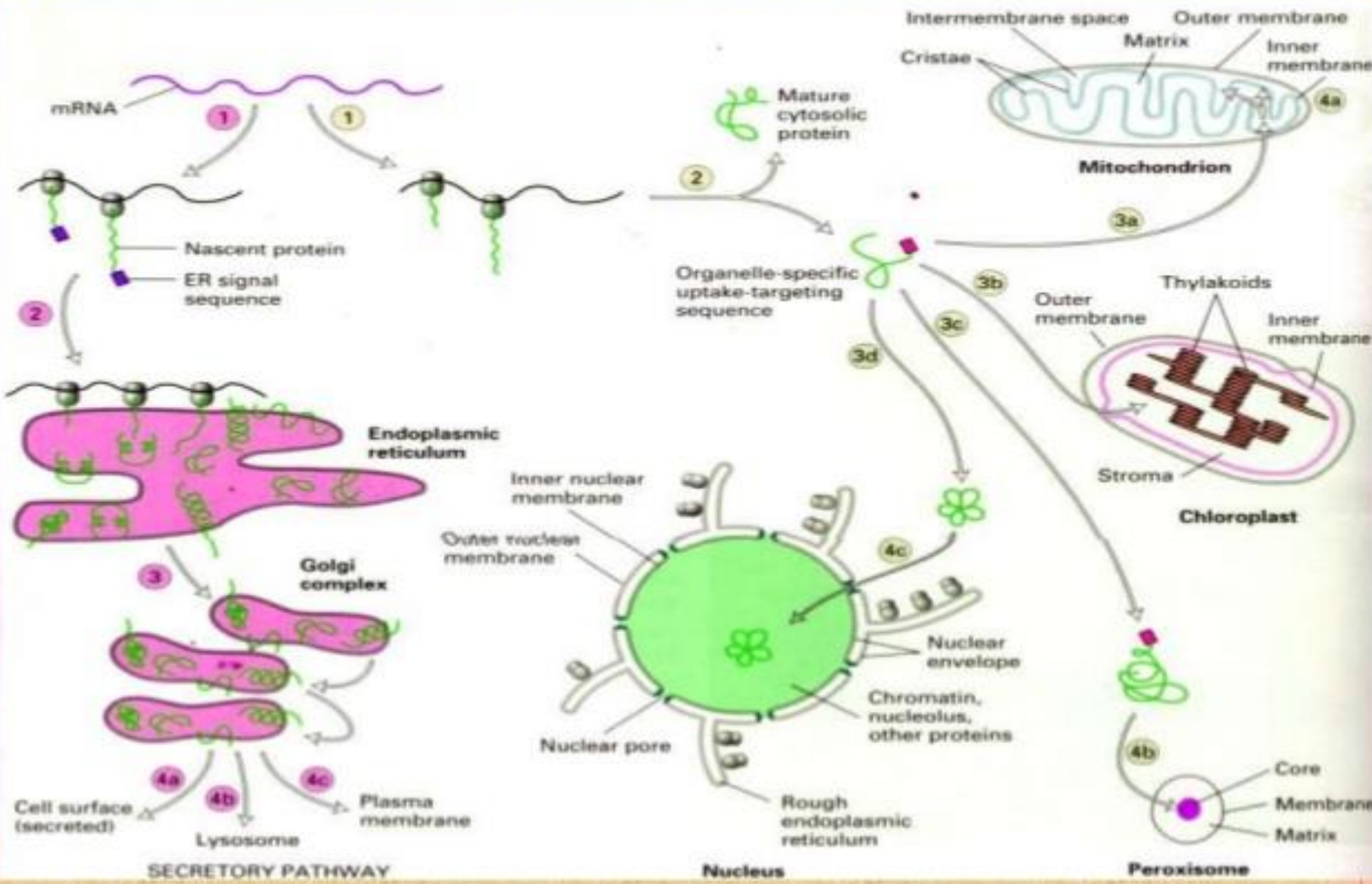
PROTEIN SORTING

Sem – 2

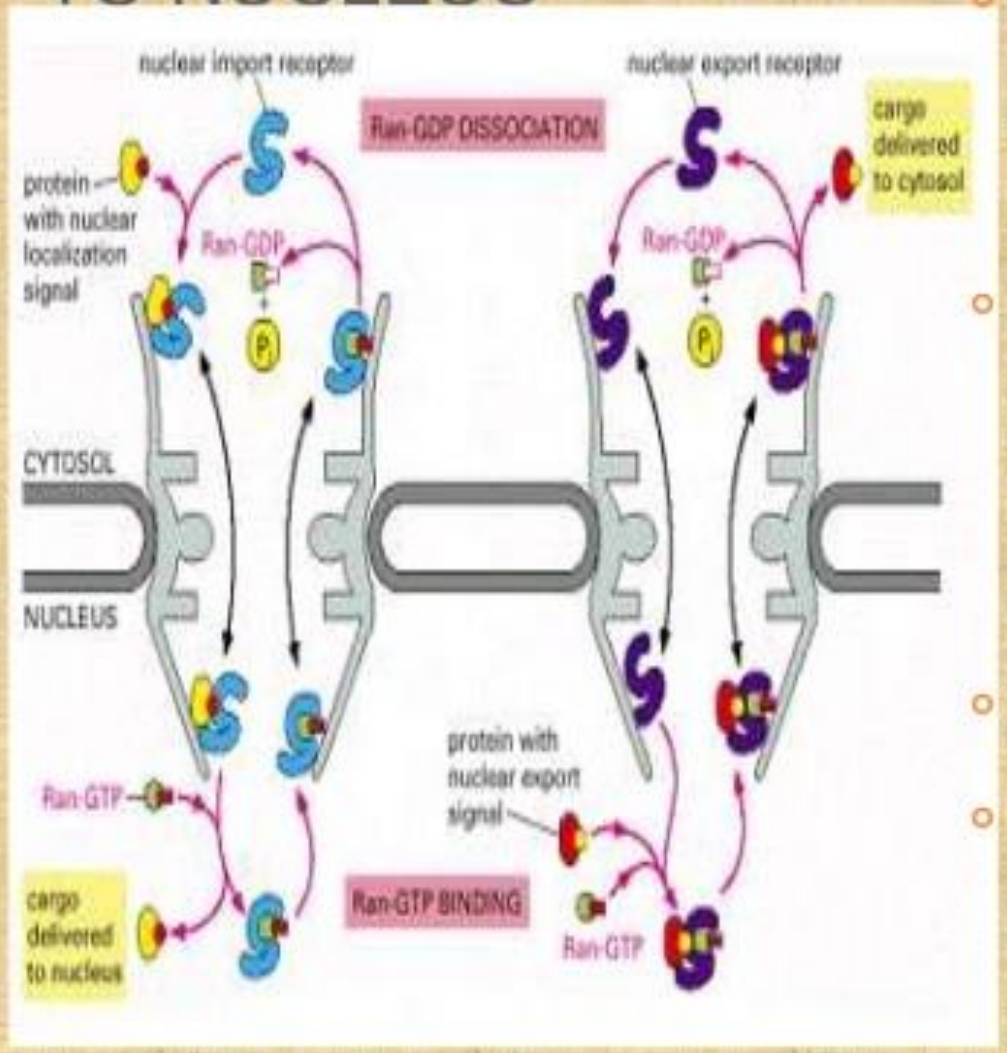
Dr. Swapna Mukherjee

Department of Microbiology

PROTEIN TRAFFICKING OR SITE SPECIFIC TRANSPORT



IMPORT AND EXPORT OF PROTEINS TO NUCLEUS



- ***Protein encodes a receptor protein that is specialized for the transport of a group of*** **nuclear proteins** ***sharing structurally similar nuclear localization signals.***
- ***Nuclear import receptors do not always bind to nuclear proteins directly.*** **Additional adaptor proteins** ***are sometimes used that bridge between the import receptors and the nuclear localization signals on the proteins to be transported.***
- ***Export -ribosomal subunits and RNA molecules.***
- ***For import and export requires energy***

MITOCHONDRIA AND CHLOROPLASTS

- Mitochondria and chloroplasts are ***double-membrane-enclosed organelles.***
- They specialize in the ***synthesis of ATP***, using energy derived from ***electron transport*** and ***oxidative phosphorylation in mitochondria*** and from ***photosynthesis in chloroplasts***.
- Both organelles contain their ***own DNA, ribosomes ,*** and other components required for protein synthesis .
- Their ***growth depends*** mainly on the import of ***proteins from the cytosol.***

