



Chapter 3: CELL STRUCTURE & FUNCTION

Unit 1: CELL: THE UNIT OF LIFE

- What is a cell?
- Cell theory
- An overview of a cell



WHAT IS A CELL?

- Cell is the fundamental, structural and functional unit of all living organisms
- Robert Hooke (1665) – an English scientist who observed honeycomb like dead cells and coined the term CELL
- Anton Von Leeuwenhock first described a living cell (1667)
- Robert Browne discovered nucleus (1833)



CELL THEORY

- Mathias J Schleiden (1838) ; a German botanist and Theodore Schwann (1839) ; a British Zoologist proposed cell theory.
- All living organisms are composed of cells and product of cells
- All cells arise from pre existing cells through the process of cell division
- The body of living organisms is made up of one or more cells



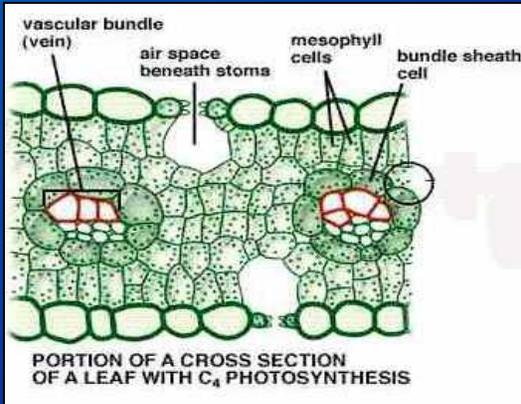
CELL NUMBER, SHAPE AND SIZE

- Unicellular organisms – Organisms with single cell, capable of independent existence and carries all functions like digestion, excretion, respiration, growth & reproduction (Acellular). Examples, Amoeba, Euglena
- Multicellular organisms – Organisms with more than one cell
- Cells in multicellular organisms vary in size & shape depending on function.

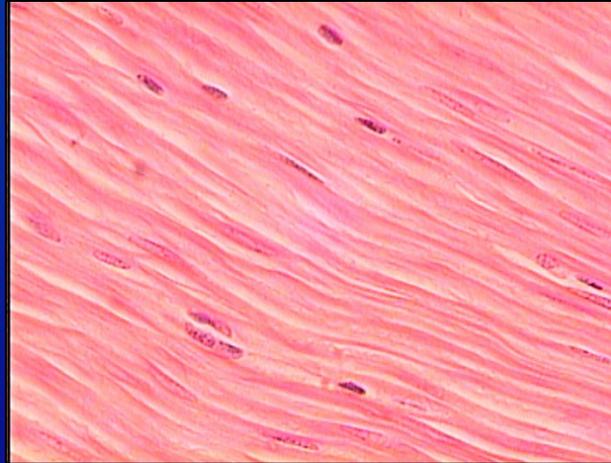


SHAPE:

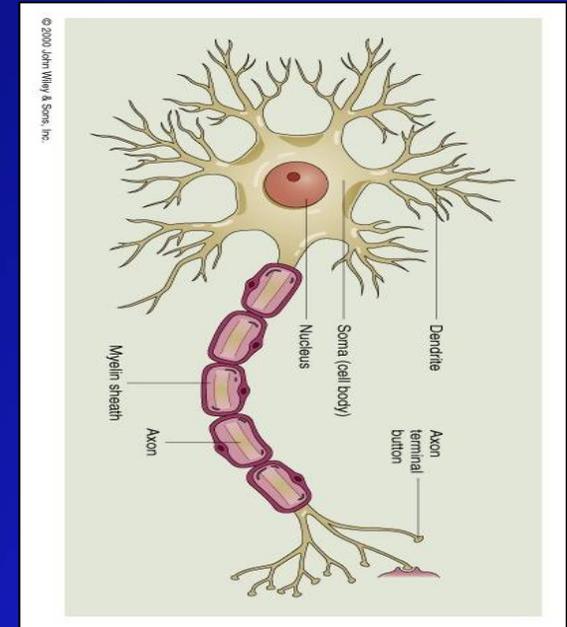
- Parenchyma - Polyhedral cells performs storage.
- Sclerenchyma - spindle shaped cells & provides mechanical support,
- Nerve cells- long and branched cells conducting nerve impulses
- RBC -Biconcave & helps in carrying oxygen
- Muscle cells- cylindrical or spindle shaped concerned with the movement of body parts.



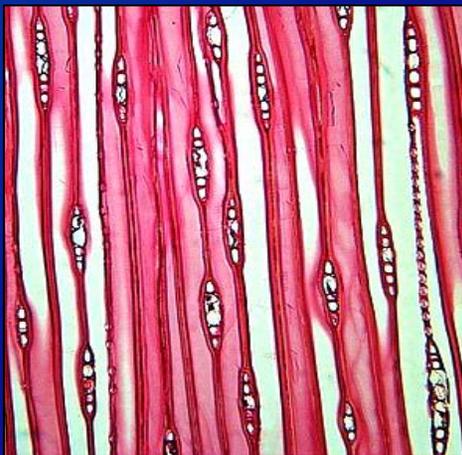
PARENCHYMA



MUSCLE FIBRE



NERVE CELLS



SCLERENCHYMA

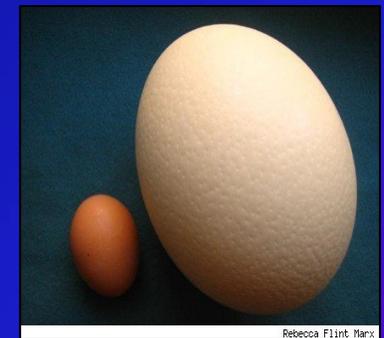
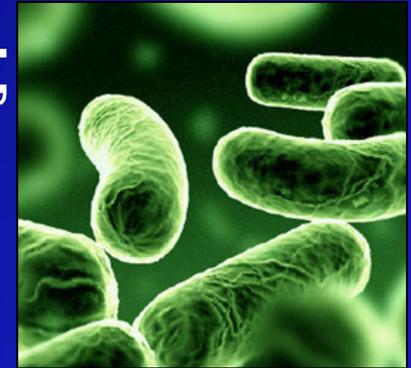


RED BLOOD CELLS



SIZE: varies from few microns ($1\text{cm} = 10\text{mm}$;
 $1\text{mm} = 1000\mu\text{m}$) to few cms

- Smallest living cell is PPLO (Pleuro Pneumonia Like Organism) - $0.1\mu\text{m}$
- Largest living cell is Egg of an Ostrich ,
170 to 180 mm in diameter.
- Bacteria – 0.1 to $0.5\mu\text{m}$
- Sclerenchyma fibre upto 60cms in length





