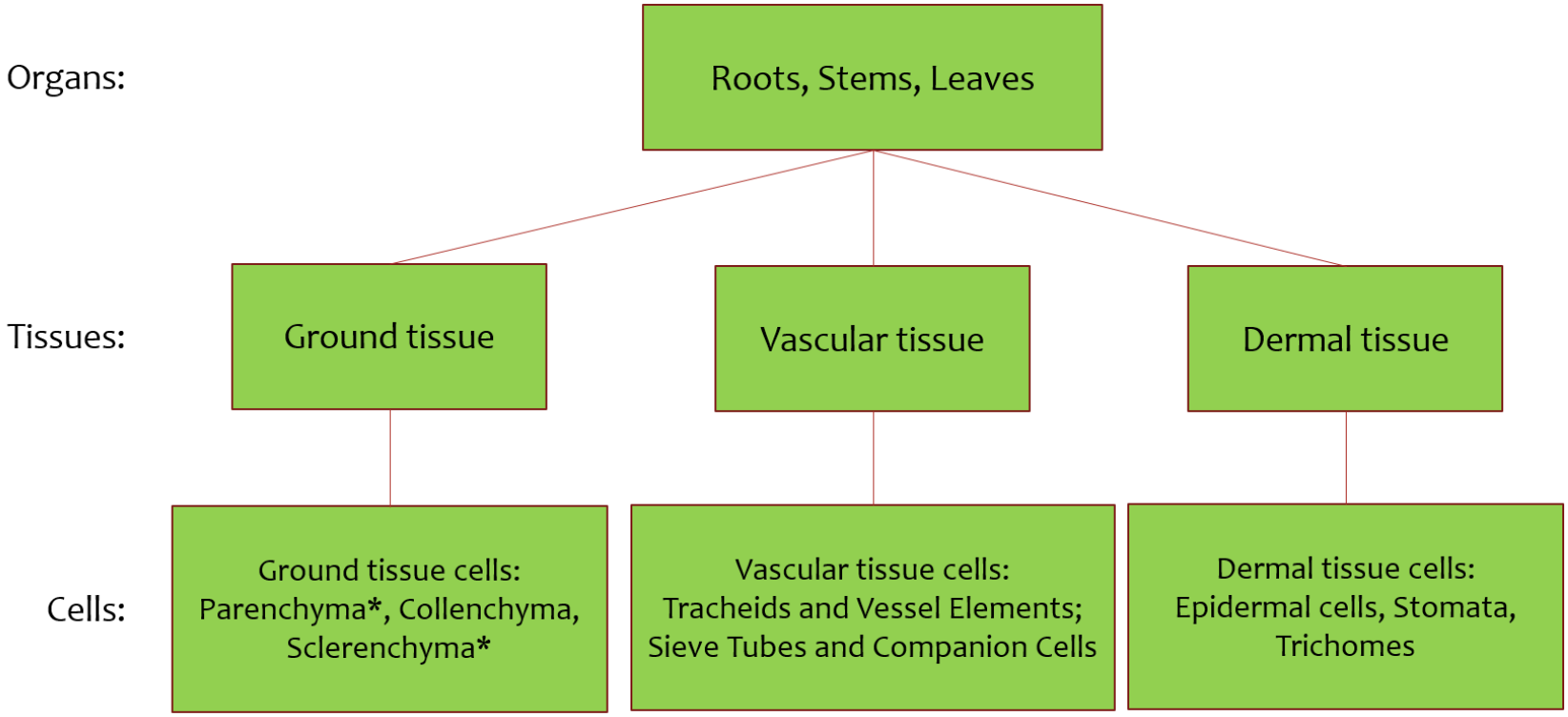




Where do these tissues originate from?

Meristem Tissues

- Cells dividing constantly (mitosis)
- Two locations: * Apical
  * Lateral



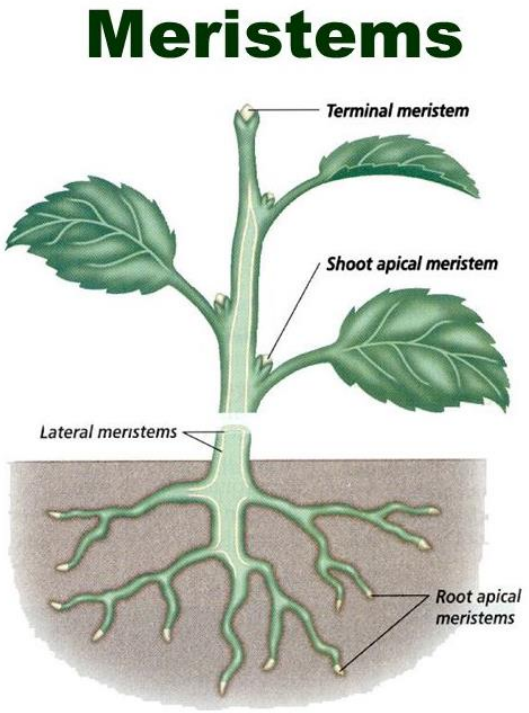
*Parenchyma and sclerenchyma are also associated with xylem and phloem (vascular tissue)

Plant cell - Types

- As a plant matures, its cells become specialized, there are a number of important specialized types of plant cells
- Some examples of specialized plant cells include:

Meristematic Cells

- These cells give rise to all three fundamental mature cell types
- Their major function is cell division
- The walls are thin, the vacuole is largely missing, the plastids are immature, etc.