PROTEIN TRANSPORT INTO THE MITOCHONDRIA

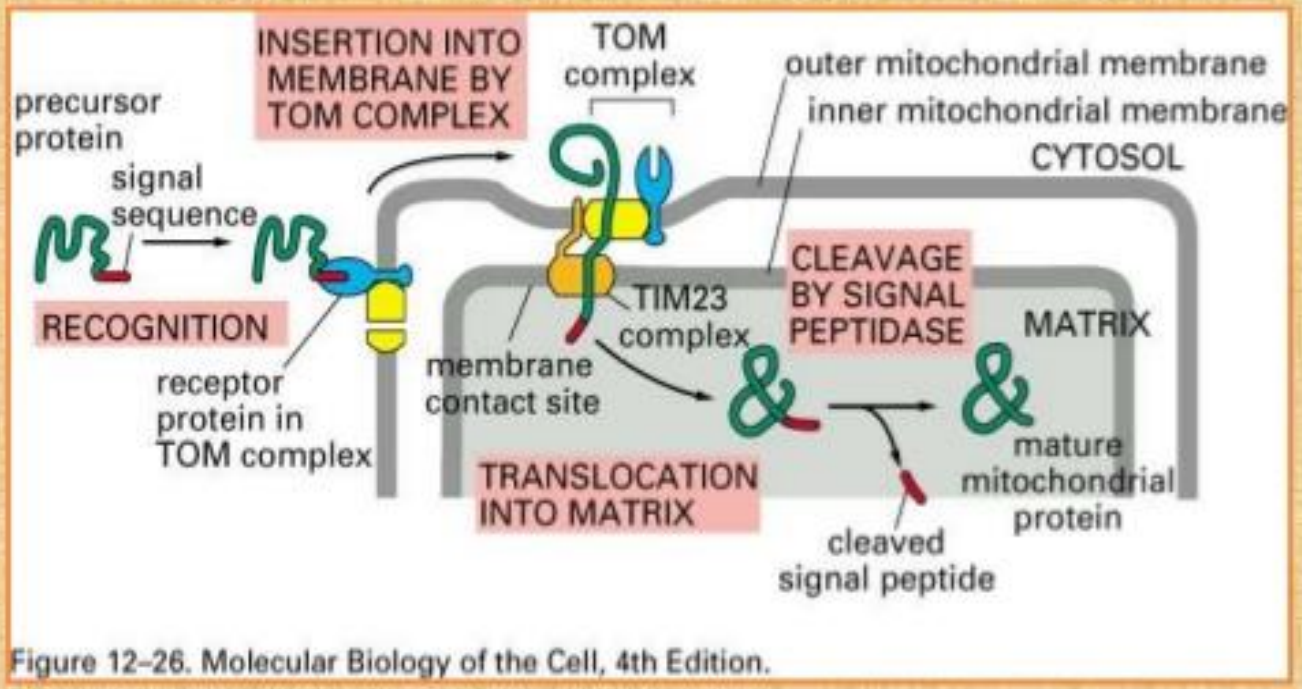


Figure 12–26. Molecular Biology of the Cell, 4th Edition.

Import of Mitochondrial Proteins

- Post-translational: Unfolded polypeptide chain
  1. precursor proteins bind to receptor proteins of TOM
  2. interacting proteins removed and unfolded polypetide is fed into translocation channel
- Occurs contact sites joining IM and OM - TOM transports mito targeting signal across OM and once it reaches IM targeting signal binds to TIM, opening channel complex thru which protein enters matrix or inserts into IM

