Advanced Cell Biology. Lecture 33

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Outline

Questions and answers

Previous final question: the answer

What will happen to cytosol protein, if it has no signal sequence?

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What will happen to cytosol protein, if it has no signal sequence?

- Will not move

Transport to mitochondria and chloroplasts

- Proteins with appropriate signal sequence squeeze through protein translocators
- They unfold and re-fold later with the help of chaperones
- Proteins also transfer lipids

Transport to ER

- Membrane-bound ribosomes form the rough ER (free ribosomes are in cytosol)
- If the protein contain SRP (signal-recognition particle), SRP receptor on ER membrane will bind ribosome
- New protein will move into ER lumen through translocation channel if it has one signal sequence

Transmembrane proteins

- Single-pass membrane proteins have start signal on the end and stop signal in the middle; they will stack halfway through the membrane
- Double pass membrane proteins have same signals both located inside molecule; they form U-shape because they double cross a membrane

Vesicular transport

- Endocytic pathway: Plasma membrane $\rightarrow$ endosome + vesicles $\rightarrow$ lysosome
- Secretory pathway: ER $\rightarrow$ AG $\rightarrow$ transport vesicles $\rightarrow$ plasma membrane

Vesicle budding

- Starts with place covered with adaptin-clathrin complex
- Dynamin punch the vesicle
- Clathrin coat dissolved lately

Vesicle docking

- Rab and SNARE proteins allow recognition of different types of vesicles
- Rab-binding tethering proteins will lock vesicle nearby the membrane
- If SNAREs are complementary with SNAREs on target membrane, membranes will fuse

Modification in ER

- Disulfide bonds
- Glycosilation through the dolichol
- N-linked oligosaccharide processing

Exit from ER

- Proteins should have ER-retention signal
- Chaperones hold all misfolded proteins in ER (e.g., in case of cystic fibrosis)
- More misfolded proteins will activate unfolded protein response machinery and growth of ER itself

Modification in AG

- AG has trans (exit) and cis (entry) faces
- Trans face sort proteins to lysosome and cell membrane proteins
- Further glycosilation happens inside AG

Secretion and exocytosis

- Secterion starts from trans AG and ends in exocytosis to outer space
- Default secretion pathway is common to all cells
- Regulated pathway is specific to secretory cells (vesicles wait for releasing extracellular signal)

Protein labeling

- Radioactive and/or GFP labeling
- Temperature-sensitive mutants are used in order to “freeze” secretion at a given state

Endocytosis and phagocytosis

- Endocytosis is a formation of endocytic vesicle
- Pinocytosis (cellular “drinking”) take things normally < 150 nm in diameter
- Phagocytosis (cellular “eating”) takes things which are generally > 250 nm

Endosomes

- Initially, early endosomes
- After uncoating and fusion, become late endosomes
- May proceed back, to lysosome or to different place in a membrane

Lysosomes

- Lysosomes are cellular shredders
- Contain multiple enzymes and proton pump
- Also participate in autophagy

Final question (1 point)

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What is the role of chaperones in mitochondria and chloroplasts?

Summary

- ER membrane makes most cell lipids and proteins
- Proteins are undergoing serious modifications in ER lumen
- Protein coat is essential for vesicle budding and docking
- AG delivers excretion proteins to membrane
- Membrane receptors, endosomes and lysosomes are parts of endocytic pathway

For Further Reading

A. Shipunov.
Advanced Cell Biology [Electronic resource].
2011—onwards.
Mode of access: http://ashipunov.info/shipunov/school/biol_250.

