CELL

Wonders in the world of cell never ceases

BY Dr Riffat Sultana

Homeostasis

- Maintenance of favourable ,suitable,optimal constant condition of internal environment is called homeostasis.
- Factors or variables in internal environment must be maintained include;

Concentration of nutrients.

Concentration of gases,

Concentration of electrolytes,

Concentration of water,pH,temperature,volume and pressure.

Variables

- Normal value of each variable is called Set point.
- Any change in the normal value is called Stimulus.
- Stimulus is detected by a sensor called Receptor.
- Information about change goes to integrating center present in the brain.
- Center produces action called Response.
- Responce is mediated via Effectors.
- Set point of body temperature is 37C.

Mechanism of homeostasis.

- Maintained by three mechanism
- Negative feedback.
- Positive feedback.
- Feed forward.

Negative feedback

- It is most commonly used mechanism.
- Always beneficial to the body.
- When any variable of the body is increased or decreased,homeostasis system tries to bring it back to the normal i,e it opposes the change and tries to minimize it.
- If the body temperature is increased, homeostatic system tries to decrease it back to the normal vice versa.
- So the initial stimulus (rise in body temprature) is opposite to the final response(decreased body temperature).

Positive feedback

- It is uncommon in health and occurs mainly in diseases.
- Mostly harmful to the body. So the initial stimulus rise of blood pressure is the same direction as the final response that is further rise in blood pressure.
- Few beneficial positive feedback mechanisms operate in body under normal condition.
- Example is birth of baby-contraction of pregnant uterus during delivery causes more powerful contraction instead of causing relaxation. This ultimately leads to birth of baby.

Vicious cycle

- Positive feedback mechanism occurring in pathological conditions can lead to death. This is called vicious cycle.
- For example if a person suddenly loses 2 lit of blood in an accident blood volume will decrease blood pressure will decrease and heart will pump less blood and will get less blood, this cycle will be repeat until heart will not be able to pump and person will die.

Feed forward

- It is less common but beneficial to the body.
- Response occurs before the arrival of actual stimulus.
- Homeostatic mechanism knows that stimulus will come soon, so it produces the response in advance.
- Example is insulin secretion is increased after taking a meal. This occurs because the homeostatic system knows that when the food will be digested blood glucose will rise and increased insulin will be needed.
- So response is produced in advance in anticipation of an expected stimulus.

Adaptive control

- It is a type of delayed negative feed back mechanism.
- For example some movements of body occurs so rapidly that it is not possible for signals from the body to reach the brain and come back to control the movement.
- So brain uses this adaptive control mechanism. Nerve signals from moving body parts inform the brain whether the movement is performed correctly or not. If not the brain corrects the feed forward signals that it sends to muscles and next time the movement is required. Then if further correction is needed, this will be done again for subsequent movement.

Failure of homeostasis

When some of body system fail to function properly homeostasis is disrupted.
Factors that disturb homeostatic ability are called stressors. For example extremes of temperature, exercise,fasting,poisons infections etc.
Generalized non specific response of body to stressors is called stress.

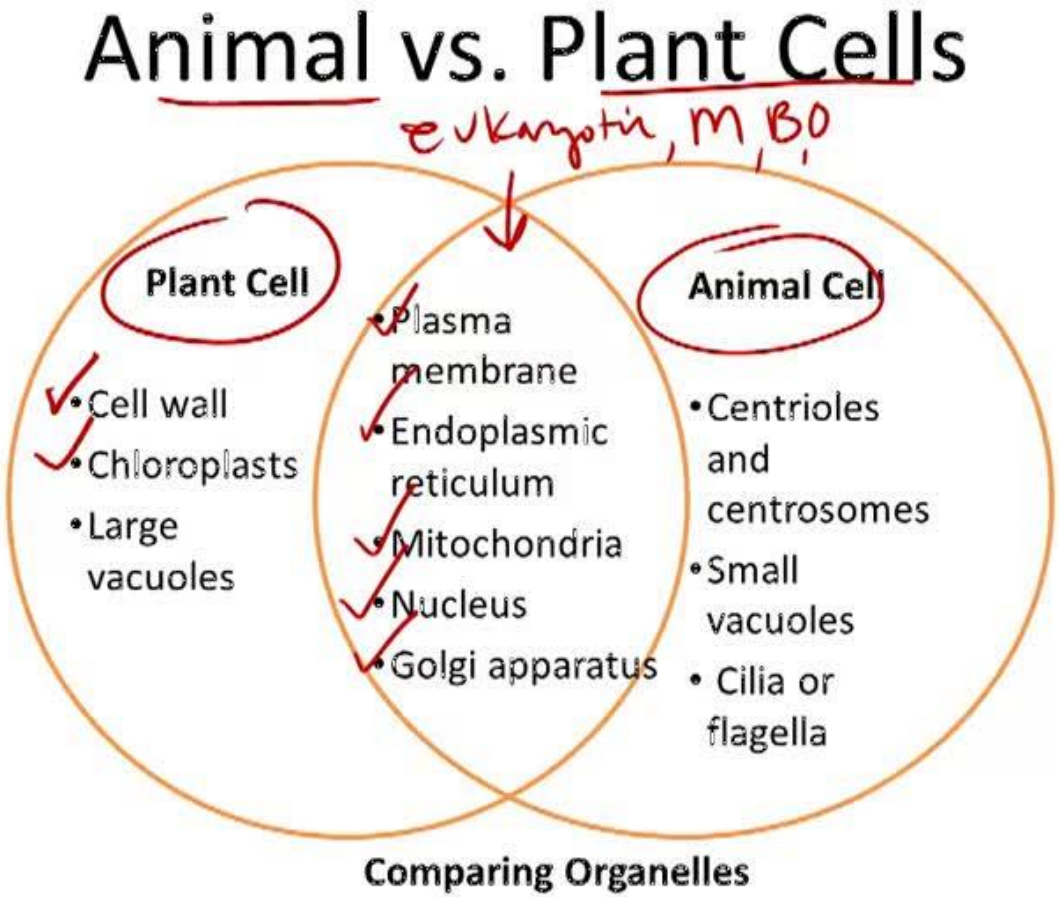
Prokaryotes and Eukaryote.

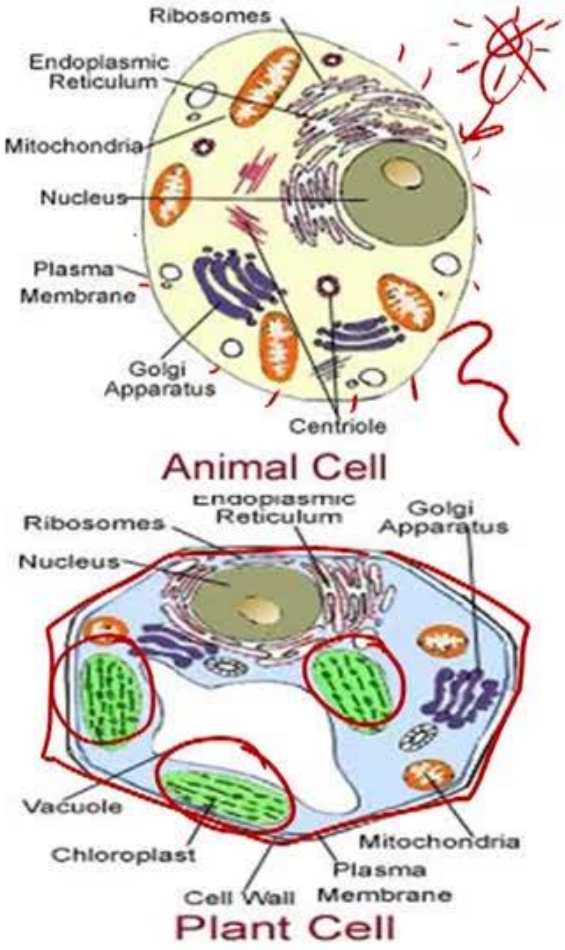
- All living organism are classified into two broad categories prokaryotes and eukaryote. Prokaryotes are those organisms whose cells lack a cell nucleus genetic information's are in cytoplasm or plasma they are always unicellular example is Bacteria.
- While Eukaryotes(plant and animal cells) posses well defined membrane bound nucleus.

Eukaryotic cell

- An eukaryotic cell has extensive and elaborate internal membranes, which partition the cell into compartments.
- The compartments created by membranes provide different local environments that facilitate specific metabolic functions, allowing several incompatible processes to go on simultaneously in a cell.

Animal and plant cells are eukaryotic cells





- Eukaryotic cells also contain other membrane-bound organelles such as mitochondria or the Golgi apparatus.Organelles themselves are often surrounded by membranes so the activities can be seperated from the surrounding cytoplasm.This is called compartmentalisation.Since each type of organelle has its own function, the cells is said to show division of labour,a sharing of the work between different specialized organelles.

