



Endoplasmic Reticulum

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INTRODUCTION

- In the year 1945- The ribbon like membranes of the endoplasmic reticulum were first seen in the cytoplasm of chick embryo cells.
- These are membrane bound channels, seen in the form of a network of delicate strands and vesicles in the cytoplasm.
- These are single membrane cell organelles.
- These form an interconnected network of tubules, vesicles and cisternae within cells.
- ER are considered as one of the components of cytoskeleton along with microtubules, microfilaments and intermediate filaments.
- These are first of all observed by Porter, Claude and Fullman in (1945) as a network.
- The term "Endoplasmic reticulum" was first used by **Porter and Fullman (195**

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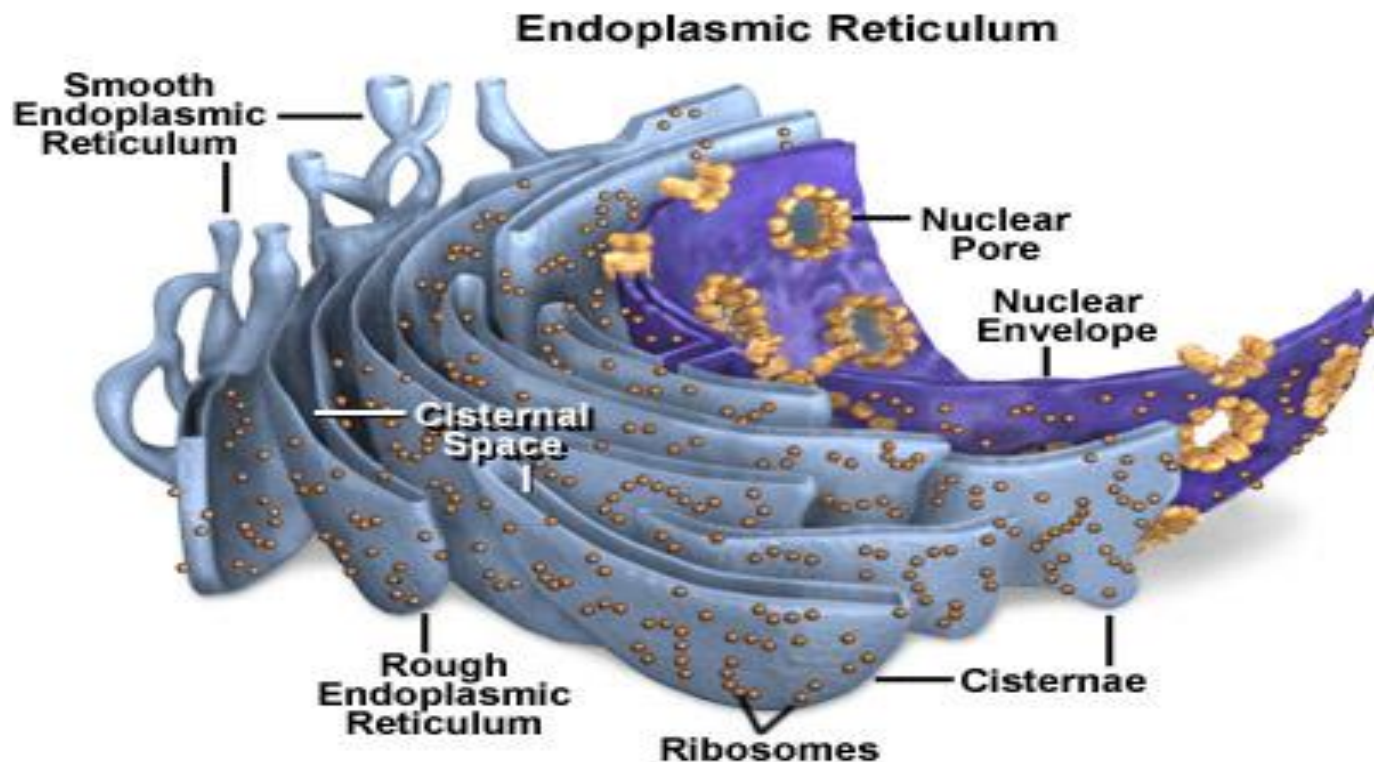
Location

- Present in almost all eukaryotic cell.
- The ER often occupies most of the cytoplasm.