B. Alberts et al.
Essential Cell Biology. 3rd edition.
Garland Science, 2009.
Chapter 15: 495–505.

Protein import movie

ER movie

Translocation movie

Clathrin movie

Compartments movie

Secretory movie

Exocytosis movie

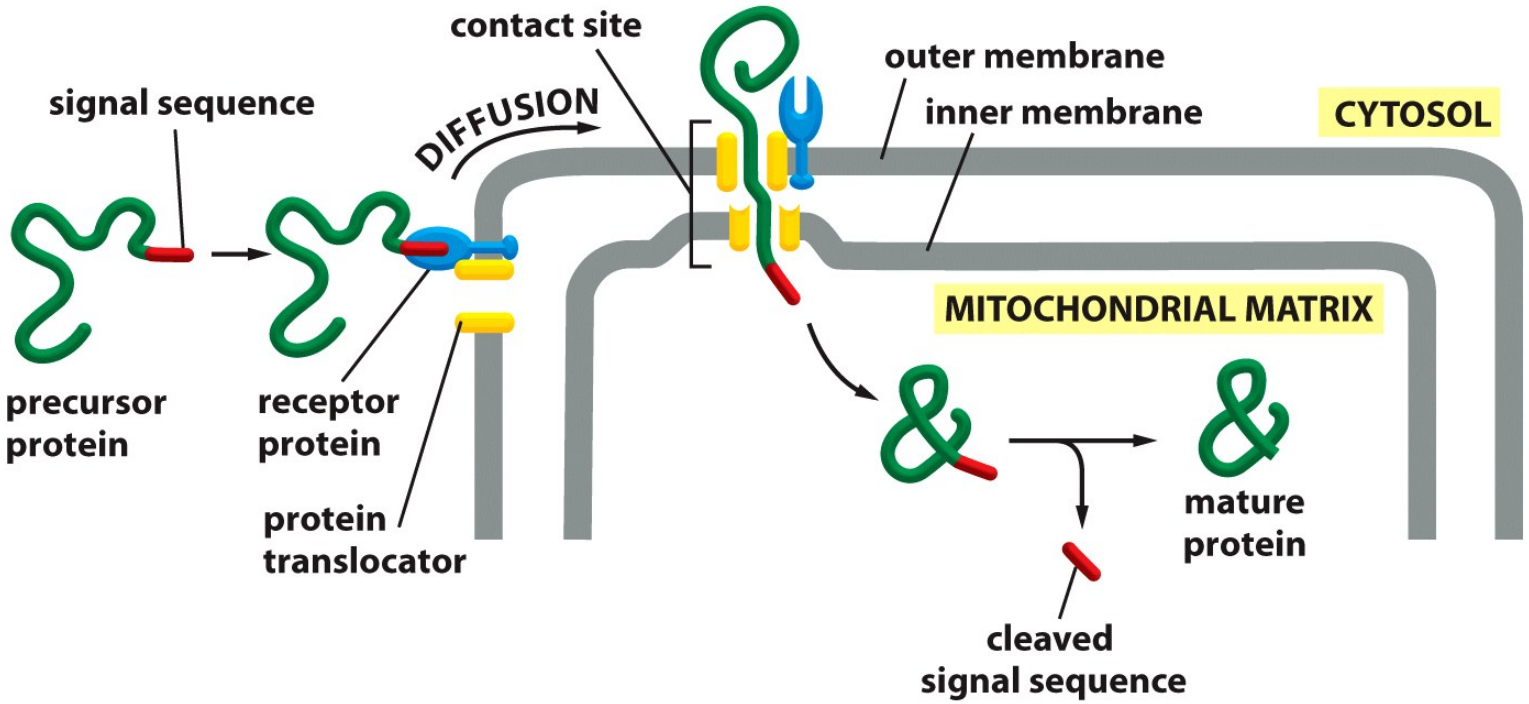
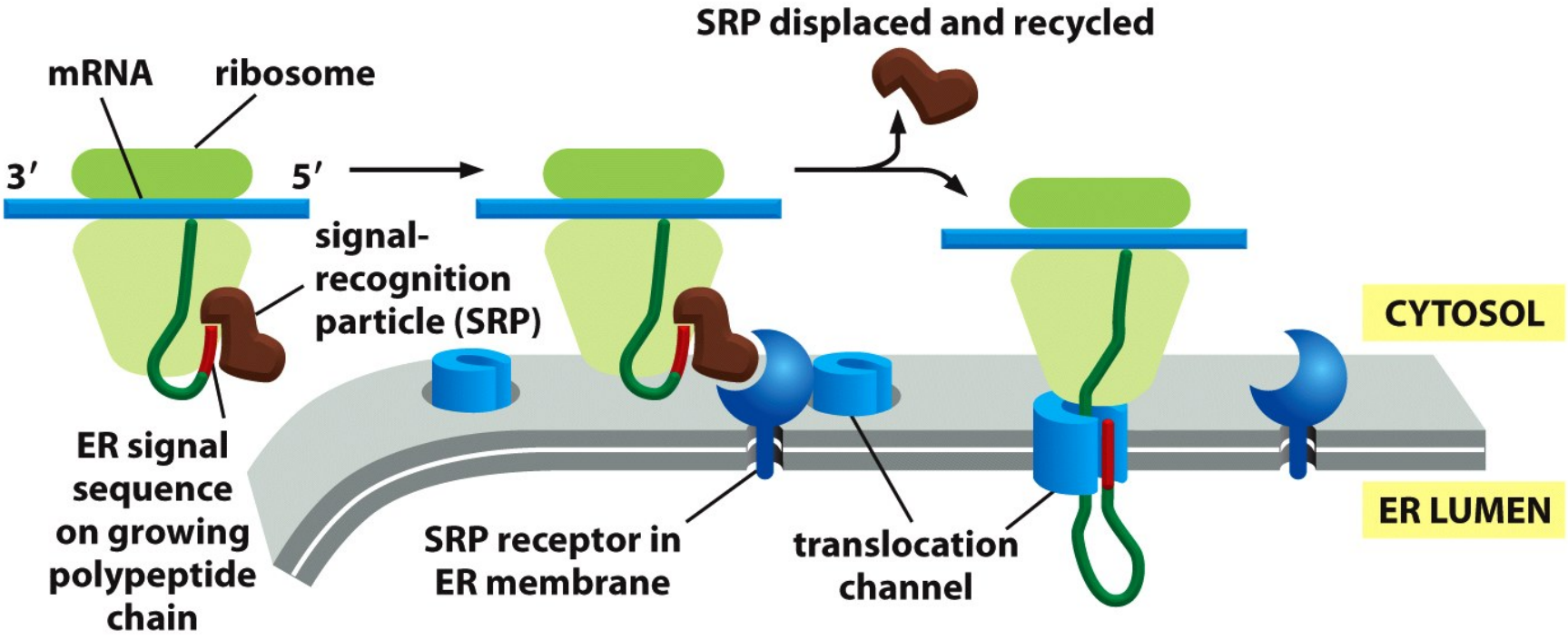


Figure 15-11 Essential Cell Biology 3/e (© Garland Science 2010)