CELL STRUCTURE AND FUNCTIONS

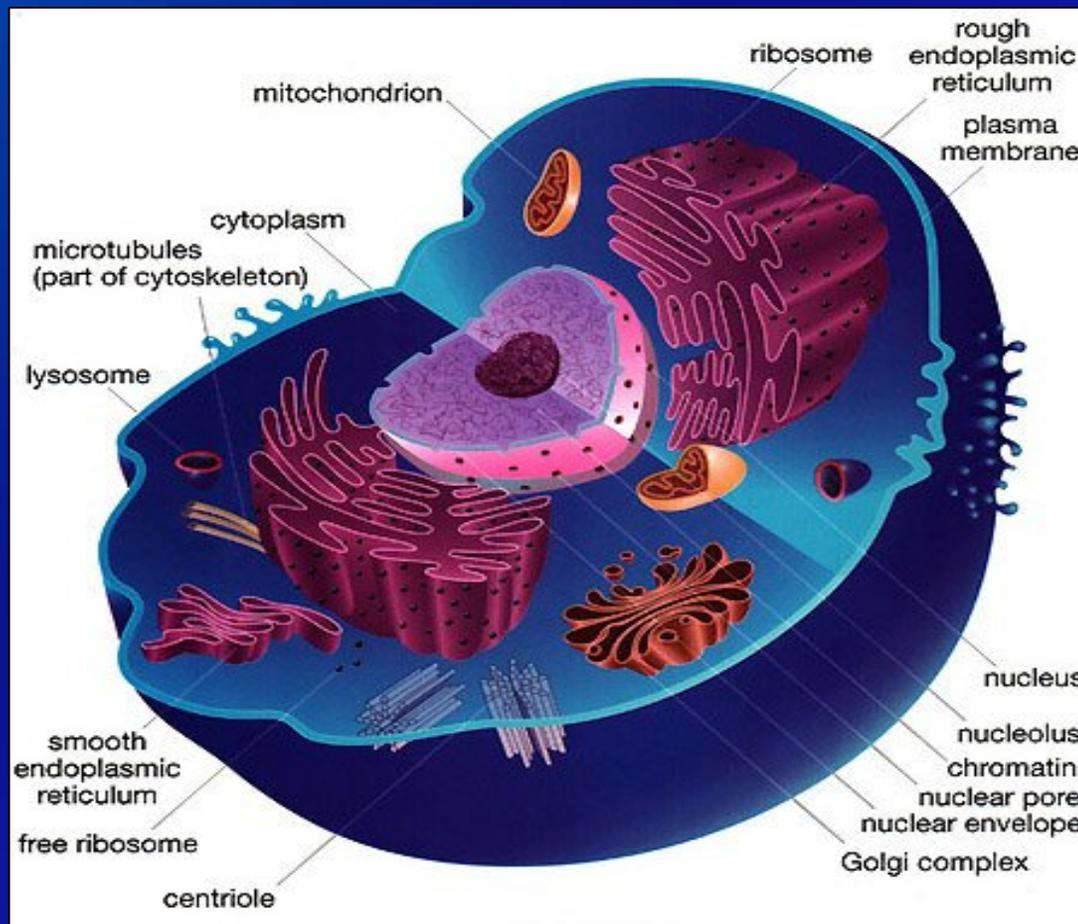
- Cell has non living outer layer called CELL WALL found only in plant cells
- Below cell wall is CELL MEMBRANE
- CELL MEMBRANE encloses PROTOPLASM
- PROTOPLASM has semi fluid matrix called CYTOPLASM and large membrane bound structure called NUCLEUS



- CYTOPLASM has many membrane bound organelles like Endoplasmic reticulum , Golgi Bodies Mitochondria ,Plastids and vacuoles.
- They also have non membrane bound structures called Ribosomes and Centrosomes
- Cytoplasm without Cell organelles are called Cytosol.



TYPICAL ANIMAL CELL

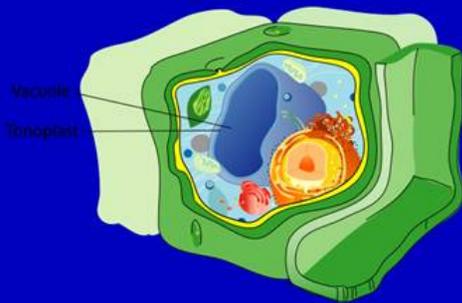




Difference between plant and animal cell

Plant cell

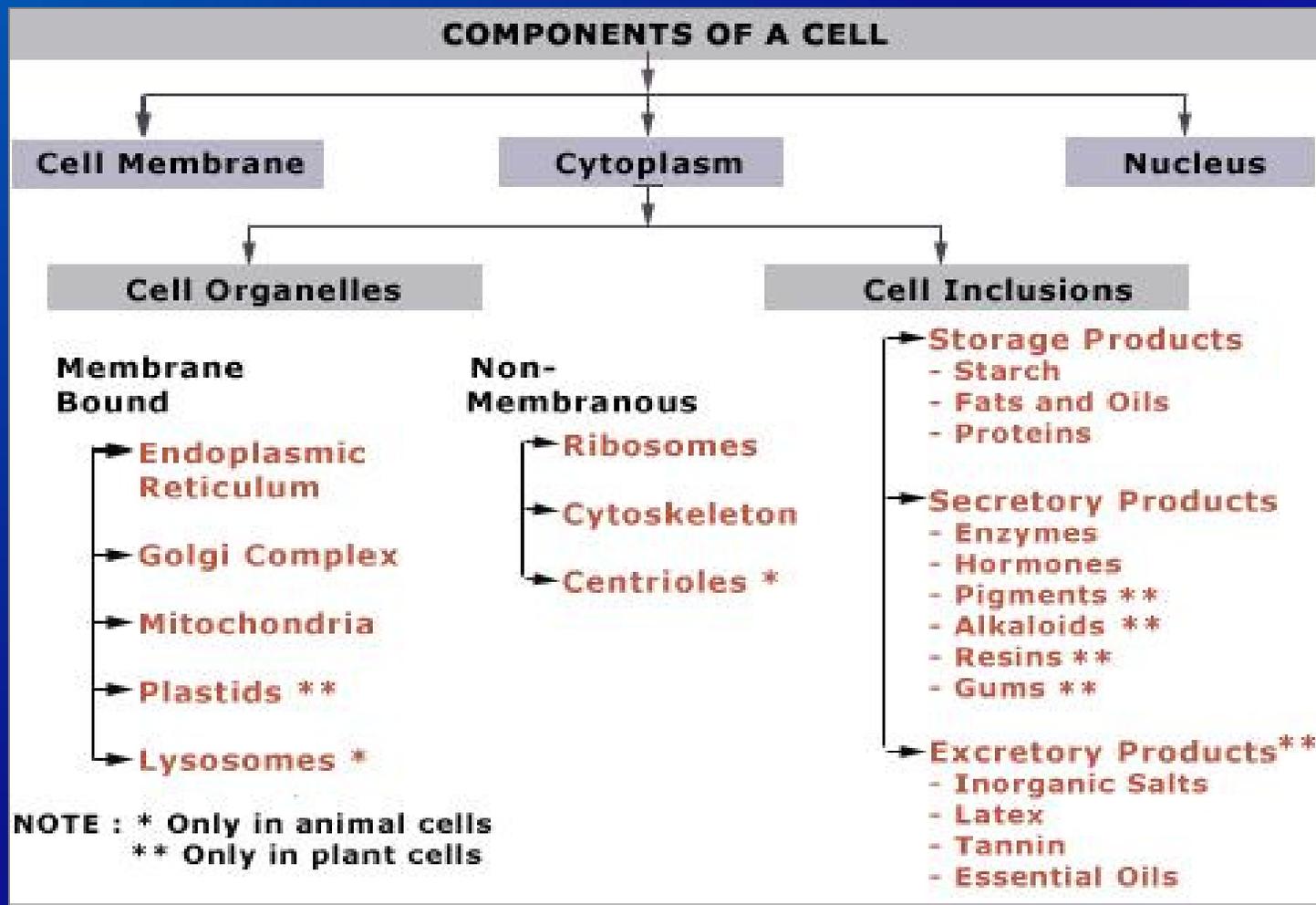
- Present in plant cell but absent in animal cell
- Cell wall
- Chloroplast
- Central vacuole



Animal cell

- Present in animal cell but absent in plant cell
- Centrosome with centriole
- Lysosome
- Flagella







CELL WALL

- Outermost layer, non living ,rigid
- Found in bacterial cells, fungal cells and plant cells.
- Permeable
- Made up of cellulose (in bacteria- peptidoglycans, in fungus- Chitin)

FUNCTION :

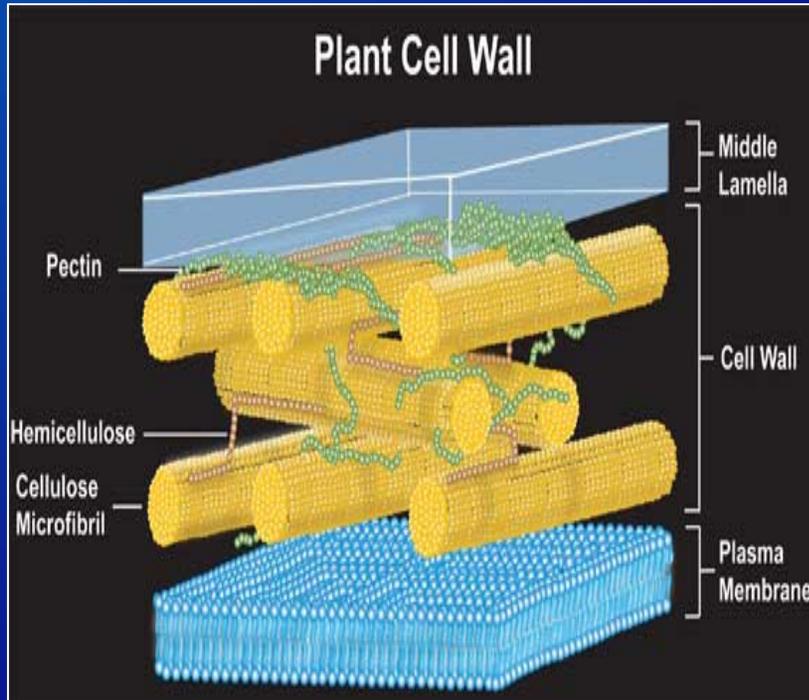
Rigidity, mechanical support and protection