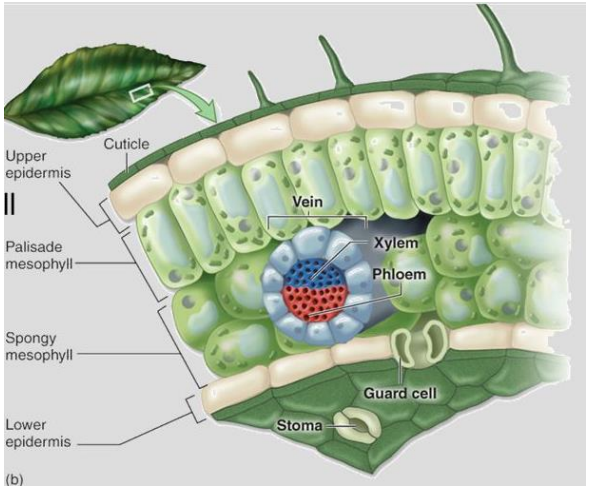
Plant cells – ground tissue

Parenchyma Cells

- Parenchyma cells make up the bulk of the soft parts of plants, including the insides of leaves, flowers and fruits
- These cells are the biochemistry machines of the plant because most of the plant's metabolism takes place in these cells
- These cells synthesize and store organic products in the plant
- They are alive at maturity and are specialized in any number of structural and biochemical ways

Plant cells – ground tissue

- Other than support functions, this cell type is the basis for all plant structure and function
- Parenchyma cells have thin primary walls, and highly functional cytoplasm
- For example, leaf is composed of parenchyma cells where these are specialized for light penetration or regulating gas exchange



Plant cells – ground tissue

Collenchyma Cells

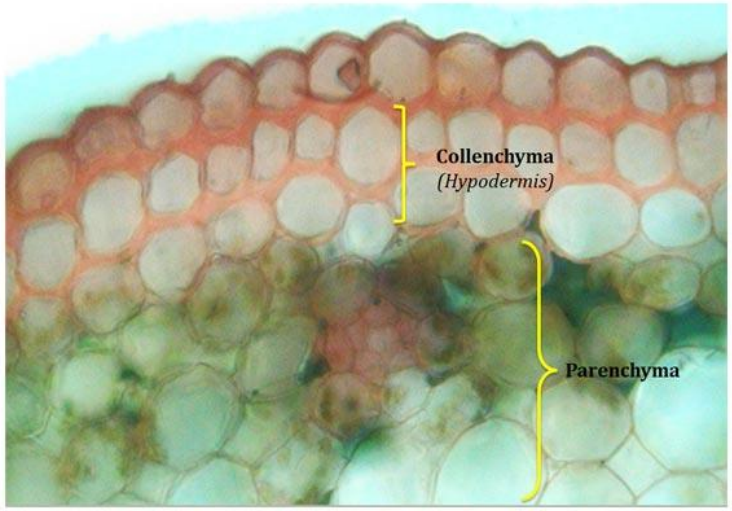
- Support function in plants, particularly in young plants
- These cells help to support plants while not restraining growth due to their lack of secondary cell walls and the absence of a hardening agent in their primary cell walls
- These cells mature from meristem derivatives
- Plastids do not develop and secretory apparatus (ER and Golgi) proliferates to assist in the accumulation of additional primary wall

Plant cells – ground tissue

- The role of this cell type is to support the plant in areas still growing in length
- The primary wall lacks lignin that would make it brittle, so this cell type provides what could be called plastic support
- Support that can hold a young stem or petiole (leaf base) into the air, but in cells that can be stretched as the cells around them elongate
- The cells are also typically quite elongate with thick uneven cell wall

