Biyani's Think Tank

Concept based notes

Biochemistry-I

(B.Sc. Biotechnology Part-I)

Ms. Juhi Saxena
M.Sc.
Lecturer
Deptt. of Science
Biyani Girls College, Jaipur

Published by :
Think Tanks
Biyani Group of Colleges

Sector-3, Vidhyadhar Nagar,
Jaipur-302 023 (Rajasthan)
Ph : 0141-2338371, 2338591-95 • Fax : 0141-2338007
E-mail : acad@biyanicolleges.org
Website :www.gurukpo.com; www.biyanicolleges.org

First Edition : 2009

Leaser Type Setted by :
Biyani College Printing Department

Preface

I am glad to present this book, especially designed to serve the needs of the students. The book has been written keeping in mind the general weakness in understanding the fundamental concepts of the topics. The book is self-explanatory and adopts the "Teach Yourself" style. It is based on question-answer pattern. The language of book is quite easy and understandable based on scientific approach.

This book covers basic concepts related to the microbial understandings about diversity, structure, economic aspects, bacterial and viral reproduction etc.

Any further improvement in the contents of the book by making corrections, omission and inclusion is keen to be achieved based on suggestions from the readers for which the author shall be obliged.

I acknowledge special thanks to Mr. Rajeev Biyani, *Chairman* & Dr. Sanjay Biyani, *Director* (*Acad.*) Biyani Group of Colleges, who are the backbones and main concept provider and also have been constant source of motivation throughout this Endeavour. They played an active role in coordinating the various stages of this Endeavour and spearheaded the publishing work.

I look forward to receiving valuable suggestions from professors of various educational institutions, other faculty members and students for improvement of the quality of the book. The reader may feel free to send in their comments and suggestions to the under mentioned address.

Author

Syllabus

B.Sc. Part-I

Biochemistry-I

Note : *Question No. 1 shall consist of questions requiring short answers and shall cover entire paper. The paper is divided to four sections. Students are required to attempt five questions in all selecting not more than one question from each section. All questions carry equal marks.*

Section-A

1. Concept of life and living processes : The identifying characteristics of a living matter.

2. Cell membrane System and Cell wall : Cell Membrane and its Organization; Elementary idea of cellular constituents : Nucleus, Mitochondria, Golgi bodies, Endoplasmic reticulum, Lysosomes and Micrabodies; Bacterial and Plant Cell walls.

Section-B

1. Important properties of water, the law of mass action association of water and its ionic product, pH, Bronsted acids, ionization of weak acids and Henderson Haeselbate uation, Titration Curves, buffering action and physiologic offers.

2. Biomolecules : The small molecules of life–Sugars, Organ acids, amino acids and nucleotides Macromolecules of life polysaccharides, fats, proteins and nucleic acids, General idea of primary, secondary, tertiary and quaternary structure.

Section-C

1. Nucleus and Heredity : Nuclear rnernbrane; Nucleolus, Nuclear pores; Chromosomes; Packaging of DNA, DNA is Genetic material; DNA replication-basic concept : From DNA to RNA: Ribosomes and protein synthesis.

2. Mitochondria and Release of Energy : Structure of organization and function; Elementary account of Glycols and Krebs cycle and role of mitochondria in the later process.

Section-D

1. Chloroplasts : Capturing energy from the sun : Structure organization and function; Basic information on 'light' and 'dark' reactions of photopsynthesis and participation chloroplast in the process in C_3 + C_4 and CAM plants.

2. Enzymes : Nomenclature and classification, co-enzymes and co-factors, reaction and derivation of Mchaelis-Menten equation kinetics and allosteric regulation of enzymes, isozymes; more of catalysis.

3. Vitamins : Their structure, properties and Biological structures.

□ □ □

Content

□ □ □

Section-A

Chapter-1

Concept of Life & Living Processes

Q.1 What are the identifying characteristics of Living matter?

Ans.: (i) Living organisms are highly complicated and organized structures and contain large number of different organic molecules.

(ii) Each component unit of a living object appears to have specific purpose or function.

(iii) The living organism have ability to extract, transform and use energy from their environment either in form of organic nutrients or radiant energy of sunlight.

(iv) The most remarkable attribute of living organism is their capacity for self replication.

Q.2 Write axioms or principles of Living State.

Ans.: (i) There is basic simplicity in structure of biological molecules.

(ii) Living organisms use same kind of building block molecules and appear to have common ancestry.

(iii) Identities of each species or organism are preserved by its possession of distinctive sets of nucleic acid and proteins.

(iv) All biomolecules have specific functions in cells.

(v) Living organisms create and maintain their complex, orderly, purposeful structures at the expense of free energy.

(vi) Living cells are self-regulating chemical engines.

(vii) It maintains itself in dynamic steady state far from equilibrium with its surrounding.

(viii) Genetic information is encoded in units that are submolecular in dimensions.

(ix) It carries out various reactions catalyzed by biocatalyst or enzymes.