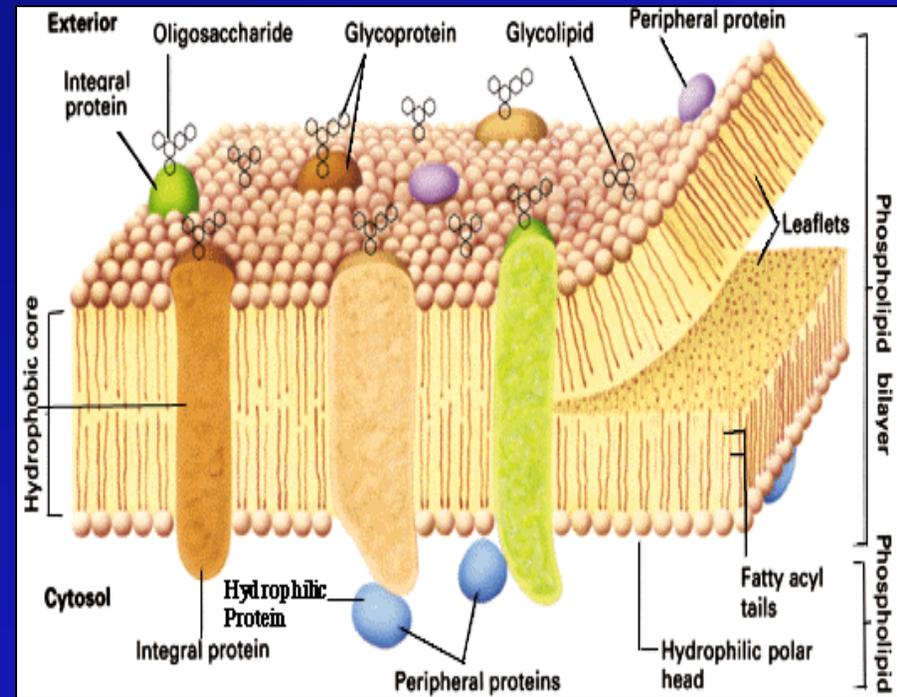
CELL MEMBRANE(PLASMA MEMBRANE)

- Present in all cells, just below the cell wall in plant cells, outermost membrane in animal cells
- Semi-permeable
- Made up of phospholipids, proteins, carbohydrates and Cholesterol

FUNCTION : It allows outward and inward movement of molecules across it like diffusion, osmosis, active transport, phagocytosis and pinocytosis



CELL WALL



CELL MEMBRANE



PROTOPLASM

- According to Huxley , protoplasm is “physical basis of life”
- Includes organic and inorganic molecules

CYTOPLASM

- Semi fluid matrix present between cell membrane and nuclear membrane
- It has various living cell inclusions called cell organelles and non living substances called Ergastic substances



