Fundamentals of Biochemistry

B.Sc. Ag

Semester II

Topic : History and scope of plant biochemistry, important Biomolcculcs.

The term Biochemistry was first introduced by German scientist / chemist CARL NEUBERG in 1903.

Definition of Biochemistry

Biochemistry may be defined as a science concerned with chemical nature and chemical behaviour of the living matter.

Biochemistry may be treated as a discipline in which biological phenomenon are analyzed in terms of chemistry. Hence termed as biological chemistry or Chemical Biology.

Chemistry of Living Things

Two branches

- **Descriptive: Studies are done about qualitative and quantitative characterization of the various cell components**

- **Dynamic: Deals with the elucidation of various mechanism and nature of the reactions involved in these cell components**

History

In terms of history biochemistry is a young science.

Sr. No.	Period	Name of scientist	Contribution
1	1742-1786	Karl Wilhelm Scheele	Isolated citric acid, lactic acid, malic acid
2	1743-1794	Antoine Lavoisier	Father of biochemistry, developed the concept of oxidation of organic materials
3	1828	Wohler	Synthesized the first organic compound, urea from inorganic components
4	1854-1864	Louis Pasteur	Proved that fermentation is caused by microorganisms
5	1877	Kuhne	Proposed the term 'Enzyme'
6	1894	Emil Fischer	Demonstrated the specificity of enzymes and the lock and key relationship between enzyme and substrate
7	1897	Buckner	Discovered alcoholic fermentation in cell-free yeast extract
8	1902	Emil Fischer	Demonstrated that proteins are polypeptides
9	1903	Neuberg	First used the term 'biochemistry'

10	1913	Michaelis and Menten	Developed kinetic theory of enzyme action
11	1926	Sumner	First crystallized an enzyme, urease and proved it to be a protein
	1933	Embden Meyerhof and Parnas	Demonstrated crucial intermediates in the chemical pathway of glycolysis and fermentation
	1937	Krebs	Discovered citric acid cycle
	1940	Lipmann	Role of ATP in biological systems
	1950	Pauling and Corey	Proposed the α-helix structure for keratins
	1950-1953	Chargaff	Discovered the base composition of DNA
	1953	Sanger and Thompson	Determined the complete amino acid sequence of insulin
	1953	Watson and Crick	Proposed the double-helical model for DNA structure
	1958	Meselson and Stahl	Confirmed the Watson-Crick model of semi conservative replication of DNA
	1961	Jacob & Monod	Proposed the operon hypothesis and postulated the function of messenger RNA
	1999	Ingo potrykus	Golden rice- rich in β-carotene
	1838	Berzelius	Suggested the name proteins
	1822-1895	Louis Pasteur	Identified organisms responsible for fermentation.
	1852-1919	Emil Fischer	Studied structure of carbohydrates, Amino acids and fats.
	1906	F. G. Hopkins	Concept of deficiency diseases
	1912	Funk	Isolated and characterized the curative agent for scurvy (Vitamin – C), rickets (Vit. – D), Beriberi (Vit – B_1)
	1954	Watson and Crick	Helical model of nucleic acid
	1926	J.B. Sumner	First crystallized enzyme urease, Father of modern enzymology
	1935	Rose	Discovery of the first essential amino acid threonine.
	1929	Haworth	Formulation of sugars as pyranose form OR Furanose form

Scope of plant biochemistry

Biochemistry deals with study of

1. The nature of the chemical constituents of the living matter and the chemical substances produced by living things.
2. The functions and transformations of their chemical entities in biological systems.
3. The chemical and energetic changes associated with the transformation in the course of the activity of living matter.

Scope and importance of biochemistry in Agriculture

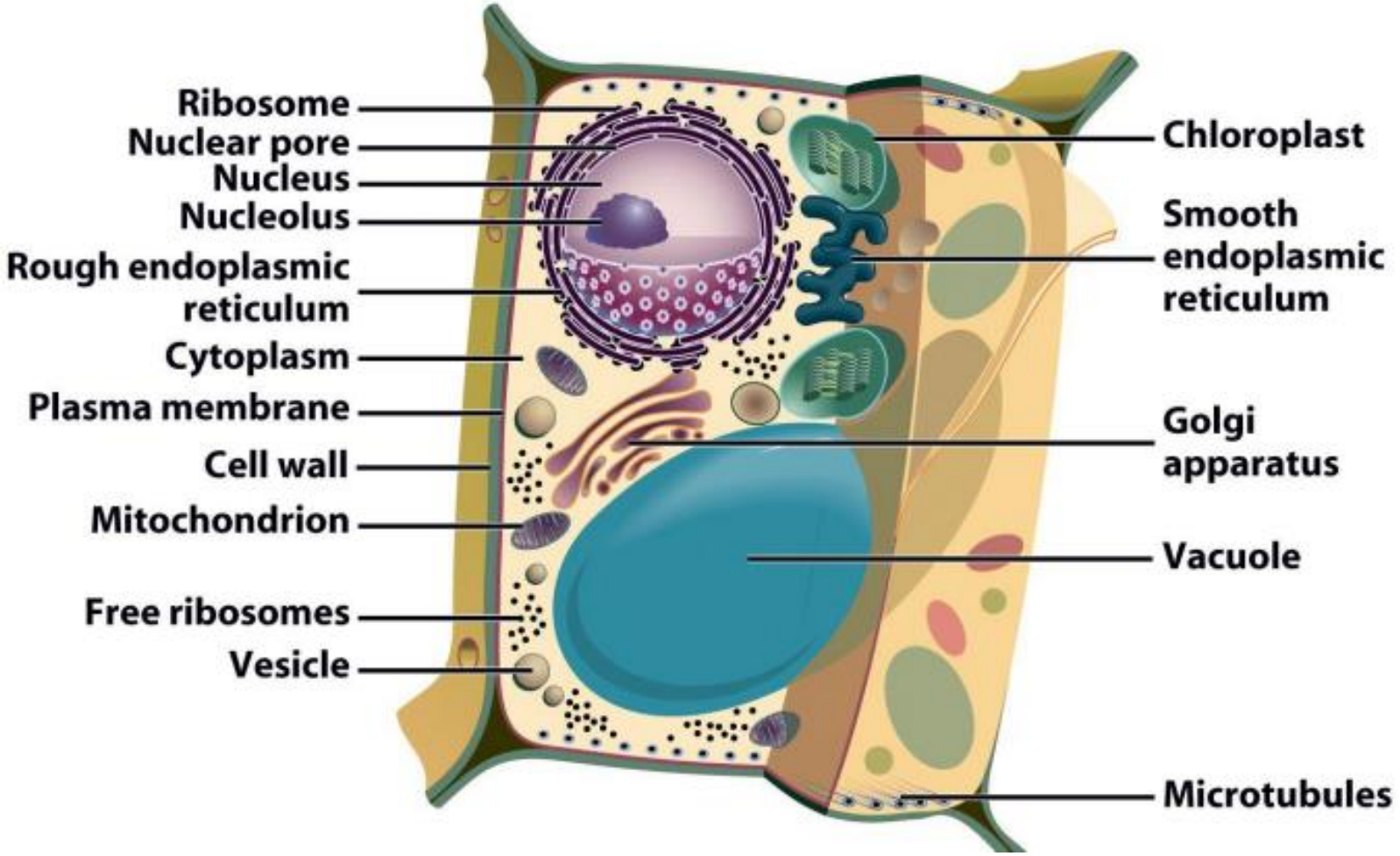
1) To evaluate nutritive value of cereals, pulses, poultry and cattle feeds.
2) Development and exploitation of better genotypes.
3) Removal and inactivation of toxic or anti nutritional factors present in food grains in general and grain legumes in particular by breeding and chemical treatments. e.g. BOAA in Lakh dal, Trypsin inhibitors of soybean, Aflatoxins of groundnut.
4) Food preservation and processing technology and post harvest physiology of fruit crops and vegetables and their nutritional quality.
5) Biochemistry of disease and pest resistance.
6) Biochemistry of drought resistance. Proline and hydroxyproline imparts drought resistance to Jowar.
7) Formulation of balanced diet.
8) Use of nonconventional sources of protein foods *viz*., single cell proteins, fish protein concentrates, mushrooms and leaf proteins.
9) Developments in the field of intermediately metabolism i.e. synthesis and degradation of constituents of living tissues.

Structures and functions of important cell Organelles, importance of water

Definition of cell

A cell may be defined as "Structural and functional unit of all living organisms". Two types of cells - 1) Eukaryotic cells 2) Prokaryotic cells.

