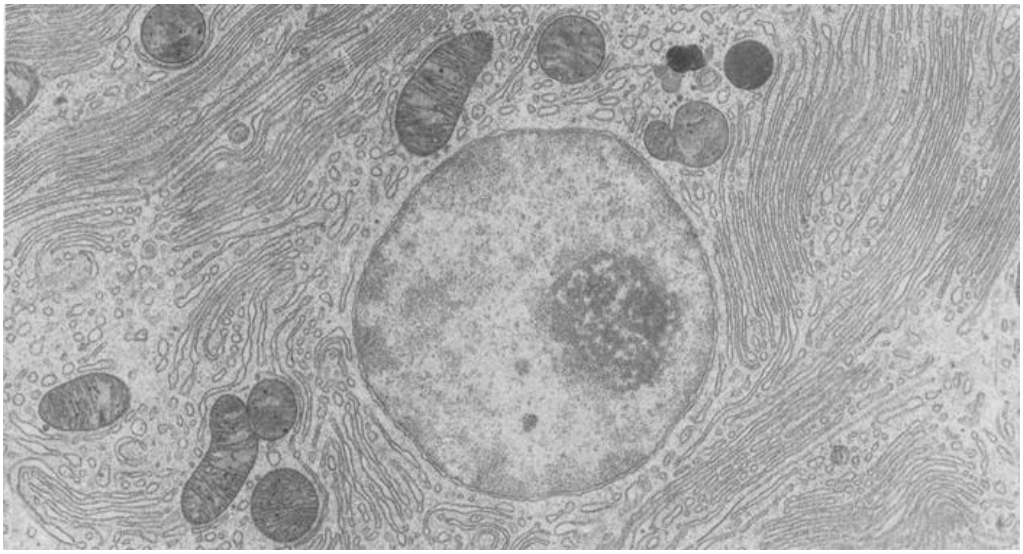
# Cytoplasm

The cytoplasm is the part of the cell located outside the nucleus full the space between nuclear envelop and plasma membrane consists of

1. **Cytosol** is a larger fluid component.
2. **Organelles** ("little organs") are bathing metabolically active structures, which may be membranous (such as mitochondria) or non membranous protein complexes (such as ribosomes and proteasomes).
3. **Cytoskeleton** is protein components which determine the shape and motility of eukaryotic cells.
4. **Inclusions** are the minor cytoplasmic structures that are not usually surrounded by a plasma membrane. They consist of such diverse materials as crystals, pigment granules, lipids, glycogen, and other stored waste products.

## Cytosol

- Cytosol is an aqueous gel called the **cytoplasmic matrix** or cell sap
- Cytosol is colorless watery fluid or gelatinous liquid (semi fluid) that fills the inside of a cell and surrounds the organelles.
- The matrix consists of a variety of solutes, including inorganic ions (Na, K, and Ca2) and organic molecules such as intermediate metabolites, carbohydrates, lipids, proteins, and RNAs.
- Cytosol also contains hundreds of enzymes, all the machinery converging on the ribosomes for protein synthesis.
- Oxygen, CO2, electrolytic ions, low-molecular-weight substrates, metabolites, and waste products all diffuse through cytosol, either freely or bound to proteins, entering or leaving organelles where they are used or produced.
- **L.M.** of cytosol: It appears as homogenous or finely granular ground substance, commonly acidophilic in reaction but may be basophilic or neutrophilic.
- **E.M.** of cytosol: Appear as **amorphous** substance with variety of **electron densities**.
- Function of cytosol: Provides a suitable medium for reactions occurring in the cytoplasm.