Plant cells – ground tissue

Collenchyma Cells

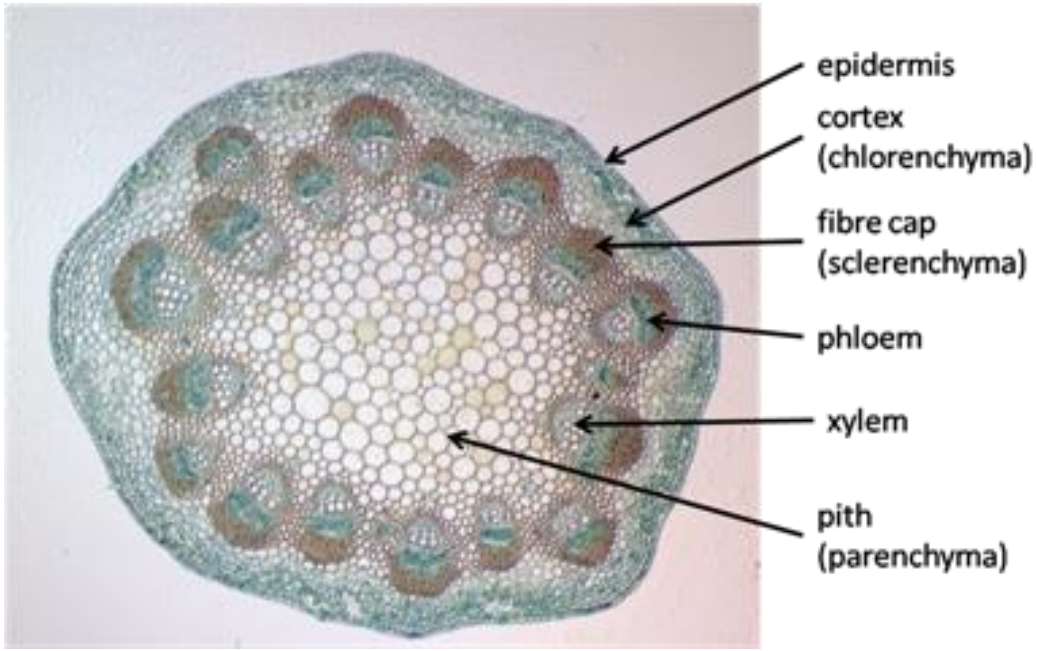


Plant cells – ground tissue

Sclerenchyma Cells

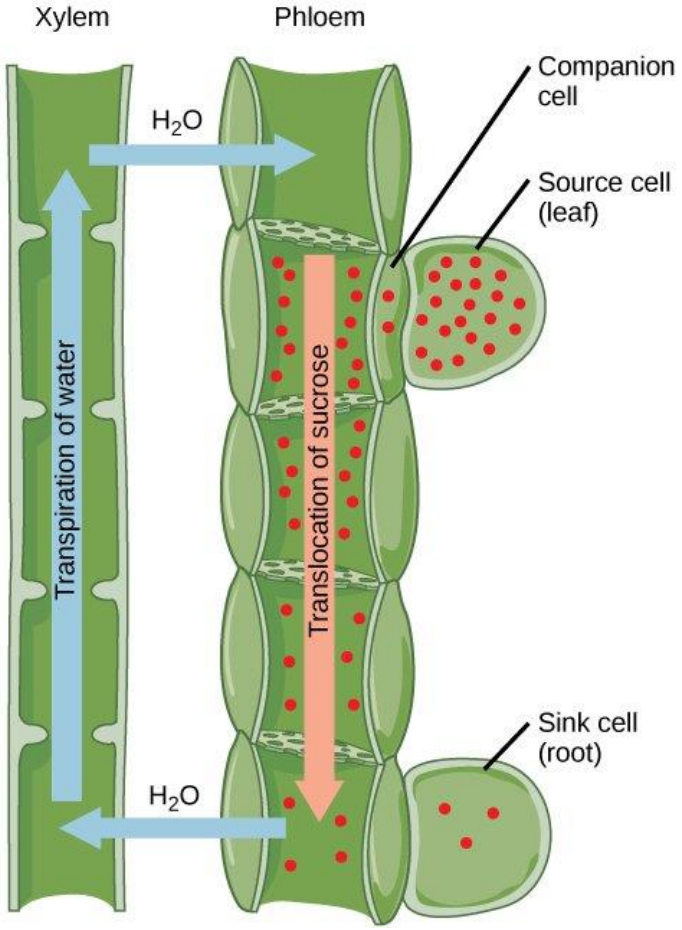
- Sclerenchyma cells also have a support function in plants but unlike collenchyma cells, they have a hardening agent and are much more rigid
- Their wall is invested with lignin, making it extremely hard
- These cells cannot survive for long as they cannot exchange materials well enough for active (or even maintaining) metabolism
- They are typically dead at functional maturity

