Cell Biology
Structure & Functions

Dr. Rajesh Choudhary
M. Pharm. (Pharmacology), Ph. D.

www.youtube.com/pharmacologyconceptsbyrajeshchoudhary

www.pharmacyconcepts.com

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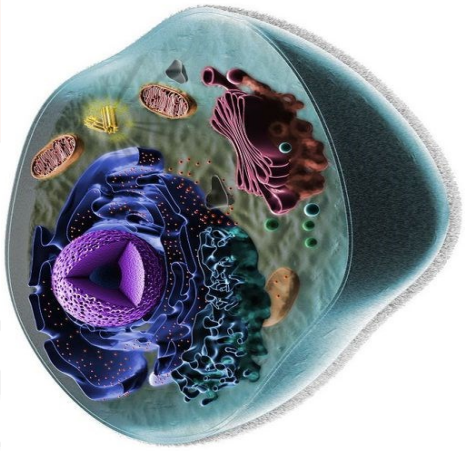
Content of the Lectures

- Introduction
- Structure of Human Cell
- Functions of Cell Organelles



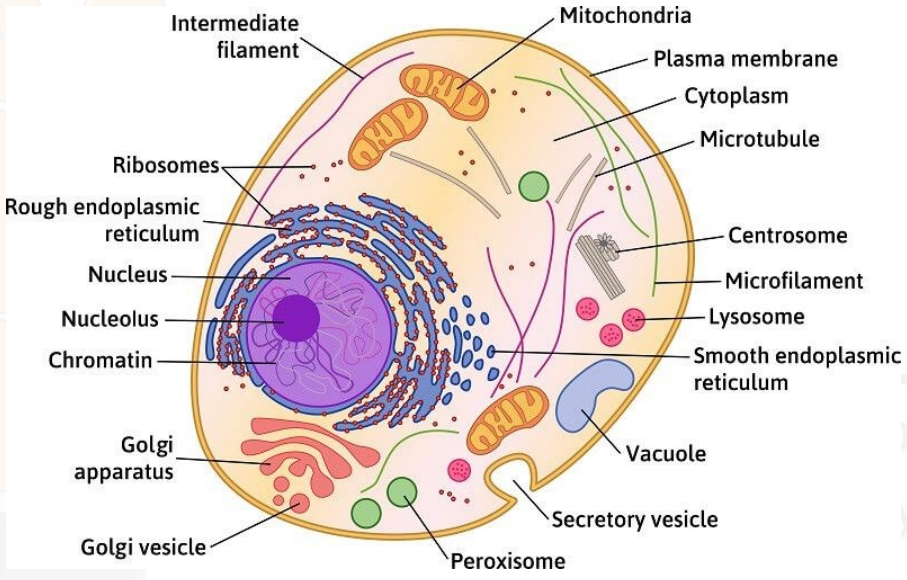
Introduction

- Cytology: Study the structure and function of cells
- Cells is the Fundamental unit of the life
- Robert Hook (1665) first observed the cell from slice of cork
- Anton Van Leeuwenhoek (1674) was the first to analyze live cells in his examination of algae

Introduction

- In the early 1800s, Schwann and Schleiden theorized that cells are the basic building blocks of all living things **(Cell Theory)**

Structure



Basic Constituents

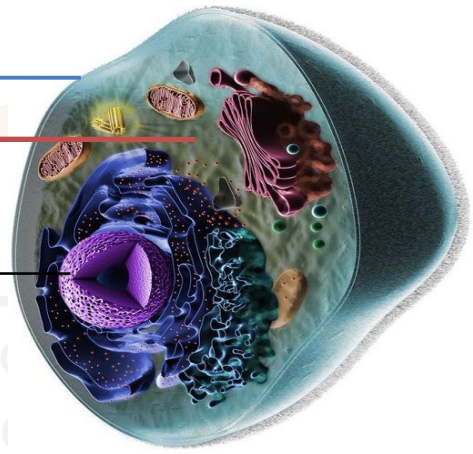
- Different substances that make a cell are collectively called **Protoplasm.**
- Protoplasm is composed of :-

1)Water - **70-80% Water is present in cell.**
2)Carbohydrates
3)Lipids
4)Proteins
5)Electrolyte - Sodium (Na+), Potassium (K+), Magnesium (Mg2+), Calcium (Ca2+), Phosphate , Chloride (Cl-), and Bicarbonate (HC03 -).