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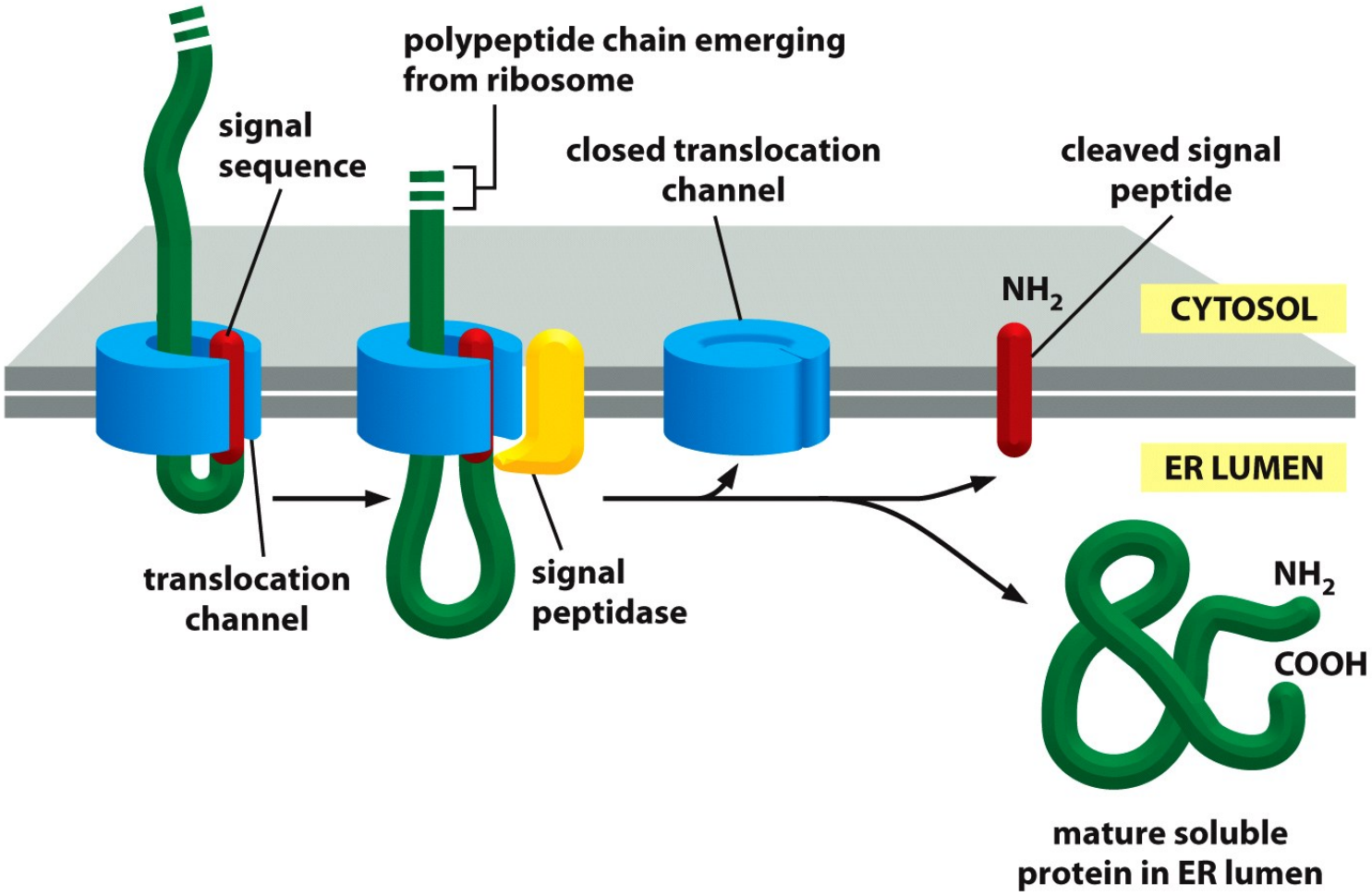

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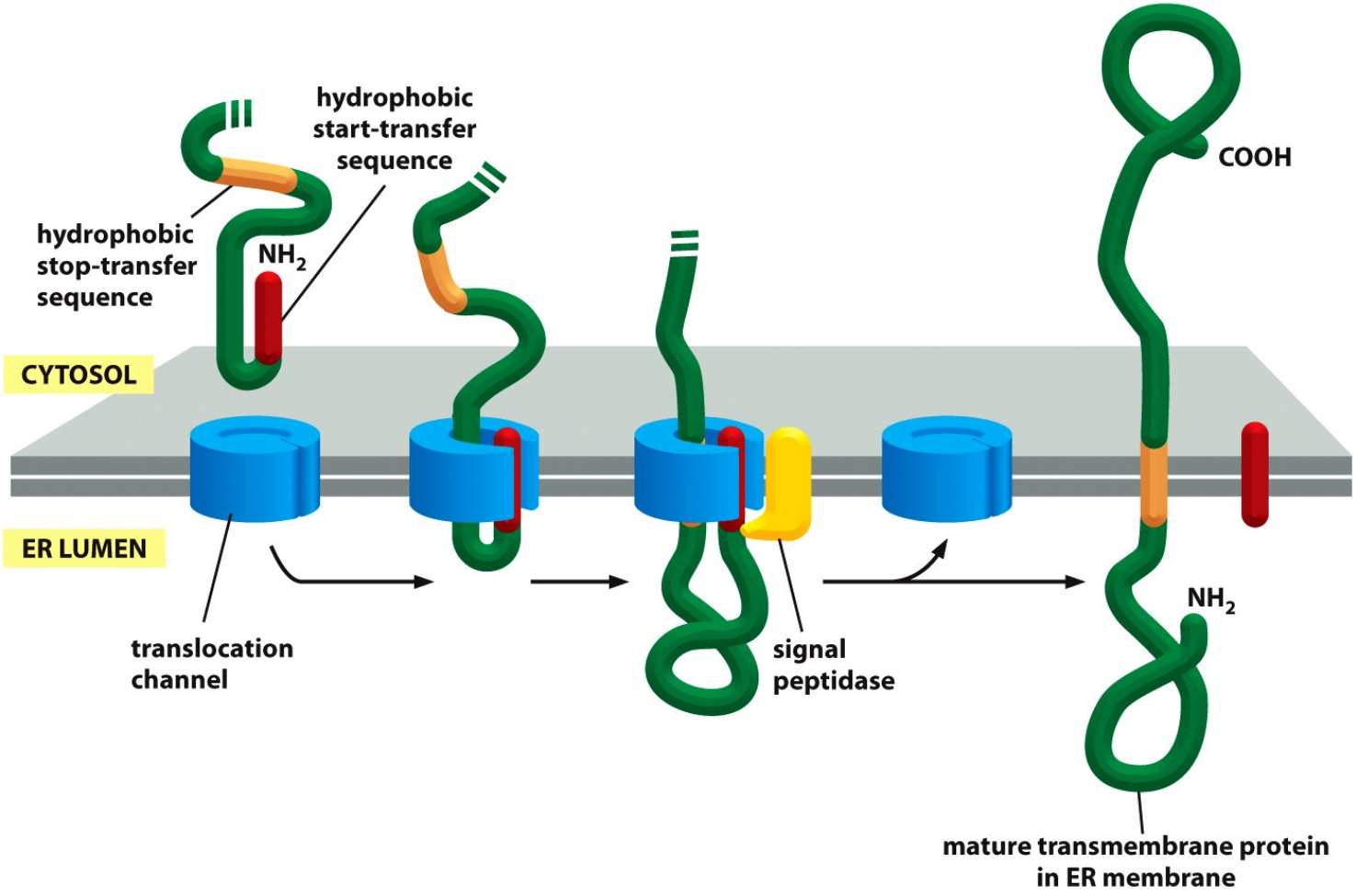