Origin of endoplasmic reticulum

- At present manner of origin of the endoplasmic is not definitely known. The most concrete hypothesis is that the **ER is “budded” off from the nuclear envelope (wischnitzer, 1974).**
- The ER appears to arise from the outer membrane of the nuclear envelope by out folding , or from the plasma membrane by in folding.
- The smooth ER seem to arise from the rough ER by detachment of ribosomes.

- There are two basic morphological types of ER namely RER and SER.
- The ER membrane is thinner (50 \AA) than that of plasma membrane ($80\text{-}100\text{ \AA}$ thick)



PHYSICAL STRUCTURE

- The ER is 3-dimensional network of intracellular. It is formed of three types of element:

1-Cisternae

2-Tubules

3-Vesicles

Cisternae

- These are flattened , unbranched, sac-like element.
- They lie in parallel to one another.
- They bear ribosomes on the surface that, therefore, appears rough.
- It contain glycoproteins named ribophorin-I & ribophorin -II that bind the ribosomes.

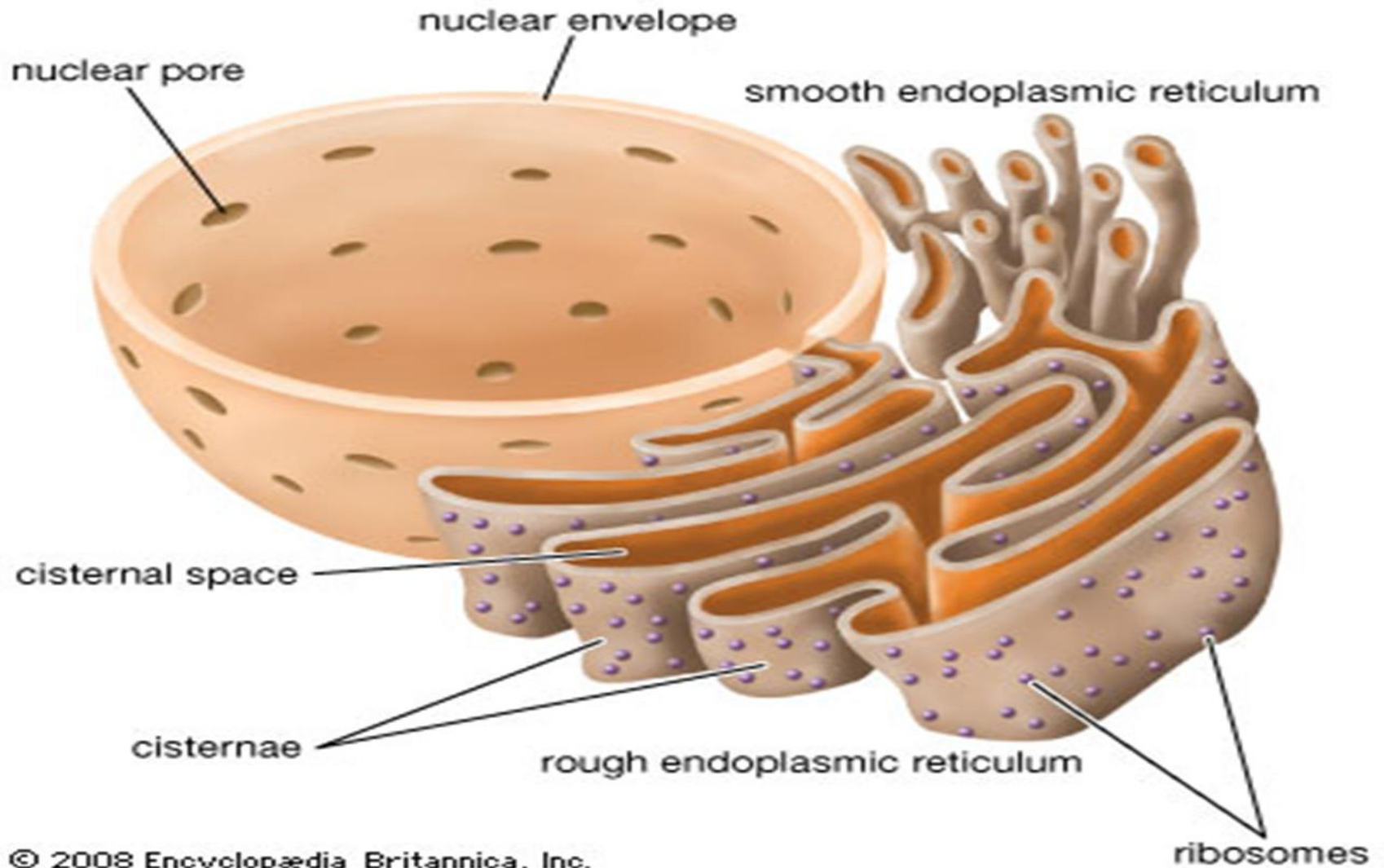
Tubules

- These are irregular branching element which form a network along with other element.
- These are often free of ribosomes.

Vesicles

- These are oval and rounded ,vacuole like element.
- These are also free of ribosomes.
- All the element of ER freely communicates with one another, and contain a fluid called endoplasmic matrix, in the ER lumen.