Plant cells – ground tissue



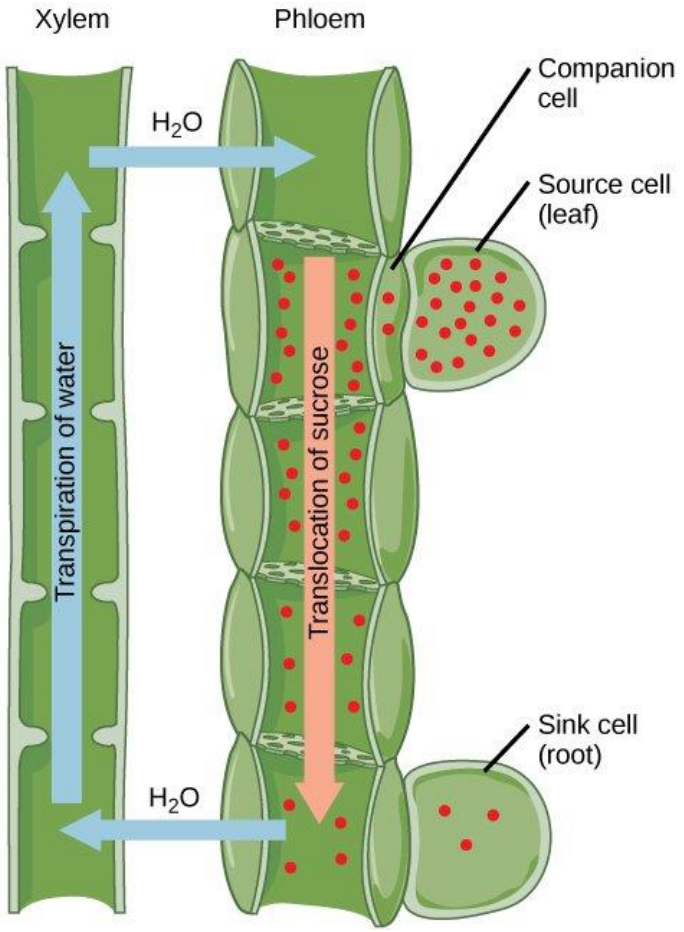
Plant cells – vascular tissue, Xylem

- These are elongated cells with lignified secondary thickening of the cell walls
- Xylem cells are specialised for conduction of water
- The possession of xylem defines the vascular plants or Tracheophytes
- The bryophytes lack true xylem cells, but have a water-conducting tissue known as the hydrome that is composed of elongated cells of simpler construction



Plant cells – vascular tissue, Phloem

- This is a specialised tissue for food transport in higher plants
- Phloem cells mainly transport sucrose along pressure gradients generated by osmosis
- This phenomenon is called translocation
- Phloem consists of two cell types, the sieve tubes and the intimately associated companion cells
- The sieve tube elements lack nuclei and ribosomes, and their metabolism and functions are regulated by the adjacent nucleate companion cells
- The bryophytes lack phloem, but have a simpler tissue with analogous function known as the leptome

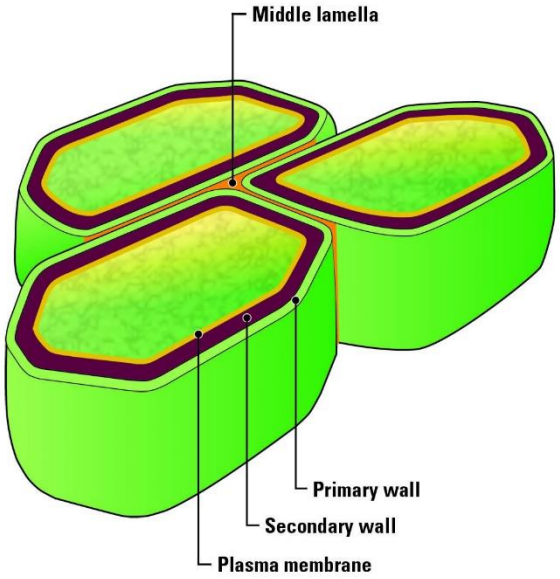


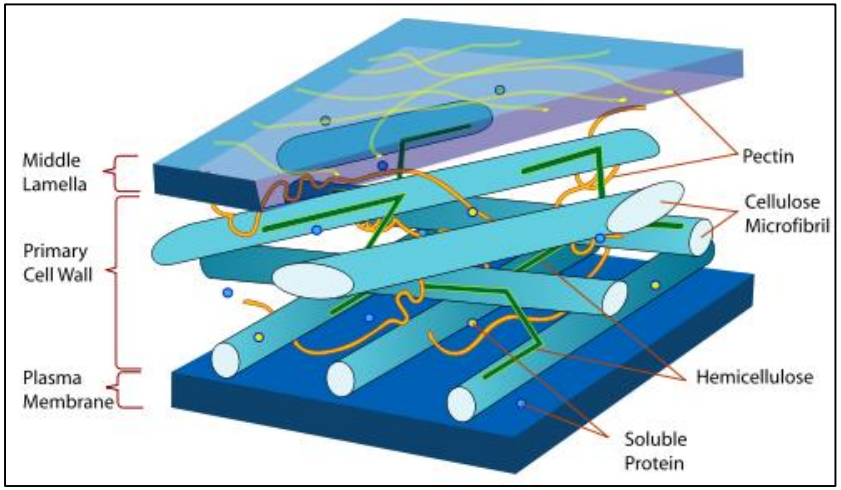
Plant Cell – Cell Wall

- The walls of plant cells must have sufficient tensile strength to withstand internal osmotic pressures of several times atmospheric pressure that result from the difference in solute concentration between the cell interior and external water
- Plant cell walls vary from 0.1 to several µm in thickness
- Up to three strata or layers may be found in plant cell walls
- The middle lamella, a layer rich in pectins which is the outermost layer forms the interface between adjacent plant cells and glues them together