Parts

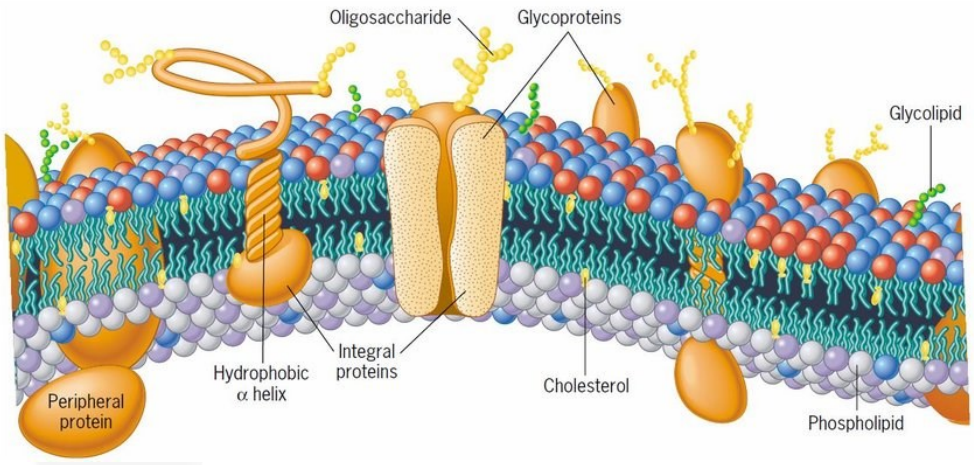
Three Major Parts of Cell

1. Cell / Plasma membrane
2. Cytoplasm and its Organelles
3. Nucleus



Functions

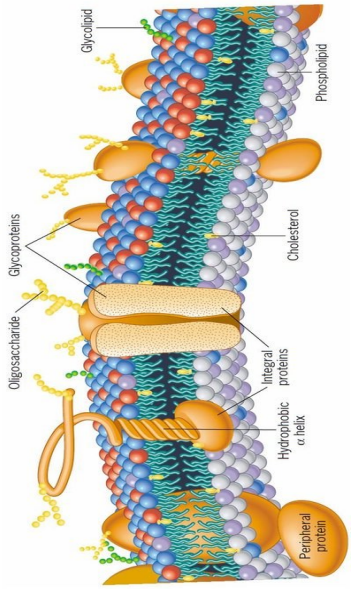
1. Plasma Membrane



Functions

1. Plasma Membrane

- Outer layer of the cells
- It covers cell's surface and act as a barrier between inside and out side the cell
- It consist bi-layer of phospholipids with embedded **proteins that are**
  - Integral Proteins
  - Peripheral proteins
- it also contains carbohydrate in form of glycoproteins and glycolipids



Functions

1. Plasma Membrane functions

A. Protection of the cell components

B. Digestive: Takes in food and excretes waste products

C. Homeostasis: helps to maintain internal environment (osmotic pressure, electrolyte, etc.)

D. Selective Permeability:

- Easily Permeable for **Non-Polar Molecules** [lipids, Gases (like O2 ,CO2, N2), Steroid Hormones], small polar molecules (water, water soluble ions, glucose, ions
- Poor/selective permeable for large polar molecules by specific transport system

Functions

2. Cytoplasm and Organelles

Cytoplasm:

- It is Thick, gel-like semitransparent fluid that is found in both plant and animal.
- It consist of **cytosol, cell organelles and cytoplasmic inclusions**
- It includes everything inside the cell except **Nucleus**
- It accounts for almost 70% of the total cell volume.
- It provides media for cell components/ organelles

Functions

Cell Organelles

Double membrane bound cell organelles

- ✓ Mitochondria

Single membrane bound cell organelles

- ✓ Endoplasmic Reticulum
- ✓ Golgi Appartus
- ✓ Lysosomes
- ✓ Peroxisomes
- ✓ Vacuole