**Electron microscope cell image**

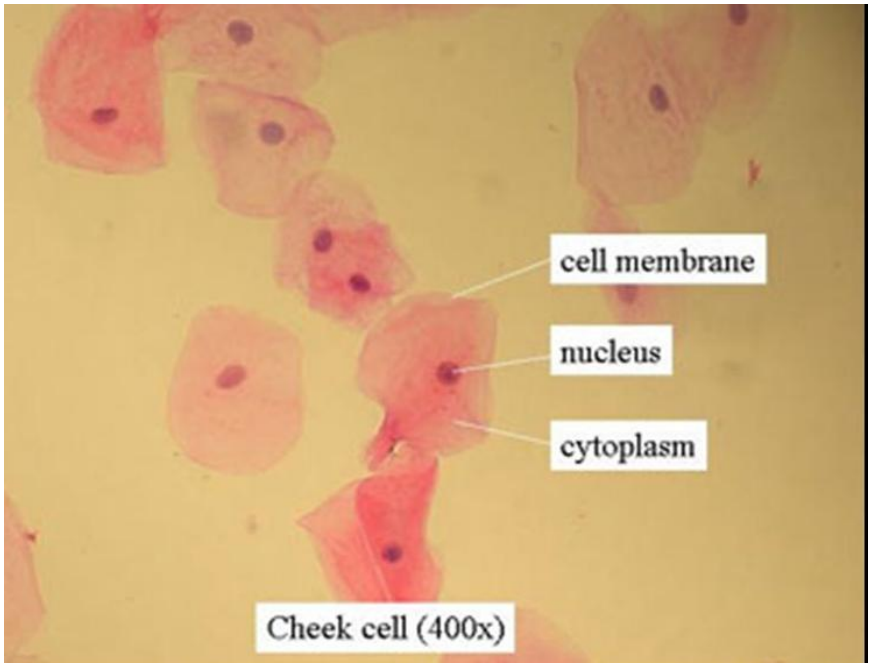



**Figure shows cells image under light microscope**

## ❖ Cytoplasmic Organelles (part1)

All cells have the same basic set of intracellular organelles, which can be classified into two groups:

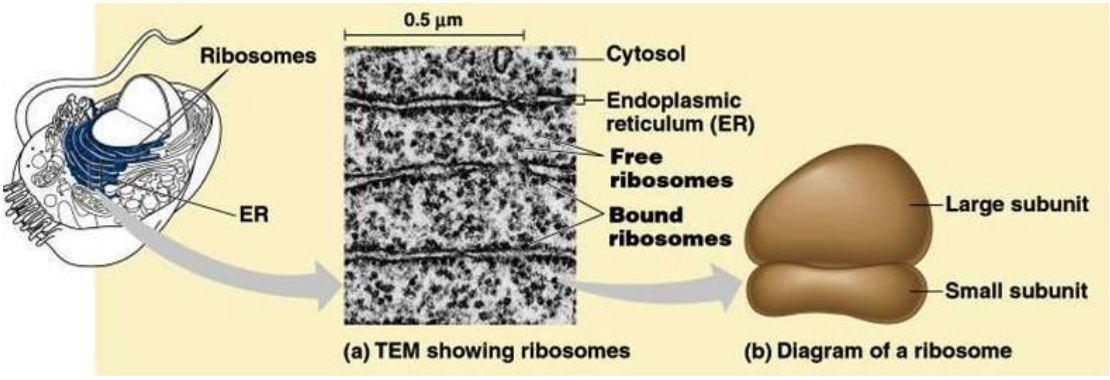
1. **Membranous organelles** with plasma membranes that separate the internal environment of the organelle from the cytoplasm.
2. **Non membranous organelles** without plasma membranes (naked organelles).

- ✓ The membranes of membranous organelles form vesicular, tubular, and other structural patterns within the cytoplasm that may be convoluted (as in smooth-surfaced endoplasmic reticulum) or plicated (as in the inner mitochondrial membrane).

- ✓ In addition, each type of organelle contains a set of unique proteins**.**
- **In membranous organelles**, these proteins are either incorporated into their membranes or sequestered within their lumens. For example, the enzymes of lysosomes are separated by a specific enzyme resistant membrane from the cytoplasmic matrix because their hydrolytic activity would be detrimental to the cell.
- **In Non membranous organelles**, the unique proteins usually self assemble into polymers that form the structural elements of the organelles.