- These matrix is different from cytoplasmic matrix outside the ER

Endoplasmic reticulum



Molecular structure

- The membrane of ER are composed of two layers of phospholipid molecules sandwiched by two layers of proteins molecules like other membrane in the cell wall.

Types

- The endoplasmic reticulum is of two types:

1-Smooth endoplasmic reticulum

2-Rough endoplasmic reticulum

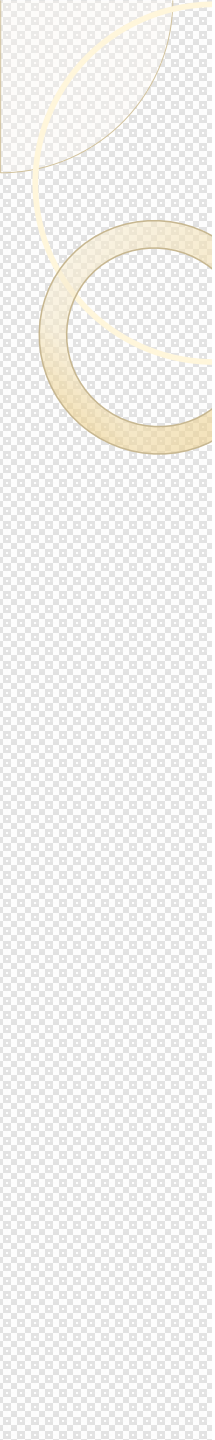
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Smooth ER

- Smooth ER is an arrangement of tubules and vesicles.
- The size and structure of the SER varies between the cells.
- There are no ribosome's attached to the membrane surface.
- The SER is connected to the nuclear envelope

ROUGH ENDOPLASMIC RETICULIM (RER)

- The surface of the RER is studded with ribosome, giving it a rough appearance.
- It mainly consists of cisternae.
- The membrane of the RER forms large double membrane sheets
- Which is located near and continuous with the outer layer of the nuclear envelope.
- RER is very imp. in the synthesis and packaging of proteins
- Binding site of the ribosome on the RER is the translocon .

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- The ribosomes that become attached to the endoplasmic reticulum synthesize all trans membrane proteins.
 - Most secreted proteins that are stored in the Golgi apparatus, lysosomes, and endosomes.
 - Translation pauses and the ribosomes complex binds to the RER translocon