Cytoplasmic Organelles

- Specialized cellular compartments
- Membranous
  - Mitochondria, peroxisomes, lysosomes, endoplasmic reticulum, and Golgi apparatus
- Nonmembranous
  - Cytoskeleton, centrioles, and ribosomes

- in eukaryotes is different from that in organisms without a nucleus (Prokaryote).
- There are two types of division processes.
- In mitosis, one cell divides to produce two genetically identical cells.
- In meiosis, which is required in sexual reproduction.

organelle

- Is a distinct part of a cell which has a particular structure and function.The only organelle found in animal cells which is absent from plant cells is the centriole.

Organelles in Eukaryotic Cells

Structure Function

Nucleus-----Contains genetic material

Ribosomes------Protein synthesis

Endoplasmic reticulum--Synthesis/modification and transport of proteins and lipids

Golgi apparatus---------- Processing, distribution of proteins, lipids

Lysosomes----Digestion of substances in cell

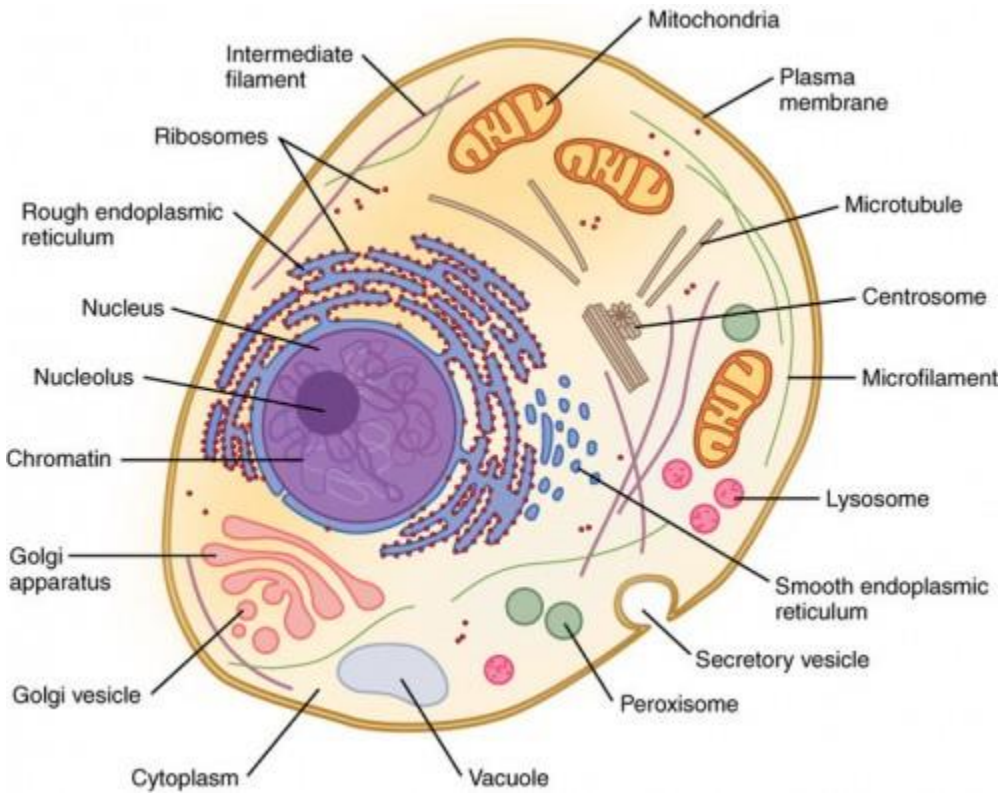
Peroxisomes-----Digestion and detoxification

Chloroplasts----------Photosynthesis

Flagella/Cilia-----Cell movement

Vacuole and vesicle-----Storage of cellular substances

Centriole-----Cytoskeletal organization


Mitochondria
Intermediate filament
Plasma membrane
Ribosomes
Microtubule
Rough endoplasmic reticulum
Centrosome
Nucleus
Microfilament
Nucleolus
Chromatin
Lysosome
Golgi apparatus
Smooth endoplasmic reticulum
Secretory vesicle
Golgi vesicle
Peroxisome
Cytoplasm
Vacuole

Mitochondria

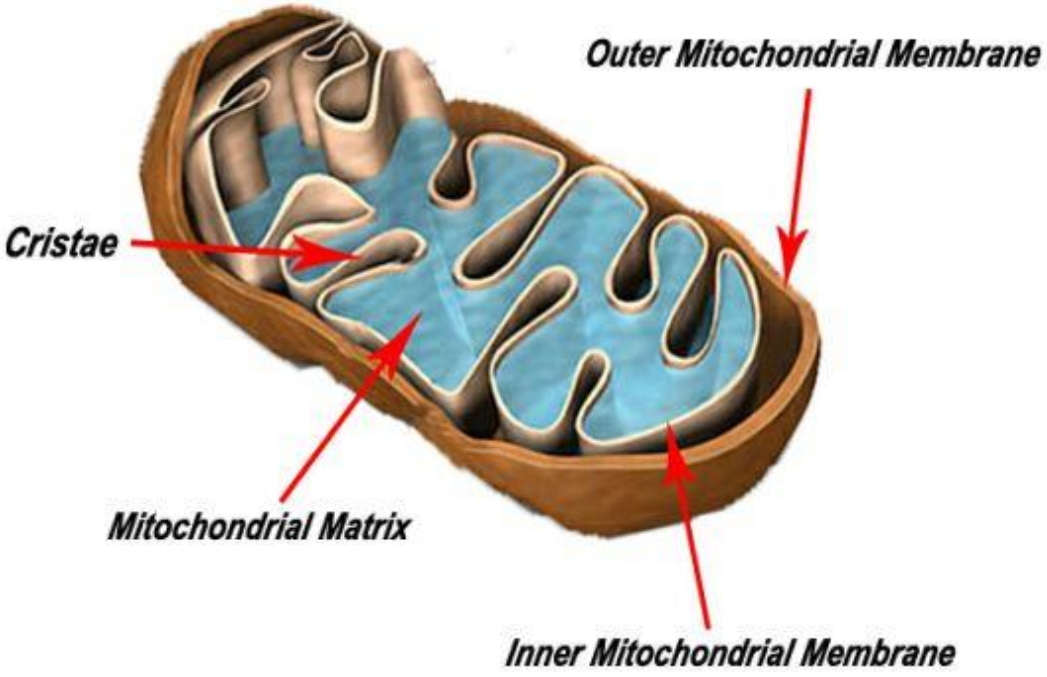
- Rod shaped organelles called power house of the cell.
- Mitochondria are the sites of cellular respiration, generating ATP from the catabolism of sugars, fats, and other fuels in the presence of oxygen.
- ATP is the chemical energy "currency" of the cell that powers the cell's metabolic activities.
- Their numbers varies from cell to cell depending upon the energy requirement of the cell.
- The number may range from single large mitochndrion to thousands.

Mitochondria

- They are also variable in size and shape.
- Some are only a few hundred nanometers

  in diameter and globular in shape, whereas others are elongated—as large as 1 micrometer in diameter and 7 micrometers long;

The Mitochondrion



Mitochondria

- Mitochondria is not part of the endomembrane system.
- In contrast to organelles of the endomembrane system, each mitochondrion or chloroplast has two membranes separating the innermost space from the cytosol.
- Their membrane proteins are not made by the ER, but rather by free ribosomes in the cytosol and by ribosomes within the organelles themselves.
- Mitochondria has small quantities of DNA that direct the synthesis of the polypeptides produced by these internal ribosomes.
- Mitochondria grow and reproduce as semiautonomous organelles.

Mitochondria

- They are spherical,oval or rod like bodies about 0.5 1 um in diameter and upto 7 um in length.
- Mitochondria are organelles found in nearly all eukaryotes. usually several or many per cell. Erythrocytes do not contain mitochondria. The tail of spermatozoa is fully packed with mitochondria.
- Mitochondria have a smooth outer membrane and a convoluted inner membrane with infoldings called cristae.
- The inner membrane divides the mitochondrion into two internal compartments.
- .

- The first is the intermembrane space, a narrow region between the inner and outer membranes.
- The inner membrane encloses the mitochondrial matrix, a fluid-filled space with DNA, ribosomes, and enzymes.
- The mitochondria are able to code for part of their proteins with these molecular tools.
- Some of the metabolic steps of cellular respiration are catalyzed by enzymes in the matrix

Mitochondria

- The outer membrane of a mitochondrion contains many channels formed by the protein **porin** and acts like a sieve, filtering out molecules that are too big.
- The inner membrane, which is highly convoluted so that a large number of infoldings called **cristae** are formed, also allows only certain molecules to pass through it and is much more selective than the outer membrane.
- The cristae present a large surface area for the enzymes that synthesize ATP.
- Mitochondria are mobile and move around the cell along tracks of the cytoskeleton.

Function of Mitochondria

- The food we eat is oxidized to produce high-energy electrons that are converted to stored energy
- This energy is stored in high energy phosphate bonds in a molecule called adenosine triphosphate, or ATP.
- ATP is a nucleotide composed of
- (1) the nitrogenousbase adenine
- (2) the pentose sugar ribose
- (3) three phosphate radicals.

