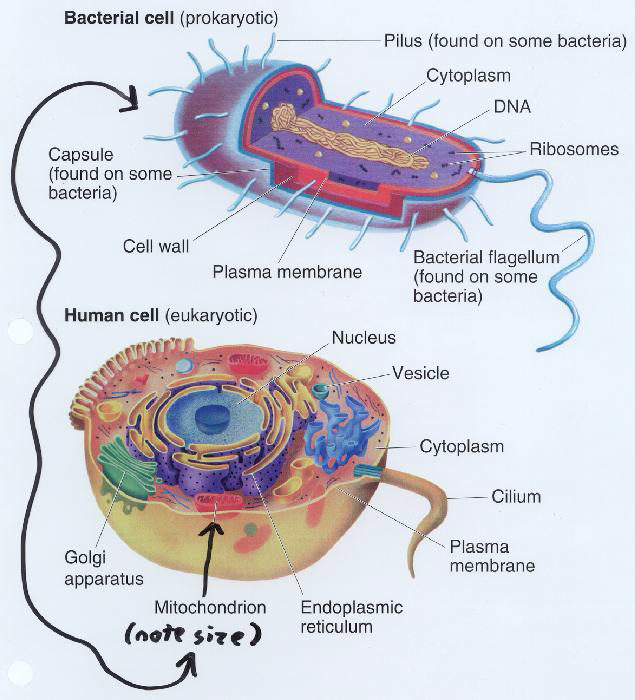
**STRUCTURE OF THE EUKARYOTIC CELL:**

In contrast, **eukaryotic** (Gr. eu, good, + karyon, nucleus) cells are larger and have a distinct nucleus surrounded by a nuclear envelope. Histones are associated with the genetic material, and numerous membrane-limited organelles are found in the cytoplasm.





**The Plasma Membrane and How Substances Cross It:**

A human cell, like all cells, is surrounded by an outer plasma membrane. The plasma membrane marks the boundary between the outside and the inside of the cell.

The plasma membrane is a phospholipid bilayer with attached or embedded proteins. A phospholipid molecule has a polar head and nonpolar tails

Phospholipids are a major component of cell membranes. They form a lipid bilayer in which their hydrophillic (attracted to water) head areas spontaneously arrange to face the aqueous cytosol and the extracellular fluid, while their hydrophobic (repelled by water) tail areas face away from the cytosol and extracellular fluid.

**Plasma Membrane Functions:**

The plasma membrane keeps a cell intact. It allows only certain molecules and ions to enter and exit the cytoplasm freely. Therefore,

The plasma membrane is said to be selectively permeable (Small, lipid-soluble molecules, such as oxygen and carbon dioxide, can pass through the membrane easily. The small size of water molecules allows them to freely cross the membrane by using protein channels called aquaporins. Ions and large molecules cannot cross the membrane without more direct assistance, which will be discussed later.

**Diffusion**

Diffusion is the random movement of molecules from an area of higher concentration to an area of lower concentration, until they are equally distributed. Diffusion is a passive way for molecules to enter or exit a cell. No cellular energy is needed to bring it about.

**Osmosis** is the net movement of water across a semipermeable membrane, from an area of higher concentration to an area of lower concentration. The membrane separates the two areas, and solute is unable to pass through the membrane. Water will tend to fl ow from the area that has less solute (and therefore more water) to the area with more solute (and therefore less water).

Normally, body fluids are isotonic to cells. There is the same concentration of non diffusible solutes and water on both sides of the plasma membrane. Therefore, cells maintain their normal size and shape

Solutions that cause cells to swell or even to burst due to an intake of water are said to be **hypotonic**. A hypotonic solution has a lower concentration of solute and a higher concentration of water than the cell

Solutions that cause cells to shrink or shrivel due to loss of water are said to be hypertonic. A **hypertonic** solution has a higher concentration of solute and a lower concentration of water than do the cells.

**Endocytosis and Exocytosis**:

During endocytosis, a portion of the plasma membrane invaginates, or forms a pouch, to envelop a substance and fluid. Then the membrane pinches off to form an endocytic vesicle inside the cell. Some white blood cells are able to take up pathogens (disease-causing agents) by endocytosis. Here the process is given a special name: phagocytosis.

Usually,cells take up molecules and fluid, and then the processes called pinocytosis. During exocytosis, a vesicle fuses with the plasma membraneas secretion occurs.