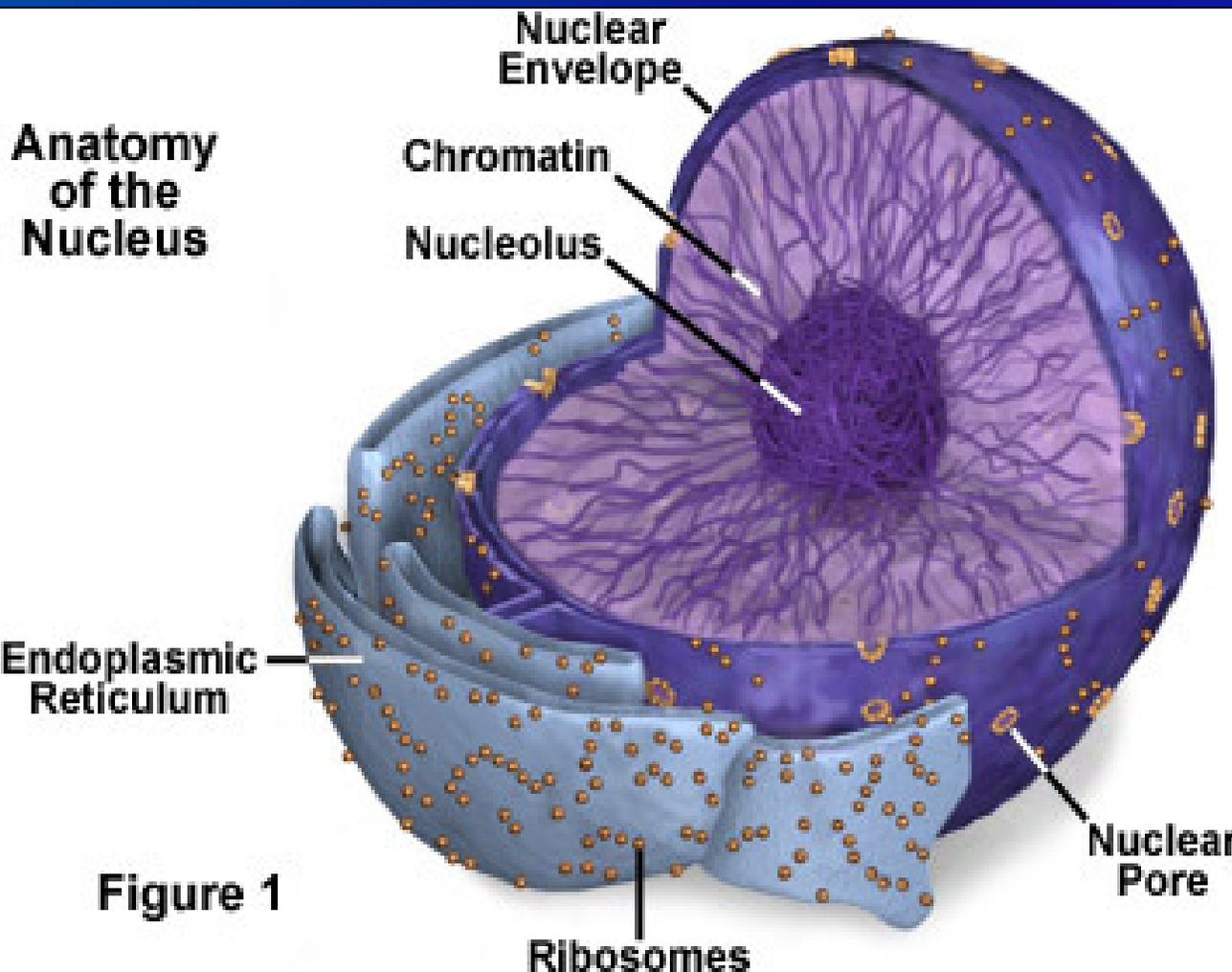
NUCLEUS

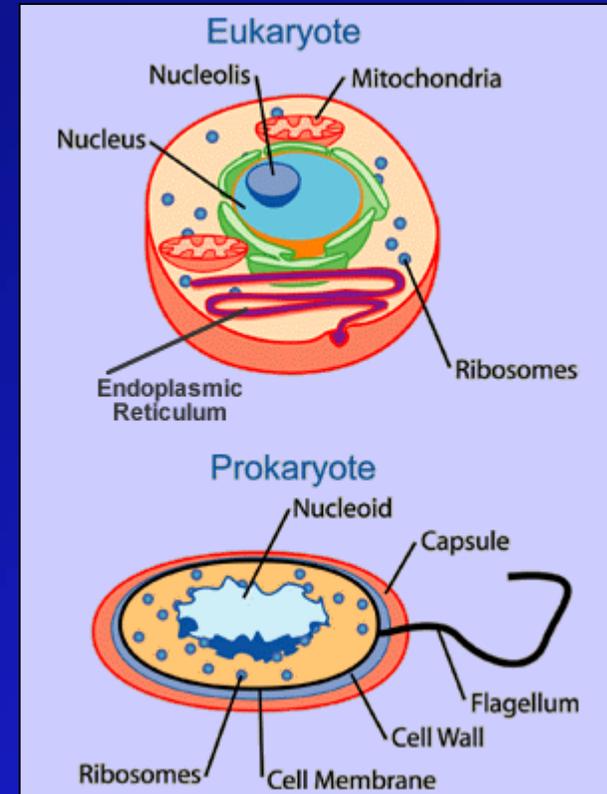
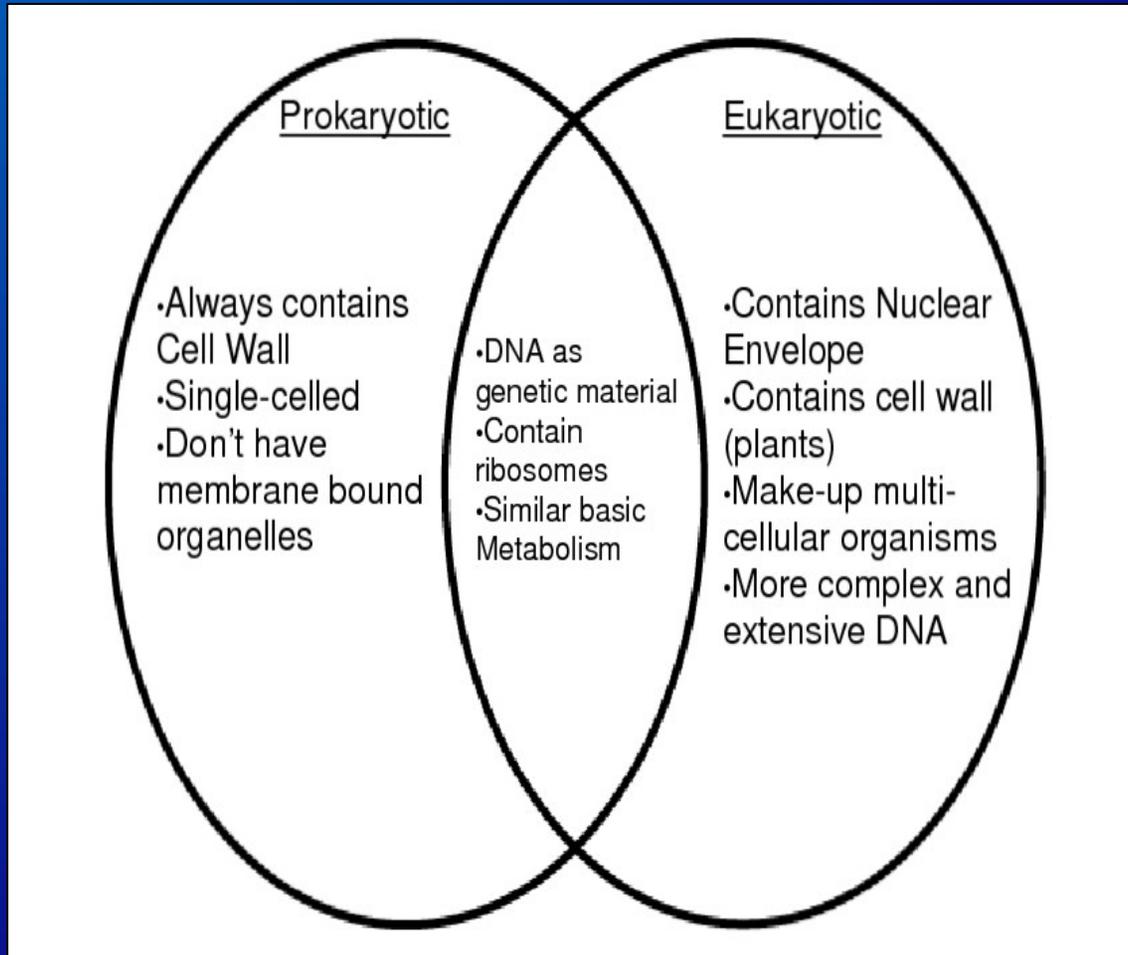
STRUCTURE:

- Largest cell organelle present in eukaryotic cells
- It is usually spherical
- It has double layer nuclear membrane with nuclear pores
- It has transparent granular matrix called nucleoplasm, chromatin network composed of DNA and histone proteins
- It also has a spherical body called Nucleolus

FUNCTION: It is the control centre of the cell.

It contains genetic material DNA which regulates all metabolic activities of the body





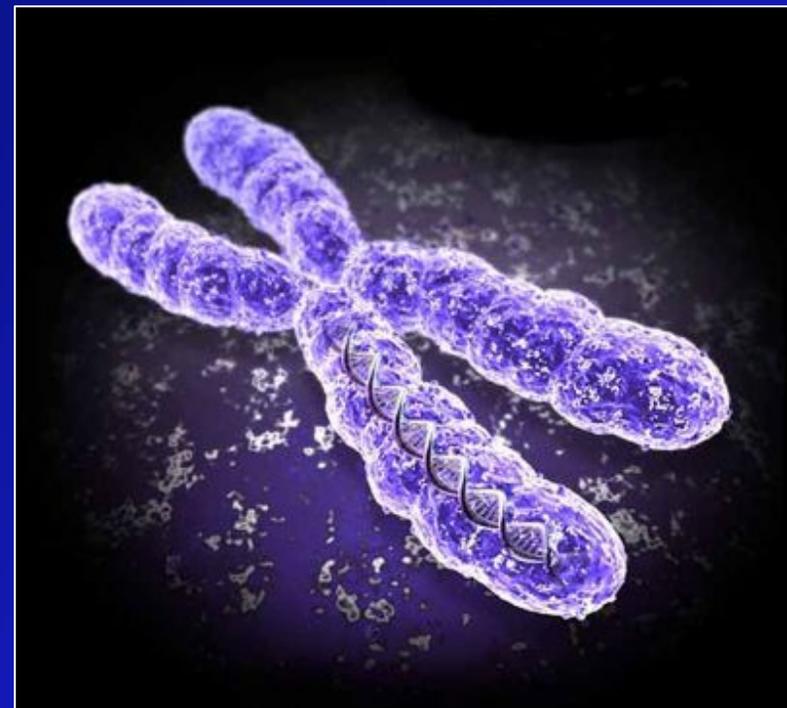
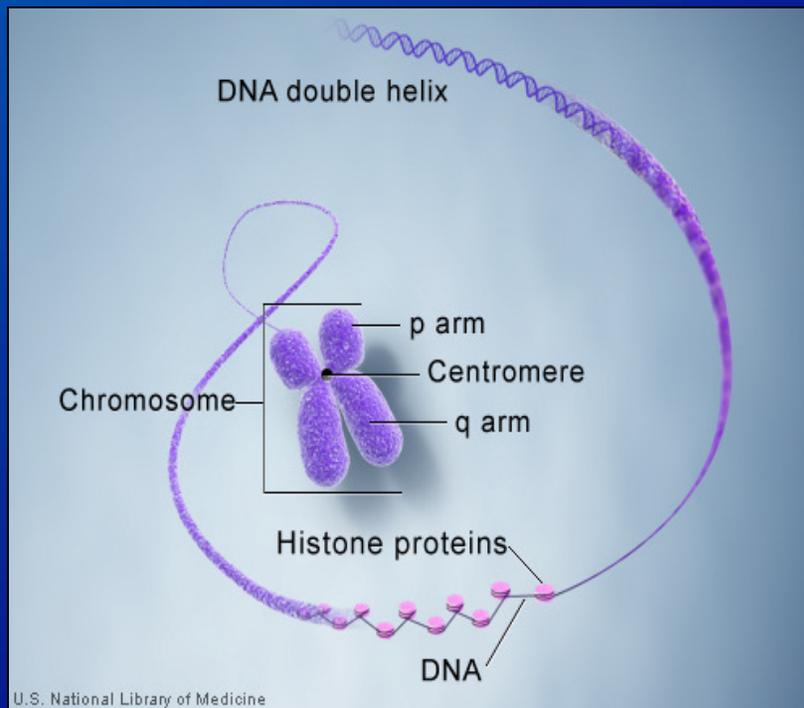


CHROMOSOME: (vehicles of heredity)

- Nucleus of a non dividing cell has network of fibres called chromatin.
- During cell division, chromatin condenses to form distinct chromosomes.
- Chromosomes help in transmission of characters or genes
- Chromosome has centromere at the centre & arms on either sides called chromatids
- Chromatid- Thread like chromonema



CHROMOSOME: (vehicles of heredity)





MEMBRANE BOUND CELL ORGANELLES

Endoplasmic Reticulum:

- ER is a network of membrane bound tubular structures in cytoplasm
- It extends from cell membrane to nuclear membrane
- it exists as flattened sacks called Cisternae, unbranched tubules and oval vesicles
- There are two types of ER, ROUGH ER and SMOOTH ER.