Function of Mitochondria

- The last two phosphate radicals are connected with the remainder of the molecule by so-called *high-energy phosphate bonds.*
- The high-energy phosphate bond is very labile.
- When ATP releases its energy, a phosphoric acid radical is split away, and *adenosine diphosphate (ADP)* is formed.
- To reconstitute the cellular ATP as it is used up, energy derived from the cellular nutrients causes ADP and phosphoric acid to recombine to form new ATP.

Mitochondria have Their Own DNA and Ribosomes

- Mitochondria contain their own DNA (separate from that in the nucleus) the integral inner membrane proteins are made by mitochondrial protein synthesizing machinery. However the majority of proteins especially of outer membrane are synthesized under the control of cellular DNA.
- The division of mitochondria is under the command of mitochondrial DNA. They control their own replication within the cell, and often can move around within the cell and change shape.

Functions of mitochondria

- Synthesis of ATP.
- Calcium storage.
- Heat production
- Cell specific e.g Ammonia detoxification in liver. Heme synthesis in RBCs.
- Apoptosis---plays important role in this process.
- Aging –leakage of electrons lead to formation of free redicals. These are involved in process of aging.

The Lysosome

- In 1955, Belgian scientist Christian de Duve observed that the cells released an enzyme called acid phosphatase in much larger amounts when they were repeatedly frozen before centrifugation.

The Lysosome

- To explain this phenomenon, de Duve suggested that the digestive enzyme must have been encased in some sort of membrane-bound organelle within the cell.
- Lysosomes are spherical organelles contained by a single layer membrane, though their size and shape vary to some extent.

The Lysosome(intracellular digestive system).

- Tiny organelle,solid wastes are usually decomposed in it, inside the cell such a process is taking place within the lysosomes.
- They are bag of hydrolytic enzymes.
- As long as the lysosomal membrane is intact the encapsulated enzymes can act only locally. But when the membrane is disrupted the released enzymes it digest all parts of the cell, including proteins, DNA, RNA, carbohydrates, lipids and cellulose, leading to tissue damage.

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Lysosomal enzymes are

- polysaccharides hydrolysing enzymes.
- Protein hydrolysing enzymes.
- Nucleic acid hydrolysing enzymes.
- Lipid hydrolysing enzymes.
- Numerous in macrophages ,neutrophils hepatic and renal cells.
- Absent in RBCs.
- Formed by golgi complex

The Lysosome

- Hydrolytic enzymes and the lysosome membrane are made by the RER (Rough endoplasmic reticulum) and transferred to the Golgi apparatus for processing

- Some lysosomes arise as vesicles from the
  - trans face of the Golgi.

- Proteins on the inner membrane of the lysosome as well as the hydrolytic enzymes themselves are probably protected from destruction by the way they are folded (vulnerable bonds are hidden)

- Form intracellular digestion---Of foreign agents and worn out cell organelles.
- Function in digestion of macromolecules by three principal ways a) phagocytosis,endocytosis,autophagy.
- **Secretary lysosome** have secretary function releasing their contents by exocytosis e.g mast cells secrete mediaters of inflammation from modified lyosome.
- **Tissue regression**.Tissue often increase in size due to functional demands but then regress back to normal.e.g uterus during pregnancy lysosome are involved in this process.
- **Cell nutrition** after phagocytosis of foreign invader,lysosome break down to basic food components like glucose, amino acids and fatty cells.
- **Bone remodeling** .bone undergo wear and tear. Old bone is removed and new bone is formed lysosome are involved in breakdown of old bone

Another Functions of Lysosomes

- Recycling of the cell's own material
  - Known as autophagy
  - Lysosome engulfs another organelle or piece of cytosol
  - Polymers of the structure are broken down and monomers are returned to the cell for re-use

- One theory of aging is that the process of elimination (e.g., exocytosis of waste by fusion of secondary lysosome with plasma membrane) becomes slow or absent and waste products/undigested material accumulate in residual bodies. These structures may be eliminated, but in most cases they remain in the cell as pigment inclusions and may be related to the aging process.

- Several congenital diseases in which some lysosomal enzymes are defective lead to the eventual enormous accumulation of undigested products (e.g., lipidosis, glycogen accumulation), which begin to interfere with other cellular functions.
- For example, in Tay-Sachs disease the lack of functional lipases (an enzyme needed to break down lipids) within the lysosomes of nerve cells leads to massive lipid accumulation in these defective lysosomes in brain, and eventual impaired nerve function and causing death.

The Nucleus

- Is a membrane enclosed organelle found in eukaryotic cell.
- It is control centre of the cell.
- Is a large organelle and contain most of genetic material.
- It appear as a dense,roughly specific organelle. It is approximately 3-10 um in diameter(occupies around 10% of cell volume).
- Usually one nucleus is present in each cell but certain cells may be binucleate (some liver cells) or multinucleate (skeletal muscle cells).

STRUCTURE OF NUCLEUS

- Basic components are nuclear envelop,nuclear pores,chromosomes,chromatin,nucleolus and nucleoplasm.
- Nuclear envelop or nuclear membrane separates the genetic material from the surrounding cytoplasm. It is lipid bilayer. Consist of two cellular membrane, an inner and outer membrane arranged parallel to one another and separated by 10-50(nm)of space.

Nucleus

- In each nucleus there are 3000-4000 nuclear pores that allow the free passage of water soluble molecules. Example of the substances entering through the nuclear pores are proteins to help make ribosomes, RNA nucleotides,ATP(adenosine triphosphate) and some hormones such as thyroid hormone T3. are transported via it.
- In apoptosis(programmed cell death)is highly regulated process in which nuclear lamina is dissassembled.
- Nuclear lamina helps in organizing nuclear envelop and plays a role in DNA elongation phase.

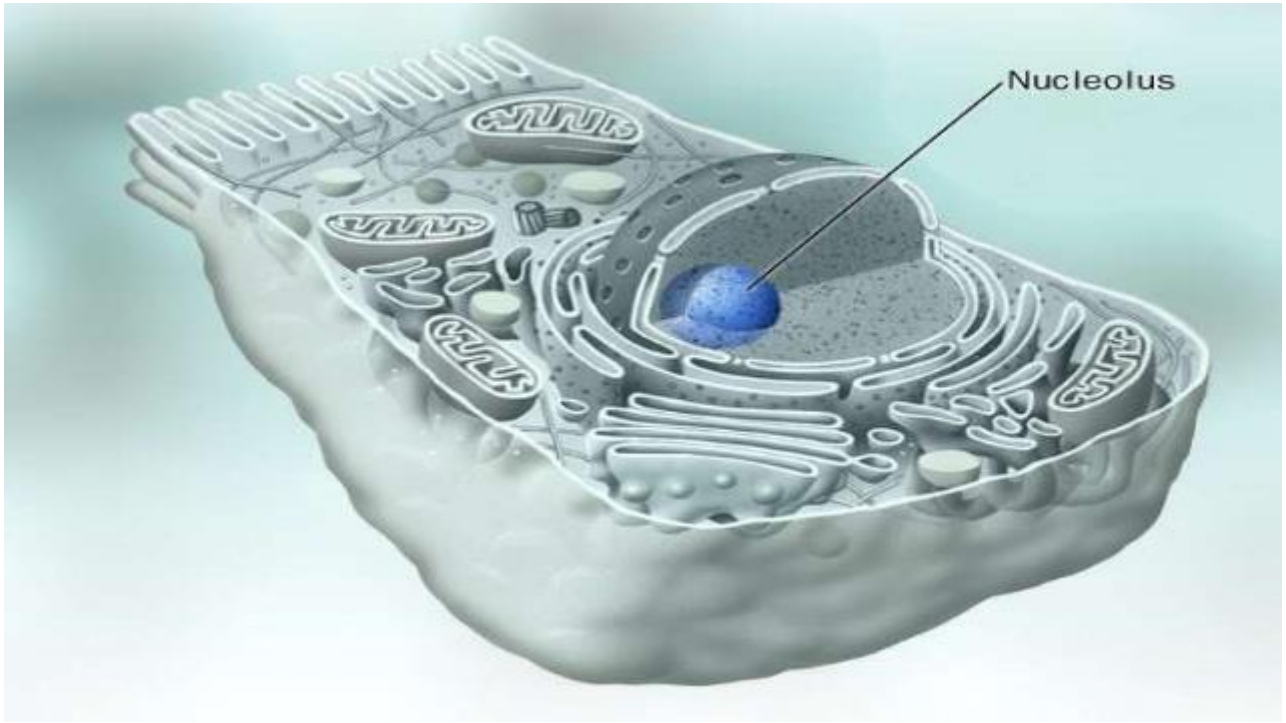
Nucleus

- The chromosomes are in a loosely coiled state known as chromatin(except during nuclear division).
- Chromosomes contain DNA which is organized into functional units called genes, which governs all the function s of the cells.
- Genes control the activities of the cell and inheritance.DNA replication and RNA synthesis (transcription) are taking place inside the nucleus.
- When the cell is about to divide the nucleus divides first so that each new cell will have its own nucleus.