**The cytoplasm:**

Cytoplasm matrix fills the space between the plasma membrane and nucleus and it is composed of highly organized complex meshwork of elongated protein molecules responsible for many of the cell functions, the colloidal properties of the cell, such as those essential to:

* Sol- gel transformation.
* Viscosity change.
* Intracellular motion (cyclosis).
* Amoeboid movement.
* Spindle formation.
* Cell division.

All of those functions depend on the cytoplasmic matrix, also the cytoplasm is the site of many fibrils differentiation found in specialized cells such as; keratin filament, myofibrils and microtubules.

Within the matrix which are located:

endoplasmic reticulum .

mitochondria .

Golgi apparatus .

Centrosome and other cells organelles.

**The Endomembrane System**

The endomembrane system consists of the nuclear envelope, the endoplasmic reticulum, the Golgi apparatus, lysosomes, and vesicles.

**The Endoplasmic Reticulum**:

The endoplasmic reticulum (E.R) is a network of membrane enclosed tubules and sacs (cisterna) that extend from nuclear membrane through the cytoplasm .

The entire E.R is enclosed by a continuous membrane is the largest organelles of most eukaryotic cells. Its membrane may a count for about half of all cell membrane and the space enclosed by the E.R ( the lumen of cisternal space ).

**There are two types of E.R that perform different functions within the cell:**

* **The Rough E.R:** This is covered by ribosomes on its outer surface, it's function in protein processing.
* **The smooth E.**R: is not associated with ribosomes and involved in lipid metabolism rather than protein metabolism.

**Rough endoplasmic reticulum:**

Which is covered by ribosomes on its outer surface, rough E.R is found in all cells except erythrocytes and it is especially a abundant in glandular cells, such as salivary gland cells.

Only rough E.R has direct connections with the nuclear membrane. This type is present in cell that are specialized for protein synthesis like digestive enzyme.

* + Cell of pan crease which synthesize collagen fibers.
  + Plasma cells which synthesize immunoglobulin.

**Functions of rough E.R:**

1. Has a role in the synthesis of proteins to be exported outside the cell.
2. Modification of newly formed polypeptides.
3. Assembly of multichain proteins.
4. Initial glycosylation of glycoprotein which mean, addition of glucose to the protein.

**Smooth E.R :**

The smooth E**.**R is not associated with ribosomes and it is less common than rough E.R.

**Function of smooth E.R:**

1. it is abundant in the liver and intestinal epithelium and seen to be involved in detoxification mechanisms of certain substances like alcohol toxins .
2. smooth E.R is also responsible for glycogen break down in the liver cells .
3. responsible for lipid and cholesterol metabolism .
4. involved in biosynthesis of steroid hormones (adrenal gland).
5. Smooth E.R also participated in the contraction process of muscle cells.

Smooth E.Rin thiscase called (sarcoplasmic reticulum).

**The Golgi Apparatus:**

The **Golgi apparatus** is named for Camillo Golgi, who discovered its presence in cells in 1898. The Golgi apparatus consists of a stack of slightly curved saccules, whose appearance can be compared to a stack of pancakes. Here, proteins and lipids received from the ER are modified. For example, a chain of sugars may be added to them. This makes them glycoproteins and glycolipids, molecules often found in the plasma membrane. The vesicles that leave the Golgi apparatus move to other parts of the cell. Some vesicles proceed to the plasma membrane, where they discharge their contents. In all, the Golgi apparatus is involved in processing, packaging, and secretion. other vesicles that leave the Golgi apparatus are lysosomes .

Functions of Golgi apparatus :

1. Participate in the proteins synthesis.
2. CHO hydrolysis
3. Initial proteolysis (cutting of protein(.
4. Terminating glycolyting and glycosylation .
5. Phosphorylation (addition of the phosphate group).
6. Sulfation(addition of sulfa group).
7. Processing and storing glycoprotein.
8. Lipid metabolism.

**Ribosome's:**

**Ribosomes** are organelles composed of proteins and rRNA. Protein synthesis occurs at the ribosomes. Ribosomes are often attached to the endoplasmic reticulum; but they also may occur free within the cytoplasm, either singly or in groups called polyribosomes. Proteins synthesized at ribosomes attached to the endoplasmic reticulum have a different destination from that of proteins manufactured at ribosomes free in the cytoplasm.