Functions

Cell Organelles

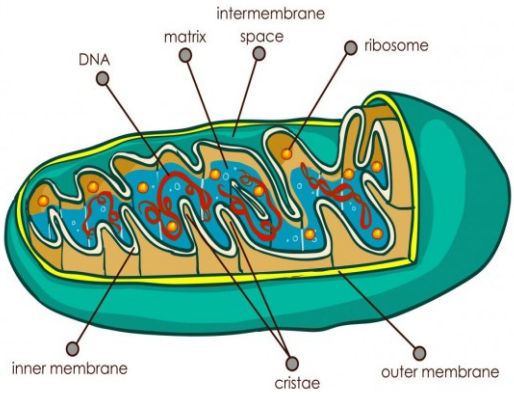
Non-membrane bound cell organelles

- ✓ Ribosome
- ✓ Centrioles
- ✓ Microtubules
- ✓ Microfilaments

Functions

Mitochondria "Power House"

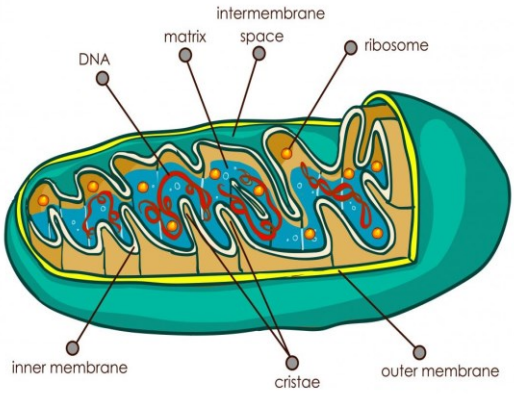
- **Kolliker (1850)** was first observed mitochondria as **granular** structures in the striated muscles
- 0.5 micron dm & 4 micron length
- **Outer membrane** contains large numbers of integral membrane proteins called **Porins,** which allow to pass molecules < 5000 daltons
- Contains enzymes concerned with biological oxidation



Functions

Mitochondria "Power House"

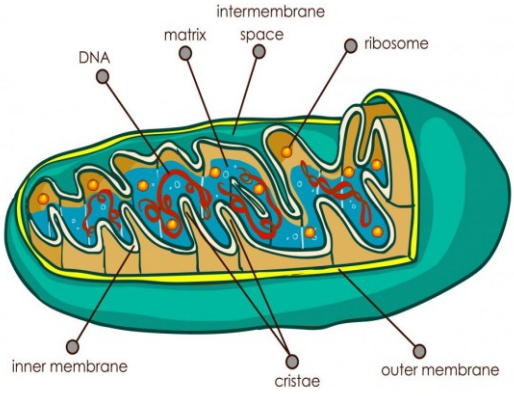
- **Matrix of the Mitochondria** contains enzymes concerned with *'citric acid cycle' and 'respiratory chain oxidation*
- Major metabolic pathways involved in oxidation of carbohydrates, lipids and amino acids and part of special biosynthetic pathways involving urea and heme synthesis are located in inner matrix.



Functions

Mitochondria "Power House"

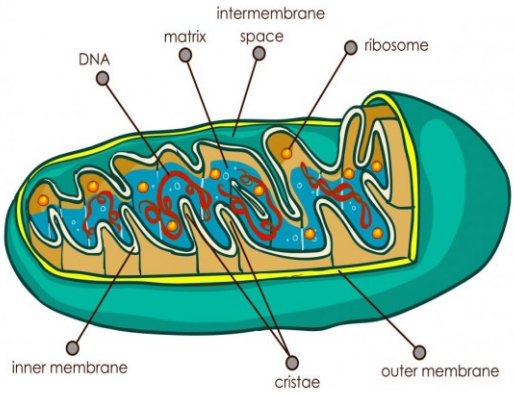
- **Inner Membrane** contains ATPase and other enzymes concerned with synthesis and metabolism of ATP. It also contains enzymes of Electron Transport Chain
- *Means Enzyme for oxidative phosphorylation and synthesis of ATP.*