(x) The energy needed is provided directly or indirectly by solar energy. □ □ □

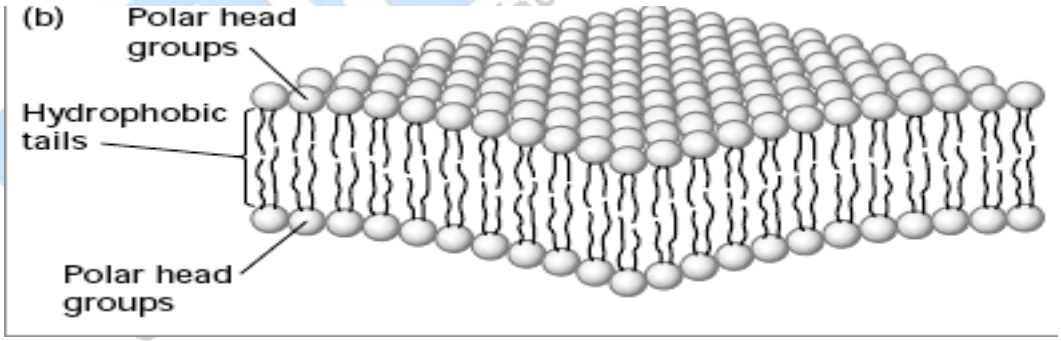
Chapter-2

Cell Membrane System & Cell Wall

Q.1 Give brief account on Membrane Phospholipids?

Ans.: Plasma membrane is a dynamic, fluid structure and forms the external boundary of cells. It acts as a selectively permeable membrane & regulated the molecular traffic across the boundary. Basic Structure of plasma membrane is phospholipids bilayer. The plasma membrane of animal cells contain four major phospholipids such as; phosphatidyl choline, phosphatidyl serine, phosphatidyl ethanolamine, sphingomyelin.

Phospholipids are amphipathic molecules and have a hydrophobic portion & hydrophilic portion. The primary physical forces for organizing biological membranes are hydrophobic interactions between the fatty acid chains of lipid molecules. These interactions result in formation of a phospholipid bilayer sheet containing two layers of phospholipid molecules whose polar head groups face surrounding watery surface while fatty acid chain form continous hydrophobic interior.



In addition to phospholipids plasma membrane of animal cells contains glycolipids and sterol. Glycolipids contain sugar residue covalently attached to lipid. Cholesterols is especially abundant in plasma membrane of animal cells, plants prokaryotes lack the same. Fluidity of bilayer depends on its lipid composition, cholesterol content and temperature.

Q.2 Write short note on Membrane Proteins?

Ans.: Many proteins are associated with membrane they can be grouped as peripheral proteins and integral membrane proteins.

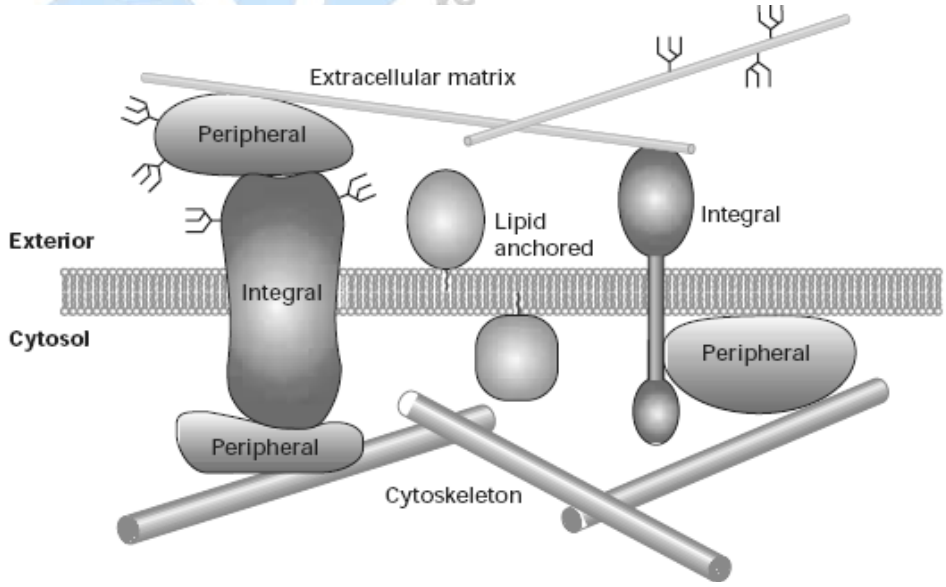
(a) **Peripheral proteins:** Also called as extrinsic proteins; they do not interact with phospholipid bilayer's hydrophobic core, instead they are usually bond to membrane indirectly by interactions with integral membrane proteins or directly by interactions with lipid polar head groups e.g. spectrin and ankyrin present in membrane of RBC.

(b) **Integral membrane proteins:** Proteins that held in bilayer by unusually tight binding to other proteins or lipids & can not be released easily are called integral membrane proteins also known as –intrinsic proteins. They have one or more segments embedded in phospholipids bilayer & contain residues with hydrophobic side chains that interact with fatty acyl groups of membrane phospholipids & thus anchoring protein to membrane. Proteins associated with membrane can be released from membrane by gentle extraction procedures such as exposure to high or low ionic strength solution or of extreme pH.