Schematic diagram of a typical plant cell.



Important plant cell-organelles and their functions

1) Cell Wall - It Provides support, prevent cells from swelling and rupture or shrinkage, gives definite shape to cell.

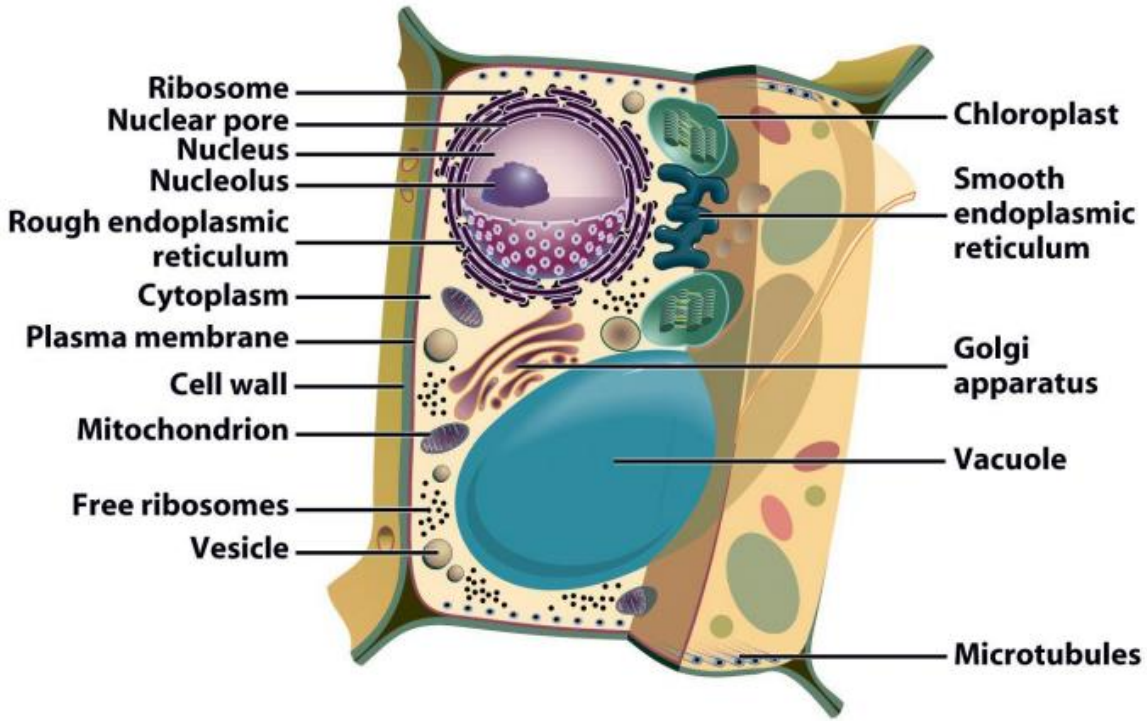
2) Nucleus - Store of genetic information, which issue appropriate signal at proper time during different stages.

3) Mitochondria - Power house of energy, contain m-tRNA and DNA and protein synthesizing machinery, synthesis of ATP required for anabolism.

4) Chloroplast - The sites of photosynthetic phosphorylation. The stroma is the site of the carbon photosynthetic enzymes involved in CO_2 fixation, ribosomes, nucleic acid-synthesizing enzymes, and fatty acid synthesizing enzymes.

5) Ribosomes - Site of protein biosynthesis.

6) Golgi apparatus - Participate in the early stage of cell wall synthesis in higher plants. Site of secretions of proteins and polysaccharides and coupling of these two components to form glycoproteins. Intense phospholipid biosynthesis observed in these organelles.



Importance of water:

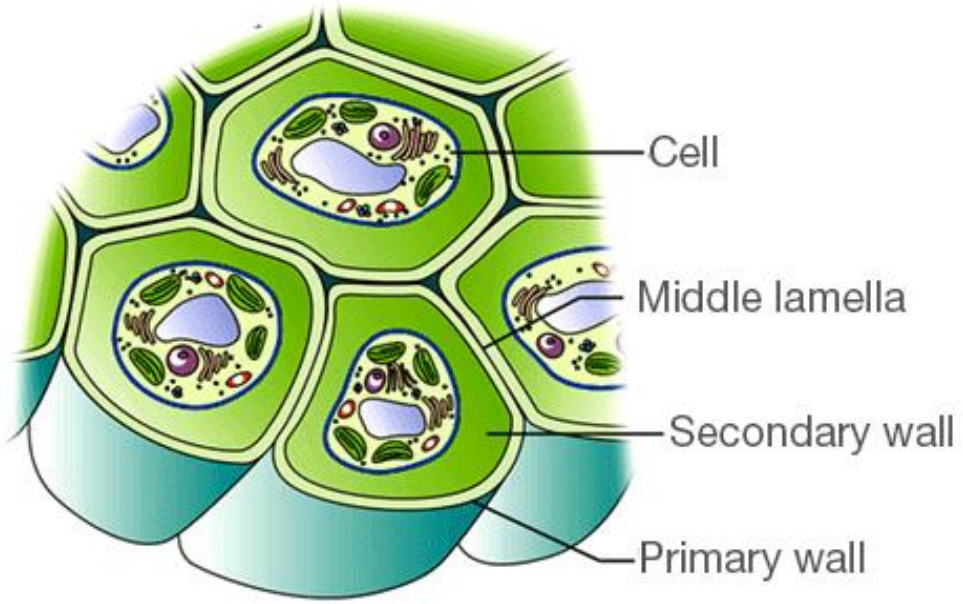
i) Serves as a medium in which substances undergo fundamental changes.
ii) Provides hydrogen for the reduction of CO_2 in photosynthesis.
iii) Water is necessary reactant for the hydrolytic splitting of carbohydrates, fats and proteins.
iv) Water is solvent and dispersion medium for all protoplasmic constituents.
v) Acts as a transporting medium for all the cell nutrients.
vi) Absorption, secretion and excretion would not be possible without water.

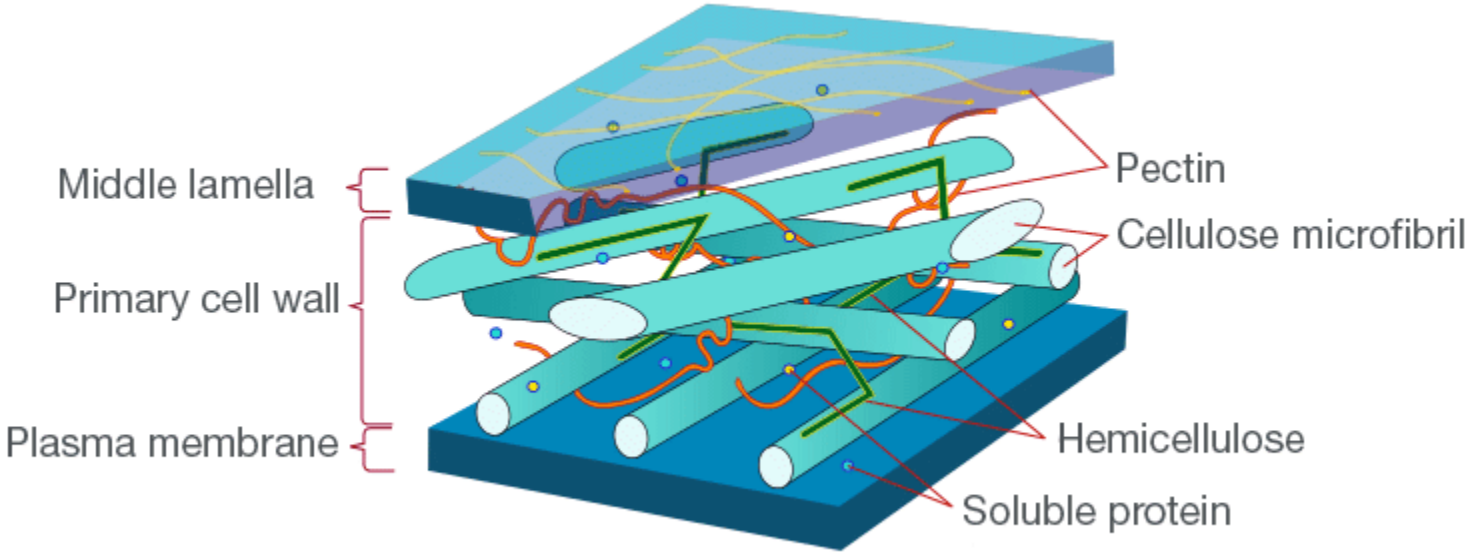
Cell components

1. Cell wall
2. Plasma Membrane
3. Protoplasm
4. Cytoplasm
5. Mitochondria
6. Ribosome
7. Endoplasmic reticulum
8. Golgi Body
9. Lysosome
10. Centriole
11. Vacuole
12. Spherosome
13. Plastids
14. Nucleus