Functions

Mitochondria "Power House"

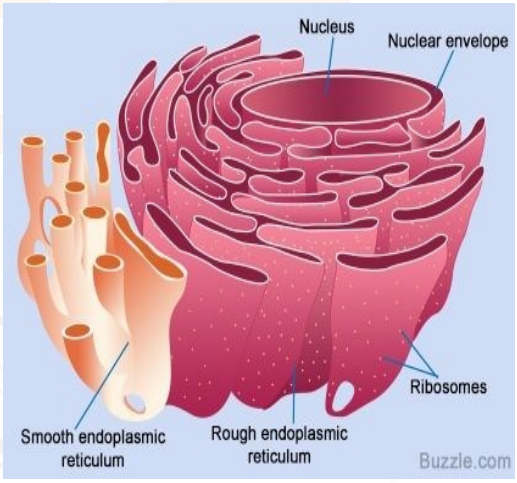
- Energy production
- Metabolic Activity
- Thermo-genesis
- Ca^{2+} ion regulation



Functions

Endoplasmic Reticulum

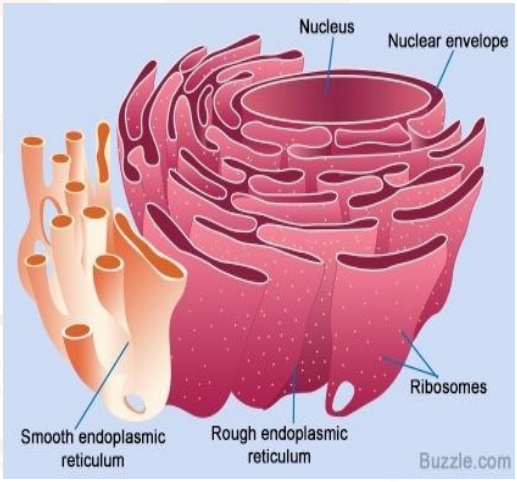
- Network of tubular and flat vesicular structures in the cytoplasm
- **Rough Endoplasmic Reticulum (RER)-** Contains Ribosome.
- Site of protein synthesis,processing and packaging
- Mainly present in protein forming cells such as pancreatic acinar cells ,Goblet cells, antibody producing plasma cells, Nissl's granules of nerve cells etc.



Functions

Endoplasmic Reticulum

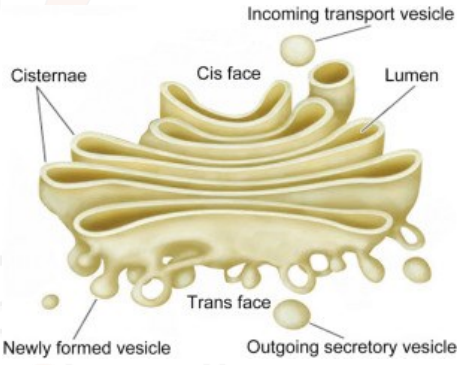
- **Smooth Endoplasmic Reticulum (RER)-** Does not Contain Ribosome.
- Site of synthesis of lipid and steroid hormones.
- Mainly present in lipid forming cells such as adipocytes, interestitial cells of testis, glycogen storing cells of liver, adrenal cortex cells, muscle cells, leucocytes etc.



Functions

Golgi Apparatus

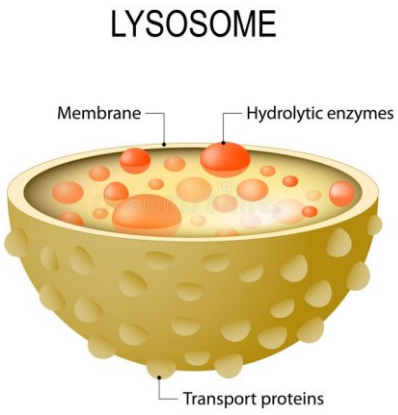
- Produce secretary granules i.e., hormones, enzymes in the protein secreting cells, it packages proteins.
- Site of formation of lysosomes i.e. large irregular structures surrounded by membrane which are present in the cytoplasm



Functions

Lysosomes (Suicidal Bags)