Following are the various **Types of Integral Membrane Proteins:**

(a) **Transmembrane Proteins:** Most integral proteins span entire phospholipids bilayer. They can be multi pass or Single pass. Examples glycophorin and band 3 proteins present in plasma membrane of RBC.

(b) **Lipid Anchored Protein:** some proteins are anchored to membrane by covalent bonds. In these proteins bound fatty acid is embedded in membrane, but polypeptide is chain doesn't enter into bilayer.



Q .3 Write in detail about Mitochondria?

Ans.: Mitochondria were first observed by kolliker as globular structure in striated muscles. The present name Mitochondria was given by Benda. Mitochondria move autonomously in cytoplasm, so they generally have uniform distribution in cytoplasm.

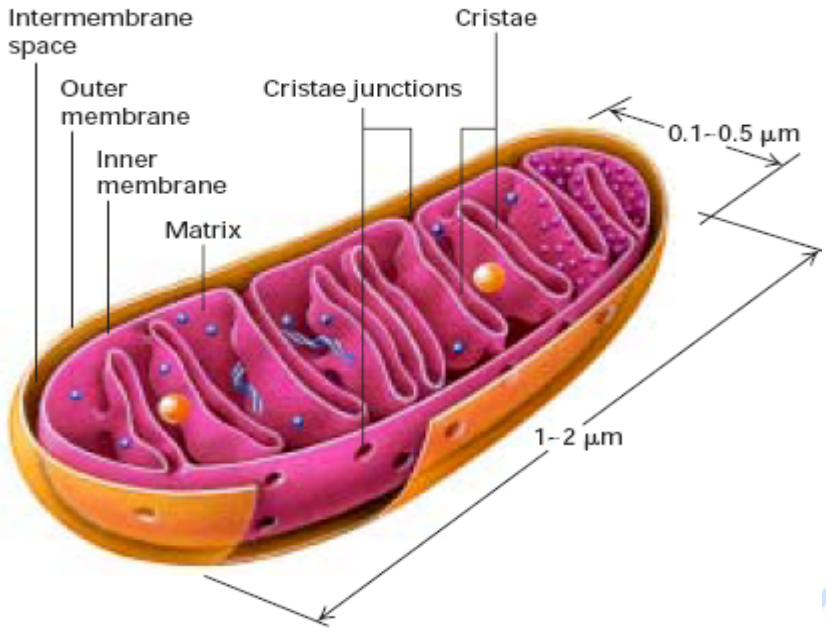
Mitochondria have definite orientation for example, in cylindrical cells; the mitochondria usually remain oriented in basal apical direction and lie parallel to main axis. The number of mitochondria in a cell depends on type and functional state of cell. It varies from cell to cell, & from species to species in shape Mitochondria may be filamentous or granular in shape and may change form one shape to another. Normally mitochondria vary in size from 0.5 μm to 2.0 μm.

Structure: Each mitochondrion is bounded by two highly specialized membranes that play crucial part in its activities. Each of mitochondrial membrane is 6 nm in thickness and fluid mosaic in ultra structure. The outer membrane is quite smooth and has many copies of transport protein called porins which form large aqueous channels through the lipid bilayer. Inside and separated from outer membrane is present the inner membrane. The inner membrane is not smooth but is impermeable and highly convoluted forming series of infolding called cristae in matrix space. Mitochondria have double membrane envelops in which inner membrane divides the mitochondrial space into distinct chambers :

(i) Outer Compartment

(ii) Peri-mitochondrial Space

(iii) Inner Compartment or Matrix Space



Inner chamber or Matrix space is filled with dense, homogenous, gel like proteinaceous material called mitochondrial matrix. Inner membrane has an outer cytosol or C-face toward peri mitochondrial space and & an inner matrix or m face toward matrix. Attached to M face of inner mitochondrial membrane are repeated units of stalked particles, called Elementary particles, inner membrane subunit oxysomes. They are also identified as F1 particles are meant for ATP synthesis.

Mitochondrial Isolation: Following are the three types of methods for Mitochondrial Isolation:

(i) **Direct Observation of Mitochondria:** Direct examination with vital stain called Janus Green which stains living mitochondria greenish blue due to its cytochrome oxidase activity.

(ii) **Cell Fractionation:** Mitochondria can easily be isolated by differential centrifugation at 20,000 to 40,000 g.

(iii) **Cytochemical marking:** Different parts of Mitochondria have distinct marker enzyme for histochemical marking such as cytochrome oxidase for inner membrane, malate dehydrogenases for matrix and adenylate kinase for outer chamber.

Enzymes present in Mitochondria:

(i) Enzymes on outer Membrane: Monoamine oxidase, cytochrome reductase, fatty acid coA ligase & enzyme involved in lipid synthesis.

(ii) Enzymes on Inner Membrane: ATP synthetase that makes ATP in inner membrane, specific transport proteins Succinate dehydorgenase four cytochromes cyt b, cyt c, cyt c_1, cyt a and cyt a_3.