Plant Cell – Cell Wall

- The primary cell wall, generally a thin, flexible and extensible layer formed while the cell is growing





Plant Cell – Cell Wall

- The secondary cell wall, a thick layer formed inside the primary cell wall after the cell is fully grown
- It is not found in all cell types
- Some cells, such as the conducting cells in xylem, possess a secondary wall containing lignin, which strengthens and waterproofs the wall

Plant Cell – Cell Wall

- In the primary (growing) plant cell wall, the major carbohydrates are cellulose, hemicellulose and pectin

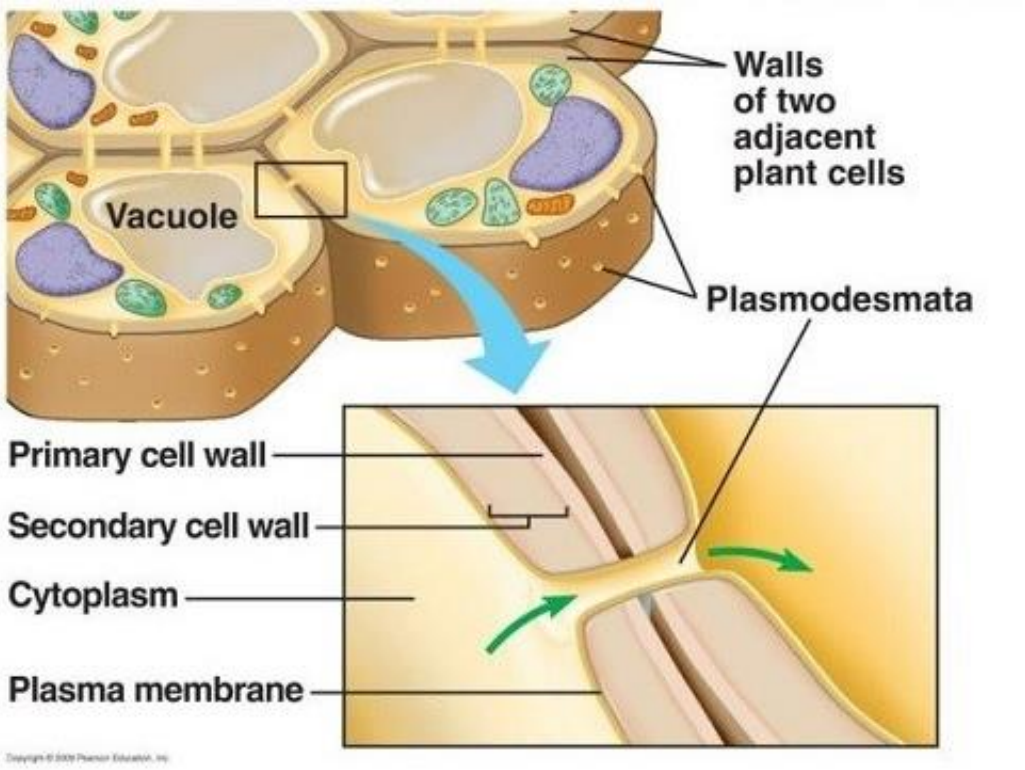
- Secondary cell walls contain a wide range of additional compounds that modify their mechanical properties and permeability

- The major polymers that make up wood (largely secondary cell walls) include:
  - cellulose, 35-50%
  - xylan, 20-35%, a type of hemicellulose
  - lignin, 10-25%, a complex phenolic polymer

Plant Cell –Plasmodesmata

- These are intercellular organelles found only in plant and algal cells
- The plasmodesmata consist of pores, or channels, lying between individual plant cells, and connect them
- They can also be termed as "bridges" between two plant cells
- Through plasmodesmata, endoplasmic reticulum of one cell is extended to the neighbouring cell
- Plasmodesmata play roles in both cellular communication and in molecule translocation
- Plasmodesmata have been shown to transport proteins (including transcription factors), short interfering RNA, messenger RNA and viral genomes from cell to cell

Plant Cell –Plasmodesmata



Plant Cell – Plastids

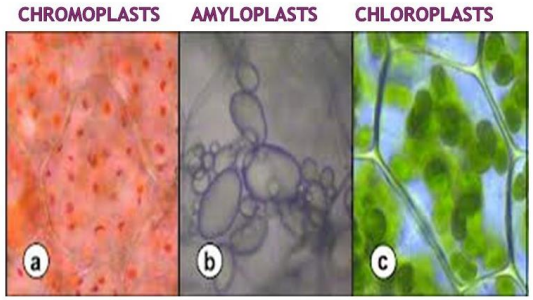
- The plastid is a major double-membrane organelle found, among others, in the cells of plants and algae
- Plastids are the site of manufacture and storage of important chemical compounds used by the cell
- They often contain pigments used in photosynthesis, and the types of pigments present can change or determine the cell's color
- They possess a double-stranded DNA molecule, which is circular, like that of prokaryotes
- In plants, plastids may differentiate into several forms, depending upon which function they play in the cell

