CONCEPT: GOLGI PROCESSING AND TRANSPORT

Proteins Leaving the ER

● Proteins leaving the endoplasmic reticulum arrive at the Golgi complex (apparatus)

□ Proteins are marked for exit by sorting signals, which sort them into special COPII vesicles (COPII protein coat)

□ Only properly _____ proteins can exit the ER for the Golgi

- **Chaperone proteins** (BiP and calnexin) control folding

- Improperly folded proteins are transported out of the ER into the cytosol for proteasome degradation

□ Arrival at the Golgi depends on vesicle _____

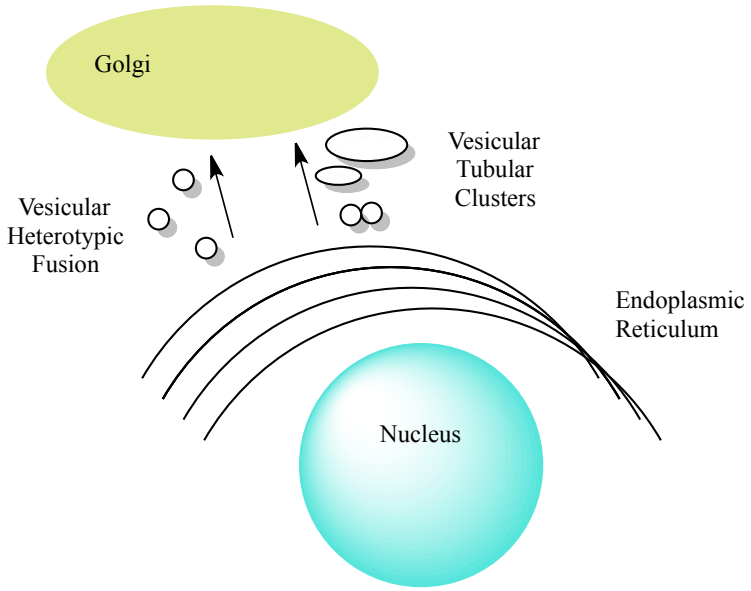
- **Heterotypic fusion**: membrane fusion from two different compartments (ER vesicle fusing with Golgi)

- *Vesicular tubular clusters*: ER vesicles fuse together to create a big compartment that fuses with the Golgi

□ ER resident proteins contain **retrieval sequences** that direct them back to the ER if they leave

- KDEL sequence bind to KDEL receptors which direct them back to the ER via COPI vesicles (COPI coat)

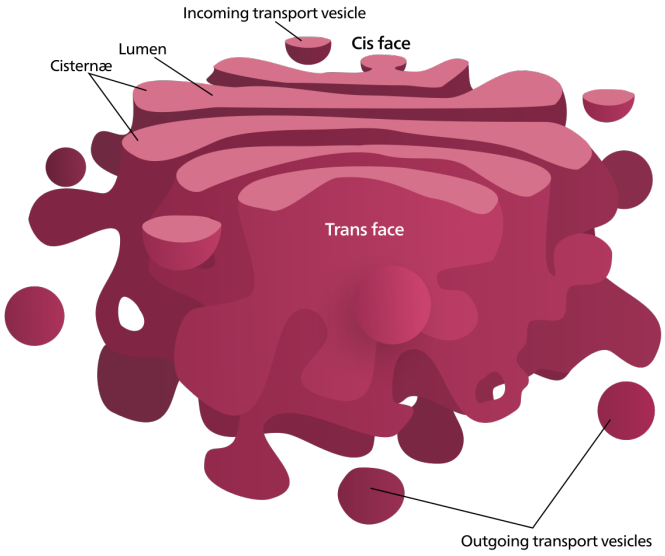
EXAMPLE: Types of arrival at the Golgi



Golgi Structure

- The Golgi Complex (apparatus) has a _____ structure made up of flattened membrane-enclosed sacs
  - □ **Cisternae** are the flattened membrane enclosed stacks that make up the Golgi
    - The number of cisternae varies between 3-20 depending on the cell type
  - □ The Golgi is ordered into three sections
    1. The ***cis*-golgi** faces the endoplasmic reticulum and takes in proteins from the ER
    2. The ***trans*-golgi (TGN)** faces the plasma membrane and is the location of protein exit
    3. The **medial-golgi** sits between the *cis* and *trans* faces, and is the place where proteins are modified