(iii) Enzymes on Inter membrane space: Enzymes require to phosphorylate the other nucleotides enzymes like adenylate kianase, nucleoside diphospokinase .

(iv) Enzymes on Mitochondrial Matrix: Enzymes that required for oxidation of pyruvate and fatty acids and for ctric acid cycle or kreb cycle.

Matrix contain: Malate dehydrogenase, isocitrate dehydorgenase, fumarase, aconitase, citrate synthetase, α-keto acid dehydrogenase.

Q.4 Describe structure and function of Golgi apparatus?

Ans.: Golgi apparatus was discovered by Camilo Golgi in 1873. It occurs in all cells except the prokaryotic cells and eukaryotic cells of certain fungi, pteridophytes. Their number per cell vary several hundred in different organisms. In animal cell they usually occurs as a single golgi apparatus,but its number may vary from animal to animal from cell to cell.

In the cell of higher plants the golgi bodies or dictyosomes are usually found scattered throughout the cytoplasm. The golgi apparatus is morphologically very similar in both plants and animal cells, the detailed structure of three basic components of the golgi apparatus are:

(i) **Flattened Sac or Cisternae :** are central, flattened plate like or saucer like closed compartments which are held in parallel bundles or stacks one above the other. Each cisternae forms dictyosome which may contain 5 to 6 golgi cisternae in animal cells. Each cisternae is bound by smooth unit membrane.

(ii) **Tubules:** Complex array of associated vesicles and anastomosing tubules.

(iii) **Vesicles :** are of three types-

(a) Transitional vesicle: Small & form as blebs from Endoplasmic vesicle and converge to golgi.

(b) Secretory vesicles: are of varied size, discharge of from margins of cisternae of golgi.

Clathrin Coated vesicles: Spherical protuberance found at periphery of the organelle usually at ends of single tubules & distinct from secretary vesicles.

The GERL region: Golgi apparatus is spatially and temporally related to endoplasmic reticulum and also found in origin of primary lysosomes. GERL is region of sorting of cellular secretary protein.

Functions: Golgi vesicles are often referred to as the traffic police of cell this play a key role in sorting many of cell proteins & membrane constituents and in directing them to proper destination.

Recently in functions of golgi apparatus sub compartmentalization with a division of labour has been proposed between cis & trans golgi in which most refined proteins are further separated for their delivery to various cell compartments. Golgi apparatus is a centre for reception, finishing, packaging and dispatch for a variety of materials in animal & plants cells.

In plants Golgi apparatus is mainly involved in secretion of materials of primary and secondary cells wall. During cytokinesis of mitosis or meiosis, the vesicles, originating from periphery of Golgi apparatus coalesae in the phragmoplast area to form semi solid layer called cell plate. The unit membrane of golgi vesicles fuses during cell plate formation and becomes part of plasma membrane of daughter cells.

In animals golgi appartus is involved in packaging and exocytose of following materials :

(i) Zymogen of exocrine pancreatics cells

(ii) Mucus secretion & goblet cells of intestine.

(iii) Also involved in formation of certain cellular organelles such as plasma membrane lysosomes, acrosome, and cortical granules of variety of oocytes.

Q.5 Describe structure and function of Endoplasmic Reticulum?

Ans.: The name endoplasmic reticulum has been coined by Porter. The occurrence of endoplasmic reticulum vary from cell to cell. The cells of those organs which are actively engaged in the synthesis of proteins such as acinar cell of pancreas, plasma cell of some endocrine glands are found to contain rough endoplasmic reticulum (RER is endoplasmic reticulum with ribosomes).

ER & Endomembrane System: ER is also called as cytoplasmic vacuolar system is main component of endomembrane. This system along with nuclear membrane and golgi apparatus form endomembrane system.. GERL refers to as special region of endmembrane system.

Morphology : ER occurs in following three forms :

(i) Lamellar form or cisternae

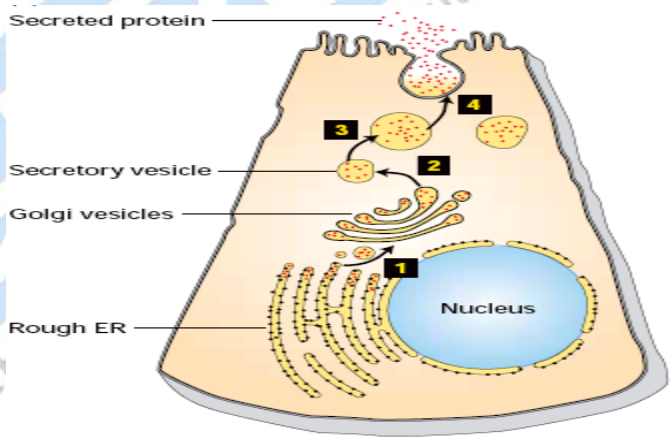
(ii) Vesicular form or Vesicles

(iii) Tubular Form or tubules

Cisternae : are long flattened sac like rough endoplasmic reticulum exsist as cisternae which occur in those cells which have synthetic roles as the cells of pancreas ,notochord and brain.

Vesicles : are oval, membrane bound vascular structure having, often remain isolated in cytoplasm & occur in most cells but abundant in smooth endoplasmic reticiulum.