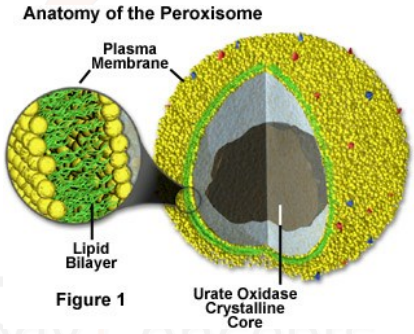
- It contains hydrolytic enzymes
- Digestive system of cell that digest essentially all macromolecules.
- Engulf exogenous substances e.g. bacteria and degrade them.
- When a cell dies , lysosomal enzymes causes autolysis of the remanant



Functions

Peroxisome

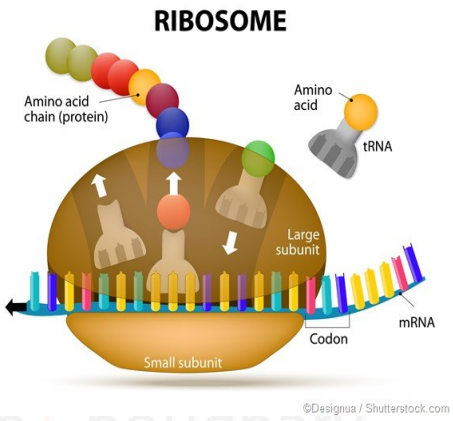
- It consist bilayered lipid membrane and Urate oxidase crystalline core
- Peroxisomes can be formed by the budding of ER.
- It contains peroxidases that produces H2O2
- Role in H2O2 metabolism; detoxifications, lipid bosynthesis, bile synthesis in liver



Functions

Ribosome

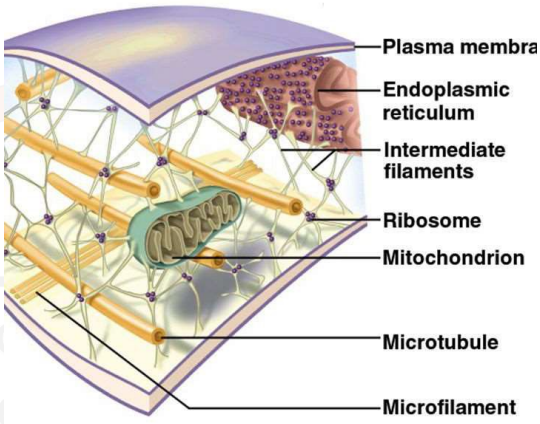
- **"Protein Factory"** of The Cell
- 80 s unit – 60s & 40s subunits (Eukaryotes)
- Also known as rRNA



Functions

Cytoskeletons

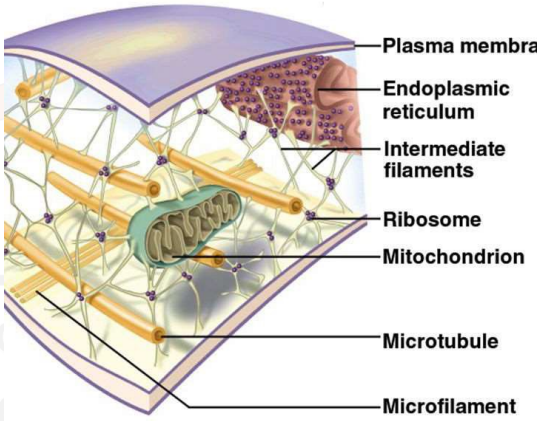
- System of fibers that not only maintains the structure of the cell but also permit it to change shape and move.
- They made up of
  i)Microtubules
  ii)Intermediate Filaments
  iii)Microfilaments



Functions

Cytoskeletons

- They are involved in the:-
- Movement of the chromosomes
- Cell movement
- Processes that move secretion granules in the cell
- Movement of proteins within the cell membrane.