Cell wall

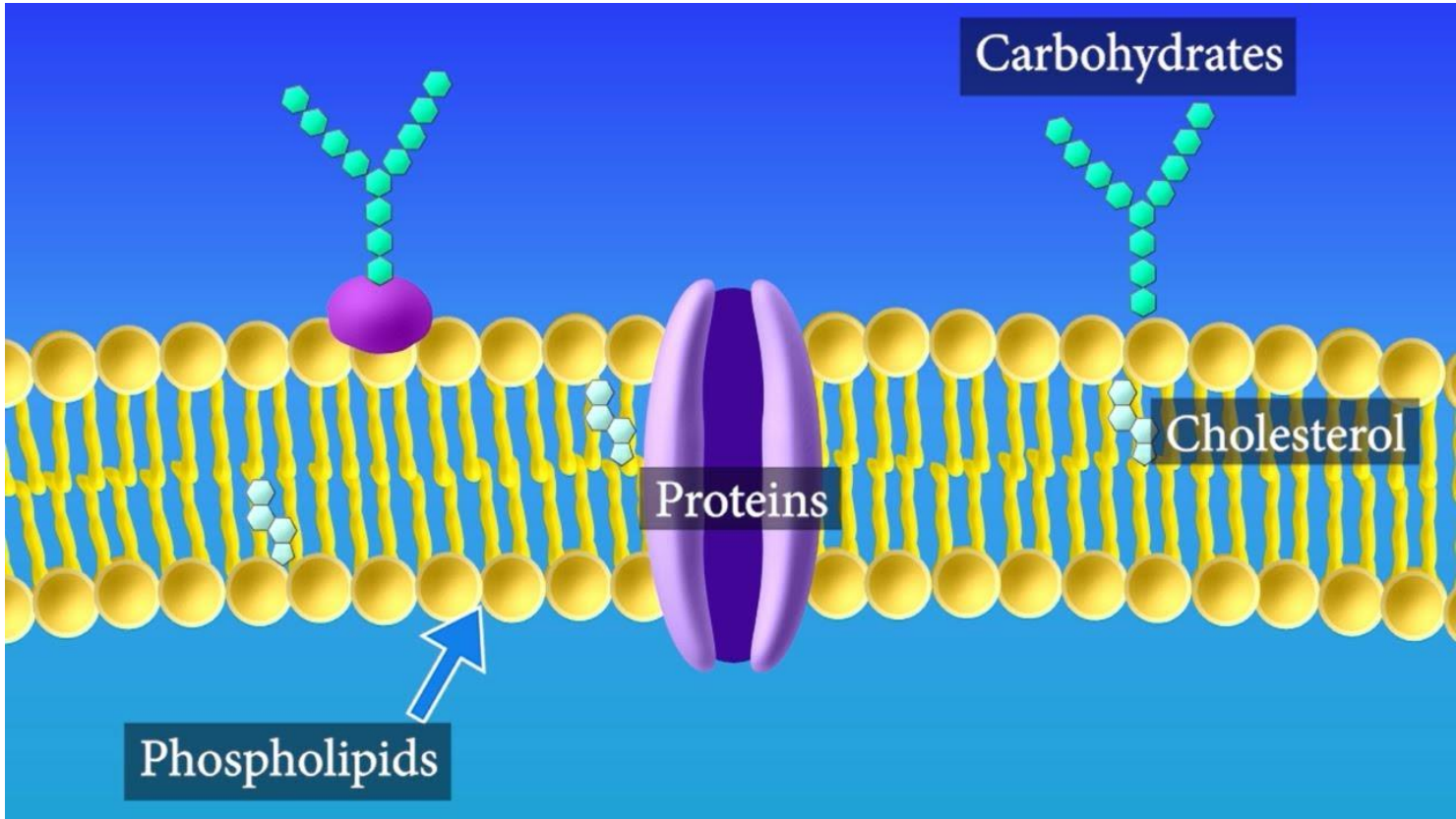
1.Primary Cell Wall
2.The Middle Lamella
3.The Secondary Cell Wall