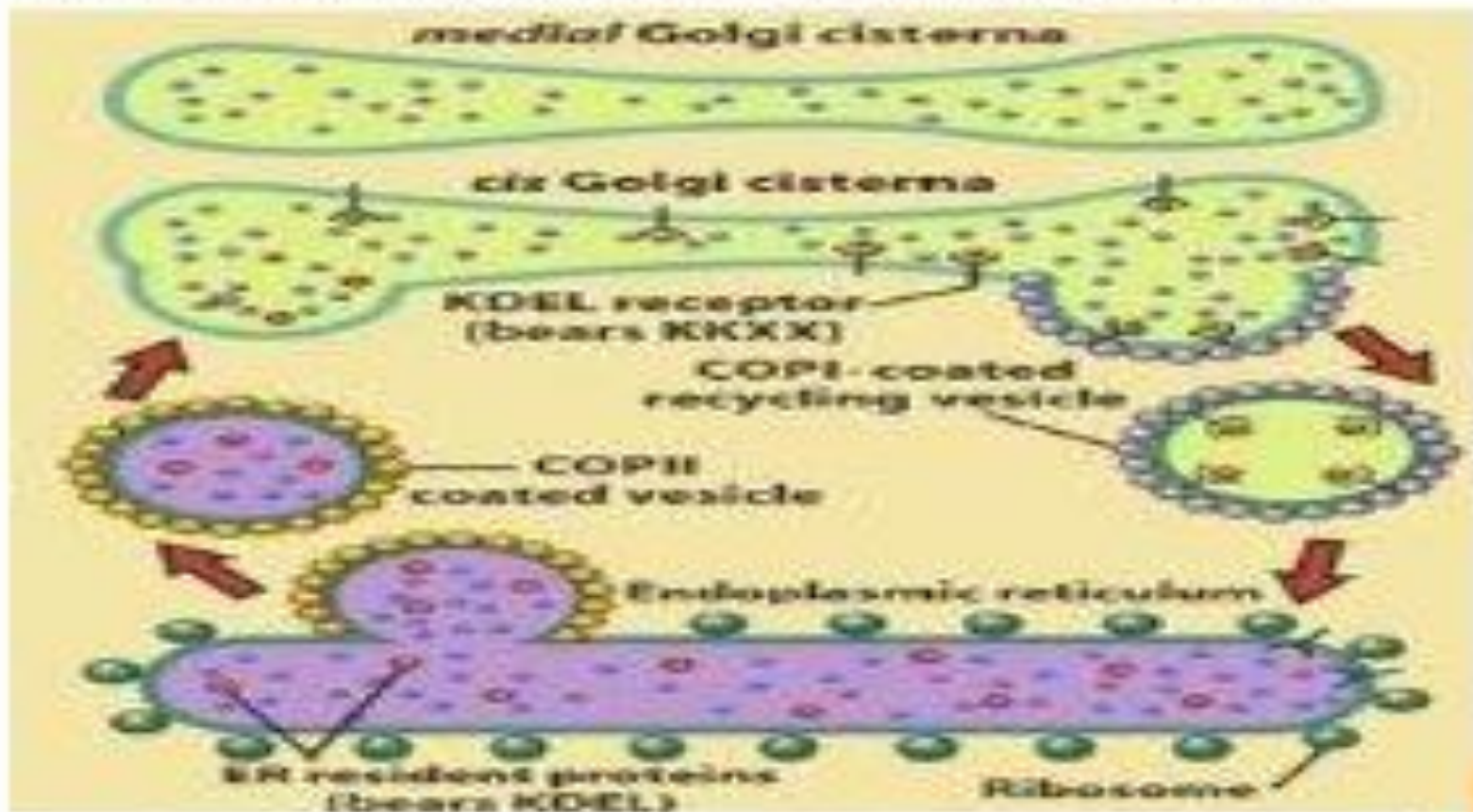
Protein Transport

- As proteins are formed in the endoplasmic reticulum, they are transported through the tubules toward proteins of the SER that lie nearest to Golgi apparatus.
- At this point, small transport vesicles composed of small envelopes of smooth ER continually break away and diffuse to the deepest layer of Golgi apparatus.
- Inside these vesicles are the synthesized proteins and other products from the ER present.

Transport vesicles

- They are surrounded by coating protein called COP I, COP II. (Coat Protein complex)
- COP II targets vesicles to the Golgi apparatus.
- Transport proteins from the RER to Golgi apparatus.
- This process is termed as anterograde transport.
- COP I transports proteins from the cis end of the Golgi complex back to the RER.
- This process is termed as retrograde transport.