Plant Cell – Plastids

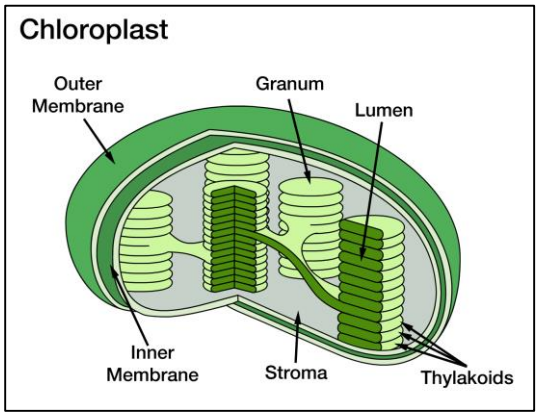
- **Undifferentiated plastids (proplastids) may develop into any of the following variants:**

1. **Chloroplasts: for photosynthesis**
2. **Chromoplasts: coloured plastids: for pigment synthesis and storage**
3. **Leucoplasts: colourless plastids for monoterpene synthesis**

- **Leucoplasts sometimes differentiate into more specialized plastids:**
  - **Amyloplasts: for starch storage**
  - **Elaioplasts: for storing fat**
  - **Proteinoplasts: for storing and modifying protein**



