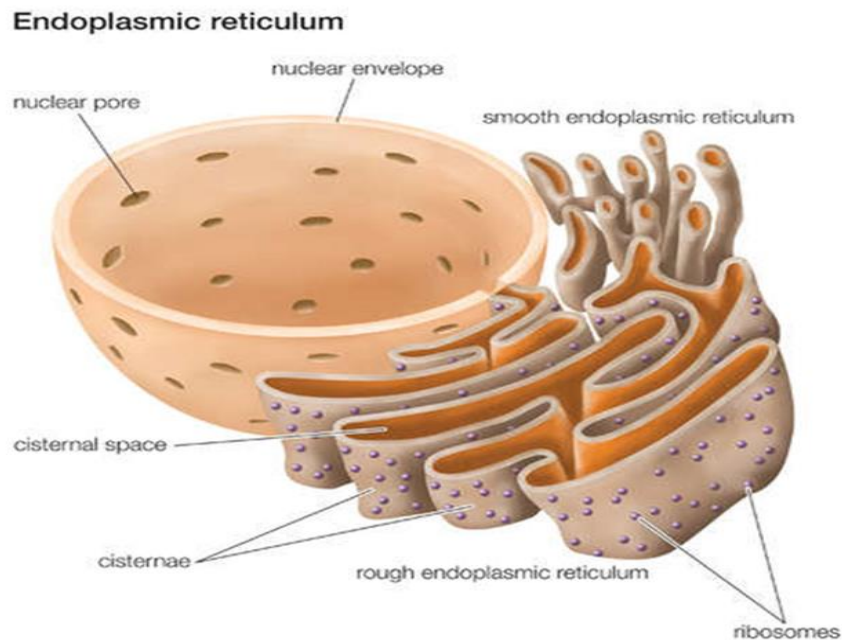


Endoplasmic reticulum (ER)

- **The endoplasmic reticulum is a network of folded membranes that form channels through the cytoplasm and sacs called cisternae.**
- **Cisternae serve as channels for the transport of various products through the cell, usually to its exterior.**
- **The ER membrane, separates the internal compartments of the ER, called the cisternal space, from cytosol.**
- **The ER often occupies most of the cytoplasm of eukaryotic cells.**
- **Endoplasmic reticulum forms 30-60 % of the total membrane in a cell.**

- 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 membrane of ER are composed of two layers of phospholipid molecules sandwiched by two layers of proteins molecules.



- **The ER has crucial roles in cell homeostasis and survival, which include protein folding, lipid biosynthesis, and calcium and redox homeostasis.**

The endoplasmic reticulum is of two types:

- **Smooth Endoplasmic Reticulum (SME)**
- **Rough endoplasmic reticulum (RER)**

Smooth endoplasmic reticulum

- **It is an arrangement of tubules, vesicles and sacs.**
- **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**