DIFFERENT COATS IN VESICULAR TRAFFICING



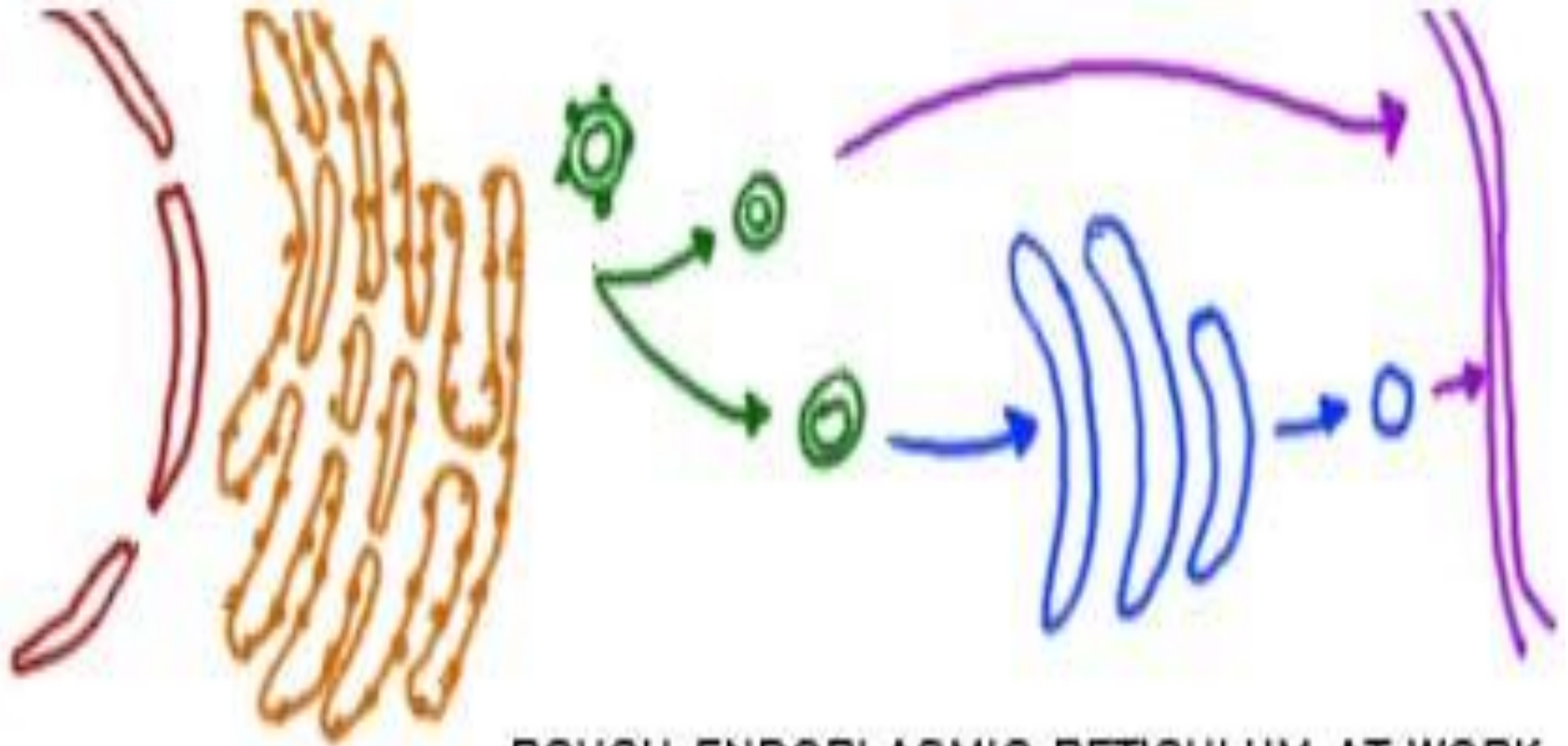
NUCLEUS

ROUGH-ER

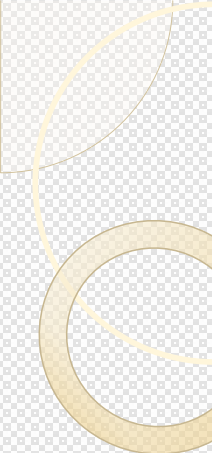
VESICLES

GOLGI

CELL MEMBRANE



ROUGH ENDOPLASMIC RETICULUM AT WORK

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- Second method of transport out of the endoplasmic reticulum involves areas called membrane contact sites.
 - Where membranes of the endoplasmic reticulum and other organelles are held together, allowing the transfer of lipid and other small molecules.