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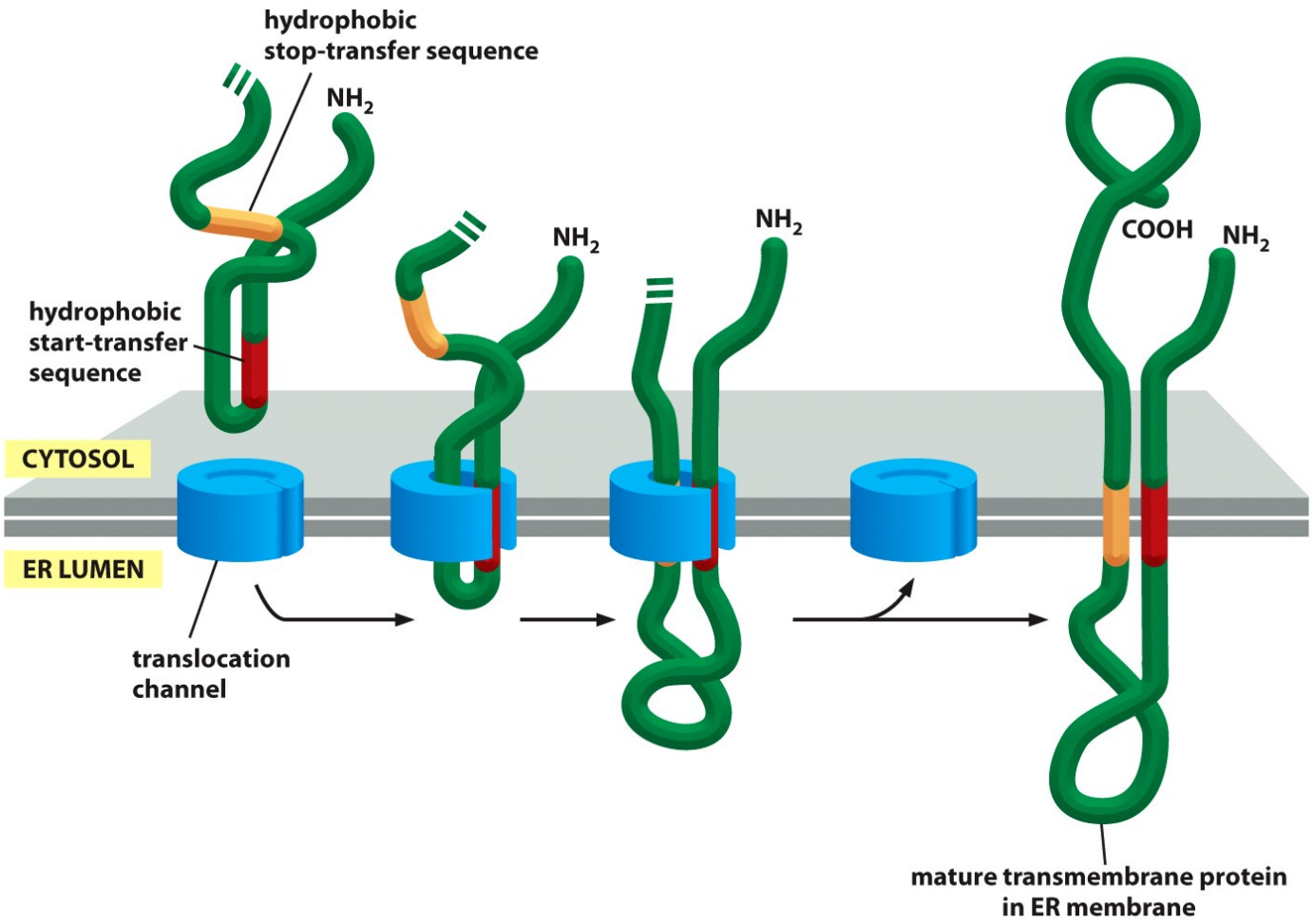

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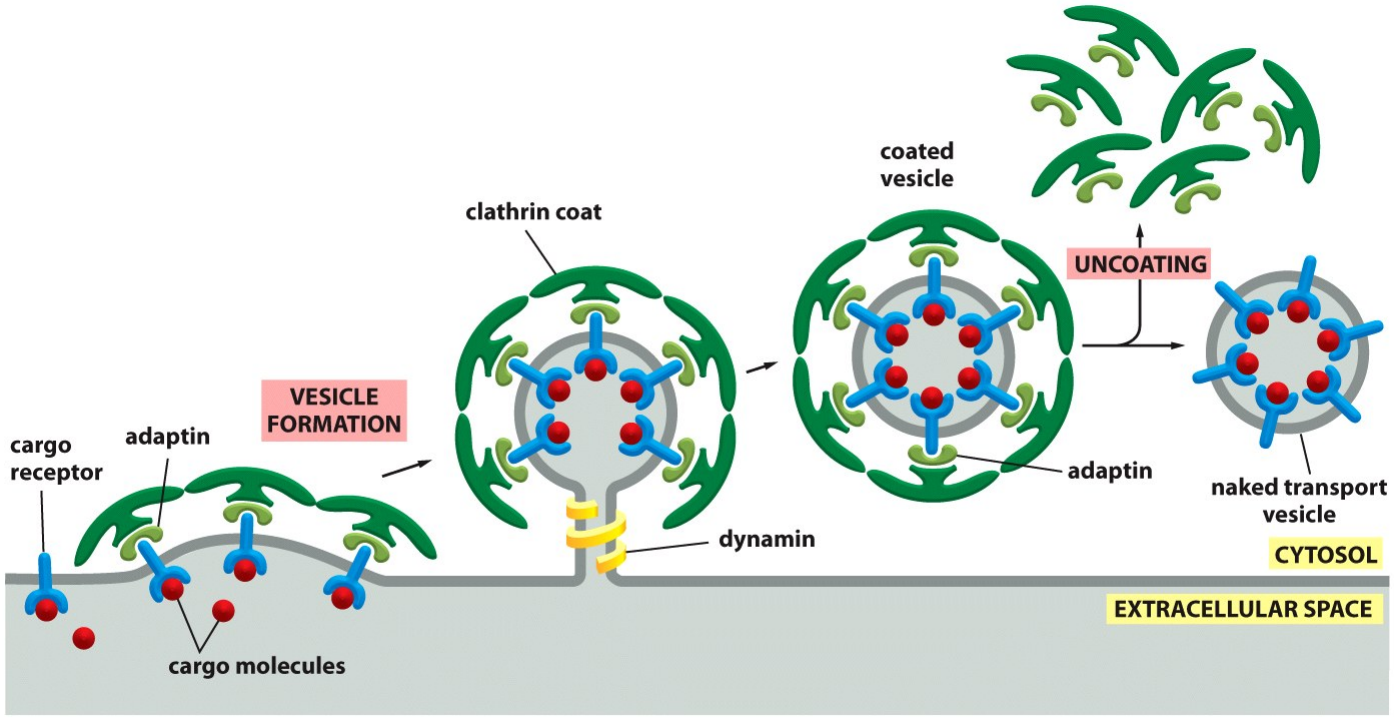