Tubules : Branched structures forming reticular system along with cisternae and vesicles. often found in SER & associated with membrane movements.



Types:

(a) **Agranular/SER:** Smooth walls because the ribosomes are not attached with its membranes. It is generally found in adipose cells, intersitial cell. Muscles are also rich in smooth endoplasmic reticulum.

(b) **Granular / RER :** Possess rough wall because ribosomes remain attached with its membrane. It is found abudantly in those cells which are active in protein synthesis such as pancreatic cells,

plasma cells etc. In RER, ribosomes are often present as polysomes held together on mRNA and are arranged in rosetts or spirals.

Origin of Endoplasmic Reticulum : It is normally assumed that the ER has originated by evagination of nuclear membranes. The synthesis of membranes of ER is found to proceeto in following direction RER – SER. In fact membrane biogenesis is a multi step, process invdving, first synthesis of basic membrane of lipids and intrinsic proteins, thereafter addition of other constituents like sugars, lipids etc.. The process by which a membrane is modified is called membrane differentiation.

Functions of Endoplasmic Reticulum :

(A) **Common Functions of Granular & Agrangular :**

(i) ER provides mechanical support & skeletal framework to all

(ii) Exchange of molecules by process of osmosis, diffusion and actenit transport occurs through ER membranes

(iii) Contain many enzymes which perform various synthetic and metabolic activities.

(iv) It acts as an intracellular circulating or transporting system.

(v) It can form the new nuclear envelop after each nuclear decision

(vi) It plays important role in releasing column which muscle is stimulated and activity transporting colleen back into ER.

(B) **Function of Smooth ER :**

(i) Synthesis of lipids

(ii) Sterol Metabolism

(iii) Detoxification

(iv) Glycogenolysis and blood glucose homeostasis.

(v) Synthesis of tridycerides and of vesicle pigments.

(C) **Functions of Rough ER :**

(i) Synthesis of Protein

(ii) Protein glycosylation

(iii) The proteins for secretion, lysosomes and membrane formation are synthesized on membrane bound ribosome.

Enzymes on ER Membranes

S.No.	Enzyme	Surface localization
1	Cytocrome b_5	Cytoplasmic face
2	NADP-cytochromic C reductase	-do-
3	ATPase	-do-
4	B.glucouronidase	Luminal face
5	Cytochrome P-450	Cytoplasmic & Luminal face
6	GDP-Mannosyl transfrase	Cytoplasmic face

Q.6 While detail account on Microbodies?

Ans.: Microbodies are organellele having central granular or crystalloid core containing some enzymes.

Structure and Types : Microbodies are spherical or oblate form bounded by single membrane and have interior or matrix which is amorphous granular. Recent biochemical studies show distinguished two types of Micorbodies namely, peroxisomes & gly oxysomes.

Peroxysomes : Occur in animal cells and in wide range of plants. Peroxysomes are variable in size & shape they have single unit membrane of lipid and protein molecules which encloses granular matrix.

Function :

(i) Peroxysomes are so called because they usually contain one or more enzymes that use molecular oxygen to remove hydrogen atoms from specific organic substrate.

$$RH_2 + O_2 \rightarrow R + H_2O_2$$

$$H_2O_2 + RH2 \rightarrow R + 2H_2O$$

of detoxify reactions. The enzymes catalase is present in peroxysomes. When excess H_2O_2 accumulates in cell, catalase converts H_2O_2 to H_2O.

(ii) Peroxysomes of plant leaves contain catalase together with enzymes of glycolate pathway as glycolate oxidase, gratamate glyoxylate sereire glyoxylate and aspartate & keto glutarate the slycolate cycle thought about to bring formation of aneeu a cids like glycene, serine.

(iii) In green leaves there are peroxysomes that carry out procose called photorespiration in which glocation and is released from chloroplast and owxidized into glyoxfate & H2O2 by peroxisomal enzyme called fycolic acid oxidase.

(iv) Peroxisomes of rat liver cell contain enzymes of β-oxidation for metabolism of fatty acids, the acetyl CoA formed by this process is transported to mitochondrial where it enters to citric acid cycle.

(v) Mammalian cells do not contain D-amino acid but peroxisomes of mammalian liver & kidney contain D-amino acid oxidase. Its possible role is to initiate degradation of D-amino acid that may arise from break down of peptidoglycan

(vi) **Glyoxysomes** : Found to occur in cells of yeast neurosporo and higher plants. They resemble peroxisomes in morphological details. There crystalloid core consists of dense rods of 6.0 um diameter. They have enzymes for fatty acid metabolism and glycogenesis. Glyoxysomes perform following biochemical activities of plant cells.

(i) During germination of oily seeds, the stored lipid molecules of spherosomes are hydorlysed by enzyme lipase to glycerol & fatty acids. During β-oxidation process, the fatty acid breakdown to molecules of acetyl COA molecules. In plant β oxidation occurs in seeds. In plant cells the acetyl COA, product of β-oxidation, chain is not oxidized by Kreb cycle because it remain spatially separated from the enzymes of Kreb cycle instead, acetyl CoA undergoes glyoxylate cycle to be converted into succinate.