NUCLEOLUS

- In some cells, a portion of the nucleus may be seen a lighter shaded area, this is called nucleolus.
- This is the area of RNA processing of ribosome synthesis.
- The nucleolus is very prominent in cells actively synthesizing protein.
- It is not surrounded by the membrane.
- Its size depends upon the metabolic activity of the cell.
- Its main function is synthesis of rRNA into ribosomal precursors.
- More the one nucleolus can be present in the nucleus.

NUCLEOLUS



Function of Nucleus

- It stores the cell hereditary material or DNA.
- Site of DNA replication.
- Site of DNA transcription to mRNA.
- Ribosomal formation.
- It coordinates the cell activities which include growth, metabolism, protein synthesis ,reproduction by regulating gene expression.

Endoplasmic reticulum

- Endoplasmic means within the plasm and reticulum means network.
- Is a type of organelle in a cells of eukaryotic organelle. It forms an interconnected network of flattened membrane enclosed sacs or tubes known as cisternae.It is internal delivery system of the cell.
- Outer membrane of nucleus is continuous at certain sites with Rough endoplasmic reticulum.

- The ER occupies most of the cytoplasm.It forms 30-60% of the total membrane in a cell.
- Walls of endoplasmic reticulum are constructed of lipid bilayer that contain large amount of proteins.
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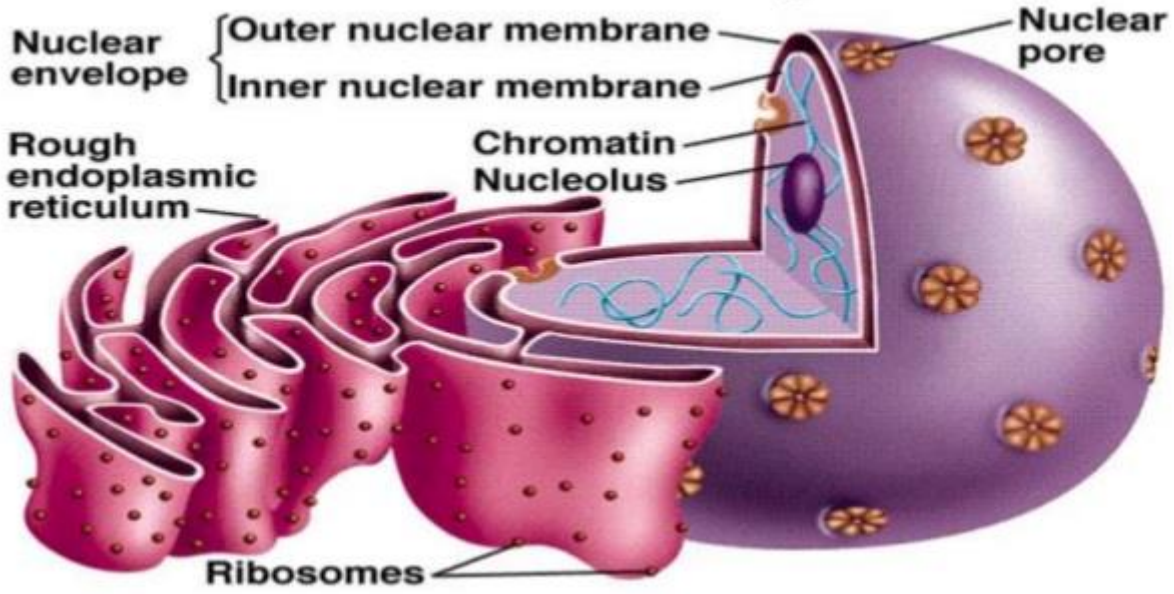
Nuclear Envelope



Endoplasmic reticulum (**ER** for short)

- Endoplasmic reticulum is connected with two membrane, surface of the nuclear membrane and it is connected with golgi apparatus and cell membrane.
- Rough ER appear as lumpy sheets of folded membrane the lumps are the ribosomes. They are not permanently attached adhering only when there is protein manufacturing work to be done.

Ribosome

- The ribosome are complex structures approx 22x32nm,containing many different proteins at least three ribosomal RNAs. Messenger RNA carries the genetic message from the nucleus to the ribosome where protein synthesis takes place.
- Ribosome stud the cytoplasmic surface of the outer nuclear membrane.

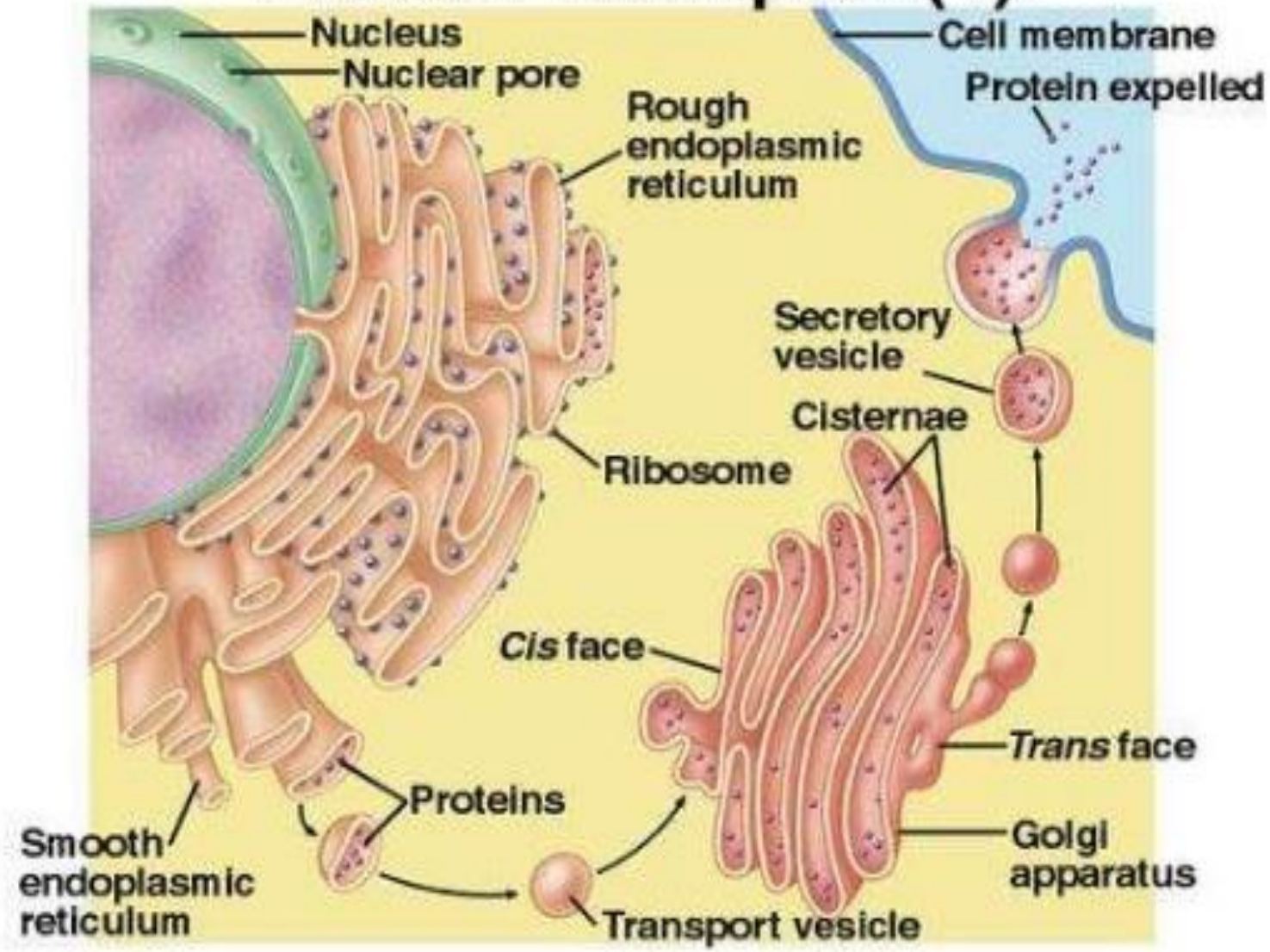
Ribosome

- Ribosome synthesize proteins that enter the perinuclear cisternae (space between two membrane 20-40nm wide).
- The ribosome that become attached to endoplasmic reticulum synthesize all transmembrane protein,and protein that are stored in golgi apparatus,lysosome.

Protein transport

- As the protein are formed in the ER they are transported through the tubules towards the protein of the smooth endoplasmic reticulum that lie nears to golgi apparatus----At this point small transport vesicles composed of small envelops of smooth ER continually bread away and diffuse to the deepest layer of golgi apparatus-----inside this vesicle are the synthesized proteins and other products from the ER present.

Protein Transport (1)



Rough endoplasmic reticulum

Free ribosome synthesize cytoplasmic proteins such as haemoglobins and the proteins found in peroxisomes and mitochondria.