PROTEIN TRANSPORT INTO THE MITOCHONDRIA

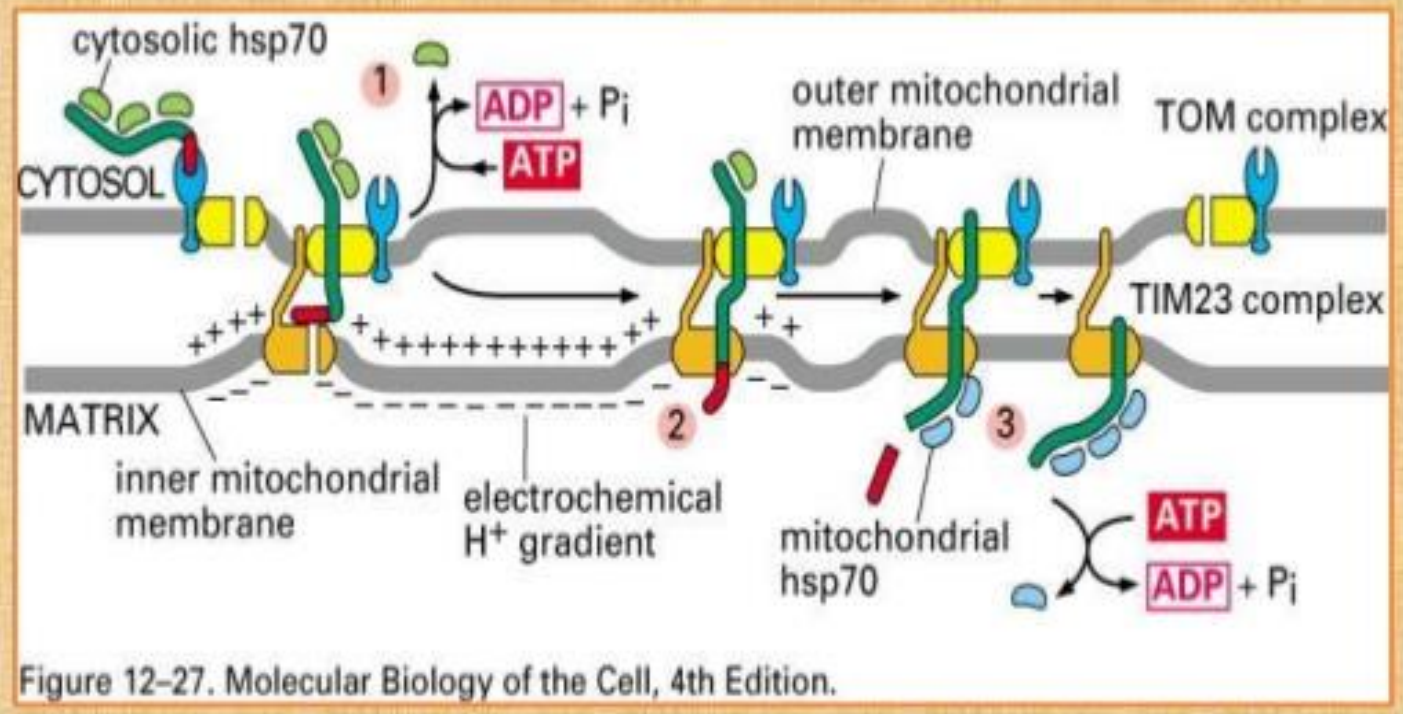


Figure 12–27. Molecular Biology of the Cell, 4th Edition.