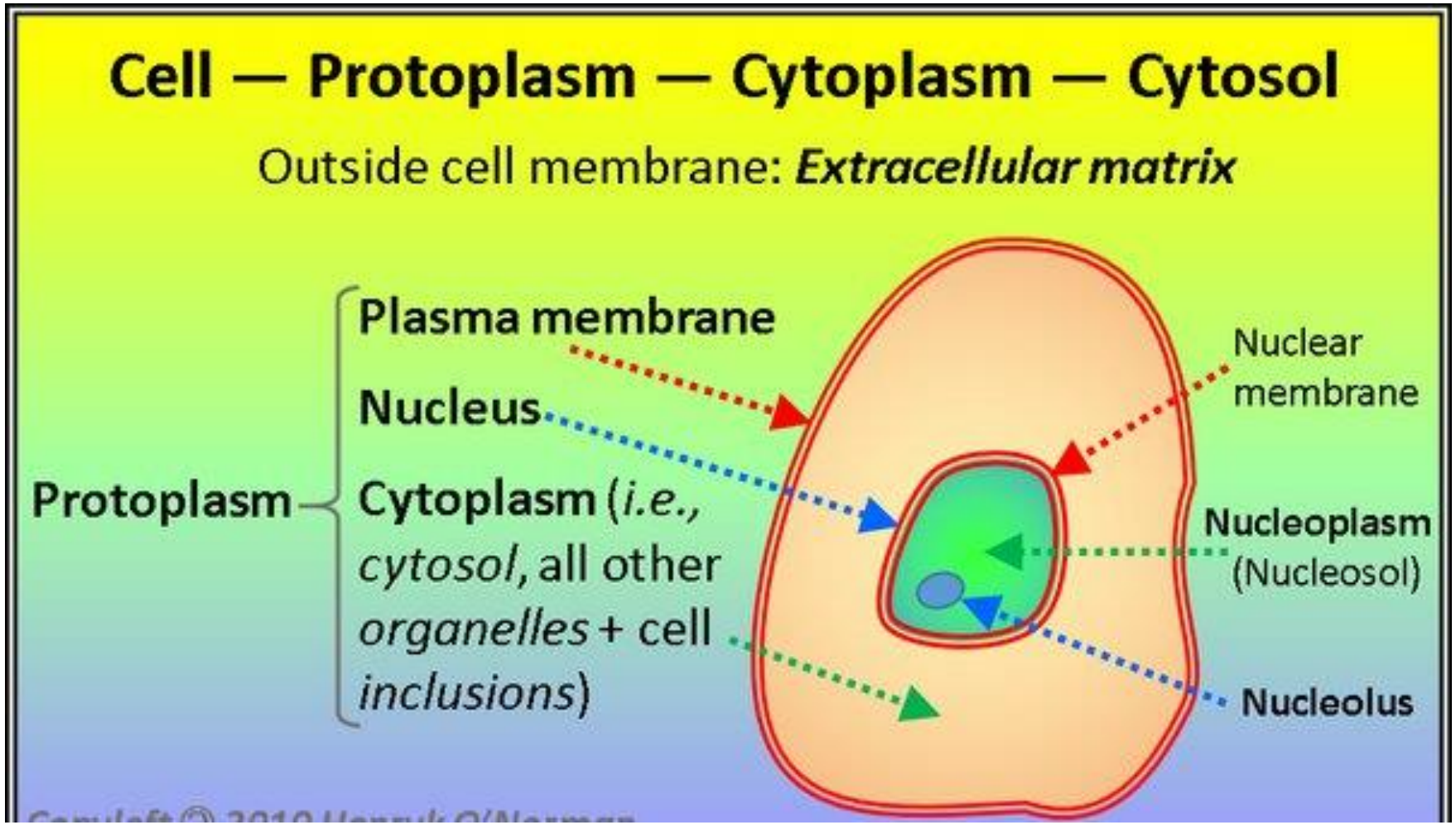


Plasma Membrane

60% protein
40% lipid

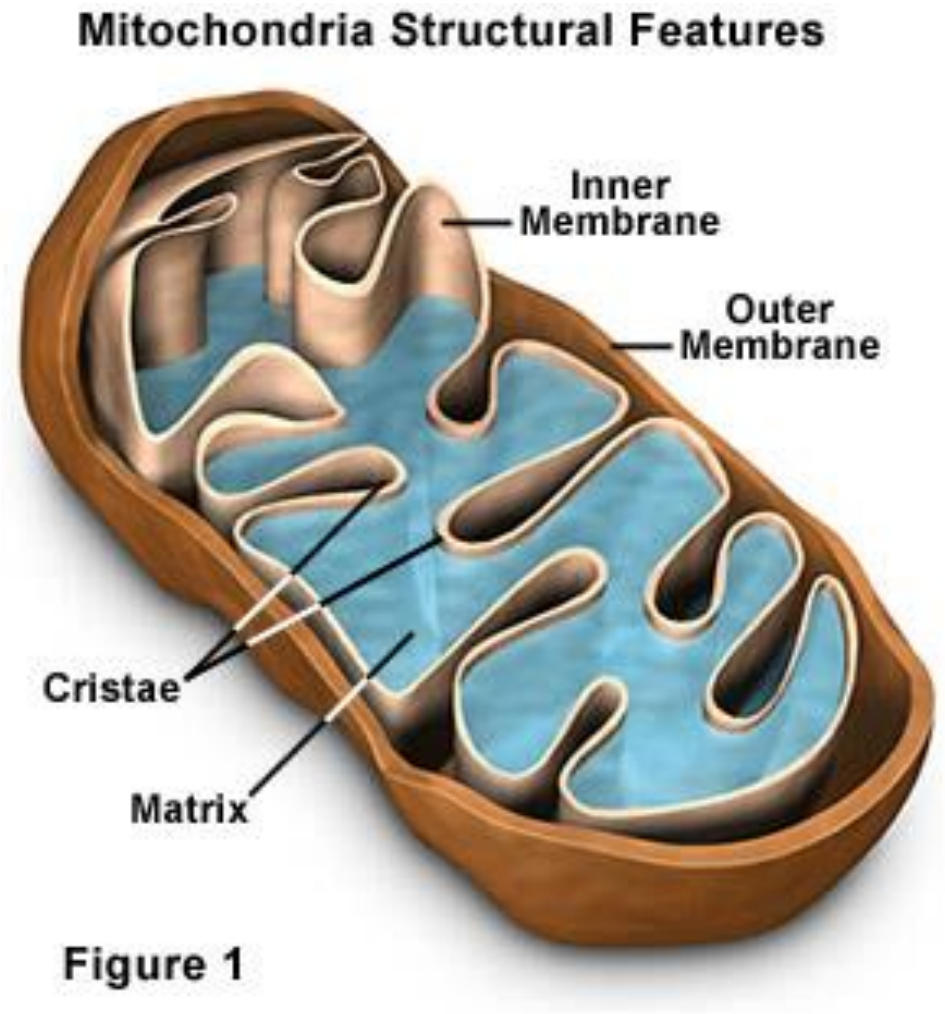


Protoplasm

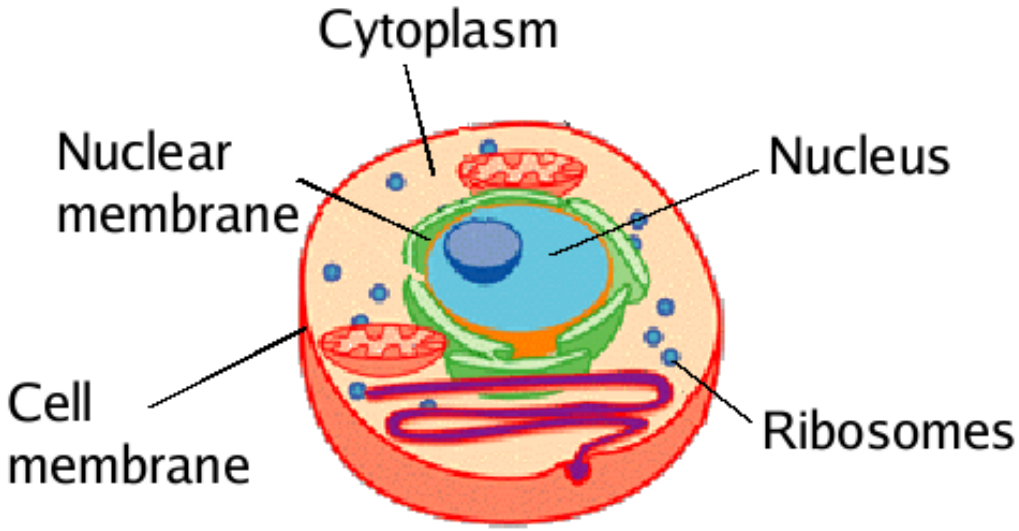

Cell — Protoplasm — Cytoplasm — Cytosol
Outside cell membrane: Extracellular matrix
Protoplasm
Plasma membrane
Nucleus
Cytoplasm (i.e., cytosol, all other organelles + cell inclusions)
Nuclear membrane
Nucleoplasm (Nucleosol)
Nucleolus