- White blood cells that produce infection fighting immune system proteins called Antibodies have highly developed rough endoplasmic reticulum.
- Some proteins are destined for export to the cells exterior as secretory products, such as proteins hormones or enzymes (all enzymes are proteins).
- Other proteins are transported to sites within the cells for use in constructing cellular membrane.

Smooth endoplasmic reticulum

- SER are site of lipid synthesis including oils, phospholipids and steroids.
- Helps in metabolism of carbohydrates,regulation of calcium concentration and detoxification of drugs and poison.
- The network of SER allows increased surface area for the action and storage of key enzymes and the product of these enzymes.
- SER is found in smooth and striated muscle. In brain it synthesize male and female hormone.

Smooth ER

- Smooth ER also contain the enzymes glucose 6 phosphatase which converts glucose 6 phosphate to glucose ,a step glucose 6 phosphate to glucose a step in gluconeogenesis.
- Pieces of the smooth ER called **vesicles** which bud off from the smooth ER and travel other places in the cell to transfer their contents.
- In most eukaryotes, these vesicles are released and further modified in stacks of flattened vesicles, called Golgi bodies or dictyosomes.

Vacuoles and **vesicles**

- Simple compartments, called vesicles or vacuoles, can form by budding off other membranes. Many cells ingest food and other materials through a process of endocytosis, where the outer membrane invaginates and then pinches off to form a vesicle. It is probable that most other membrane-bound organelles are ultimately derived from such vesicles.

Vacuoles and **vesicles**

- Vesicles may be specialized for various purposes. For instance, lysosomes contain enzymes that break down the contents of food vacuoles, and peroxisomes are used to break down peroxide, which is toxic otherwise.
- **Vacuoles** and **vesicles** are similar in that both are storage organelles. Generally, vacuoles are larger than vesicles. Vesicles are small enough and mobile enough that they are often used to move chemicals to other locations in the cell where they might be needed

Peroxisomes

- Have a granular matrix.
- They are 0.3-1.5 um in diameter.
- They contain peroxidases and catalase.
- They are prominent in leukocytes and platelets.
- Peroxidation of polyunsaturated fatty acids in vivo may lead to hydro peroxide formation.
- THE FREE RADICALS DAMAGE MOLECULES,CELL MEMBRANE ,TISSUE AND GENES.
- Catalase peroxidase are the enzymes present in peroxisomes which will destroy the unwanted peroxides and other free radicals.
- THERE ARE FEW GENETIC DISEASES WHERE LYSOSOMAL ENZYMES ARE DEFICIENT OR ABSCENT.THIS LEADS TO ACCUMULATION OF LIPID OR POLYSACHARIDES.

Golgi apparatus or **Golgi bodies**.

Noticeable with both light and electron microscope.

Present in eukaryotic cells and abscent in prokaryotes extensive in secretary cells abcent in red blood cells.

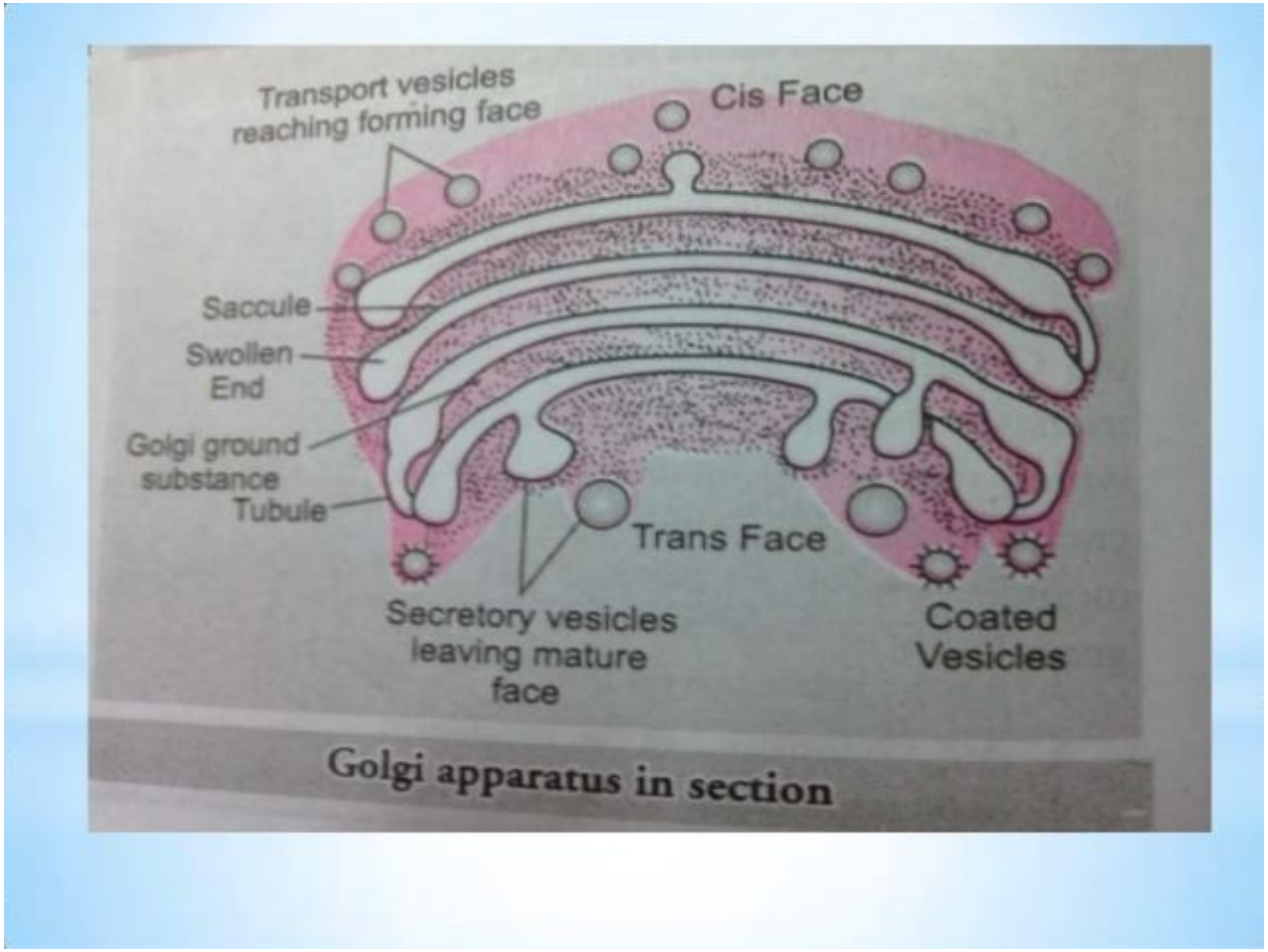
A cell have one large golgi apparatus or several small one.

Electron microscope shows it as a central stack of parallel flattened interconnecting sacs or cisternae and many peripheral tubules and vesicles.

Every layer has a different set of enzymes.

Golgi complex is involved in sorting ,processing ,packing,distribution of material formed in endoplasmic reticulum

Golgi apparatus or **Golgi bodies**.



Golgi apparatus or **Golgi bodies**.

- Vary in number from 3-7 in most animal cells from 10-20 in plant cells.
- Usually equally spaced in the stack, separated from each other by thin layers of inter cisternal cytoplasm.
- Cisternae may be flat but are often curved.Golgi complex has a distinct polarity,the two poles are called cis face and trans face which act respectively as the receiving and shipping department.
- Convex side of stack----forming Cis face.
- Concave side of stack----forming trans face.