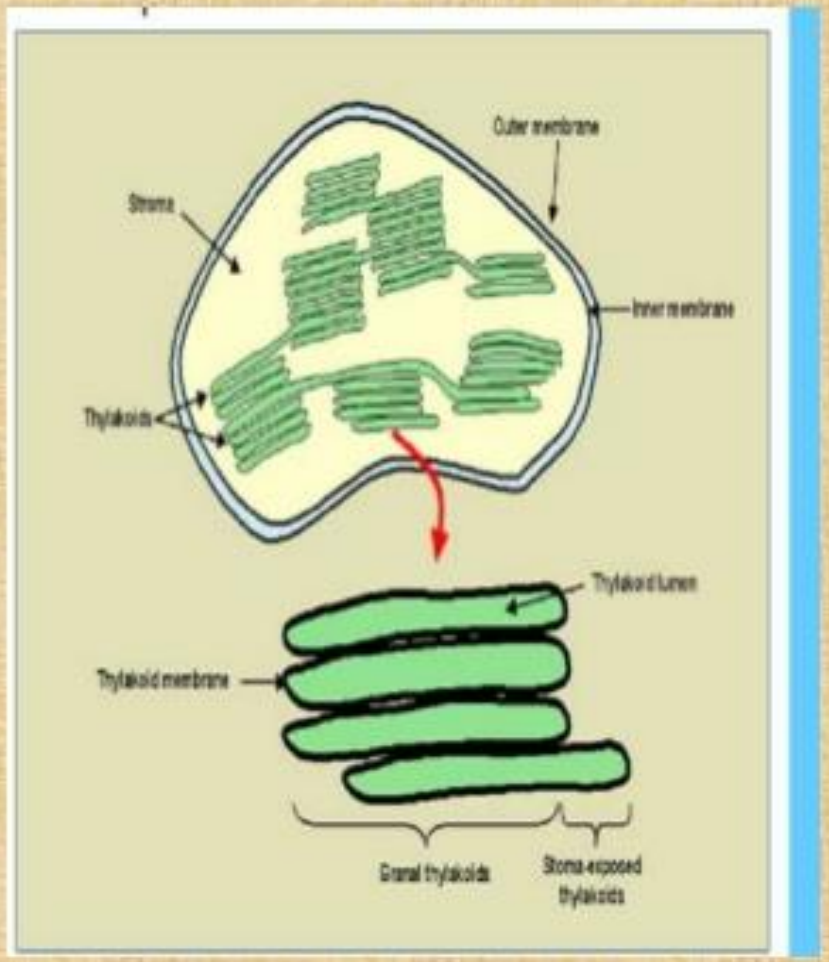
Import of Mitochondrial Proteins

- Requires energy in form of ATP and H+ gradient and assitance of hsp70

  -release of unfolded proteins from hsp70 requires ATP hydrolysis

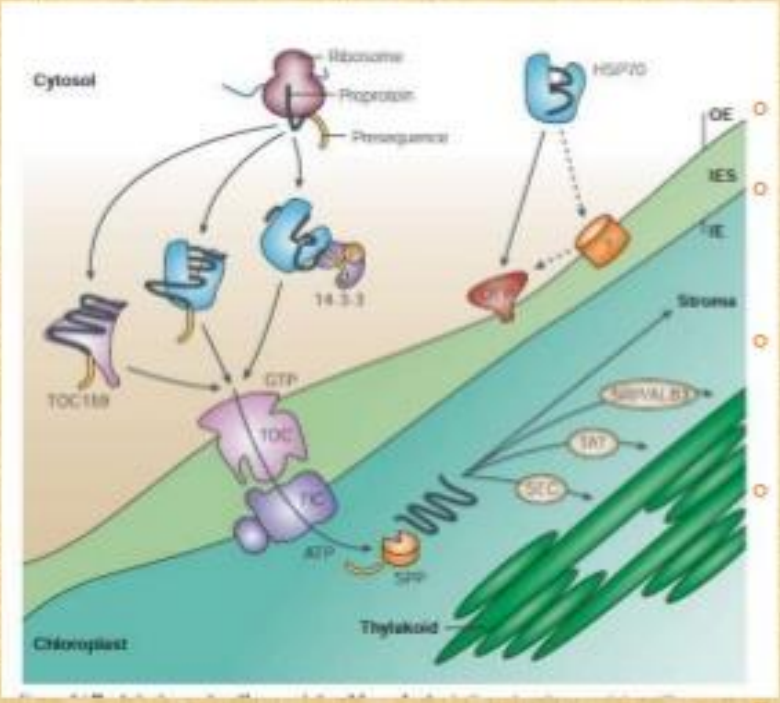
  -once thru TOM and bound to TIM, translocation thru TIM requires electrochemical gradient

CHLOROPLAST



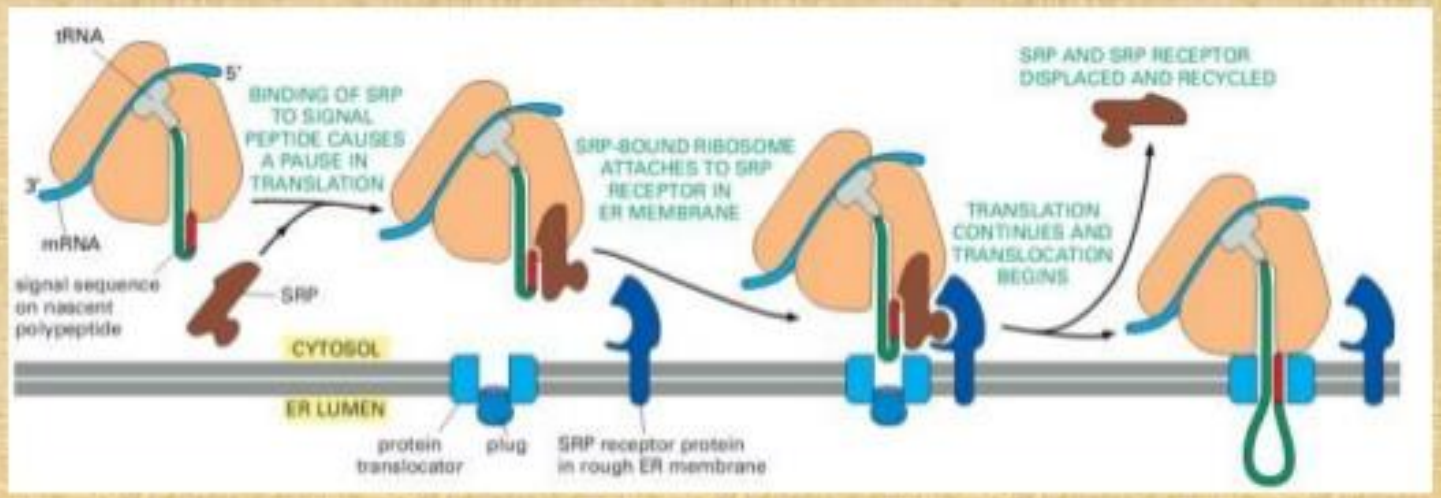
- The preprotein for chloroplasts may contain a stromal import sequence or a stromal and thylakoid targeting sequence. The majority of preproteins are translocated through the Toc and Tic complexes located within the chloroplast envelope.
- In the stroma the stromal import sequence is cleaved off and folding as well as intra-chloroplast sorting to thylakoids continues.
- Proteins targeted to the envelope of chloroplasts usually lack cleavable sorting sequence.