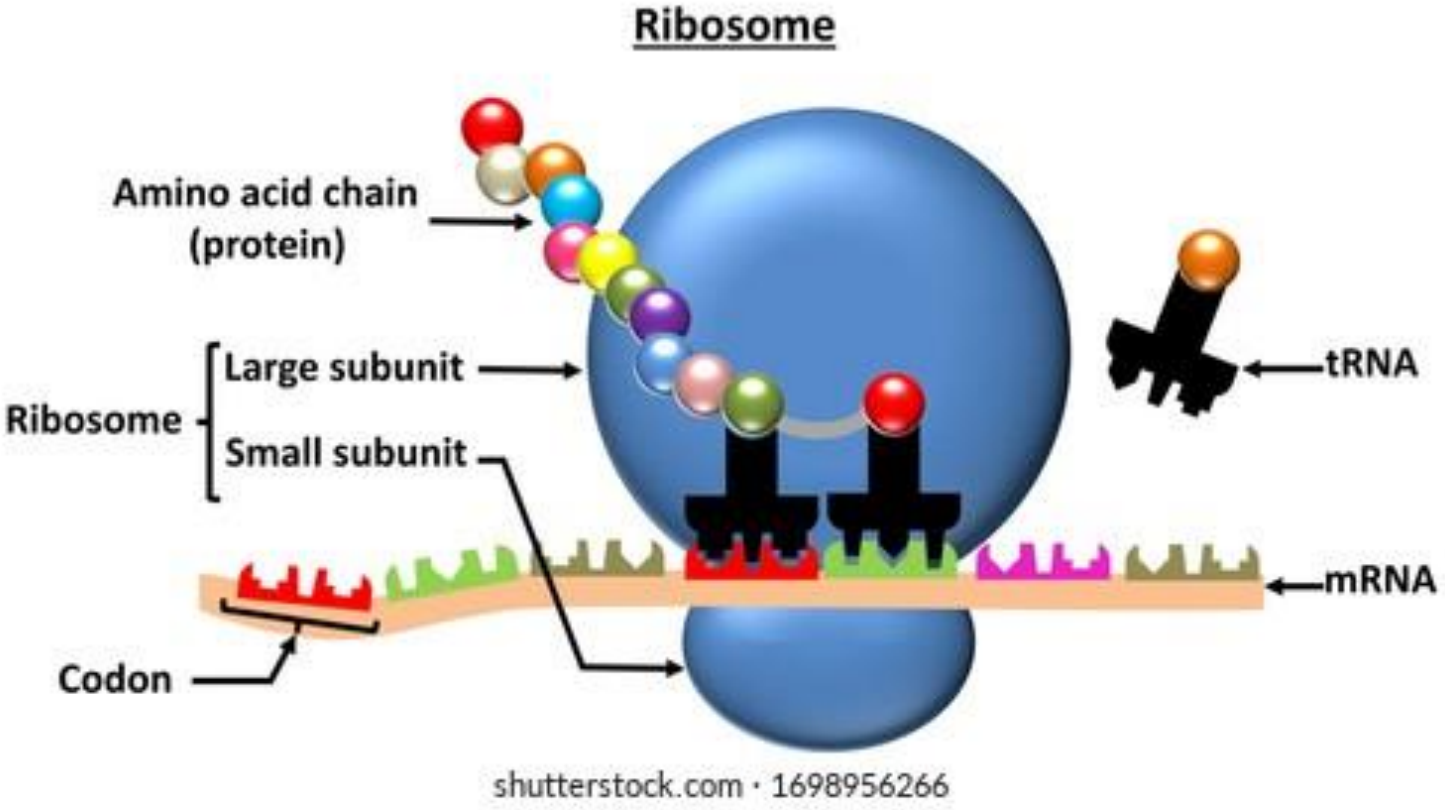
Mitochondria

Powerhouse of cell



Ribosome


Cytoplasm
Nuclear membrane
Nucleus
Cell membrane
Ribosomes


Ribosome
Amino acid chain (protein)
Ribosome
Large subunit
Small subunit
tRNA
mRNA
Codon
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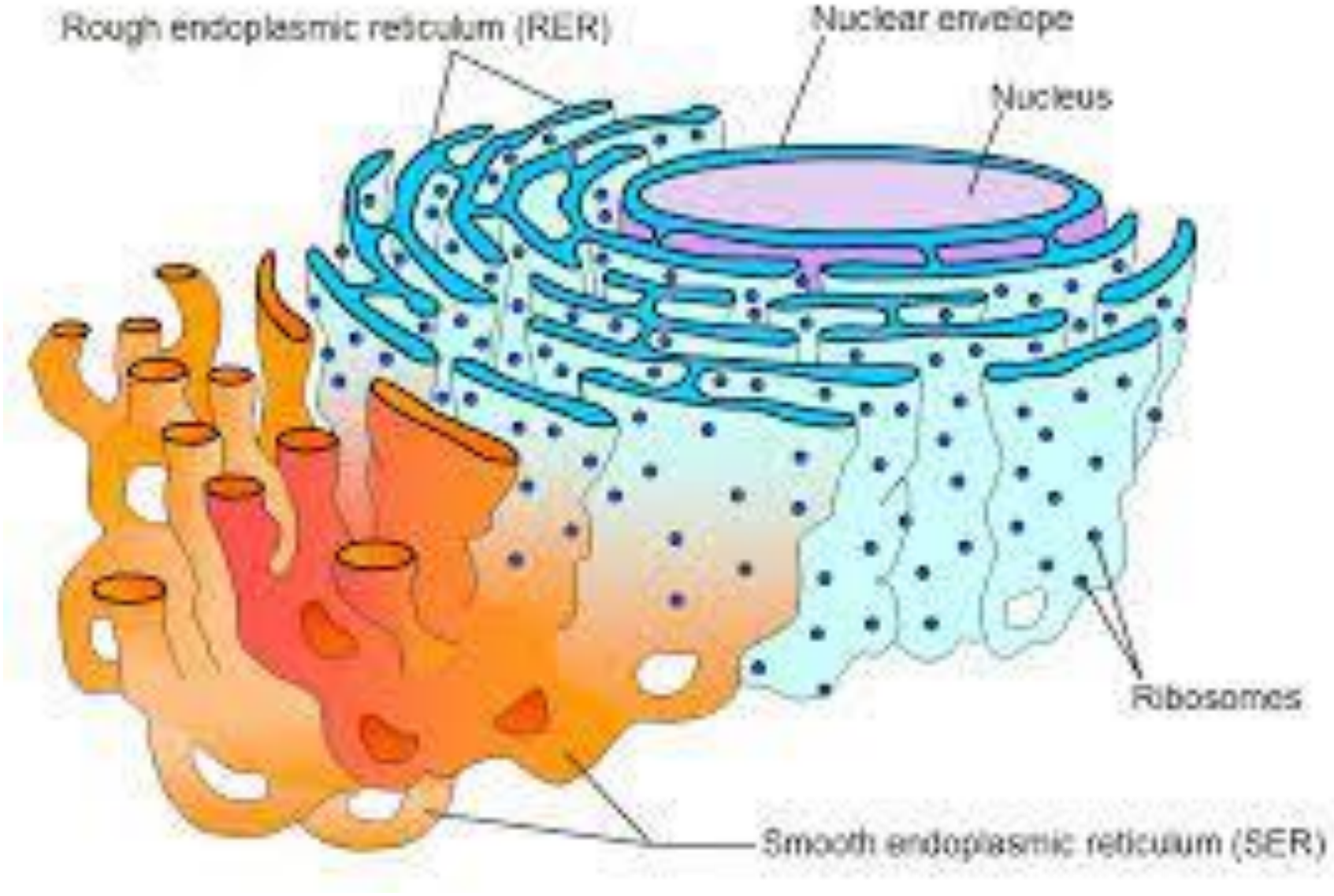
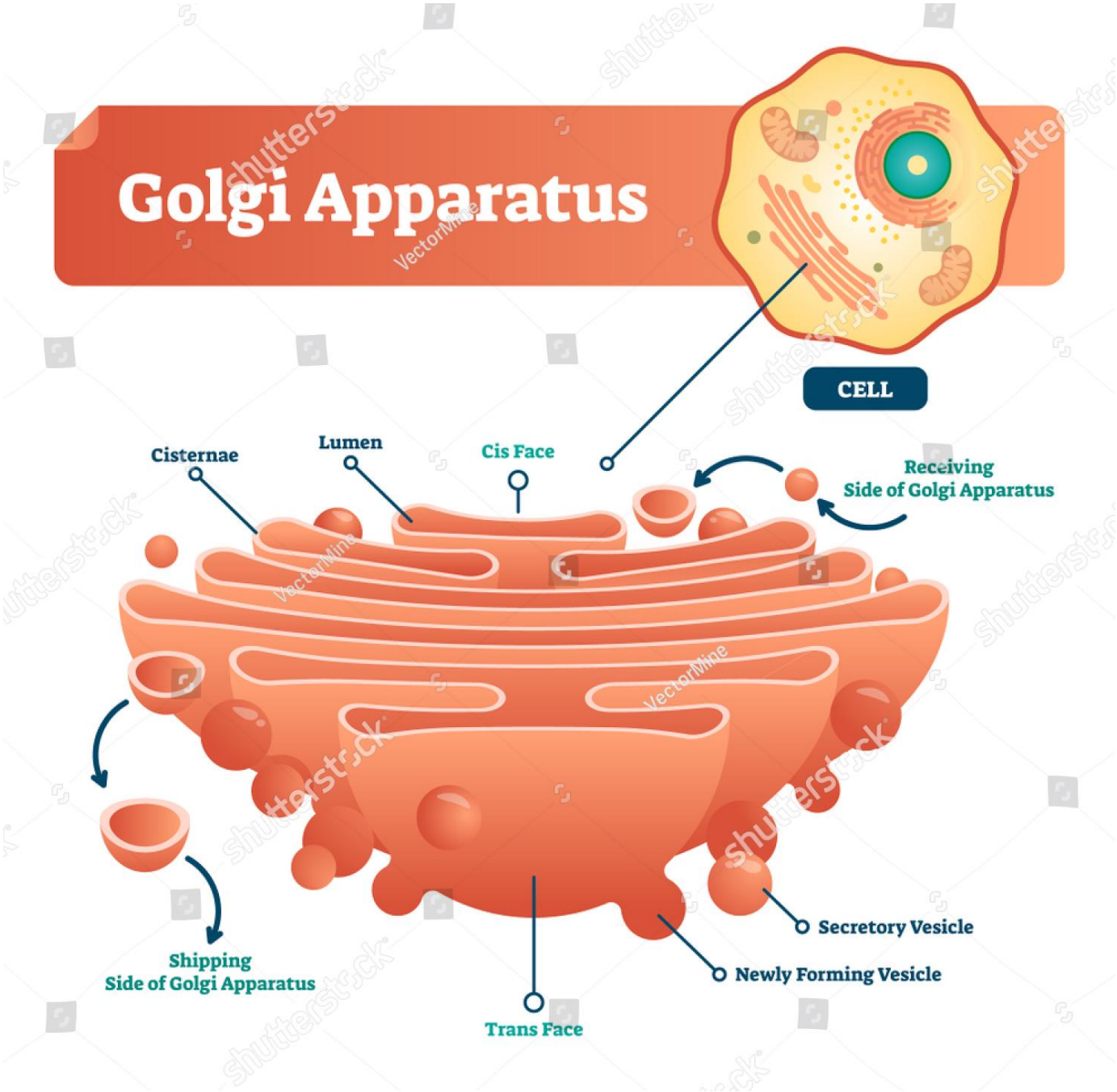
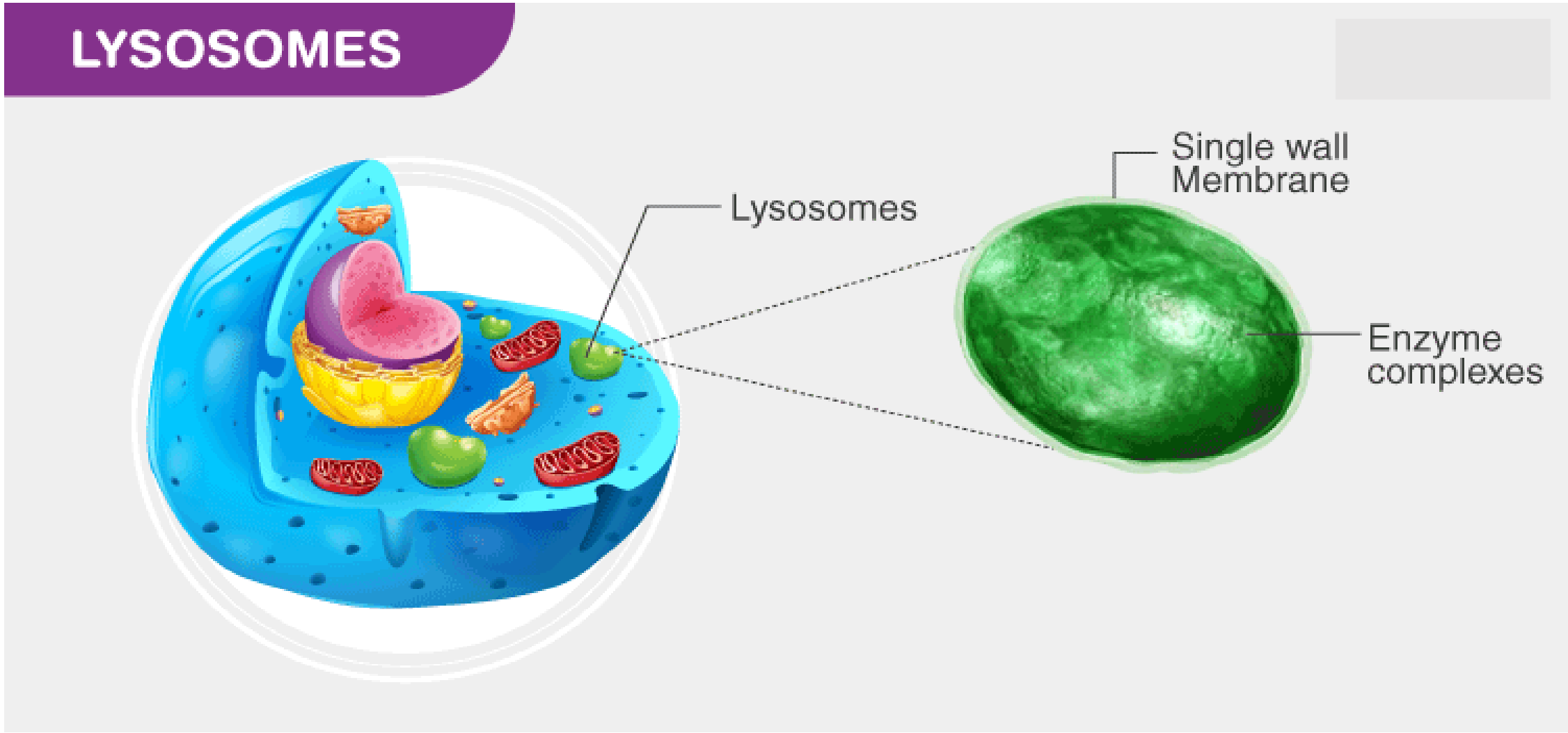
Endoplasmic reticulum