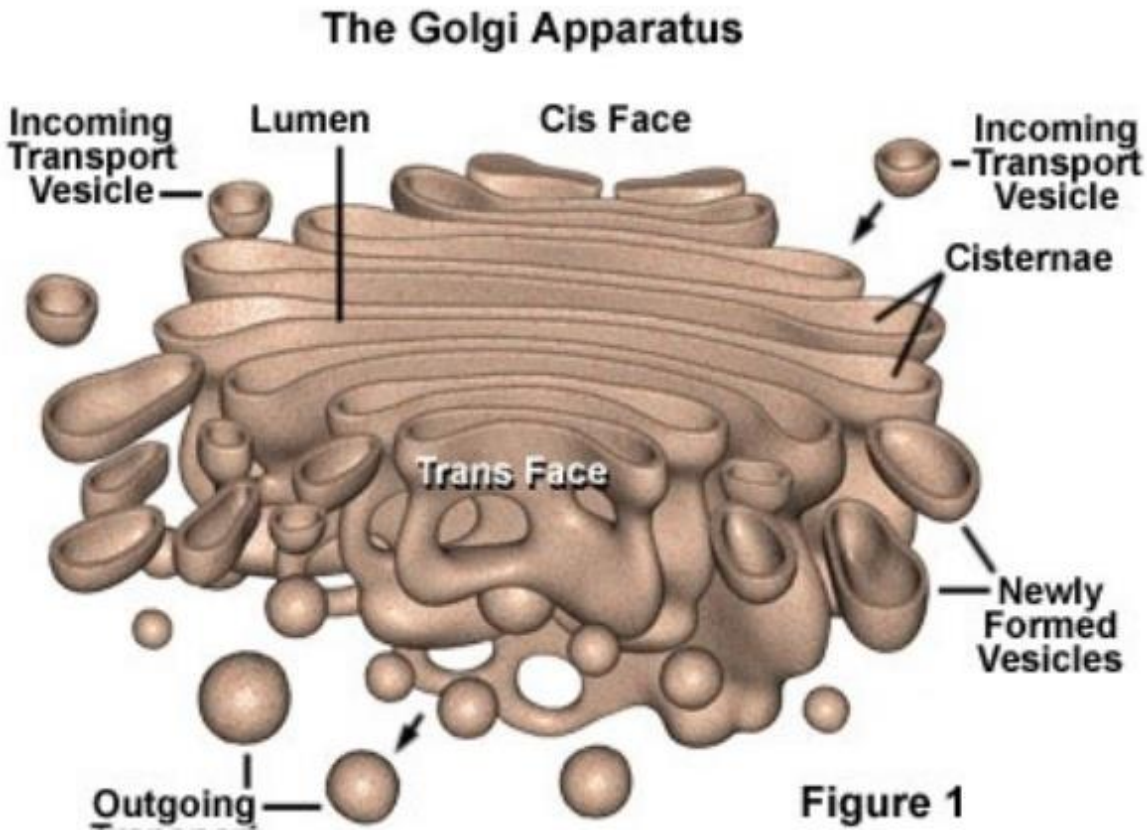
Golgi apparatus or **Golgi bodies**.

- Secretary material reach the Golgi complex from smooth ER by way of transport vesicles which bud off from the SER and fuse with golgi cisternae on the cis form.
- From the trans face secretary vesicles arises that carry the processed material to their destination.
- Vesicles lie near the ends and concave surface of the golgi complex.Golgi elements are filled with fluid the golgi matrix.

Golgi apparatus or **Golgi bodies**.

- Is inv in different cellular processes its role is in cell secretion.
- Carbohydrate synthesis.
- A newly characterised protein GAAP(Golgi anti apoptotic protein)protects cells from apoptosis.

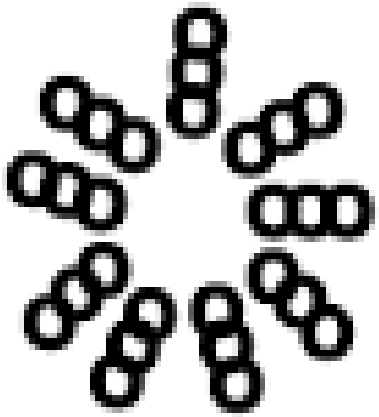
Golgi apparatus or **Golgi bodies**.

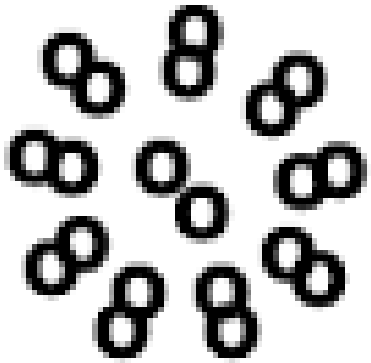


Cytoskeleton

- is a network of three types of filaments that provide structural integrity to the cell.
- Actin is the fundamental building block for thin filaments and represent as much as 15% of cellular protein,they are important in cellular contraction,migration and signeling.
- Intermediate filaments are primarily structural protein that make up intermediate filaments are cell type specific. Microtubules are made up of tubulin subunits which play an important role in defining the cell's organization and shape.
- **Microtubules** are hollow tubes(globular proteins) found in **cilia**, **flagella**, and **centrioles**.
- The arrangement of microtubules in cilia and flagella consists of nine doublets around the edge and two single microtubules in the center, all running the length of the structure. This is referred to as the “nine-plus-two formula.”

Cytoskeleton





Centriole & Basal Body (9 + 0 pattern)
A ring of 9 microtubule triplets with
no microtubules in the center.

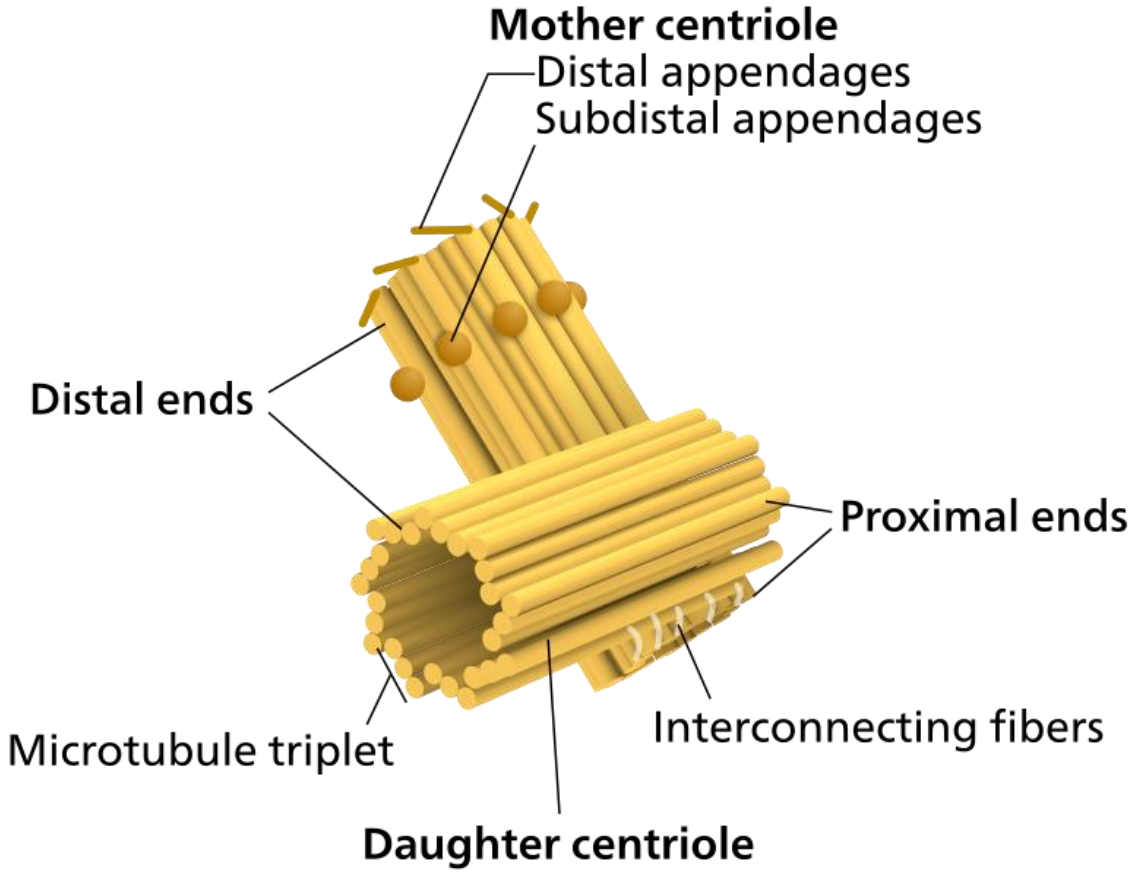
Flagellum & Cilium (9 + 2 pattern)
A ring of 9 microtubule doublets
with 2 microtubules in the center.

Cross section of centriole and flagellum showing
the distinctive arrangement of the microtubules.

Cytoskeleton

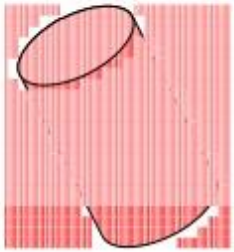
- In centrioles, arranged in a cylinder microtubules are arranged in 9 sets of 3 each. Microfilaments are also part of the cytoskeleton .
- Animal cells typically have a pair of centrioles located just outside the nucleus and oriented at right angles to each other. These function in cell division.
- A **centriole** is composed mainly of a protein called tubulin that is found in most eukaryotic cells. An associated pair of centrioles, surrounded by an shapeless mass of dense material, called the pericentriolar material, or PCM, makes up a compound structure called a centrosome

Cytoskeleton



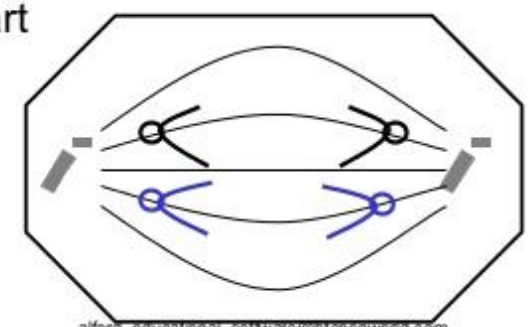
Cytoskeleton

Centrioles



Centrioles arise from a region of the cytoplasm called the **centrosome** and consist of 2 hollow cylinders

At cell division they migrate to opposite poles of the cell and produce the microtubules of the spindles that pull chromosomes apart



Apoptosis

- In addition to dividing and growing under genetic control, cells can die and be absorbed under genetic control. This process is called Programmed cell death or Apoptosis.

