

# *Ribosome*

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*Definition*

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Ribosomes are the protein synthesis units of a cell described by G.E. Palade in 1952. Ribosomes are small, electron-dense particles, found in the cytosol and composed of four segments of rRNA and approximately 80 different proteins.

## *The structure of Ribosome*

In eukaryotes, the ribosomes are (20 – 30) nm, and in prokaryotes (including mitochondria) they are slightly smaller. In both types of cells, ribosomes are composed of two subunits, one large and one small. The two subunits come together by binding an mRNA strand, and typically numerous ribosomes are present on an mRNA as **polyribosomes (polysomes)**.

The number of ribosomes in a cell varies depending on its functions, for example, pancreatic cells and those of other glands have many ribosomes because they produce secretions that contain proteins.

## *Locations*

In eukaryotic cells, some ribosomes occur freely within the cytoplasm like in (lymphocytes, embryonic nerve cells and cancerous cells) or in groups called **polyribosomes**, and others are attached to the endoplasmic reticulum (ER) like in (pancreatic cells, plasma cells, hepatic parenchymal cells, adult nerve cell (Nissl's bodies) and osteoblasts. In prokaryotic cells the ribosomes often occur freely in the cytoplasm or sometimes as polyribosome.

### *The function*

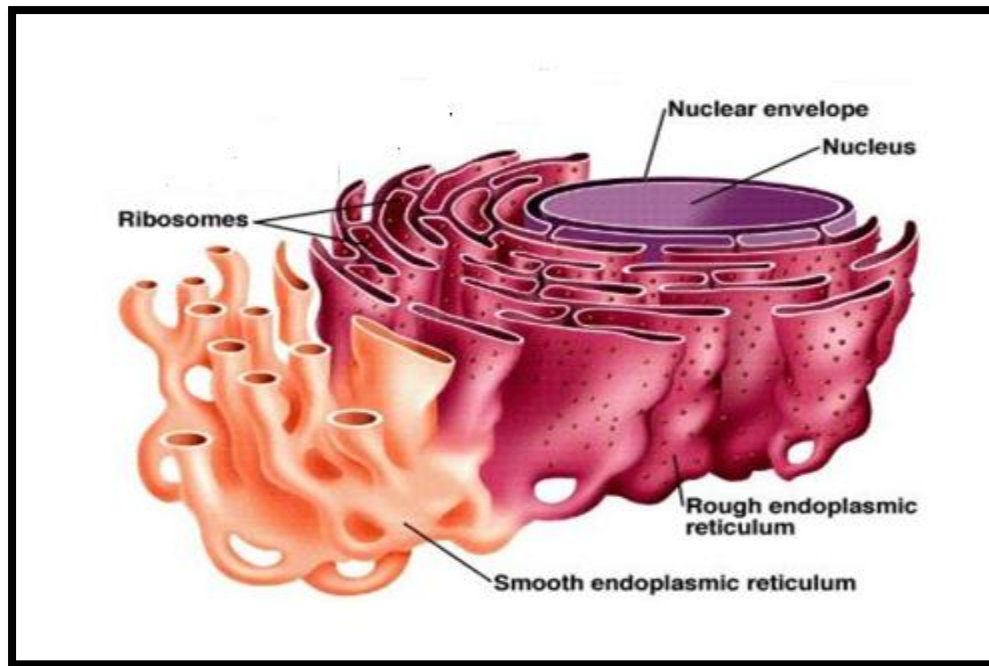
- Proteins synthesized for use within the cell cytosol (e.g., glycolytic enzymes) are synthesized on polyribosomes existing as isolated clusters within the cytoplasm.

- Polyribosomes that are attached to the membranes of the endoplasmic reticulum (via their large subunits) translate mRNA that code for proteins that are sequestered across the membranes of the endoplasmic reticulum.

### *Endomembrane system*

The endoplasmic reticulum (ER), consisting of a complicated system of membranous channels and saccules (cisternae), is physically continuous with the nuclear envelope. In many places the cytosolic side of the membrane is covered by polyribosomes synthesizing protein molecules which are injected into cisternae. This permits the distinction between the two types of endoplasmic reticulum **rough** and **smooth**.

These two types of membranes have different structure and functions. Only rough ER is studded with ribosomes on the side of the membrane that faces the cytoplasm, and because of this, rough ER has the capacity to produce proteins. Distributes transport vesicles, proteins surrounded by membranes.



### **Rough endoplasmic reticulum (RER)**

Is prominent in cells specialized for protein secretion, such as pancreatic acinar cells (digestive enzymes), fibroblasts (collagen), and plasma cells (immunoglobulins). RER consists of sac-like as well as parallel stacks of flattened cisternae, limited by membranes that are continuous with the outer membrane of the nuclear envelope. Inside its lumen, rough ER contains enzymes that can add carbohydrate (sugar) chains to proteins, and then these proteins are called **glycoproteins**. While in the ER, proteins fold and take on their final three-dimensional shape.

### **Smooth endoplasmic reticulum (SER)**

Which is continuous with rough ER, does not have attached ribosomes. Certain organs contain an abundance of smooth ER and its function depends on the organ. In some organs, smooth ER is associated with the production of lipids. For example, in the testis, smooth ER produces testosterone, a steroid hormone. In the liver, smooth ER helps detoxify drugs.

### ***The functions of smooth ER***

●The smooth ER serves a number of different purposes. It is responsible for protein translation by aiding in the folding and the transporting of proteins to be used in the cell membrane.

●The smooth ER also helps in the production and storage of glycogen, triglycerides, steroids, and other macromolecules. Inside the smooth ER are a number of enzymes that are important to detoxification. As a result, the smooth ER turns drugs, poisons, and toxic by-products of cellular metabolism into substances that are suitable for the body.

●The smooth ER is important to muscle cells. It stores and regulates the calcium ions in the muscle cells, as well as facilitating muscle contraction; the smooth ER contracts impulses from surface membranes of the cell into the depths of muscle cells.

●The smooth ER synthesizes membrane phospholipids which go inward from the endoplasmic reticulum to the nuclear membrane to replace it. Sometimes, though, the membrane phospholipids go outward to form the Golgi complex, lysosome, and the cell membrane.

### ***The endoplasmic reticulum occurs in three forms:***

- 1- ***Lamellar form or cisternae*** which are a closed, fluid-filled sac, vesicle or cavity is called cisternae. The cisternae are long, flattened, sac-like, unbranched tubules. They remain arranged parallel in bundles or stacks as the cells of pancreas and brain.
- 2- ***Vesicular*** form or vesicle. The vesicles are oval, membrane-bound vacuolar structures. They often remain isolated in the cytoplasm and occur in most cells but especially abundant in the smooth ER.

3- ***Tubular*** form or tubules. The tubules are branched structures forming the reticular system along with the cisternae and vesicles, occur almost in all the cells. Tubular form of ER is often found in smooth ER and is dynamic in nature, *i.e.*, it is associated with membrane movements, fission and fusion between membranes of cytocavity network.