Plant Cell – Plastids

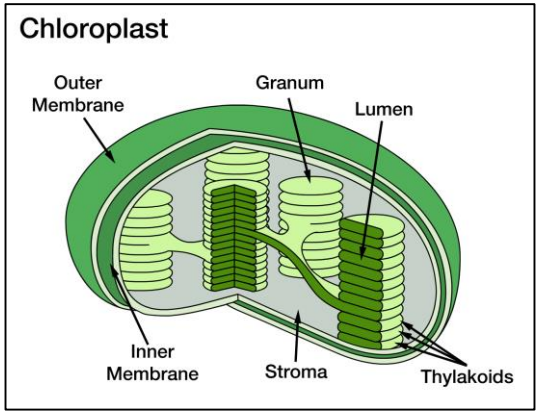


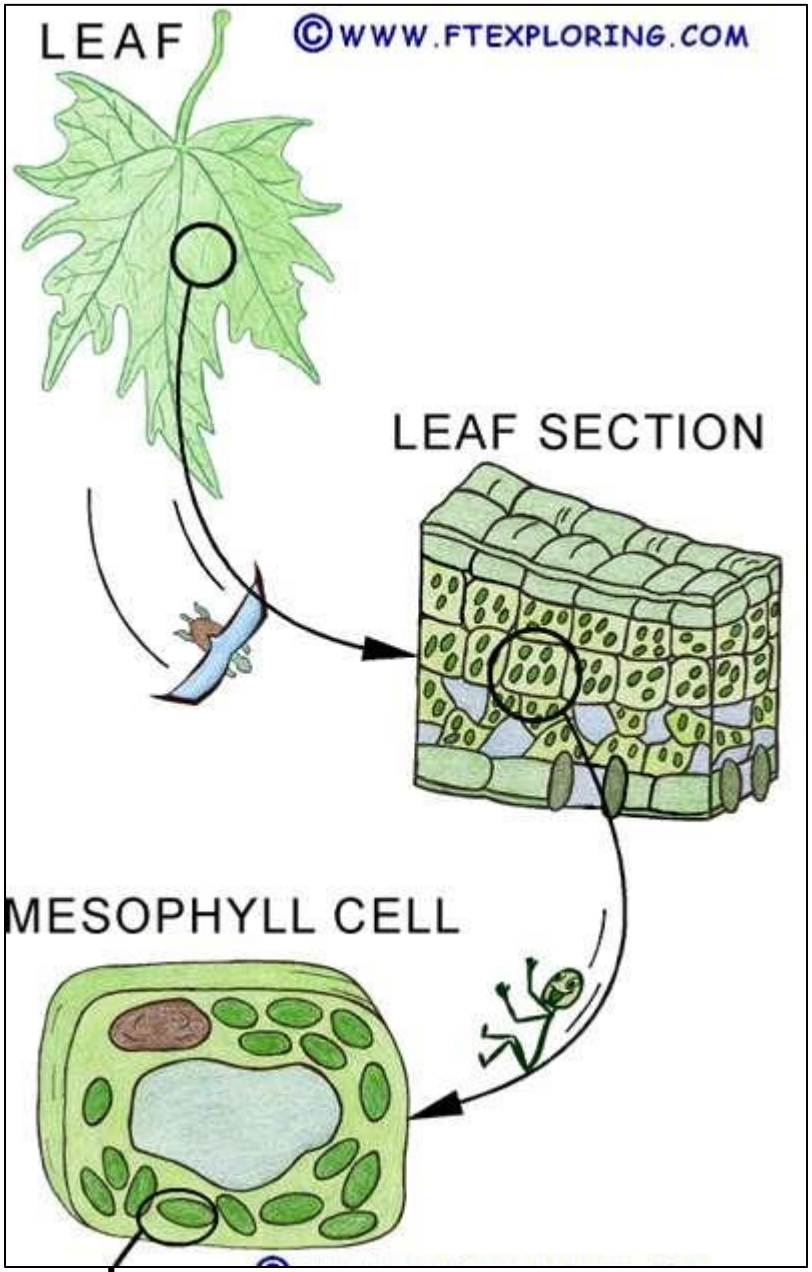
Chloroplast

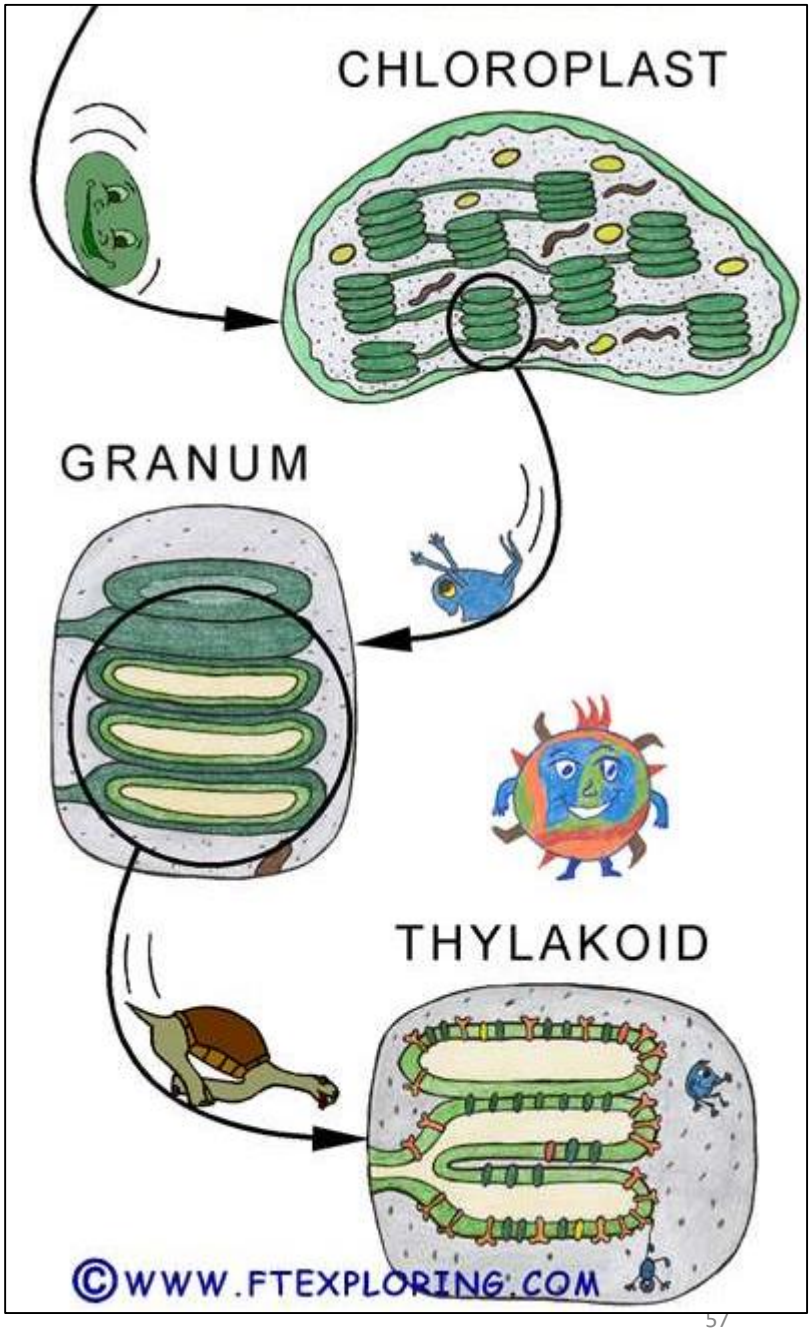
- Their main role is to conduct photosynthesis, where the photosynthetic pigment chlorophyll captures the energy from sunlight, and stores it in the energy storage molecules like ATP
- They then use the ATP to make organic molecules from carbon dioxide in a process known as the Calvin cycle
- Chloroplasts carry out a number of other functions, including fatty acid synthesis and amino acid synthesis
- The number of chloroplasts per cell varies from 1 chloroplast per cell in algae and can get up to 100 chloroplasts per cell in plants like wheat

Plant Cell – Plastids

- These are double-membrane bound organelles that contains an inner and outer membranes that act as protective coverings and keep chloroplast structures enclosed
- Inside they have flattened sac-like membrane structures called thylakoids that serve as the sites of conversion of light energy to chemical energy
- The interior space of thylakoid is known as lumen
- Embedded in the thylakoid membranes are important protein complexes and pigment like chlorophyll that carry out the light reactions of photosynthesis
- Dense layered stacks of thylakoid sacs are called grana
- Dense fluid within the chloroplast is called Stroma which is inside the chloroplast envelope but outside the thylakoid membrane
- This is the site of conversion of carbon dioxide to carbohydrates (sugar)




