Endoplasmic Reticulum

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All eucaryotic cells have an endoplasmic reticulum (ER). Its membrane typically constitutes more than half of the total membrane of an average animal cell. The ER is organized into a netlike labyrinth of branching tubules and flattened sacs extending throughout the cytosol. The ER membrane separates the ER lumen from the cytosol, and it mediates the selective transfer of molecules between these two compartments. The ER is made up of two subunits —

(i) rough endoplasmic reticulum (RER) and
(ii) smooth endoplasmic reticulum (SER).

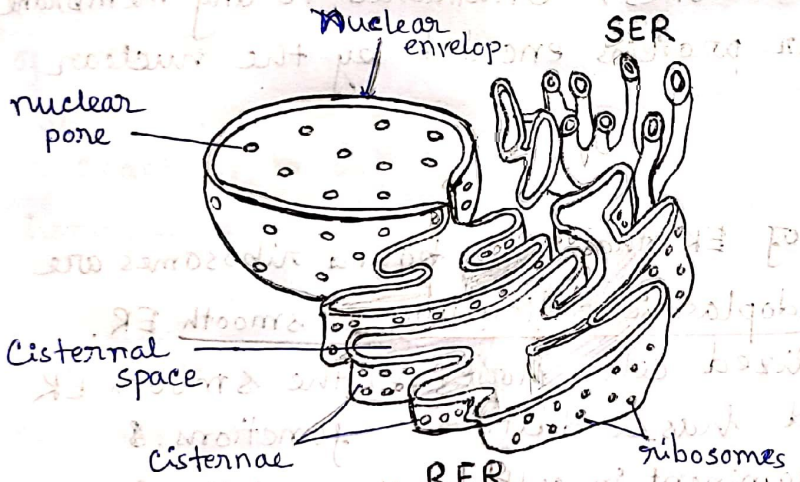


Fig: Endoplasmic Reticulum

The ER captures selected proteins from the cytosol as they are being synthesized. These proteins are of two types: —

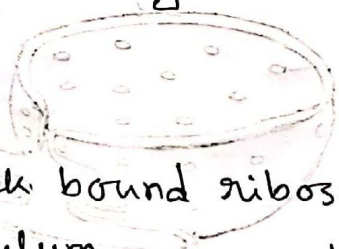
a) Transmembrane proteins and
b) Water soluble proteins.

In mammalian cell, import of proteins into the ER begins before the polypeptide chain is completely synthesized - that is import is a co-translational process.

This process is different from the import of proteins into mitochondria, chloroplasts, nuclei and peroxisomes, which are post translational processes. The ribosome that is synthesizing the protein is directly attached to the ER membrane. These membrane-bound ribosomes coat the surface of the ER, creating regions termed rough endplasmic reticulum, or RER. Therefore, there are two spatially separate populations of ribosomes in the cytosol seen —

1. Membrane-bound ribosomes: Attached to the cytosolic side of the ER membrane, are engaged in the synthesis of proteins that are being concurrently translocated into the ER.

2. Free ribosomes: Unattached to any membrane, synthesize all other proteins encoded by the nuclear genome.



Regions of ER that lack bound ribosomes are called smooth endoplasmic reticulum, or smooth ER. In certain specialized cells, however, the smooth ER is abundant and has additional functions. S SER is usually prominent in cells that specialize in lipid metabolism. Cells that synthesize steroid hormones from cholesterol, for example, have an expanded ~~so~~ smooth ER compartment to accomodate the enzymes needed to make cholesterol and to modify it to form the hormones. The main cell type in the liver, the hepatocyte, is another cell with an abundant smooth ER. It is the principal site of production of lipoprotein particles.

Function: ① The ER has a central role in lipid and protein biosynthesis. Its membrane is the site of production of all the transmembrane proteins and lipids for most of the cell's organelles, including ER itself, the Golgi apparatus, lysosomes, endosomes, secretory vesicles, and the plasma membrane.

② The ER membrane makes a major contribution to mitochondrial and peroxisomal membranes by producing most of their lipids. In addition, almost all of the proteins that will be secreted to the cell exterior – plus those destined for the lumen of the ER, Golgi apparatus, or lysosomes – are initially delivered to the ER lumen.

③ The enzymes that synthesize the lipid components of lipoproteins are located in the membrane of the smooth ER, which also contains enzymes that catalyze a ~~series of~~ series of reactions to detoxify both lipid-soluble drugs and various harmful compounds produced by metabolism.

④ Another function of the ER in most eukaryotic cells is to sequester Ca^{2+} from the cytosol. The release of Ca^{2+} into the cytosol from the ER, and its subsequent reuptake, is involved in many rapid responses to extracellular signals.