(ii) Glyoxylate cycle occurs in glyoxysomes and it invokes some of the reactions of Kreb cycle. The citrate formed converted to isocitrate & isocitrate to glyoxylate and succinate.

$$\text{Isocitrate} \longrightarrow \text{Glyoxylate} + \text{Succinate}$$

$$\text{AcetylCoA} + \text{Glyoxylate} \xrightarrow[\text{Malate dehydrogenase}]{} \text{Malate}$$

$$2\ \text{AcetylCoA} + NAD^{+} \longrightarrow \text{Succinate} + NADH + H^{+}$$

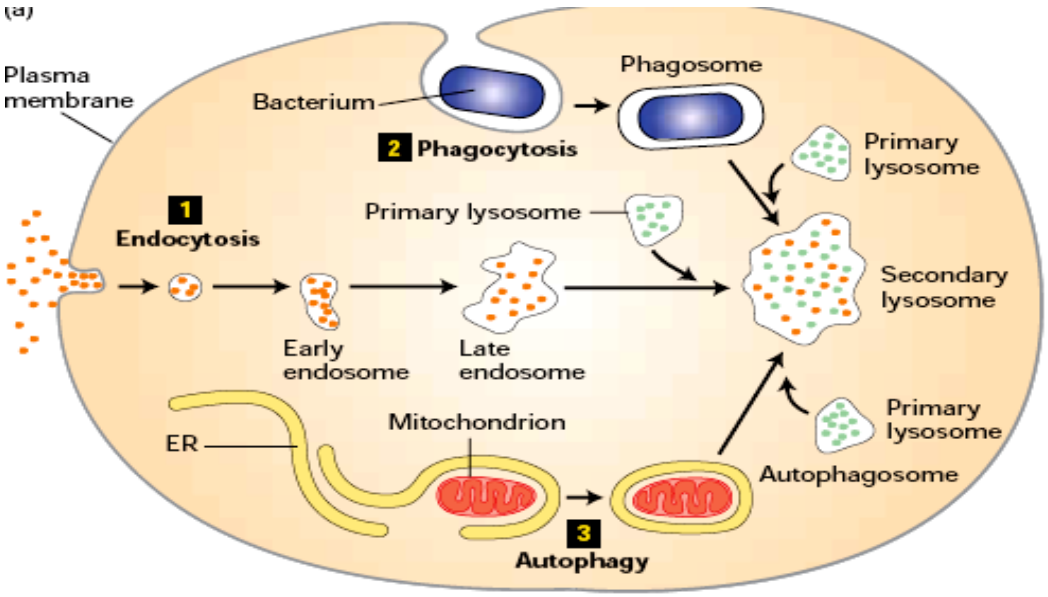
Succinate is end product of glyoxysomes metabolism of fatty acid and is not further metabolized in this organelle.

Q.7 What are Lysosomes?

Ans.: Lysosomes were initially described as perinuclear dense bodies by C. de Duve renamed these organelles as Lysosomes to indicate the internal

digestive enzymes only become apparent than the membrane of these organelles as lysed.

Lysosomes occur in most animal and plant cells, absent in mature mammalian RBC. They occur in abundance in epithelial cell of lungs and uterus. Phagocytic cells and cells of reticulo endothelial system are also rich in lysosomes.



Structure: Lysosomes are round vacuolar structures which remain filled with dense material bounded by single unit membrane.

It should contain two or mores acid hydordases and should demonstrate the property of enzyme.,when treated in a way that adversary effects organelle's membrane structure.

Lysomal enzymes: Lysosomes contain 40 types of hydrolytic enzymes, they include proteases, nucleases, glycosidases, lipases, phospholipases, phosphatases sulphatases. All lysosomal enzymes are acid hydrolases. Acid dependency of lysosomal enzymes protects the contents of cytosol against any damage if leakage of lysosomal enzymes should occur.

Function of Lysosomes :

(i) Digestion of Large extra cellular particles which enables to devour the foreign bacteria of verieses

(ii) Digestion of intracellular substances like protein, lipids and carbohydrates of the cytoplasm & supply to cell, necessary amount of energy.

(iii) **Autolysis or Cellular Autophagy :** In pathological conditions the lysosomes start to digest the various organelles. When cell dies, the

lysosmal membrane ruptures and enzymes are liberated. These enzymes digest dead cell.

(iv) **Extra Cellular Digestion:** The lysosomes of certain cells such as sperms discharge their enzymes outside the cell during the process of fertilization, the lysosomal enzyme digest the limiting membrane of ovum and forms penetration ratio. Acid hydrolases are also released from osteoclast & break down bone for the reabsorbtion.

Lysosome and Disease: Malfunctioning of lysosome often results in various pathological disorders eg; Tay Sachs disease which is inborn disorder, other induced by environmental pollution eg; s silicosis.