The events of apoptosis include

- Shrinkage of nucleus and cytoplasm.
- Disintegration of chromatin.
- Cell is endulfed by local phagocytes and disappear.
- Cell membrane remain intact.
- There is no inflammatory reaction.

Apoptosis can be triggered by

- Internal stimuli

Those are produced following cellular stress.

Cellular stress may occur from exposure from radiation ,chemicals or to viral infection.

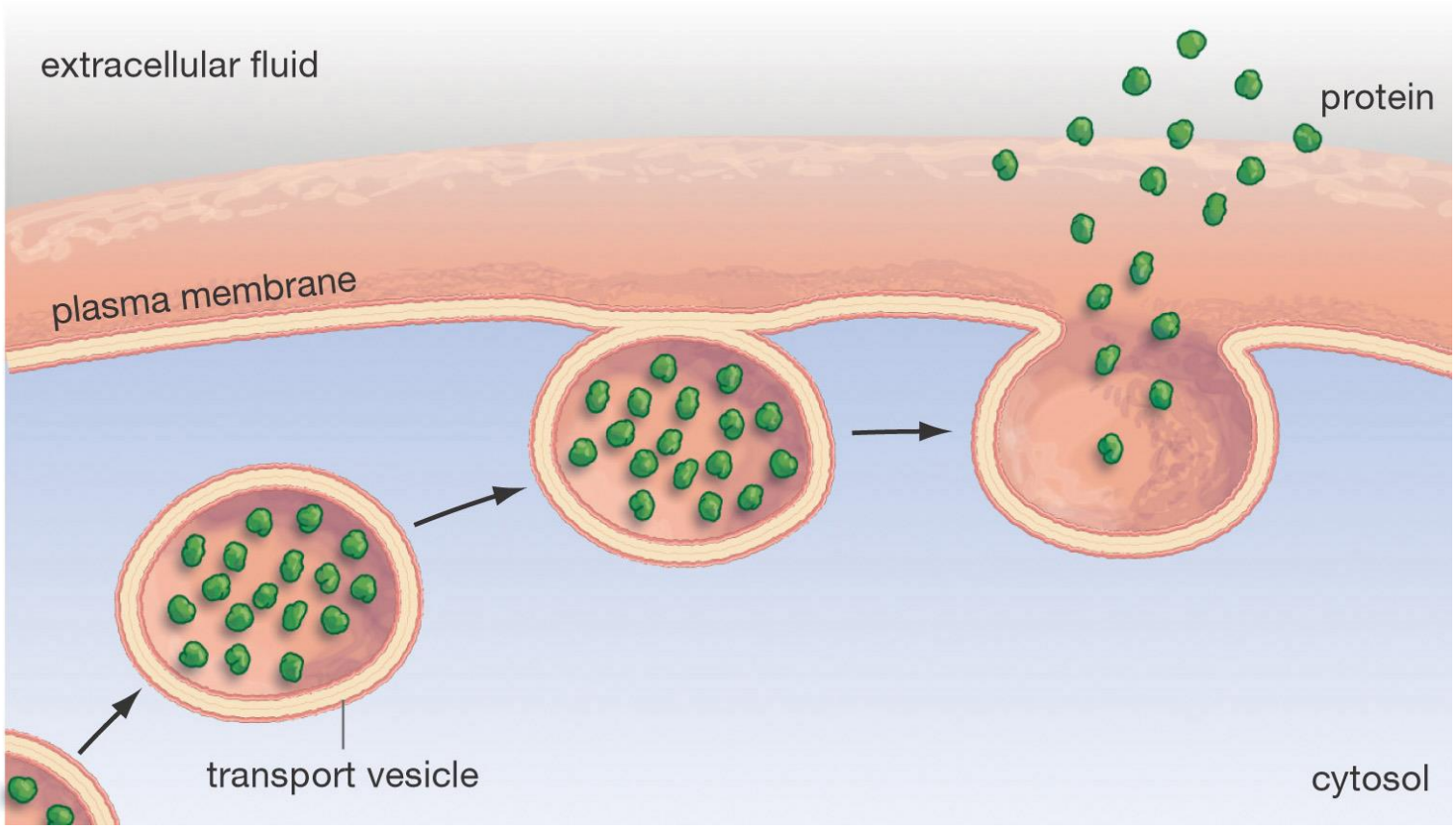
Growth factor deprivation.

Oxidative stress caused by free radicals.

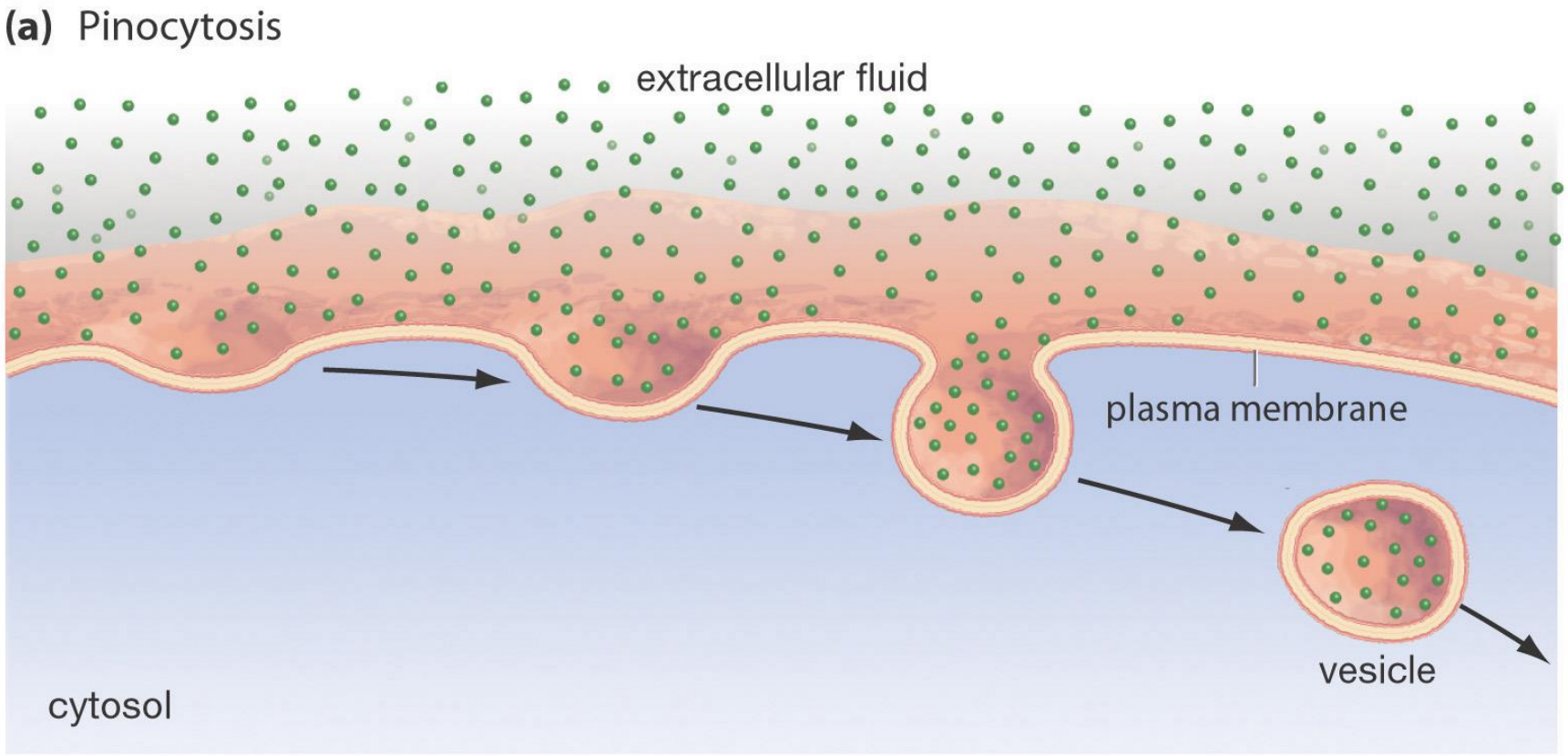
- Diffusion is a PASSIVE process which means no energy is used to make the molecules move, they have a natural kinetic energy.