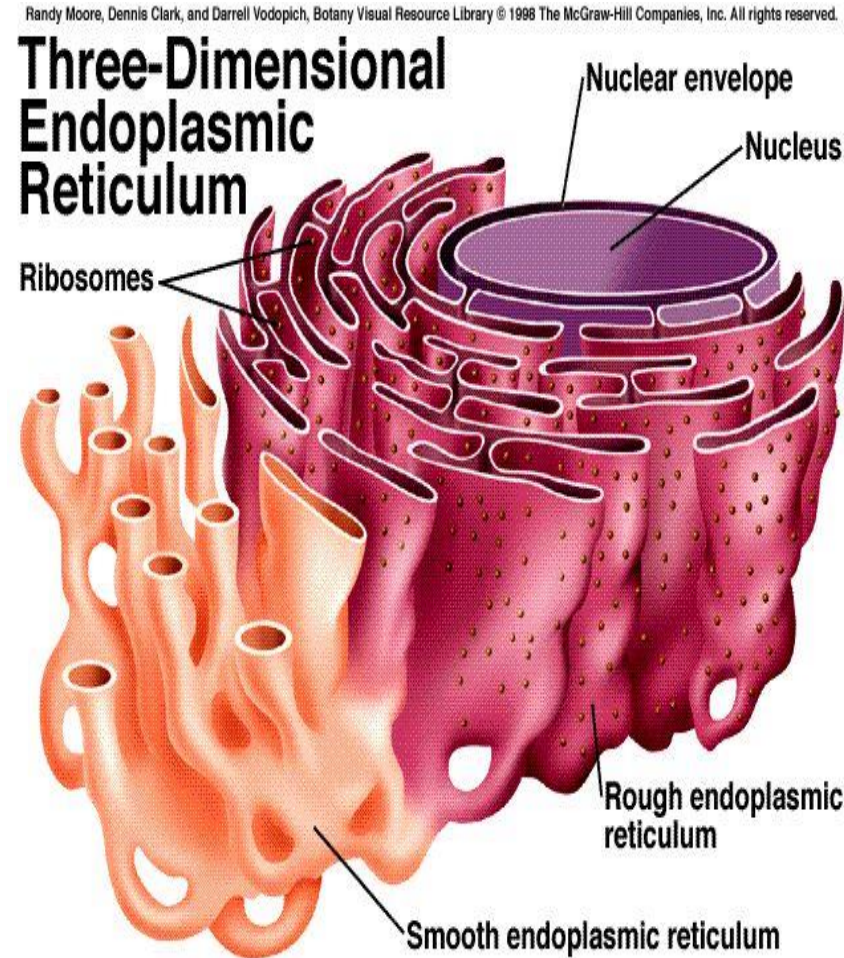
FUNCTION OF RER-


Surface for Ribosomes- The RER provides space and ribophorins for the attachment of ribosomes to itself.

- *Surface for protein synthesis*
- *Formation of Glycoprotein-* Linking of sugars to form glycoprotein starts in the RER and is completed in Golgi complex.
- *Synthesis of precursors-* The RER produce enzyme precursors for the formation of lysosomes by Golgi Complex.
- *Smooth ER formation-* The RER gives rise to the smooth ER by loss of ribosomes.

FUNCTION OF SER

- The smooth endoplasmic reticulum lacks ribosomes and functions in lipid metabolism, carbohydrate metabolism, and detoxification and is especially abundant in mammalian liver and gonad cells.
- It also synthesizes phospholipids. Cells which secrete these products, such as those in the testes, ovaries, and skin oil glands have a great deal of smooth endoplasmic reticulum.





• Detoxification-The SER brings about detoxification in the liver , i.e., converts harmful materials (drugs, poisons) into harmless ones for excretion by the cell.

- Formation of organelles- The SER produces Golgi apparatus , lysosomes and vacuoles.
- It also carries out the attachment of receptors on cell membrane proteins and steroid metabolism.
- In muscle cells, it regulates calcium ion concentration
- The smooth endoplasmic reticulum also contains the enzyme glucose-6-phosphatase, which converts glucose-6-phosphate to glucose, a step in gluconeogenesis.