Lysosomes in Plants : Plant contain several hydrolases. Plant lysosomes can be defined as membrane bound cell compartment containing hydrolytic digestive enzyme. vacuoles in plants have been divides in following types:

(a) **Vacuoles:** formed by fusion of to small provacuoles which are believed to be derived from ER and Golgi and contain acid hydrolases. Enzymes are associated with tonoplast of large Vacuole of differentiating cells.

(b) **Spherosomes :** Membrane bound spherical particles occurring in most plant cells they have fine granular structure rich in lipids and proteins. They originate from ER, like lysosomes they are not only responsible for the accumulation and mobilization of reserve lipids but also for the digestion of other cytoplasmic components in corporated by phagocytosis.

(c) **Aleurone Grains:** The aleurone Grains or protein bodies are spherical membrane bound storage particles occurring in cells of endosperm and cotyledons of seed they are formed during later stages of seed ripening and disappear in early stages of germination. Thus like spherosome, aleurone store reserve materials, mobilize them during germination and in addition form comportment for digestion of other cell components.

Q.8 Describe structure and function of Nucleus.

Ans.: Nuclei were first discovered and named by Robert Brown and were quickly recognized as constant feature of all animal and plant cells. Nucleoli was first noticed by Fontana , Strasburger introduced the term cytoplasm and nucleoplasm.

Nucleus is found in all eukaryotic cells of plants and animals. However mammalian erythrocyte contains no nucleus. The prokaryotic cells of bacteria do not have true nucleus i.e single circular and large DNA molecules remains in direct contact with cytoplasm. Usually nucleus

remains located in the centre. But its positions may change time to time according to metabolic status e.g., in embryonic cells nucleus generally occupies geometric centre of cells but as the cell start to differentiate, displacement in nucleus position will take place.

Morphology: Usually cells contain single nucleus but the number of nucleus may vary from cell to cells, most plant and animal cells are uninucleate. The shapes of nucleus remain related to shape of cell. The nuclei of cylindrical, prismatic or fusiform cell contain ellipsoid nucleus whereas, cells of squamous epithelium contain discoidal nuclei.

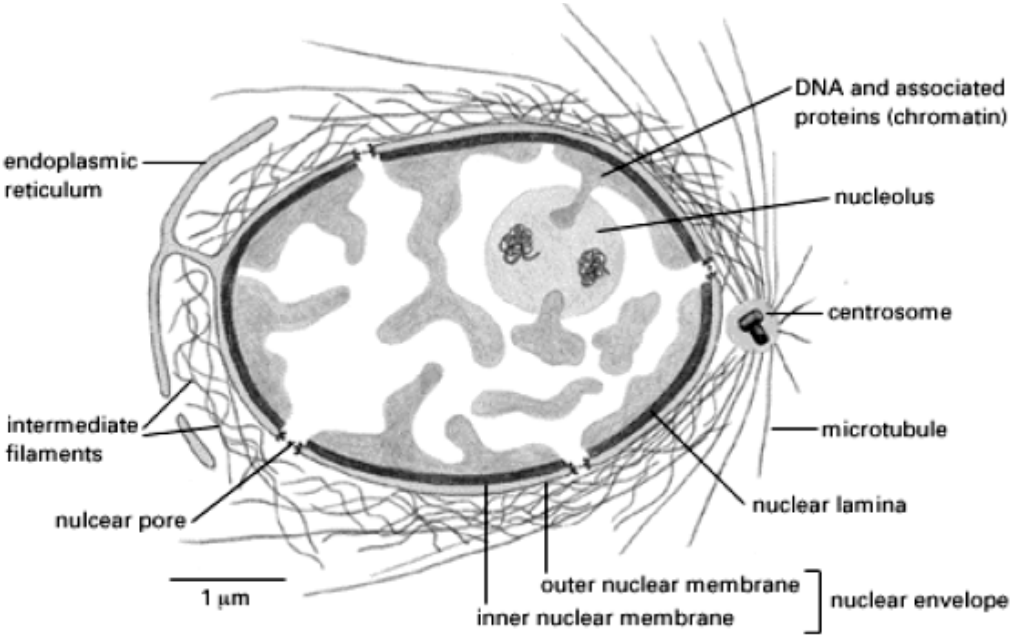
Ultra-structure:

(i) **Nuclear Envelope:** Nuclear envelope encloses DNA and defines the nuclear compartment of inter phase and prophase nuclei. It is formed of true concentric unit membranes, the spherical inner nuclear membrane contain specific proteins that act as binding site for supporting fibrous sheath of inter mediate filaments called nuclear lamina. The inner nuclear membrane is surrounded by the outer nuclear membrane which closely resembles the membrane of endoplasmic reticulum, outer surface of outer membrane has ribosomes engaged in protein synthesis The space between inner and outer membrane is called peri nuclear space. The perinuclear space is fluid filled compartment which is continuous with ER lumen.

(ii) **Nuclear Lamina:** Also called fibrous lamine It is a protein meshwork and present inside surface of inner nuclear membrane, except the areaof nucleopores and consist of intermediate filaments also it is very dynamic structure. In mammalian cells undergoing mitosis, the transient phosphorylations of several serine residues on lamins causes the lamina to dissamble.