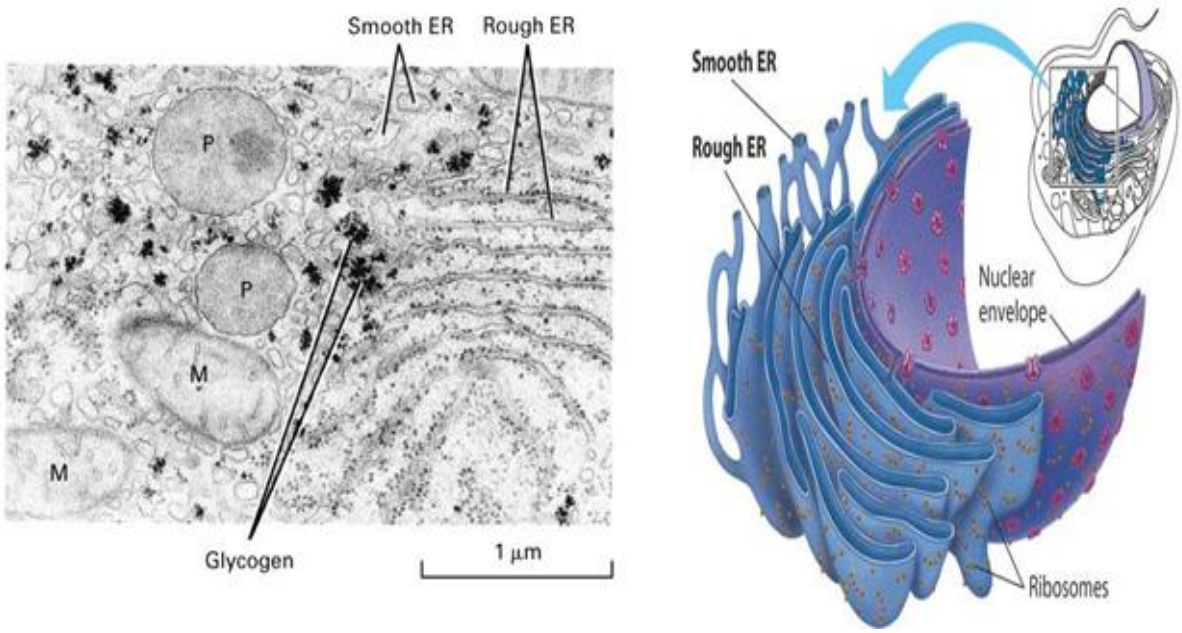
## Ribosomes

- ✓ Ribosomes are membrane naked organelles present in all cells types( prokaryotes and eukaryotes)
- ✓ Ribosomes are small electron-dense particles composed of proteins and rRNA.
- ✓ All ribosomes have two subunits of different sizes and act to catalyze the process of protein translation (Protein synthesis), so that is more abundant in protein secreting cells.
- ✓ In eukaryotic cells, the rRNA molecules of both subunits are synthesized within the nucleus. Their numerous proteins are synthesized in the cytoplasm but then enter the nucleus and associate with rRNAs. The assembled large and small subunits then leave the nucleus and enter the cytoplasm to participate in protein synthesis.
- ✓ Ribosomes are often **attached** to the endoplasmic reticulum; but they also may occur **free** within the cytoplasm, either singly or in groups called **polyribosomes or polysomes.**
- ✓ The location of the ribosome in a cell determines what kind of protein it makes. If the ribosomes are floating freely through the cell, it will make proteins that will be utilized within the cell itself.
  But when the ribosomes are attached to endoplasmic reticulum, proteins made on the rough endoplasmic reticulum are used for usage inside the cell or outside the cell.



## Endoplasmic reticulum (ER)

- The largest organelle of most eukaryotic cells is ER.
- Membrane bounded organelles
- ER is a network of intercommunicating channels and sacs formed by a continuous membrane which encloses a space called **cisternae** this network (reticulum) extends from the surface of the nucleus to the cell membrane.
- The main function of ER is the transport of materials by forms transport vesicles in which large molecules are transported to other parts of the cell. Often, these vesicles are on their way to the plasma membrane or the Golgi apparatus.
- There are two types of ER according to the present of ribosome, **Rough ER** and **Smooth ER.**




**Transmission EM of RER&SER**

### Rough ER (RER)

It's studded with ribosomes on the side of the membrane that faces the cytoplasm. Here, proteins are synthesized and enter the ER interior, where processing and modification begin. Some of these proteins are incorporated into membrane, and some are for export. Is found in all cells except erythrocytes and is especially abundant in pancreas, fibroblasts and plasma cells.

- ✓ **Function of RER:**
  1. Has role in the synthesis of protein to be exported outside the cell.
  2. Modification of newly formed polypeptides.
  3. Assembly of multichain protein.
  4. Initial glycosylation of the glycoprotein which means addition of glucose to the protein.
- ✓ RER has a highly regulated system to prevent nonfunctional proteins being forwarded to the pathway for secretion or to other organelles. New proteins that cannot be folded or assembled properly by chaperones undergo **ER-associated degradation (ERAD)**, in which unsalvageable proteins are translocated back into the cytosol, conjugated to ubiquitin, and then degraded by proteasomes.
- ✓ *Quality control during protein production in the RER and properly functioning ERAD to dispose of defective proteins are extremely important and several inherited diseases result from malfunctions in this system. For example, in some forms of osteogenesis imperfect bone cells synthesize and secrete defective procollagen molecules which cannot assemble properly and produce very weak bone tissue.*