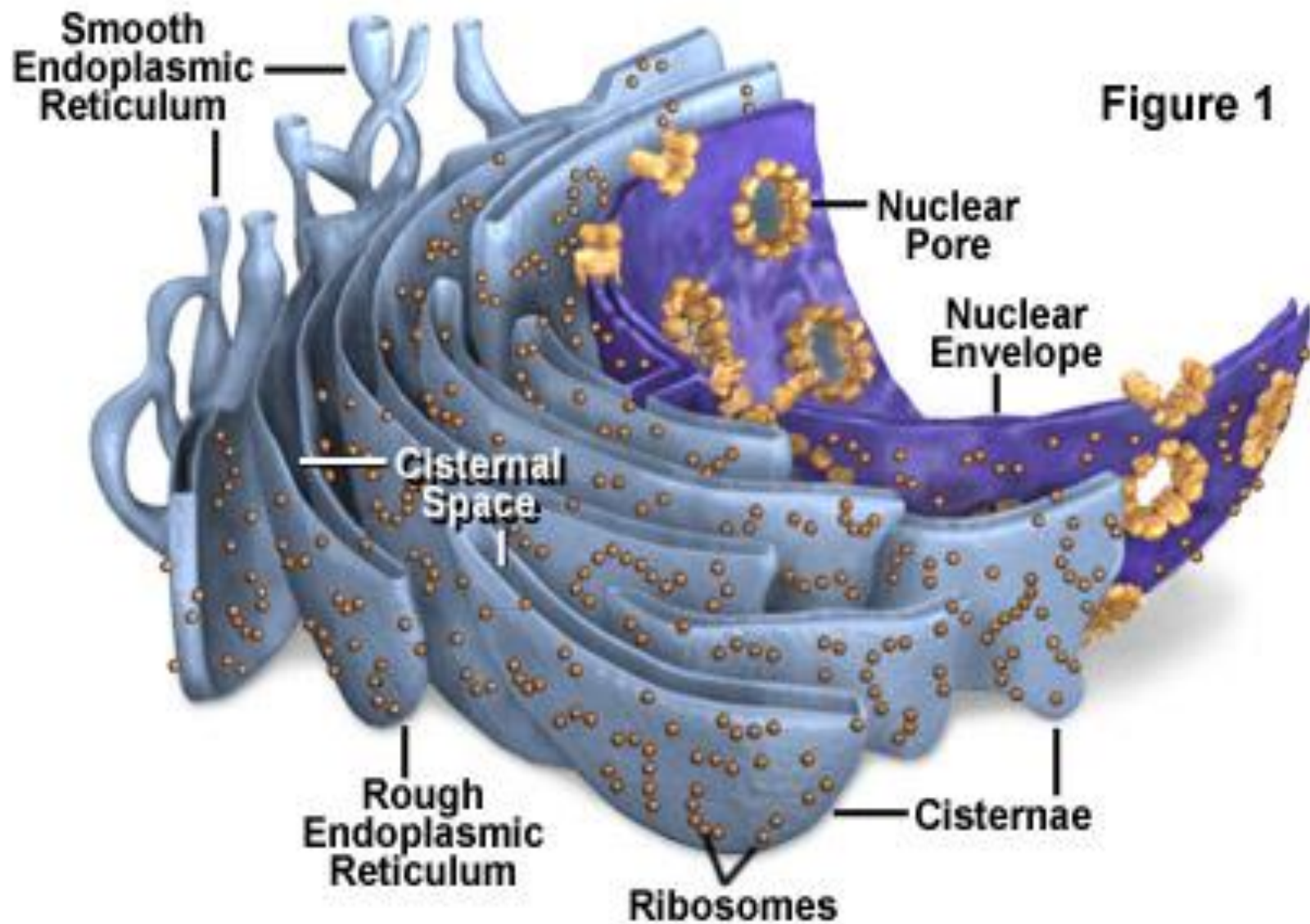
- **The network of the SER allows there to be enough surface area for the action or storage of key enzymes or the products of the enzymes.**
- **The SER is characteristic of cells in which synthesis of non-protein substances takes place.**

Function of smooth ER

The smooth ER of various cell types function in divers metabolic processes:

Endoplasmic Reticulum

Figure 1



1) Synthesis of lipids:

- **Enzymes of smooth ER are important for the synthesis of lipids including phospholipids and steroids (e.g. steroid hormones).**

2) Smooth ER has a role in carbohydrate metabolism:

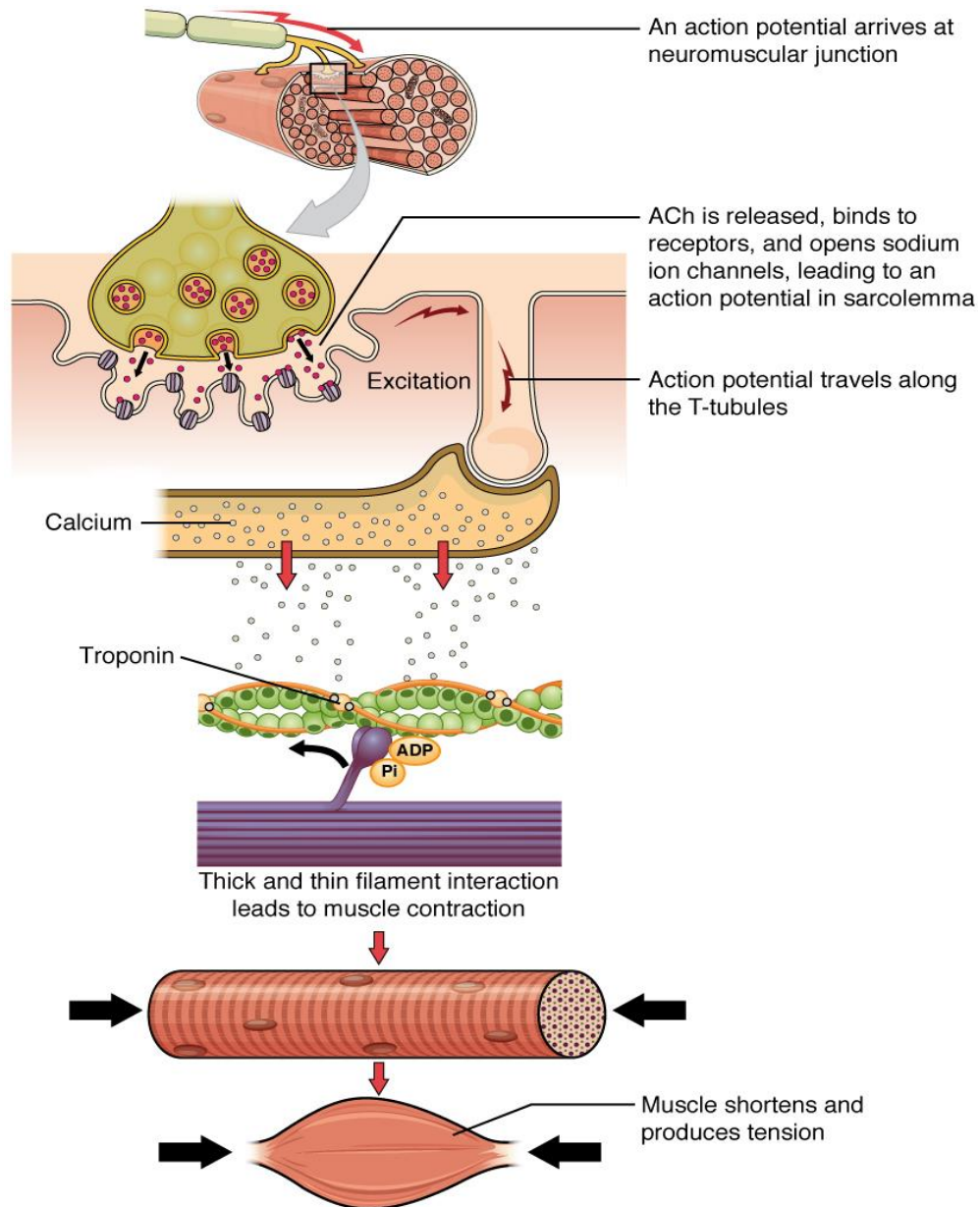
- **Liver cells store carbohydrate in the form of glycogen.**
- **The smooth endoplasmic reticulum also contains the enzyme glucose-6-phosphatase, which converts glucose-6-phosphate to glucose, a step in gluconeogenesis.**

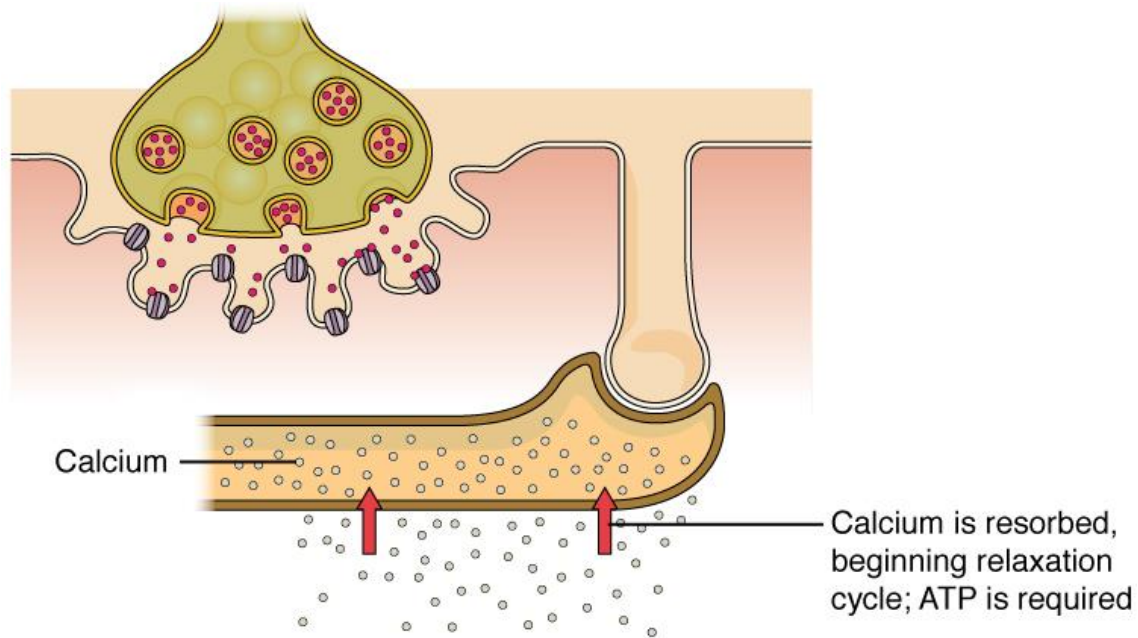
3) Detoxification of drugs and poisons:

- **Enzymes of smooth ER help detoxify drugs and poisons, especially in liver cells.**

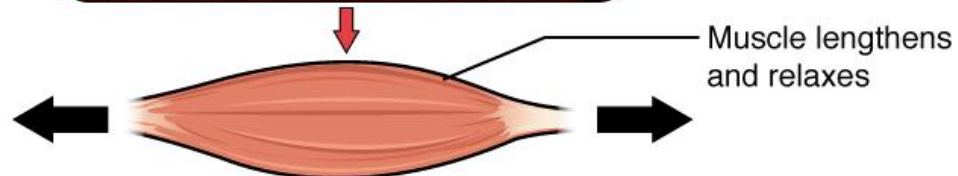
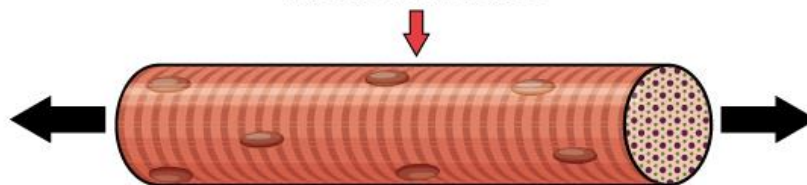
4) Specialized function of smooth ER in muscle cells:

- **The ER membrane pumps calcium ions from the cytosol into the cisternal space.**
- **When a muscle cell is stimulated by a nerve impulse, calcium rushes back across the ER membrane into the cytosol and triggers contraction of the muscle cell.**





Thick and thin filament interaction relaxes



Rough endoplasmic reticulum

- **The surface of the RER is studded with ribosome, giving it a rough appearance.**
- **It mainly consists of cisternae.**
- **Which is located near and continuous with the outer layer of the nuclear envelope.**
- **RER is very important in the synthesis and packaging of proteins.**

- The ribosomes bound to the RER at any one time are not a stable part of this organelles structure.
- Because ribosomes are constantly being bound and released from the membranes.
- Ribosomes only binds to the RER once a specific *protein-nucleic acid complex* forms in the cytosol.
- 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.

Function of RER:

Rough ER and the synthesis of secretory proteins:

- The ribosomes that are attached to the rough ER are engaged in the biosynthesis of proteins that are to be temporarily stored or transported out of the cell.
- Many types of specialized cells secrete proteins produced by ribosomes attached to rough ER.

e.g. certain cells in the pancreas secrete the protein insulin (a hormone) into the blood stream.