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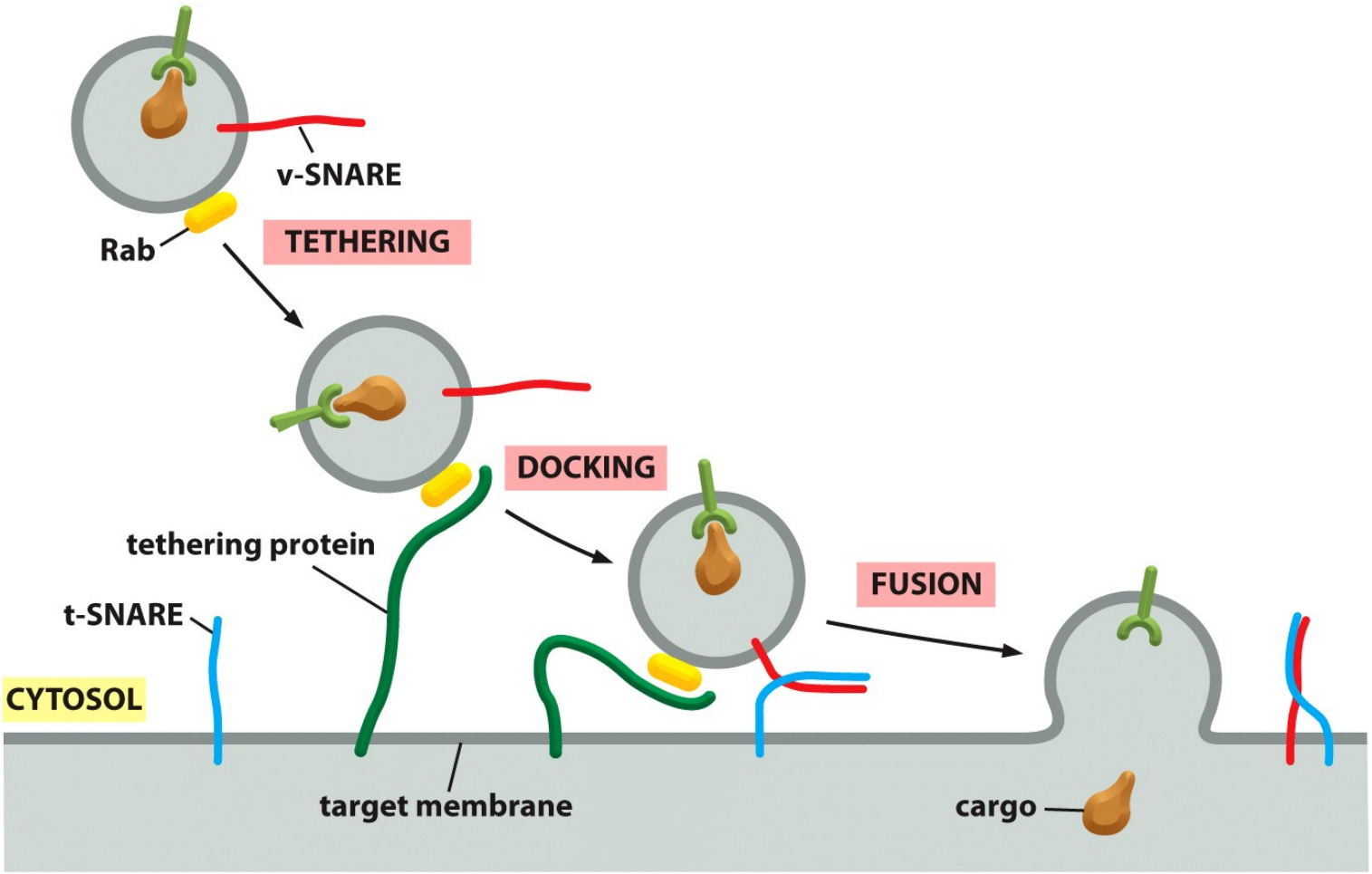

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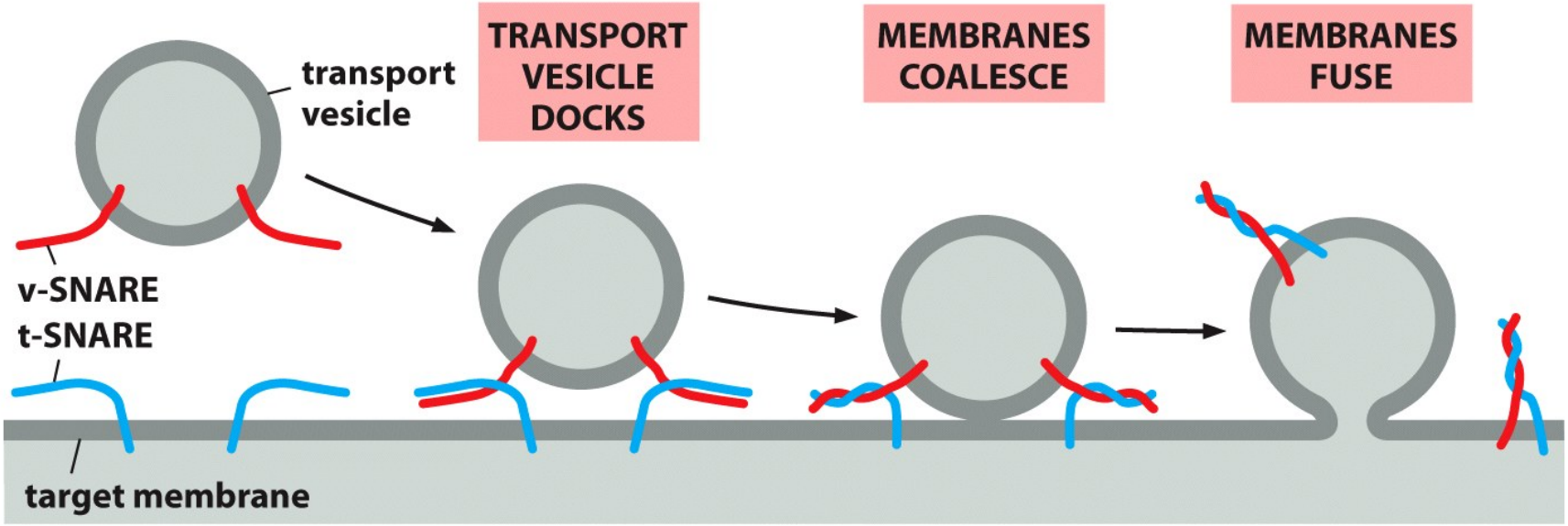