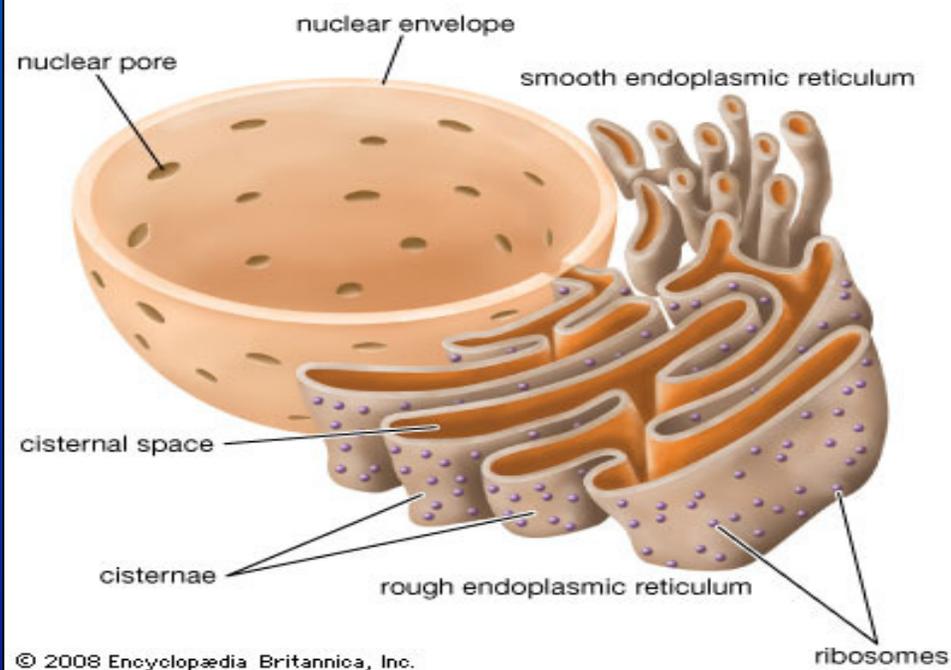


FUNCTIONS:

- Helps in intracellular transportation
- It provides mechanical support to cytoplasmic matrix
- It helps in the formation of micro bodies, nuclear membrane and golgi complex.
- It helps in detoxification of metabolic wastes



Endoplasmic reticulum



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Endoplasmic Reticulum

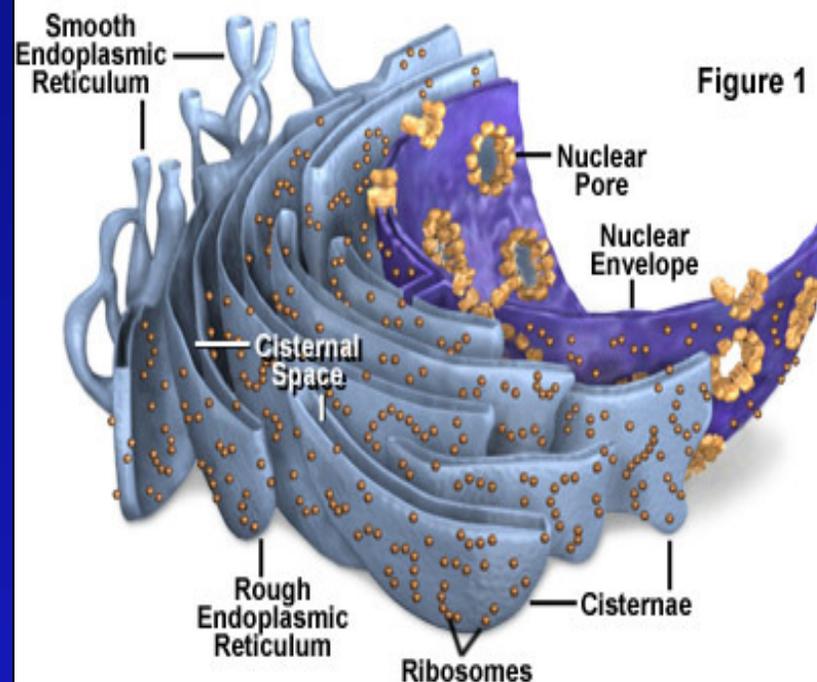


Figure 1



GOLGI COMPLEX

- It has a group of curved, flattened plate like compartments like Cisternae.
- The cisternae produce a network of tubules from the periphery
- These tubules end in spherical enzyme filled vesicles.
- Commonly called packaging centres of the cell

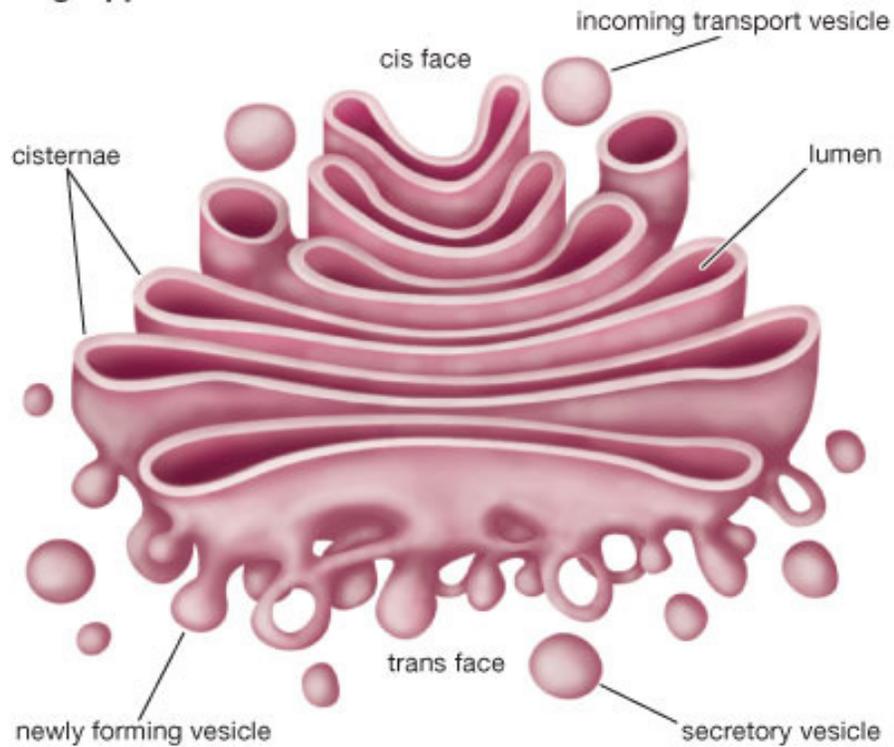


FUNCTIONS:

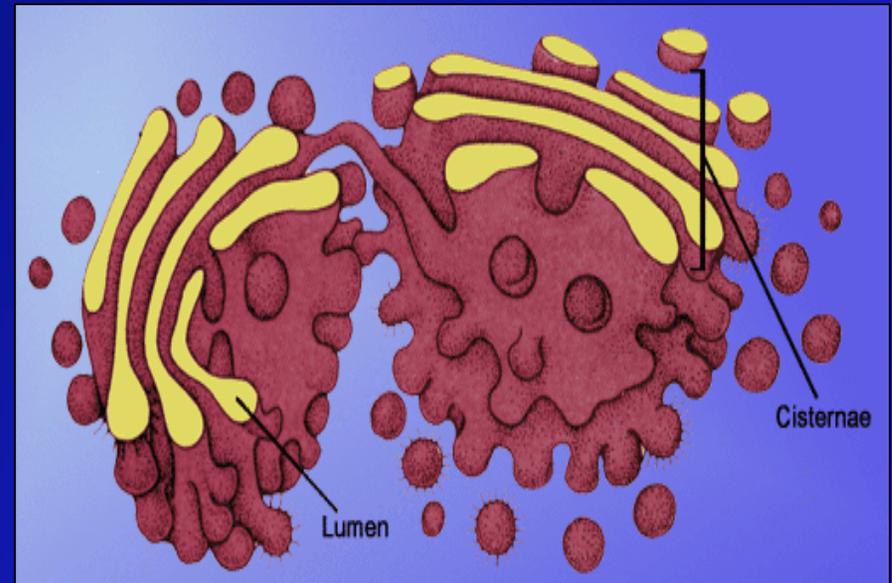
- They store the product of ER
- They produce Lysosomes
- They secrete various Enzymes, hormones and cell wall material