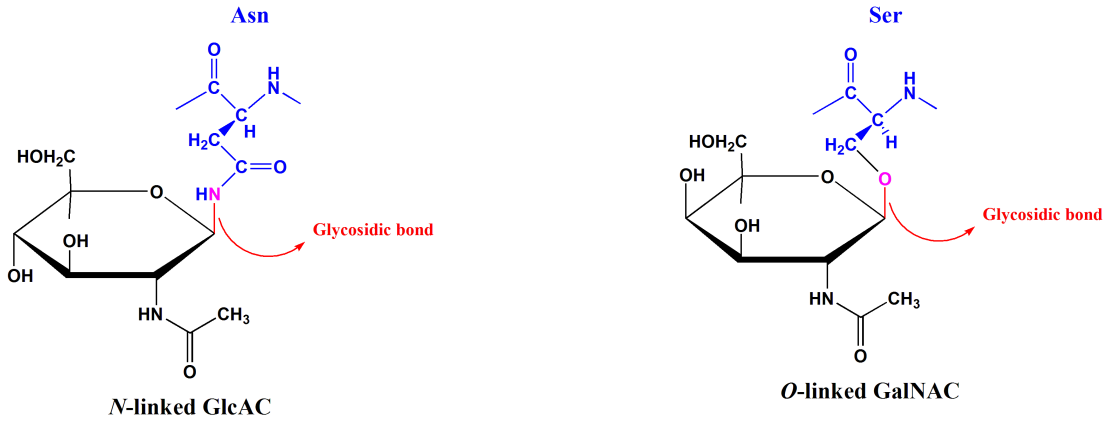
EXAMPLE: Structure of the Golgi complex



Glycosylation and Other Protein Modifications

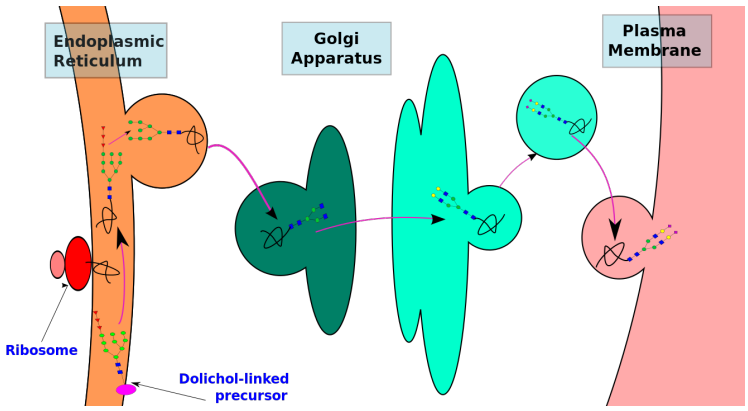
- The Golgi complex is a major location where proteins are _____
  - □ **Glycosylation** or the addition of carbohydrates occurs in two forms on proteins
    - **N-linked glycosylation** links an oligosaccharide to a nitrogen atom on an asparagine
    - **O-linked glycosylation** links an oligosaccharide to a hydroxyl group on a serine or threonine
  - □ Protein glycosylation helps in protein folding and stability

EXAMPLE: Two forms of glycosylation



  - □ **Terminal glycosylation** is the final modification that removes carbohydrates. It occurs in the Golgi
    - N-terminal glycosylation occurs in the ER with removal of glucose and mannose sugars in the Golgi
    - *Glycosyltransferases* and *glycosidases* are the two main enzymes responsible for this modification
  - □ Each modification occurs in a different cisternae _____ within the Golgi
    - Functional differences between the three Golgi regions (*cis, trans* and medial)

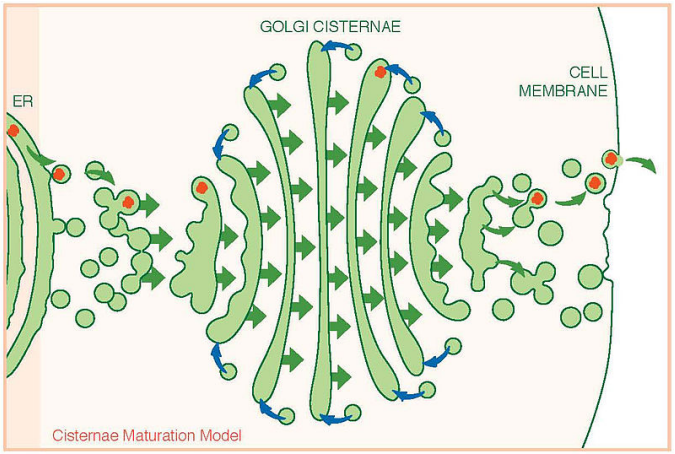
EXAMPLE: Protein modifications occurring in the Golgi apparatus