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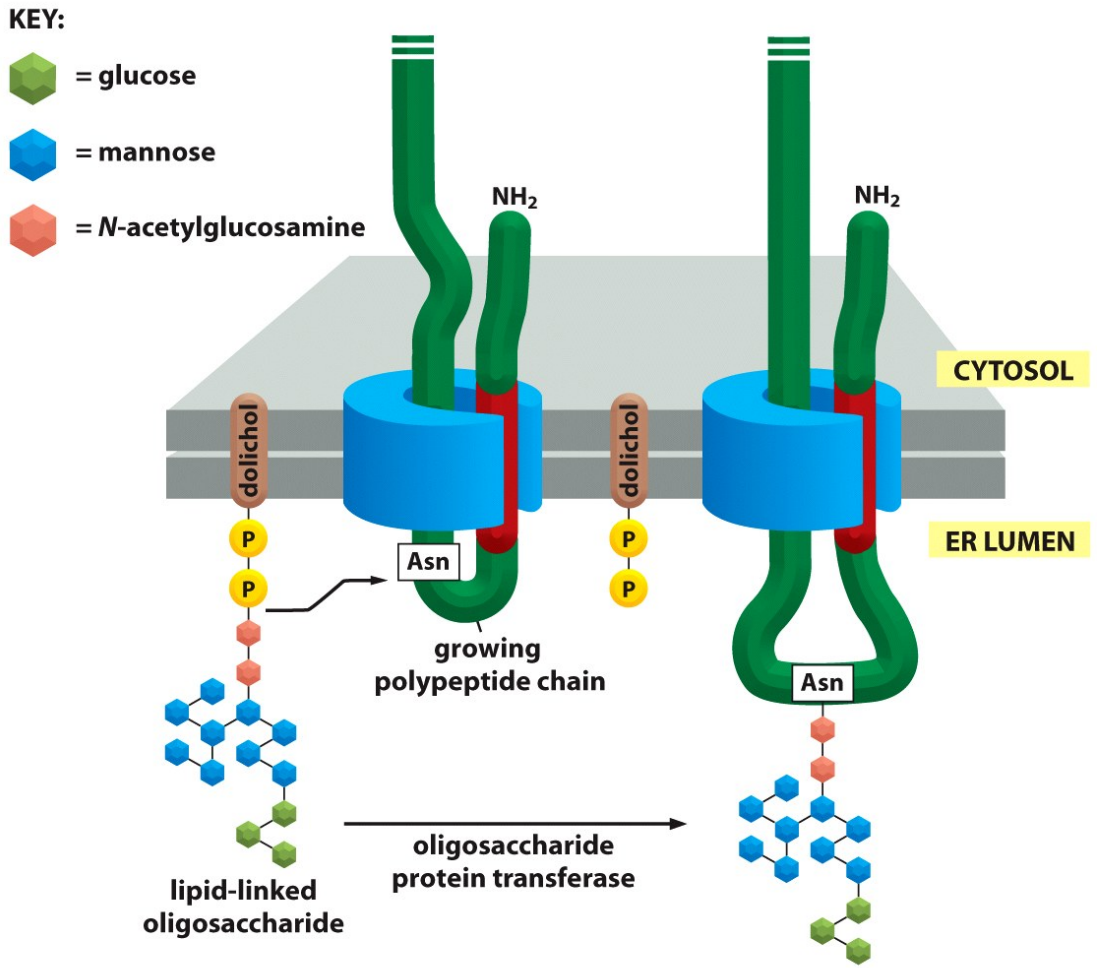