Functions

3.Nucleus

Control System (Brain) of Cells

- Major Parts:
  - Nucleolus
  - Nucleoplasm & Genetic Materials
  - Nuclear Envelop
- Functions
- **Nuclear membrane** is permeable only to small nonpolar (lipid soluble)
- Convey the genetic information

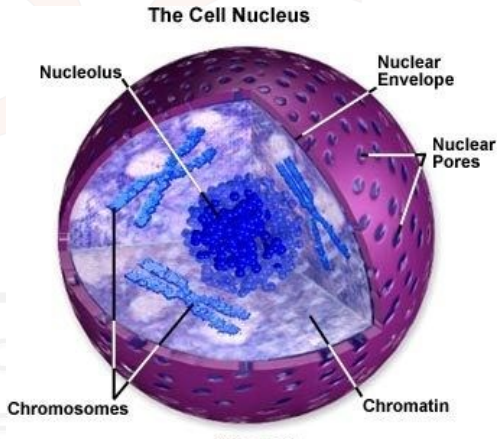
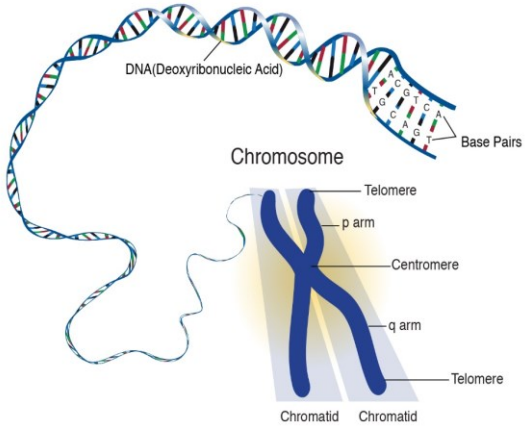


Figure 1

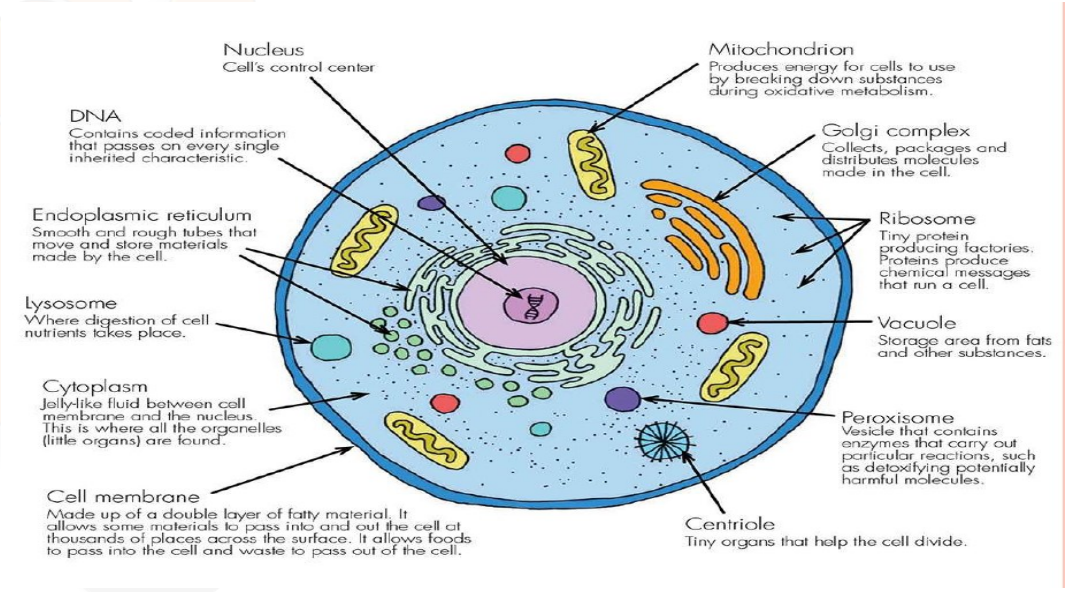
Functions

3.Nucleus

- **Chromatin** is the set of hereditary material consisting of Deoxyribose Nucleic Acid (DNA) in the form of genes. During the cell division chromatin converts into **chromosome**
- **Nucleus** also contains RNA which helps to protein synthesis
- **Nucleolus** responsible for synthesis of ribosomal RNA



Summary



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