- **As a polypeptide chain grows from a bound ribosome**

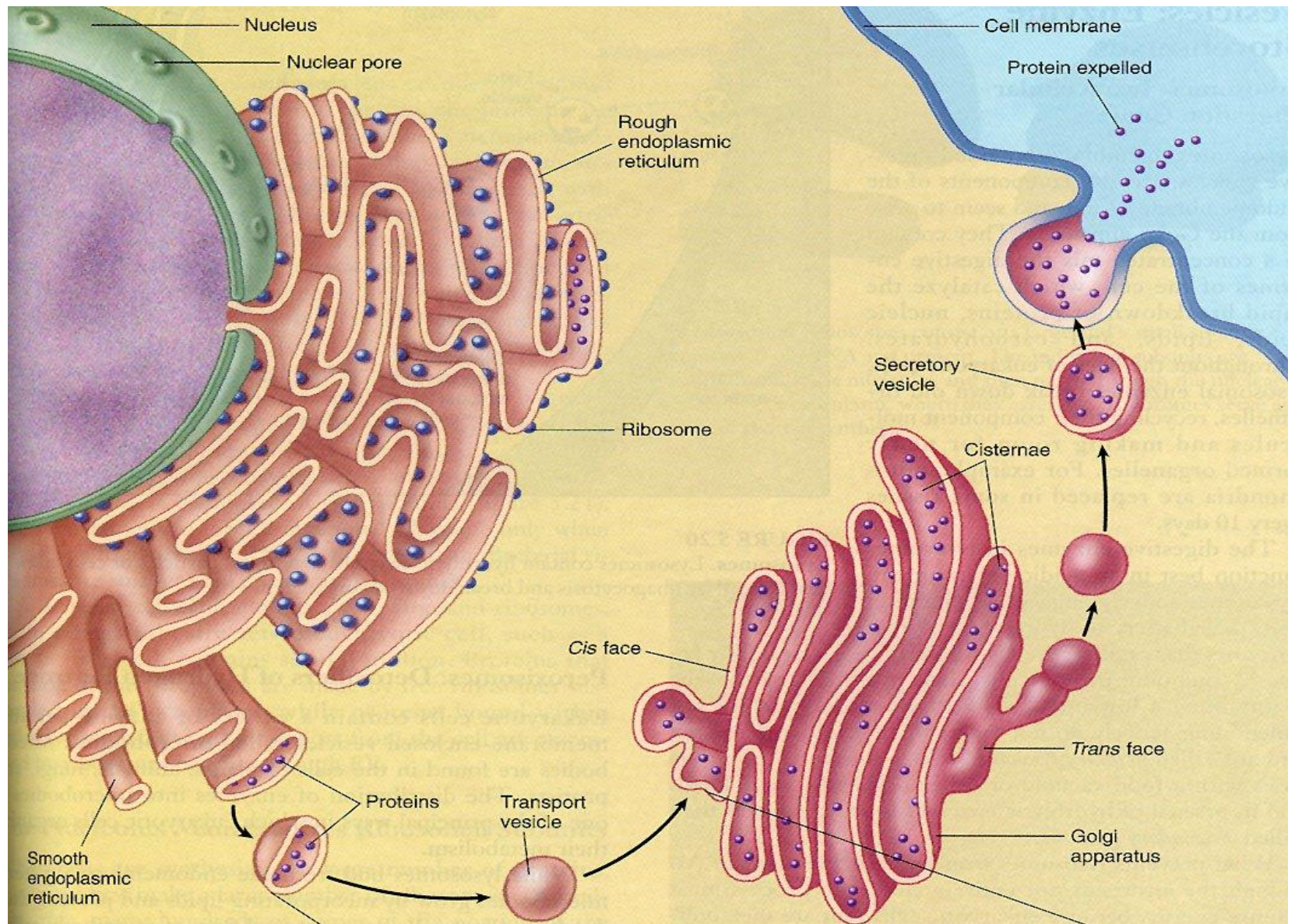
 **it passes into the cisternal space .**



- **As it enters the cisternal space, the new protein folds into its native conformation.**



- **As secretory protein formed, it departs from the ER in transport vesicle.**



- **The lumen of the ER is the major site for proper protein folding and contains molecular chaperones and folding enzymes**
- **Only properly folded proteins are exported to the Golgi organelle, while incompletely folded proteins are retained in the ER to complete the folding process or are delivered to the cytosol to undergo endoplasmic reticulum–associated degradation.**

Diseases:

- **Alterations in ER homeostasis due to increased protein synthesis, accumulation of misfolded proteins, or alterations in the calcium or redox balance of the ER lead to a condition called ER stress.**
- **ER stress associated with many diseases including:**
 - **Neurodegeneration**
 - **Atherosclerosis**
 - **Liver disease**