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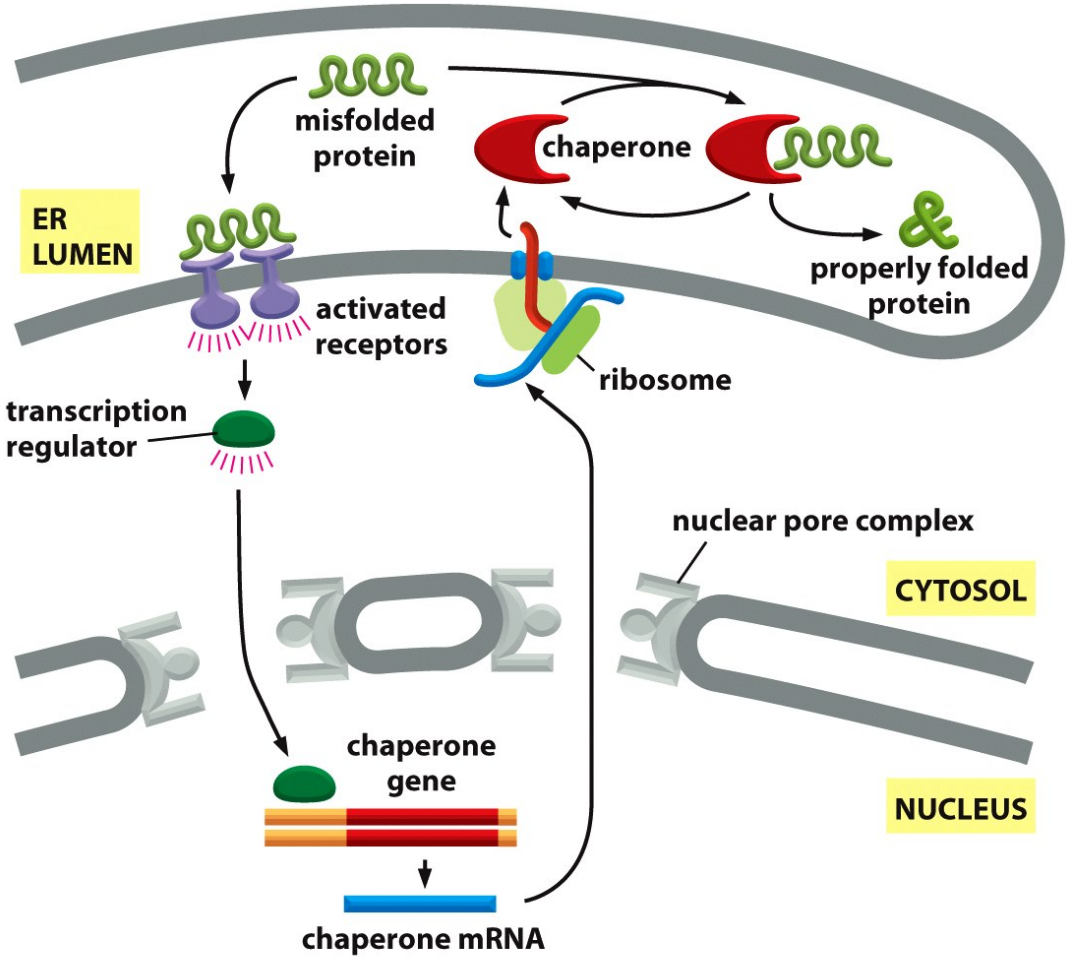

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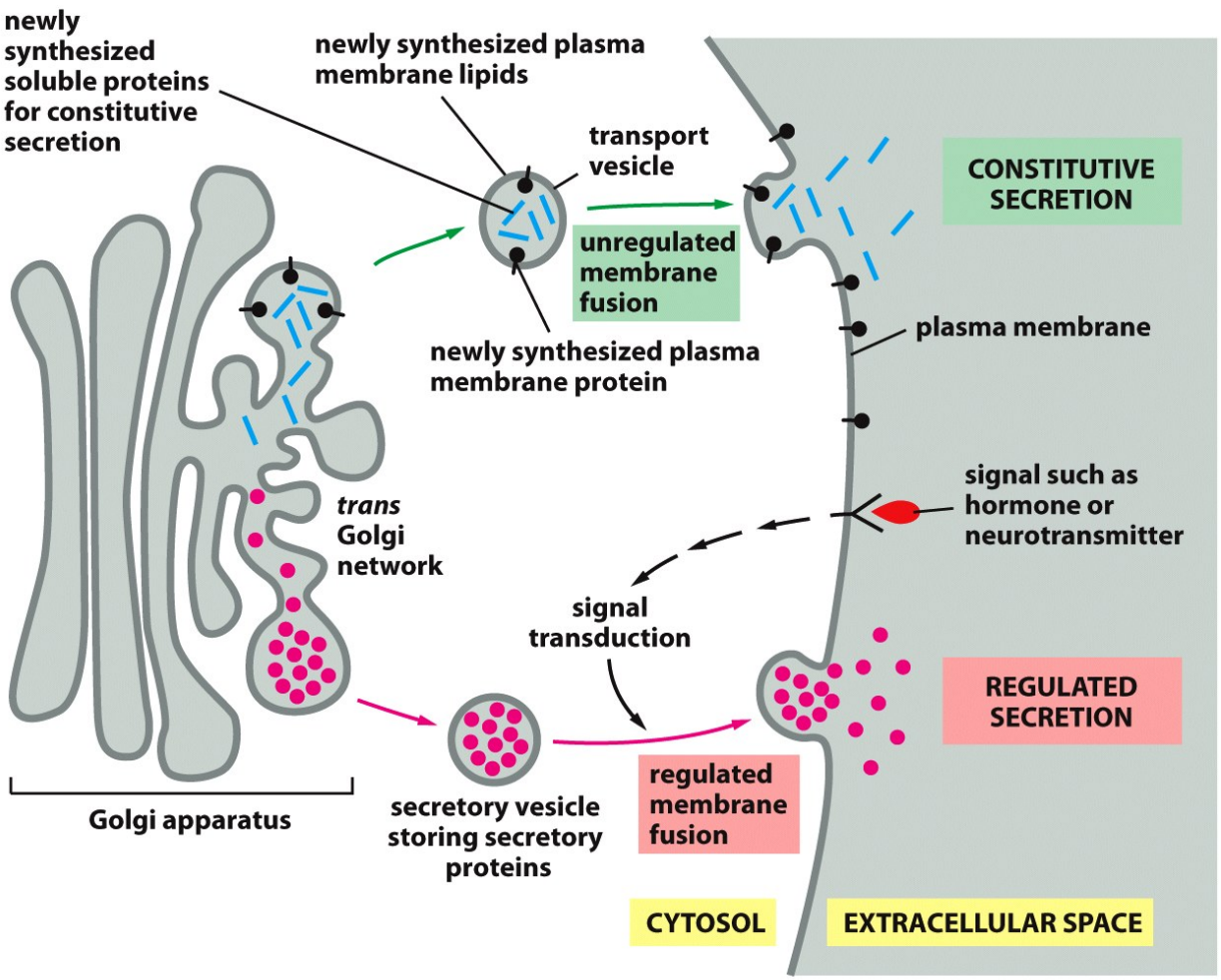