**Lysosomes:**

Lysosomes, membranous sacs produced by the Golgi apparatus, contain hydrolytic enzymes. Lysosomes are found in all cells of the body but are particularly numerous in white blood cells that engulf disease-causing microbes. When a lysosome fuses with such an endocytic vesicle, its contents The organelles in the endomembrane system work together to produce, modify, secrete, and digest proteins and lipids. Membrane is digested by lysosomal enzymes into simpler subunits that then enter the cytoplasm. In a process called autodigestion, parts of a cell may be broken down by the lysosomes . Some human diseases are caused by the lack of a particular lysosome enzyme.

**Function of Lysosomes:**

1. The lysosomal enzyme can break all types of macromolecules example : carbohydrates into micro molecules and proteins into peptides.
2. During development and body growth, Lysosomes are responsible for the removal of an wanted tissue and waste product.
3. Digestion of extracellular materials ex: during bone development osteoclasts ((which are one type of cells present in bone tissue)) release enzyme of secondary Lysosomes by exocytosis to remolding the bone.
4. The acrosome of the sperm is a special type of lysosomes which plays an important role in the differentiation of the sperm.
5. Lysosomes in the white blood cells and macrophages are essential in the defense against bacteria and viruses.

**Mitochondria and Cellular Metabolism:**

Mitochondria (sing., **mitochondrion**) are often called the powerhouses of the cell. Just as a powerhouse burns fuel to produce electricity, the mitochondria convert the chemical energy of glucose products into the chemical energy of ATP molecules. In the process, mitochondria use up oxygen and give off carbon dioxide. Therefore, the process of producing

ATP is called **cellular respiration.**

The structure of mitochondria is appropriate to the task. The inner membrane is folded to form little shelves called cristae. This project into the matrix, an inner space filled with a gel-like fluid. The matrix of a mitochondrion contains enzymes for breaking down glucose products. ATP production then occurs at the cristae. Protein complexes that aid in the conversion of energy are located in an assembly-line fashion on these membranous shelves.

The structure of a mitochondrion supports the hypothesis that they were originally prokaryotes engulfed by a cell. Mitochondria are bounded by a double membrane, as a prokaryote would be if taken into a cell by endocytosis. Even more interesting is the observation that mitochondria have their own genes—and they reproduce themselves!

**vacuoles:**

A vacuole is a large membranous sac; a vesicle is smaller than a vacuole. animal cell have vacuoles , but they are much more prominent in plant cell, the vacuole present in protozoa are quite specialized , they are include contractile vacuole for ridding the cell of excess water and digestive vacuole for breaking down nutrients.

**Centrosome:**

The Centrosome of most animal cells contains pairs of centriols oriented perpendicular to each other, the centriol is cylindrical structure consist of nine triplet microtubules , similar to the basal bodies of cilia and flagella.

They are not found in plant cell ; may be found in unicellular eukaryotes , and some animal cells such as mouse egg .

The centriols play important role in cell division , one of the pair moves around to the opposite side of the nucleus from the other centriol, fibers spread from each centriol towards the centre of the cell and in some way act to move the chromosomes in the cell division (mitosis and meiosis) .

**Cilia and flagella**:

Are motile projection of the plasma membrane that is responsible for movement of variety of eukaryotic cells. eukaryotic cilia and flagella are very similar structure, each with a diameter of approximately 0.25Mm.

The fundamental structure of both cilia and flagella is the axoneme which is composed of microtubules and their associated proteins.

**Basal body:**

The intracellular end of the microtubules of cilia and flagella are fixed in basal body, which is similar in structure to a centriols and contains nine triplets of microtubules.

**Non- living inclusion bodies:**

They are temporary component of the composed of one the following metabolites:

1. lipid : fat droplet , , they are present mainly in adipose tissue , adrenal cortex and liver cells , they serve as a source of energy.
2. Glycogen: present in liver and skeletal muscle cell, they can be breakdown into glucose and used by the cell.
3. Proteins: they present either as a granules or as crystal example: in adrenal cells.
4. Pigments: they are deposit of colored substances example :
   1. Melanin: dark-brown pigments present in the skin , hair , retinae and some parts of the central nervous system .
   2. Lipofusin : yellow-brown pigments represent undigested substances of secondary Lysosomes they are present in liver cells .
   3. Hemosidrin: gold- yellow in color ,they are the end product of Hb degradation of old red blood cells, they are present in the liver , spleen and bone marrow.