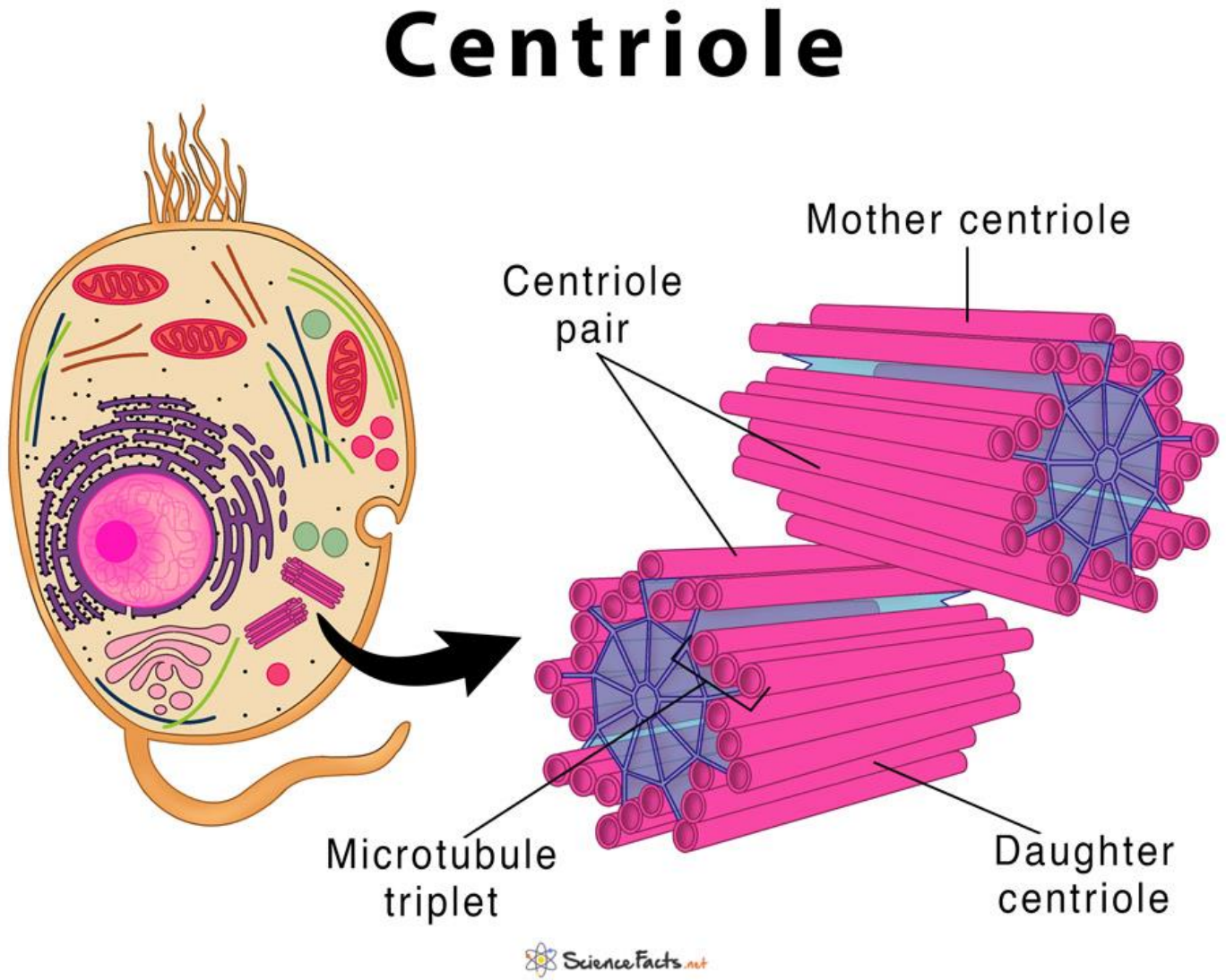
Golgi body


Golgi Apparatus
CELL
Cisternae
Lumen
Cis Face
Receiving
Side of Golgi Apparatus
Shipping
Side of Golgi Apparatus
Trans Face
Secretory Vesicle
Newly Forming Vesicle