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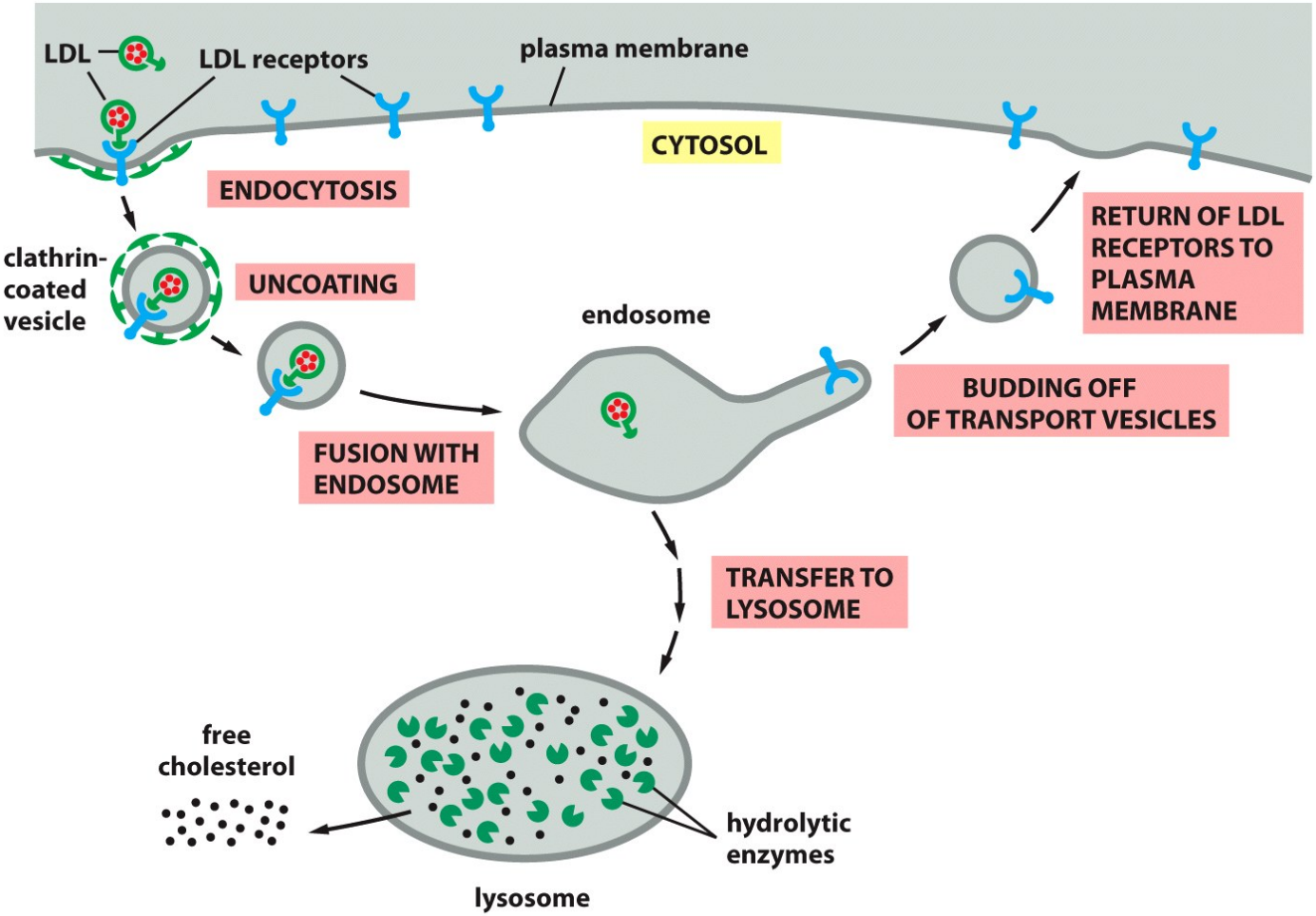

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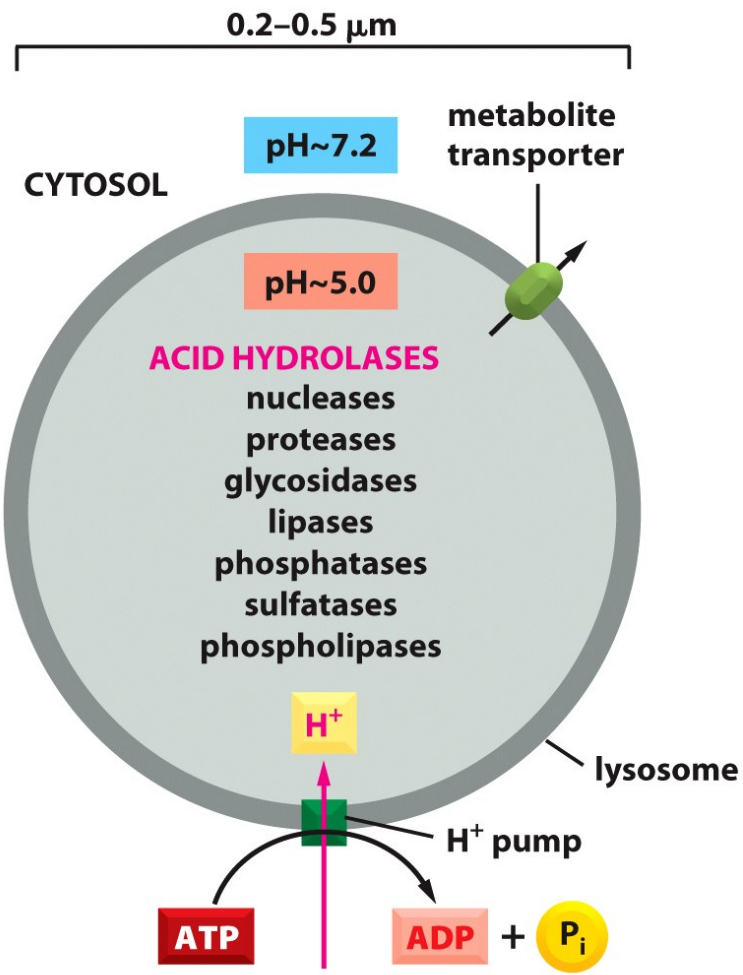

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TABLE 15–4 SOME TYPES OF COATED VESICLES

TYPE OF COATED VESICLE	COAT PROTEINS	ORIGIN	DESTINATION
Clathrin-coated	clathrin + adaptin 1	Golgi apparatus	lysosome (via endosomes)
Clathrin-coated	clathrin + adaptin 2	plasma membrane	endosomes
COP-coated	COP proteins	ER Golgi cisterna Golgi apparatus	Golgi apparatus Golgi cisterna ER

Table 15-4 Essential Cell Biology 3/e (© Garland Science 2010)