LEAF
©WWW.FTEXPLORING.COM
LEAF SECTION
MESOPHYLL CELL


CHLOROPLAST
GRANUM
THYLAKOID
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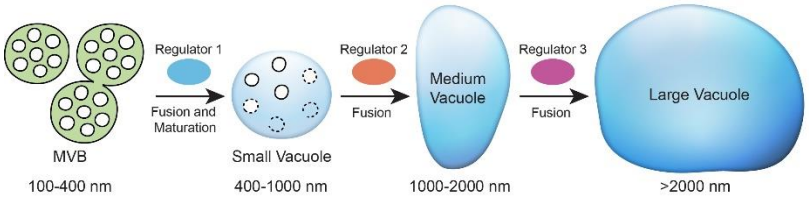
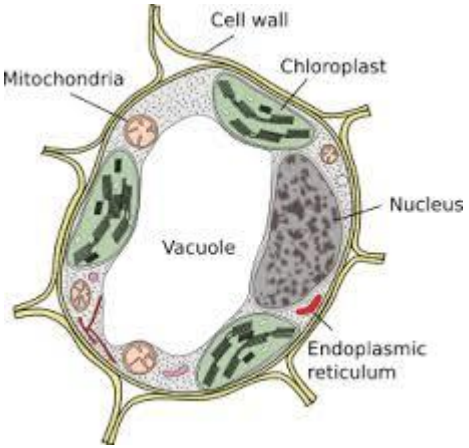
Vacuole

- No specific shape and size is seen in vacuoles
- This is typically a large structure in a plant cell that provides support and participates in a variety of cellular functions including storage of water and other solutes, detoxification, protection, internal turgor pressure and growth
- Tonoplast or vacuolar membrane





Plant cell – organelle functions

Cell wall: Its main function is to provide rigidity, strength, protection against mechanical stress and infection

Cell membrane: In plants cells it is inside the cell wall and allows specific substances to pass through and blocking others

Chloroplasts: The process of photosynthesis occurs in this region of the plant cell. The chlorophyll is a green pigment that absorbs energy from sunlight to make food for the plants by converting light energy into chemical energy

Plasmodesmata: They enables transport and communication between plant cells

Vacuole: Vacuoles are known as cells storage center. Plant cells have large membrane bound chamber called vacuole. Its main function is storage. Vacuoles are found in the cytoplasm of most plant cells. They are membrane bound organelles, they perform functions of secretion, excretion and storage.

Tonoplast: A vacuole that is surrounded by a membrane is called tonoplast

Plastids: Plastids are storage organelles. They store products like starch for synthesis of fatty acids and terpenes. Eg: Chloroplast, Leucoplast and Chromoplast

Differences and similarities between animal and plant cell

	Animal Cell	Plant Cell
Cell wall		
Shape		
Vacuole		
Centrioles		
Chloroplast		
Cytoplasm		
Endoplasmic Reticulum (Smooth and Rough)		
Ribosomes		
Mitochondria		

Plastids

Golgi Apparatus

Plasma Membrane

Microtubules/
Microfilaments

Flagella

Lysosomes

Nucleus

Cilia

Differences between Animal and Plant cell

	Plant Cell	Animal Cell
1.	A cellulose cell wall is present surrounding the plasma membrane.	Cell wall is absent. The limiting membrane of the cell is plasma membrane.
2.	Plant cells contain plastids.	Do not contain plastids.
3.	These have a large vacuole filled with cell sap.	Vacuoles may be absent, if present they are very small in size.
4.	Centrosome occurs in motile cells of lower plants.	It is present in all animal cells.
5.	Mitochondria are fewer and their cristae are tubular.	Mitochondria are many and with plate-like cristae.
6.	Nucleus is generally pushed to one side in the peripheral cytoplasm by sap vacuole.	Nucleus is usually located in the centre.
7.	Plant cells do not burst if placed in hypotonic solution due to the presence of cell wall.	Animal cells usually burst if placed in hypotonic solution unless and untill they possess contractile vacuoles.

Contd…….

8.	Centrioles are absent except in lower plants.	Centrioles are present.
9.	Cytoksleton does not contain intermediate fibres.	Cytoskeleton contains intermediate fibres.
10.	Lysosomes absent.	Lysosomes present.
11.	Glyoxysomes may be present.	Absent.
12.	Reserve food is in the form of starch and fat.	Reserve food is in the form of glycogen and fat.
13.	Crystals of inorganic substances may occur in the cells.	Do not occur in animal cells.
14.	Plant cells are able to synthesise all the amino acids, vitamins and coenzymes needed by them.	Animal cells cannot synthesize all the amino acids, vitamins and coenzymes needed by them.