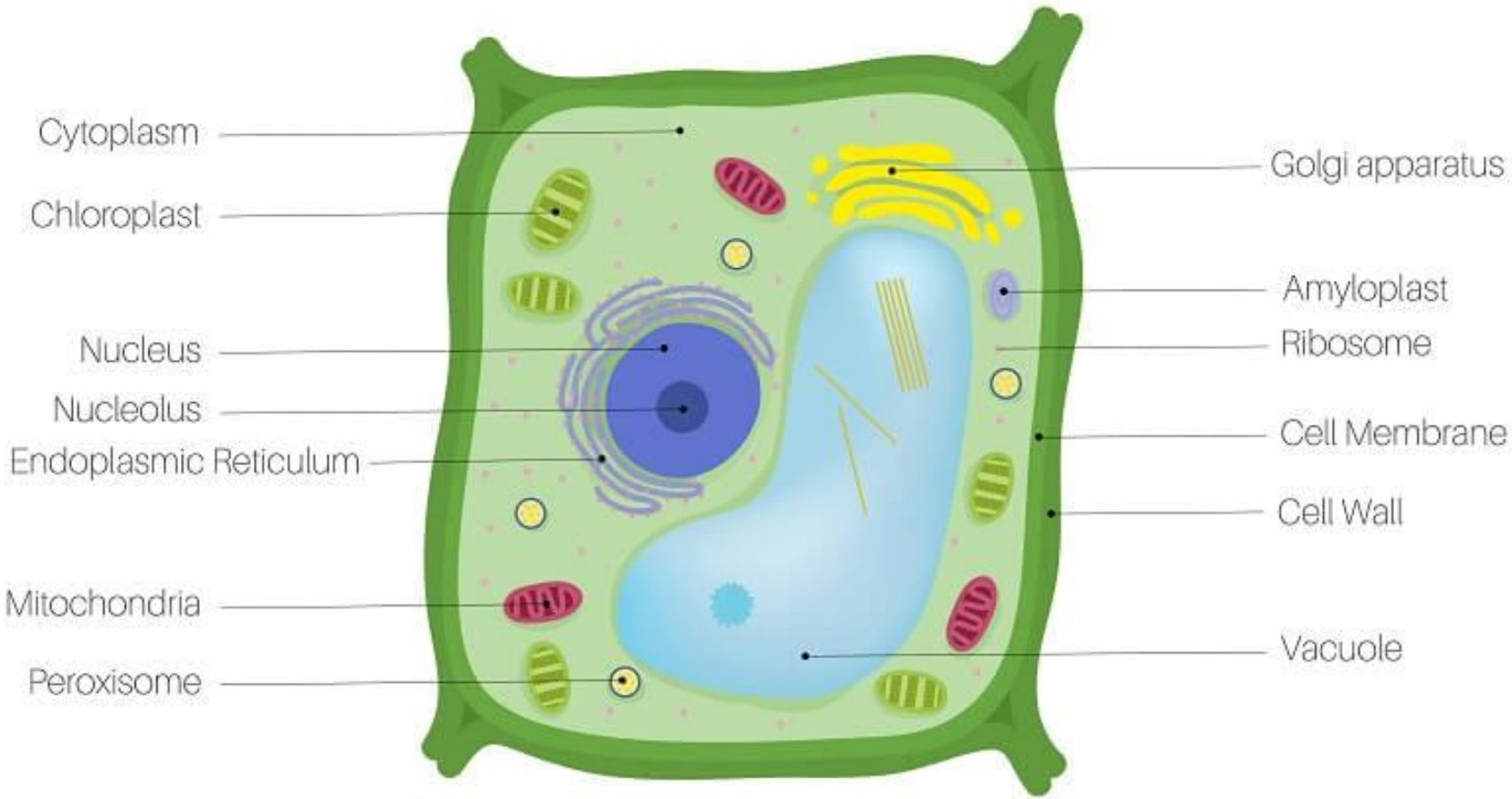
Lysosome


LYSOSOMES
Lysosomes
Single wall
Membrane
Enzyme
complexes

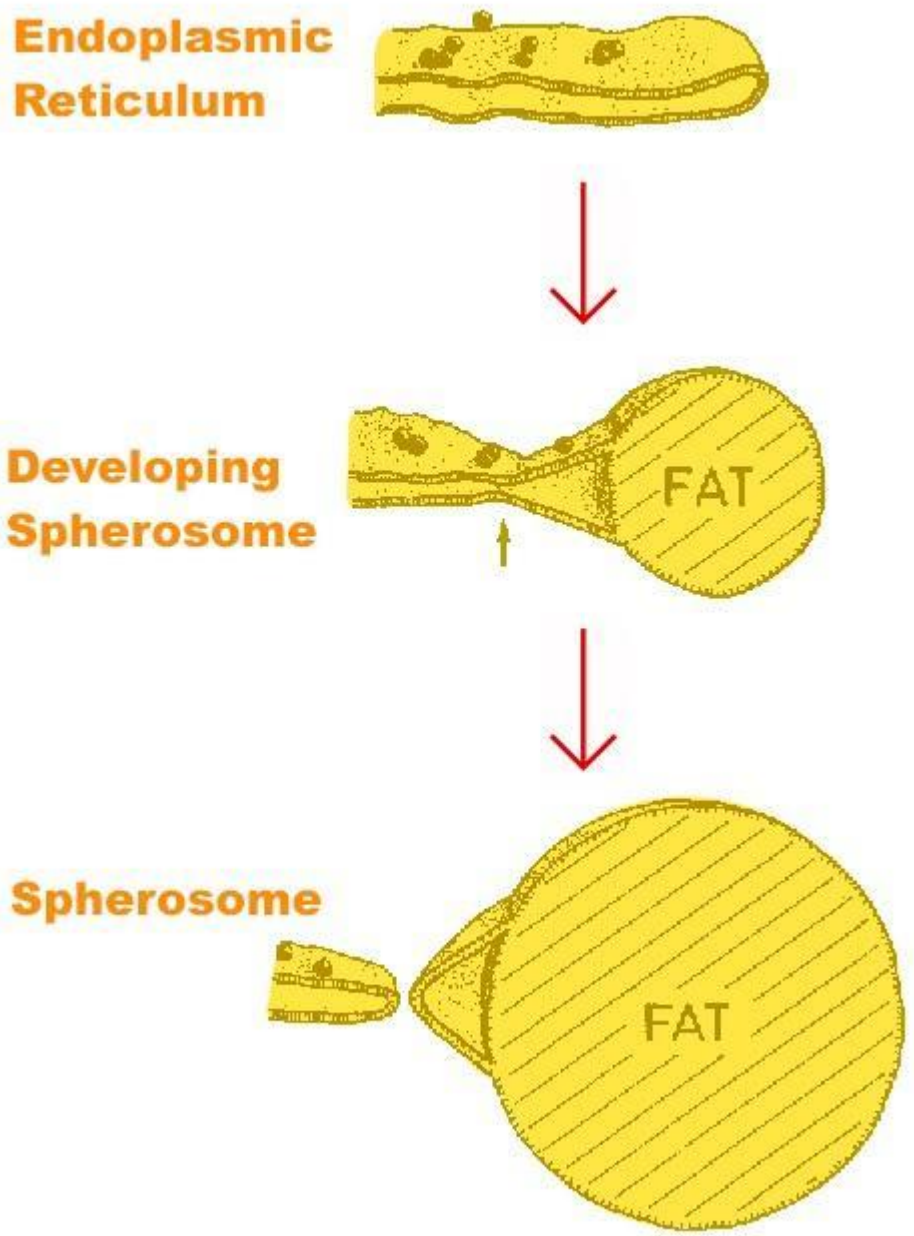
Centriole


Centriole
Mother centriole
Centriole pair
Microtubule triplet
Daughter centriole
ScienceFacts.net