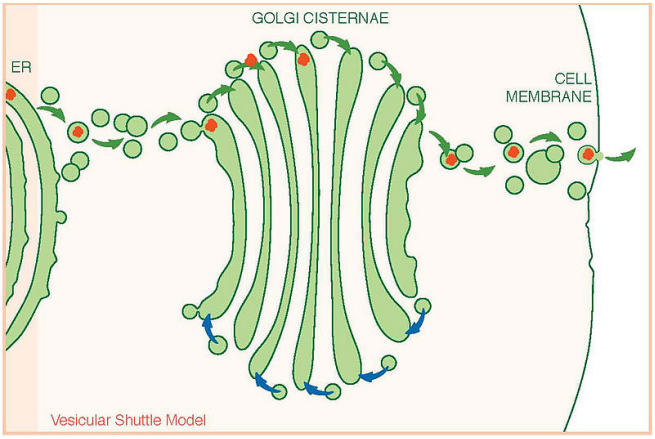


Golgi Maturation and Protein Transport

- Molecules move through the Golgi in two main ways
  - □ **Vesicular transport model**: Golgi cisternae are stationary, and proteins move via vesicles between golgi stacks
  - □ **Cisternal maturation model**: Golgi cisternae move upwards while maturing, disappearing due to vesicle budding
    - Replaced by the cisternae below it
  - □ Evidence suggests proteins move using a combination of the two pathways

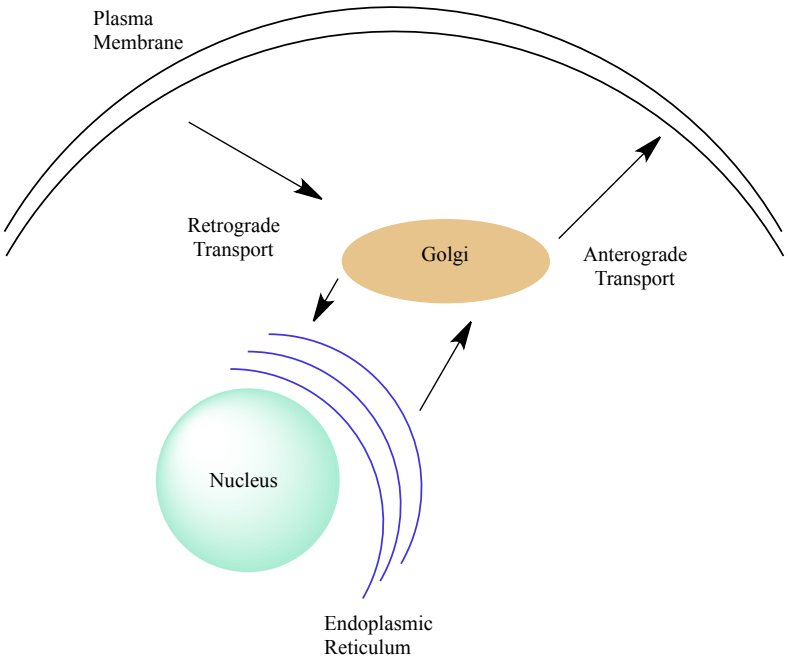
EXAMPLE: Two methods of protein travel through the Golgi





- Protein transport occurs in two _____
  - □ **Anterograde transport**: Moves from ER through Golgi and towards the plasma membrane
  - □ **Retrograde transport**: Moves from the plasma membrane to the Golgi and then to the ER
  - □ Golgi acts as a sorting hub: recognizes sorting sequences and sorts them into vesicles for transport
    - Protein receptors on the TGN bind to sorting sequences and trigger proper sorting and packaging

EXAMPLE: Anterograde vs. Retrograde Transport



PRACTICE:

1. Which of the following is not a method of Golgi transport?
    a. Retrograde transport
    b. Vesicular transport model
    c. Cisternal transport model
    d. Medial golgi transport

2. Which side of the Golgi faces the endoplasmic reticulum?
    a. *Cis*-Golgi
    b. *Trans*-Golgi
    c. Medial-Golgi

3. True or False: Each Golgi cisternae matures by moving upwards through the Golgi.
    a. True
    b. False

4. Which of the following transport moves molecules from the plasma membrane to the Golgi?
    a. Cisternal transport
    b. Vesicular transport
    c. Retrograde transport
    d. Anterograde transport