TRANSLOCATION OF PROTEIN IN CHLOROPLAST



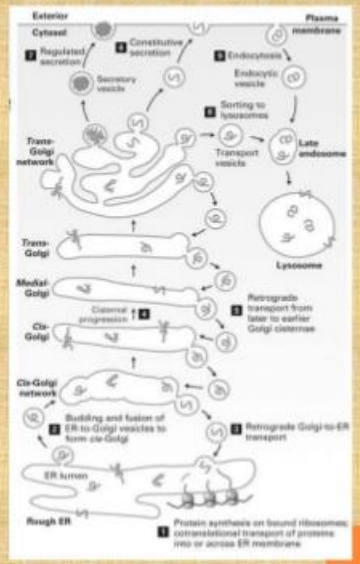
- The vast majority of chloroplast proteins are synthesized as precursor proteins (preproteins) in the cytosol and are imported post-translationally into the organelle.
- Most proteins that are destined for the **thylakoid membrane,**
- Preproteins that contain a cleavable transit peptide are recognized in a GTP-regulated manner12 by receptorsof the outer-envelope translocon, which is called **theTOC complex.**
- The preproteins cross the outer envelope through an aqueous pore and are then transferred to the translocon in the inner envelope,which is called **the TIC complex**.
- The TOC and TIC translocons function together during the translocation process Completion of import requires energy,which probably comes from the ATP-dependent functioning of molecular chaperones in the stroma.
- The stromal processing **peptidase** then cleaves the transit sequence to produce the mature form of the protein, which can fold into its native form.

TRANSLOCATION OF PROTIENS IN E.R



THE GOLGI APPARATUS

- The Golgi apparatus is integral in modifying, sorting, and packaging these macromolecules for cell secretion (exocytosis) or use within the cell.
- Post office; it packages and labels items(a mannose-6-phosphate label to proteins destined for lysosomes) which it then sends to different parts of the cell.
- glycosylation refers to the enzymatic process that attaches glycans to proteins, lipids, or other organic molecules.
- Glycosylation is a form of co-translational and post-translational modification



Five classes of glycans are produced:

- N-linked glycans attached to nitrogen of asparagine or arginine side-chains. N-linked glycosylation requires participation of a special lipid called dolichol phosphate.
- O-linked glycans attached to the hydroxy oxygen of serine, threonine, tyrosine, hydroxylysine, or hydroxyproline side-chains, or to oxygens on lipids such as ceramide
- phospho-glycans linked through the phosphate of a phospho-serine;
- C-linked glycans, a rare form of glycosylation where a sugar is added to a carbon on a tryptophan side-chain
- Glypiation, which is the addition of a GPI anchor that links proteins to lipids through glycan linkages.

SUMMARY

- Both in prokaryotes and eukaryotes, newly synthesized proteins must be delivered to a specific subcellular location or exported from the cell for correct activity. This phenomenon is called protein targeting. Secretory proteins have an N-terminal signal peptide which targets the protein to be synthesized on the rough endoplasmic reticulum (RER). During synthesis it is translocated through the RER membrane into the lumen. Vesicles then bud off from the RER and carry the protein to the Golgi complex, where it becomes glycosylated. Other vesicles then carry it to the plasma membrane. Fusion of these transport vesicles with the plasma membrane then releases the protein to the cell exterior.