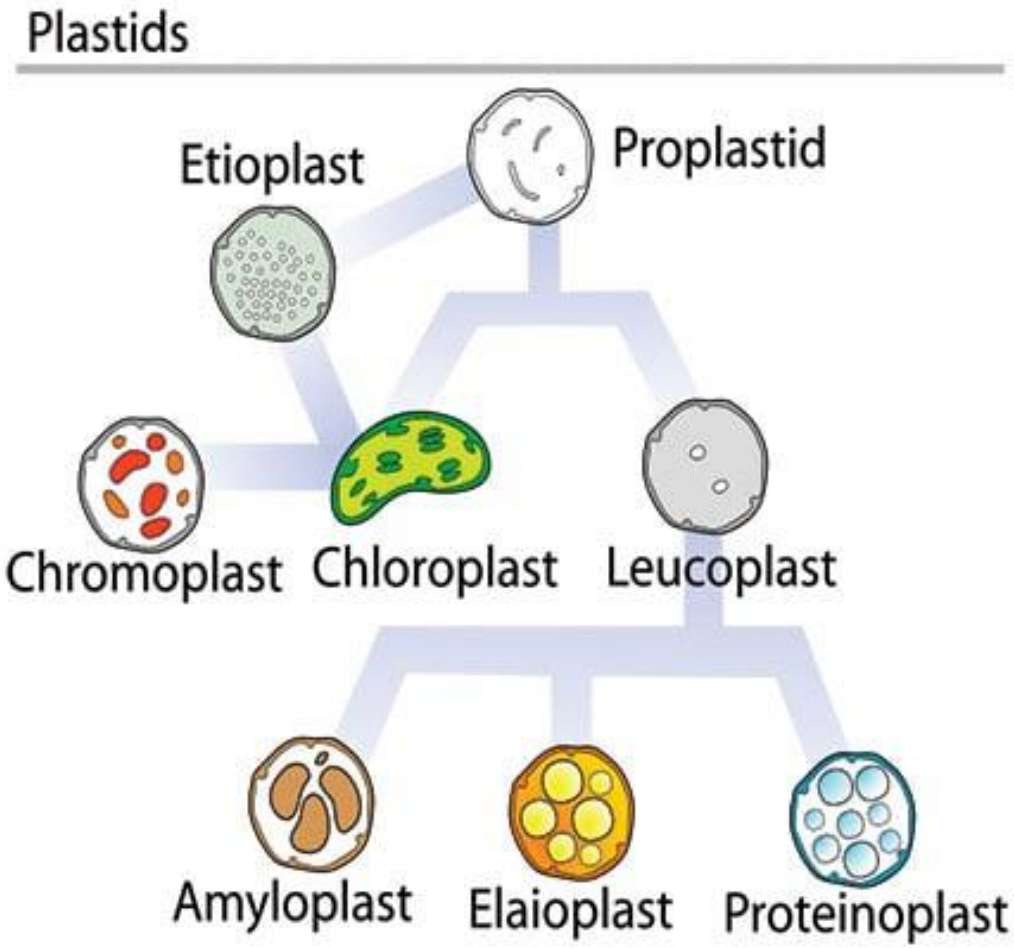
Vacuole

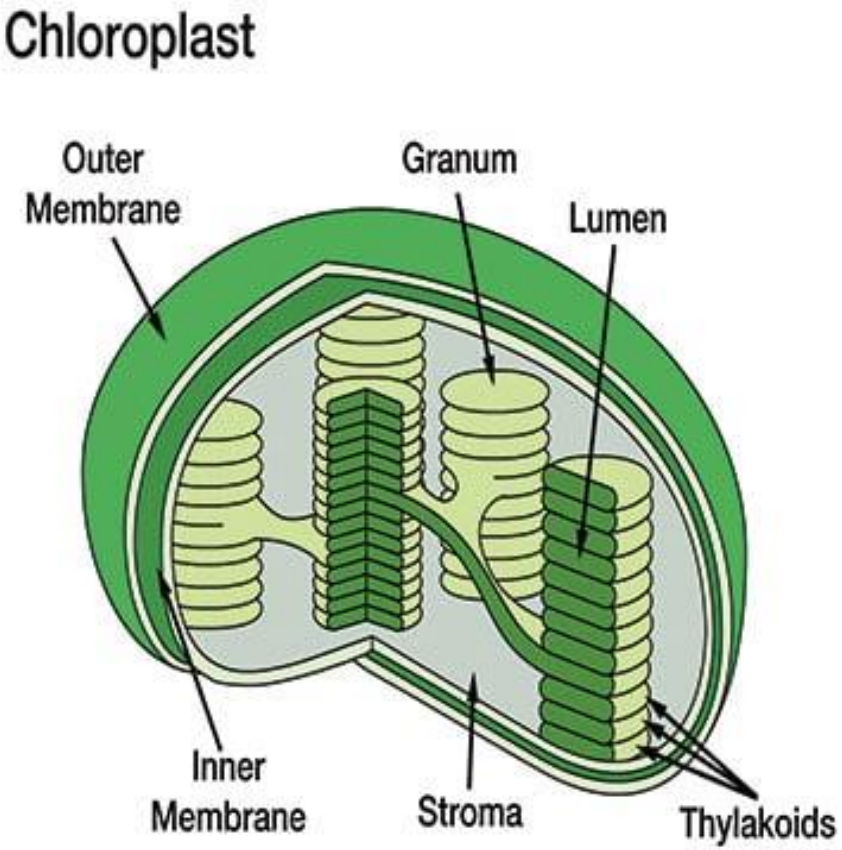

Cytoplasm
Chloroplast
Nucleus
Nucleolus
Endoplasmic Reticulum
Mitochondria
Peroxisome
Golgi apparatus
Amyloplast
Ribosome
Cell Membrane
Cell Wall
Vacuole

Spherosome

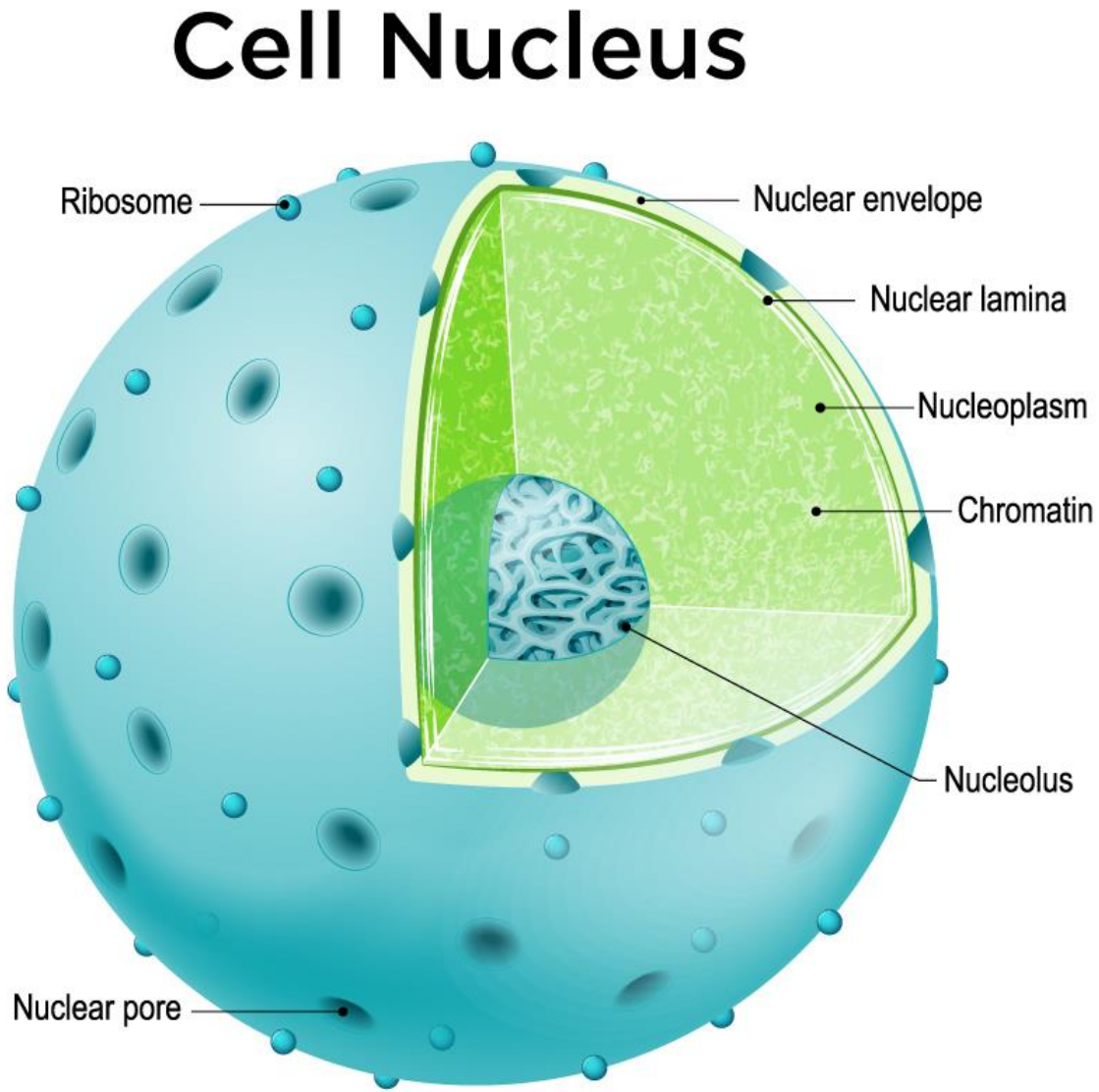

Endoplasmic
Reticulum
Developing
Spherosome
FAT
Spherosome
FAT

Plastids


Plastids
Proplastid
Etioplast
Chromoplast
Chloroplast
Leucoplast
Amyloplast
Elaioplast
Proteinoplast


Chloroplast
Outer Membrane
Granum
Lumen
Inner Membrane
Stroma
Thylakoids

Nucleus


Cell Nucleus
Ribosome
Nuclear envelope
Nuclear lamina
Nucleoplasm
Chromatin
Nucleolus
Nuclear pore

THANK YOU