(iii) **Nuclear Pore Complex:** The nuclear envelop in all eukaryotic forms is perforated by nuclear pores, nuclear pore appear circular in surface view and diameter between 10 nm -100 nm. Nuclear pore complex consists of two rings at it periphery and large particle that forms a central and radial spokes ,partices anchored to cytoplasmic ring are thought to bind ribosomes. The hole in the centre of pore complex is aqueous channel through which water soluble molecules shuttle between nucleus and cytoplasm. In nuclei of mammals it has been calculated that nuclear pores account for 5-15% of surface area of the nuclear membrane. The number of pores in nuclear envelop or pore density correlate with activity of cell. Nuclear pore are evenly distributed in somatic cells, however in other cell pores are arranged in rows or clusters.

(iv) **Nucleoplasm :** Space between nuclear envelop and nucleus is filled with ground substance or matrix called nuclear sap or nucleoplasm.



Q.9 Describe Plant & Bacterial Cell Wall.

Ans.: The plant cells is always surrounded by cell wall which is a nonliving structure formed by living protoplast. It is rigid and protective layer around the plasma membrane which provides mechanical support to the cell. It also determines the shape of plant cell.

Cellulose : The polysaccharide of cell wall include polymer of glucose unit linked by 1-4 β glycosidic bonds. Its structural units known as micro fibrils which get associated with macrofibrils. Hemicullose are short but branched heteropolymers of various monosaccharides. Some of common eg: of hemicellulose are xylans, glucomannans

Pectins : Water soluble, heterogenous branched polysaccharide that contain many negatively charged D- galatouronic acid residues along will D-glucuronic acid residues ,they are helpful in keeping cell wall component together. Mannans, agar, lignin and chitin are also present in cell wall.

Cutin : Is a biological plastic and is made of fatty acid. Suberin is water resistant substance, comprising of fatty acid and found in Cork and Cell wall of many plants.

Structure:

(i) **Primary Cell Wall:** First formed cell wall, outer most layer of cell and comparatively thin, the primary cell wall of yeast and fungi is composed of chitin.

(ii) **Secondary Cell Wall:** Primary cell wall is followed by secondary cell wall .It is thick permeable and composed of compactly arranged macrofibrils of cellulose.

(iii) **Tertiary Cell Wall:** There occurs another cell wall beneath the secondary cell wall called as tertiary cell wall. Tertiary differs in staining, chemical composition ,besides cellulose, tertiary wall also consist of xylem .

Middle Lamella: Cell of plant tissues generally remain cemented together by an inter cellular matrix known as middle Lamella. It is mainly composed of pectin and lignin. Each plant cell is interconnected with each other through cytoplasmic channels called Plasmodesmata which pass through intervening cell wall.

Origin and Growth of Cell Wall: It includes formation of matrix and synthesis and orientation of cellulose microfibrils. Extension of cellulose microfibril is presumably achieved by lateral movement of enzyme complex in fluid phase of plasma-membrane. During lignifications, lignin is deposited in spaces between the cellulose molecules making cell wall more rigid rendering it impermeable. The lignified tissue become well adapted to two types of functions:

(i) It provides mechanical strength due to it lingo- cellulose composition

(ii) It transports water & salts, since lignifications involve loss of the protoplasm resulting in formation of hollow waterproof tube.

Bacterial Cell Wall: Present outside plasma membrane in all the bacteria. It is very thick in gram positive bacteria and is comparatively thin in gram negative bacteria. The cell wall in bacteria is much more complex then cellulose wall of plant cells. It is formed of mucopeptide, polysaccharide, amino acid and lipid.

Polysaccharides: Forms backbone of cell wall and confer structural rigidity, the polysaccharide of bacterial wall formed of sugars like glucose,galactose.

(i) N-Acetyl Muramicic Acid (ii) N-Acetyl Glucosamine

They are arranged alternatively and joined by glycosidic linkages. In gram positive bacteria matrix of cell wall formed of teichaic acid which are polymers of glucose, alanine and glycerol or Ribitol .Techoic acid has

glycerol or ribitol phosphate and only one of the two can be present in cel wall of particular strain of gram positive bacteria.

In gram negative bacteria there is no teichoic acids and only 5-10% peptidoglycans present which protect cell from osmotic rupture and provide rigidity and shape to cell wall. teichoic acid if present obtain Mg+2 from environment for metabolic function of cell.

Amino acid: Amino acid present are glutamic acid, alanine, glyune, lysine. In gram positive bacteria amino acids are alanins & glycene which are present in large proportions.

Lipids : About 20% lipid present in cell wall of gram negative bacteria and in gram positive bacteria only traces of lipid found.

S.No.	Gram Positive Bacteria	Gram Negative Bacteria
1	Cell Wall is thick.	It is thin.
2	95% Peptidoglycones.	Peptidoglycons are 5-10%of cell wall.
3	Teichoic acid present.	Absent.
4	Lipids found in traces.	Lipid form 20% or more of cell wall.
5	Amino acids of four type present glycine, alanine main are in major proportion.	Many types of amino acids are present.

Difference between gram positive & gram Negative bacterial cell wall.

□ □ □