- **<u>Endocytosis</u>** – the process of taking material into the cell by folding in pockets of the cell membrane into pouches called vesicles
  - **Phagocytosis** – endocytosis involving large solid particles
  - **Pinocytosis** – endocytosis involving liquid
- **<u>Exocytosis</u>** – the process of removing material out of the cell where vesicles merge with the cell membrane to release contents

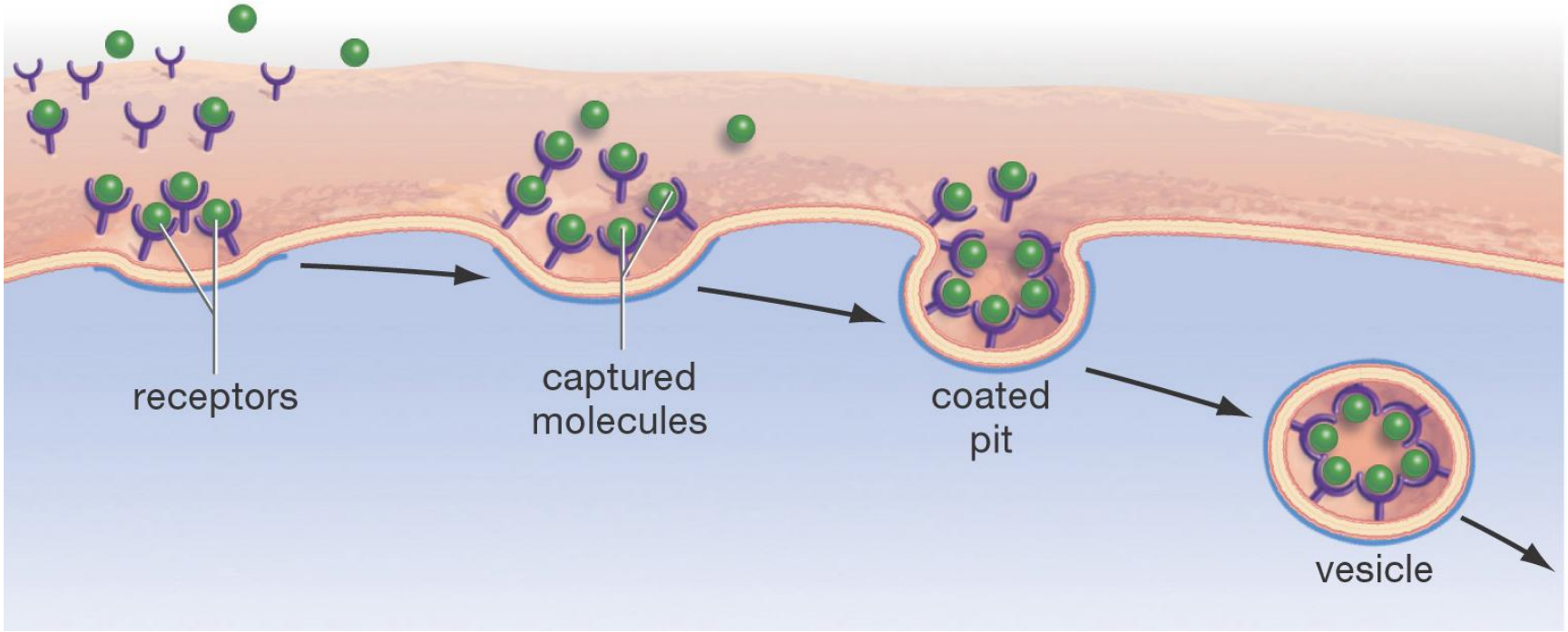
(a) Exocytosis



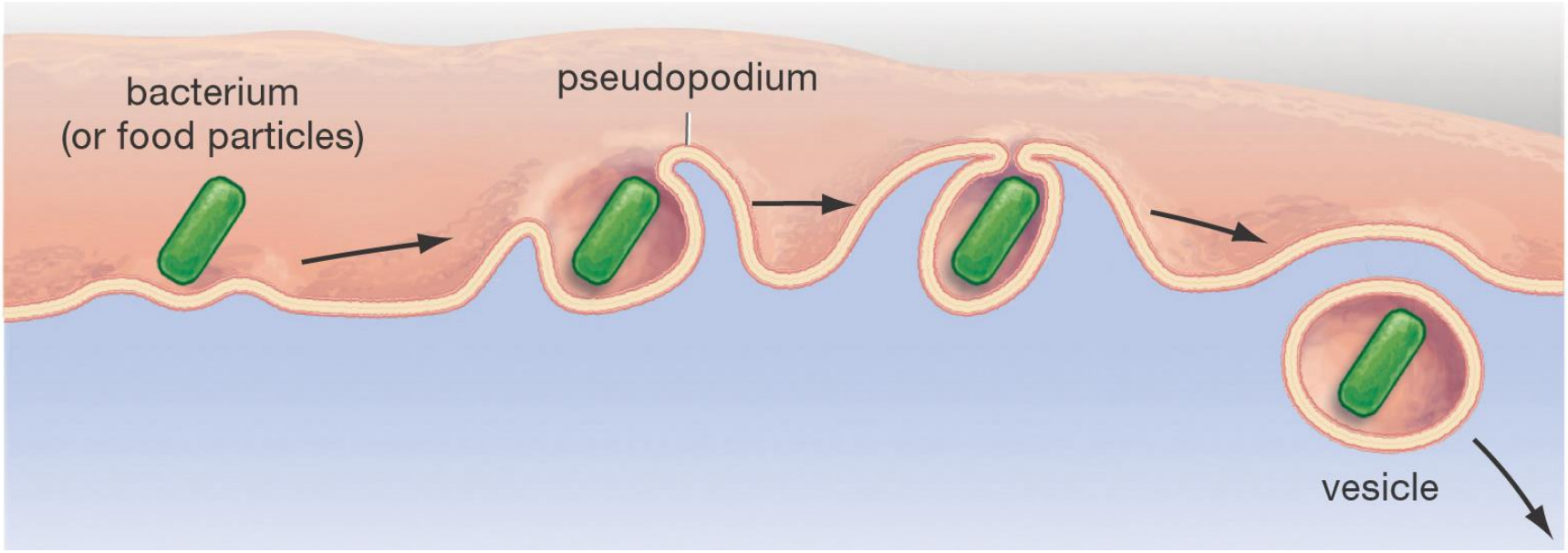
- Endocytosis is the case when a molecule causes the cell membrane to bulge inward, forming a vesicle.
- Phagocytosis is the type of endocytosis where an entire cell is engulfed.
- Pinocytosis is when the external fluid is engulfed. Receptor-mediated endocytosis occurs when the material to be transported binds to certain specific molecules in the membrane. Examples include the transport of insulin and cholesterol into animal cells.


(a) Pinocytosis
extracellular fluid
plasma membrane
vesicle
cytosol

Receptor-Mediated Endocytosis



Endocytosis – Phagocytosis



endocytosis.

- The cell membrane can also engulf structures that are much too large to fit through the pores in the membrane proteins this process is known as endocytosis.
- In this process the membrane itself wraps around the particle and pinches off a vesicle inside the cell. In this animation an ameba engulfs a food particle

1. Describe the structure of the cell membrane.
2. How do molecules get into and out of the cell?
3. What is selective permeability?
4. What is diffusion and how does it work?
5. What is facilitated diffusion and how does it work?
6. What is active transport and how does it work?
7. What is osmosis and how does it work?
8. What is the function of transport proteins?

2) The substance that contributes maximally to the osmolality inside the cell is

- a. protein
- b. phosphate
- c. urea
- d. Potassium
- *Ans. c*

3. **Proteins that are secreted by cells are generally**

- a. not synthesized on ribosomes that are bound to endoplasmic reticulum
- b. are synthesized in the mitochondria
- c. packed in the golgi apparatus
- d. moves across the cell membrane by endocytosis
- *Ans. c*

4.The unique feature in mitochondria is

- a. myosin
- b. actin
- c. DNA
- d. prothrombin
- *Ans. c*

- **The resting membrane potential of a cell**
- a. is dependant on the permeability of the cell membrane to K+ being greater to Na+
- b. falls to zero if Na+/K+ ATPase in membrane is inhibited
- c. is equal to the equilibrium potential for K+
- d. is equal to the equilibrium potential of Na+
- *Ans. a*

- **The somatic cells containing the full complement of 46 chromosomes in their nuclei, containing all the genes necessary for carrying out the cell activities are called**
- a. autosomes
- b. haploid cells
- c. allosomes
- d. diploid cells
- *Ans. d*

- **In some cases DM is due to**
- a. excessive receptors
- b. antibodies against receptors
- c. deficiency of receptors for extra cellular proteins
- d. deficiency of nucleotide regulatory G proteins
- *Ans. b*

- **Many substances are removed from the cell to outside by**
- a. pinocytosis
- b. chemotaxis
- c. phagocytosis
- d. exocytosis
- *Ans. d*

- **Excessive formation of a substance/ secretion in the body is controlled in order to maintain homeostasis by**
- a. +ve feedback mechanism
- b. -ve feedback mechanism
- c. osmosis
- d. haemodynamics
- *Ans. b*

- **An action potential in a nerve**
- a. is terminated by influx of Na+ excessive receptors
- b. is terminated by efflux of K+
- c. is initiated by efflux of Na+
- d. is initiated by influx of K+
- *Ans. b*

- **An example of co-transport is**
- a. Na+-K+ pump
- b. Ca++ pump
- c. Na+- H+ pump
- d. Na+ glucose transport
- *Ans.d*