Golgi apparatus



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MITOCHONDRIA (POWER HOUSE OF THE CELL)

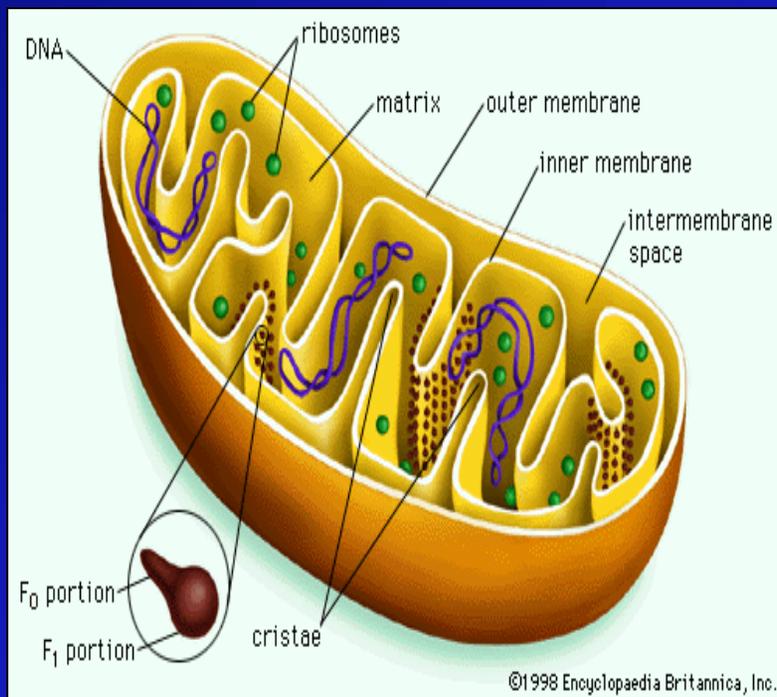
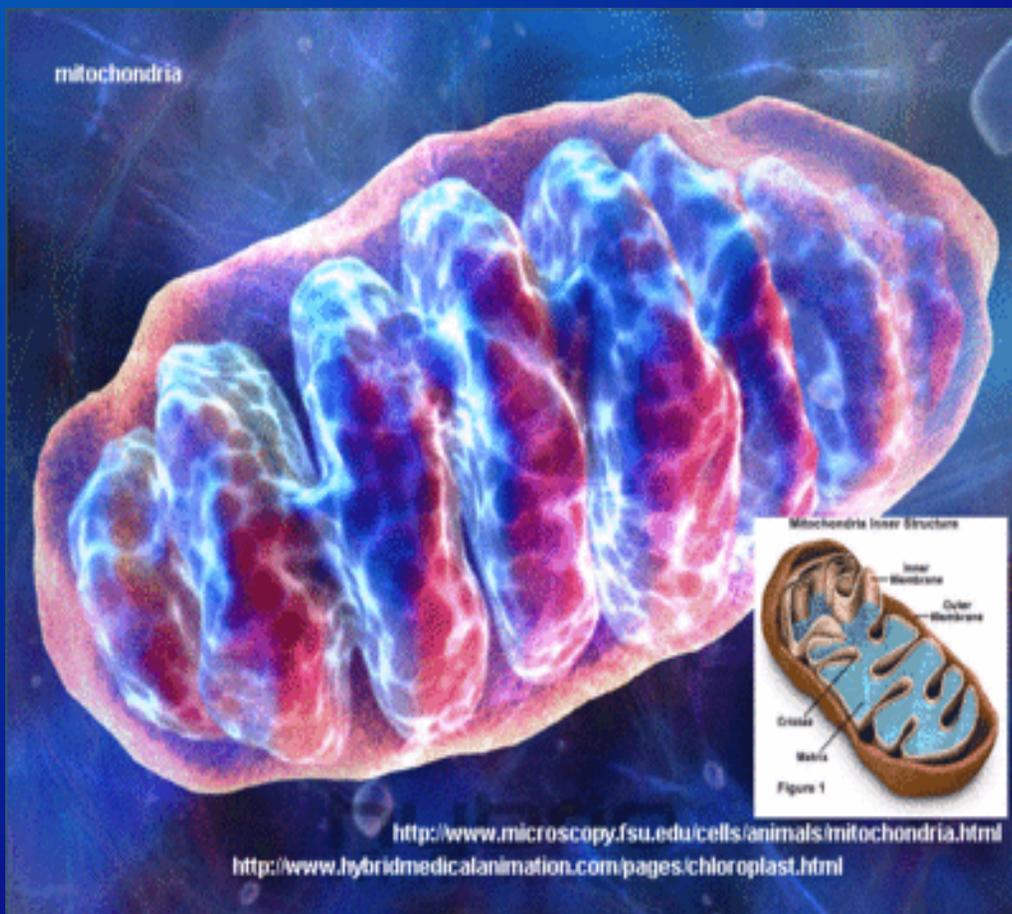
- Spherical or rod shaped
- It has two membranes, outer membrane is smooth, inner membrane produces finger like infoldings called Cristae
- Inner membrane also has stalked particles called Racker's particles or Oxysomes
- The mitochondria is filled with granular mitochondrial matrix



- Matrix has circular mitochondrial DNA, RNA, 70s Ribosomes, proteins, Enzymes and lipids

FUNCTION:

- Synthesizes and stores energy rich molecules ATP(Adenosine Tri phosphate) during aerobic respiration





PLASTIDS

- Present in plant cells, photosynthetic bacteria and Euglena (bacteria can be chemosynthetic also)
- 3 types- Chromoplast (different colored plastids), Leucoplast (Colourless) and Chloroplast(Green colored plastids)

CHLOROPLAST: (kitchen of the cell)

- Contains green colour pigment called chlorophylls
- Chloroplast has double membrane
- Matrix is called Stroma

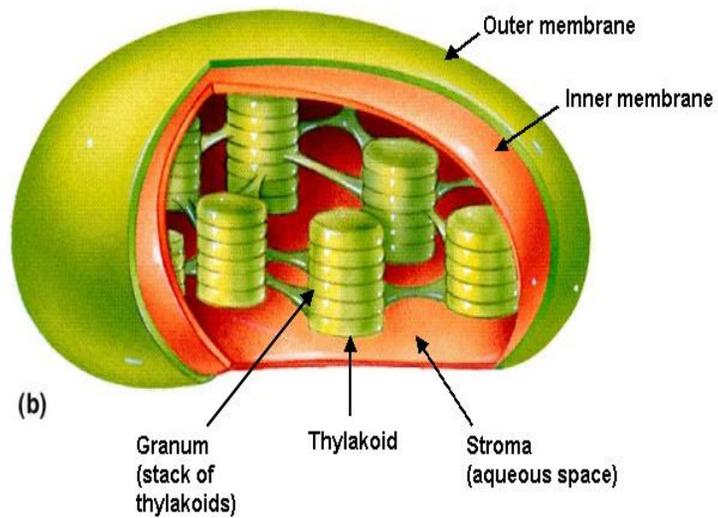


- Stroma has membranous sacks called Thylakoids
 - Thylakoids are arranged one above the other to form granum
 - Grana are interconnected by Frets
- FUNCTION:** Helps in photosynthesis