## Smooth ER (SER)

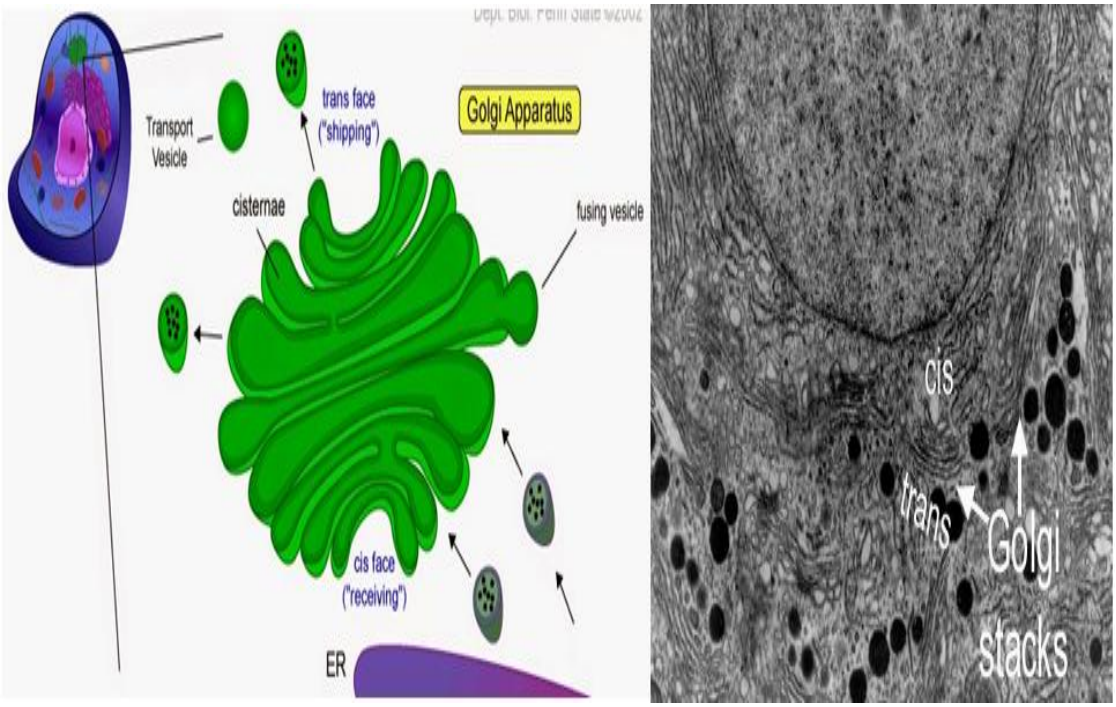
Are continuous with rough ER, does not have attached ribosomes. Smooth ER synthesizes the phospholipids that occur in membranes and has various **other functions**, depending on the particular cell.

1. SER in **Testes** is produce testosterone.
2. SER in **liver** is detoxified drugs, alcohol and toxin. Also have role in lipid and cholesterol synthesis. And glycogen breakdown.
3. SER in **adrenal glands** is produces steroid hormones
4. SER in **muscle cells** has role in contraction process (SER in muscle cells called sarcoplasmic reticulum).
5. SER Transport molecules to the Golgi body.
6. SER is metabolized lipid and cholesterol.

*Jaundice denotes a yellowish discoloration of the skin and is caused by accumulation in extracellular fluid of bilirubin and other pigmented compounds, which are normally metabolized by SER enzymes in cells of the liver and excreted as bile. A frequent cause of jaundice in newborn infants (physiological jaundice) is an under developed state of SER in liver cells, with failure of bilirubin to be converted to a form that can be readily excreted.*

## Golgi apparatus

- Golgi apparatus is consists of a stack of slightly curved saccules with convex side as the *cis* face and mature concave side is the *trans* face that separated from ER.
- Present in typical eukaryotic cells, highly developed in secretary cells.
- In most cells, there is a polarity in the Golgi bodies**.(most polar organelle)**
- Protein and lipid vesicle from ER fused with *cis* face of Golgi apparatus then subsequently progress through the stack to *trans* face of Golgi apparatus that contain cisternae enzyme. Cisternae enzyme modify, sort and package proteins also add sugar to protein and lipid to form glycoproteins, glycolipids and lipoproteins. These molecules packaged in membrane for export outside of cell or for lysosomes.




**TEM shoeing the Golgi apparatus**