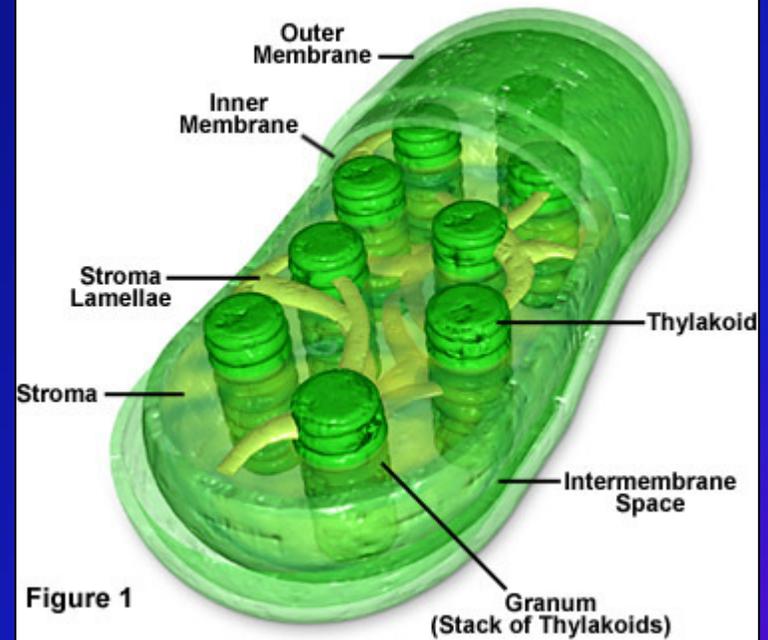


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Three-dimensional Model of Chloroplast Membranes



Plant Cell Chloroplast Structure



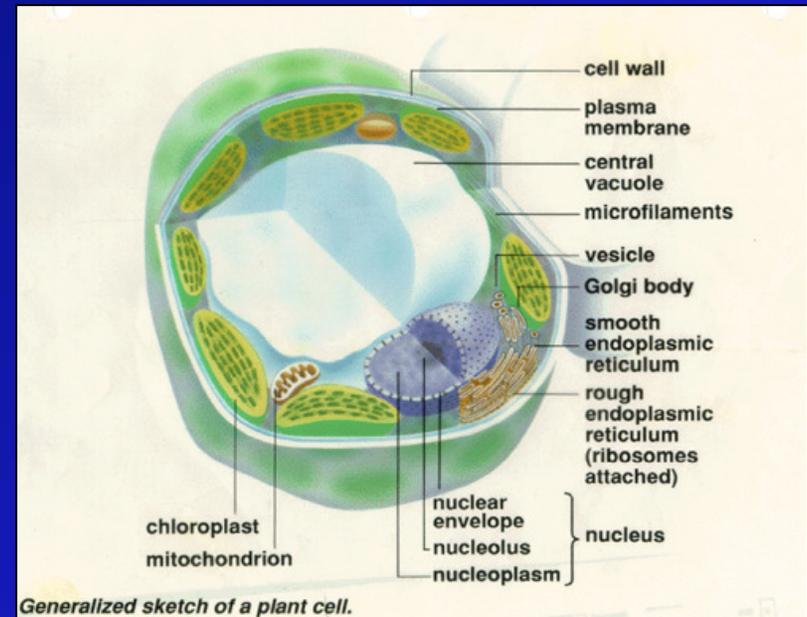
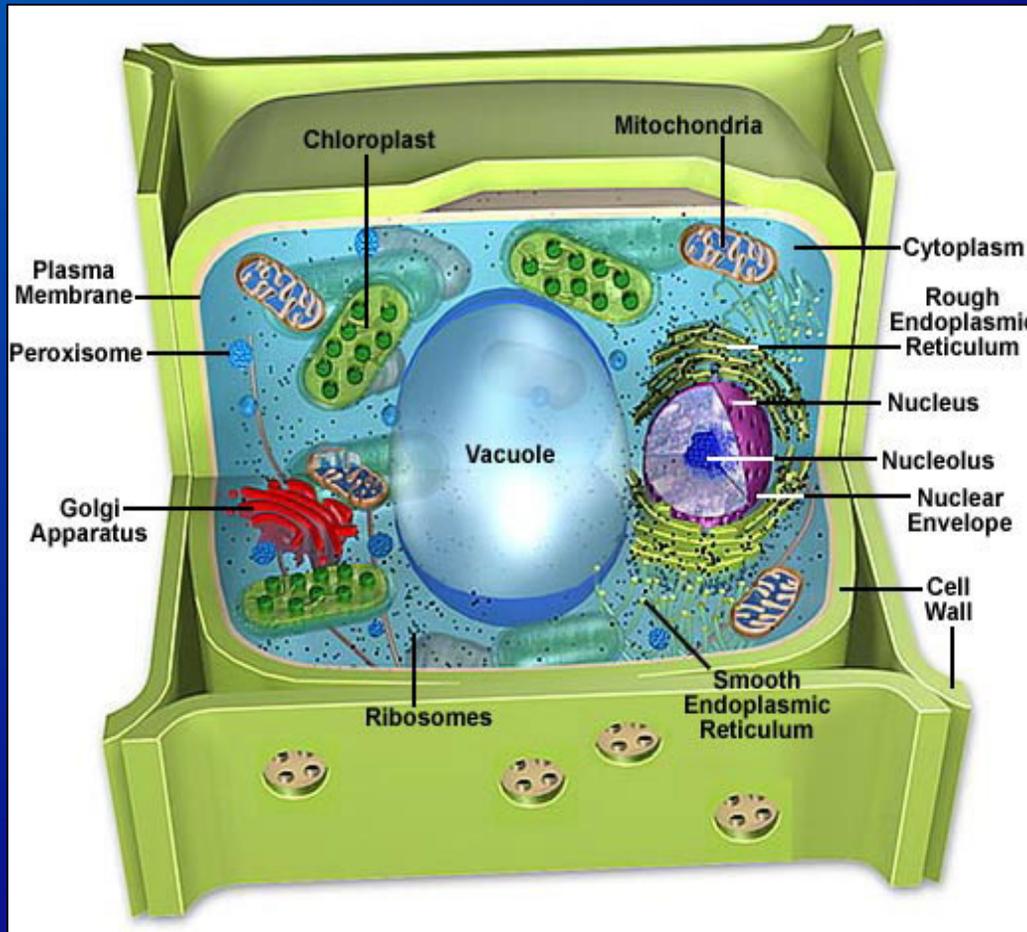


VACUOLES

- Single membrane bound sack like vesicles
- Absent in animal cells
- Plant cells have large vacuoles- distinct character
- Also present in lower organisms
- The membrane of vacuole is called tonoplast
- Vacuole is filled with watery fluid called cell sap which has dissolved salts, sugars, enzymes etc



VACUOLES





LYSOSOMES(suicidal bags of cell)

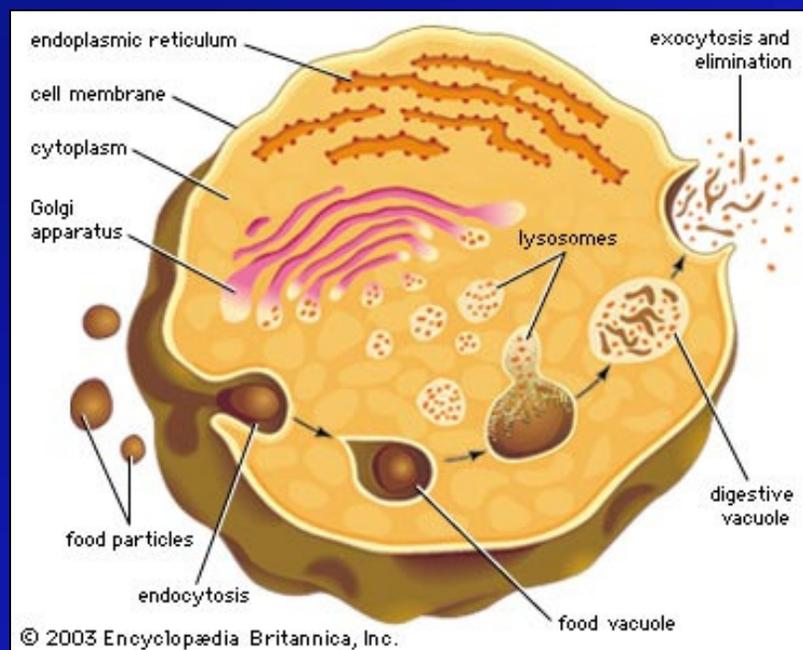
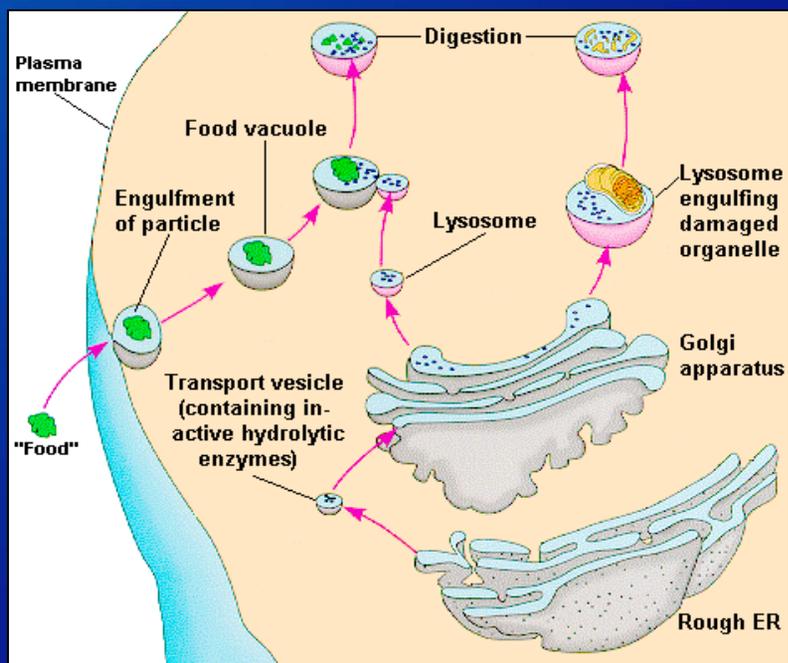
- Single membrane bound vesicles filled with hydrolytic enzymes found only in animal cells.
- Produced from golgi complex
- 4 types- Primary, secondary, residual & auto lysosomes

FUNCTION:

- Intracellular digestion
- Destroy old and non functional cells
- Recycles worn out cells



LYSOSOMES (suicidal bags of cell)



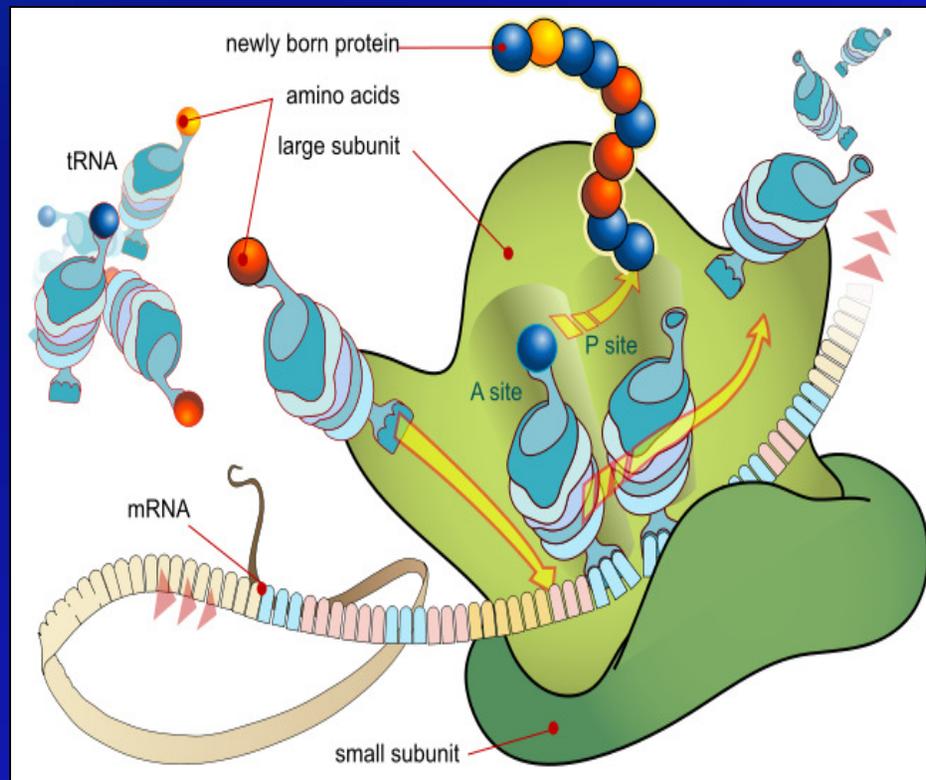
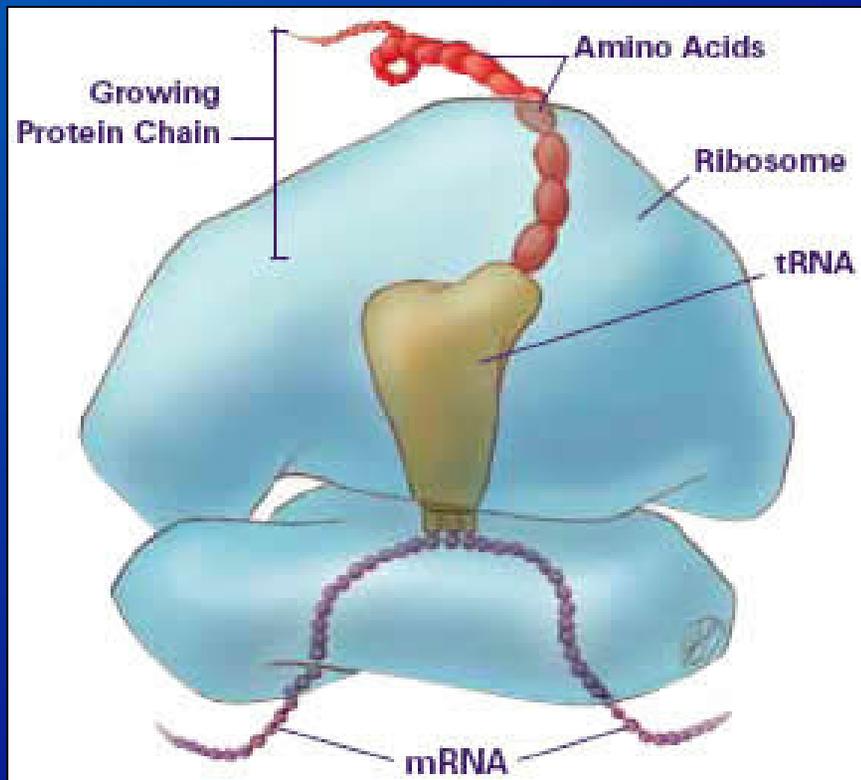


NON MEMBRANOUS CELL ORGANELLES

RIBOSOMES (Protein factories of the cell)

- Present in cytoplasm, mitochondria, chloroplast & also found attached to rough ER & nuclear membrane
- They are made up of r RNA and proteins
- Prokaryotes have 70s ribosomes, Eukaryotes have 80s ribosomes .

FUNCTION: These are sites of protein synthesis





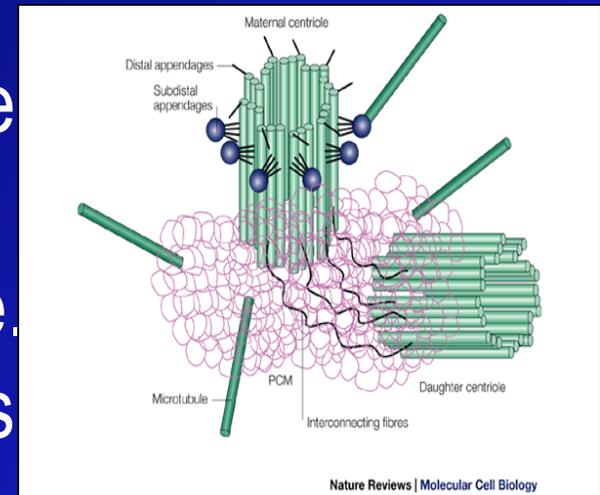
CENTROSOMES:

- Found in animal cells & in motile algae
- It has two cylindrical structures called centrioles surrounded by centrosphere.
- Centrioles are arranged at right angles
- They are made up of micro tubules

FUNCTION: Helps in cell division.

NON LIVING CELL INCLUSIONS:

- Ergastic substances
- Cytoskeleton





“A cell is regarded as a true biological atom”

THANK YOU