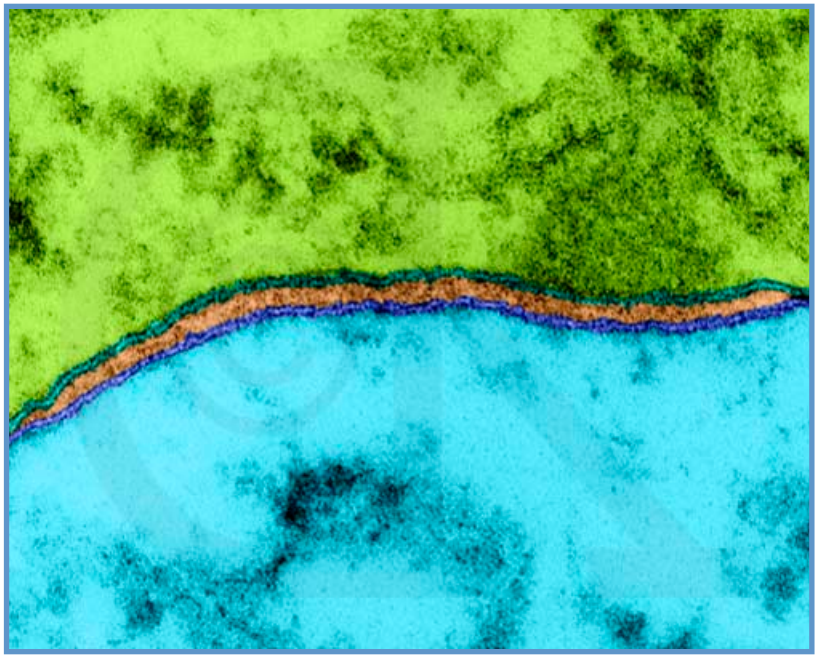
Celični razdelki in transport proteinov

Kompartmentalizacija celic



Kompartmentalizacija celic

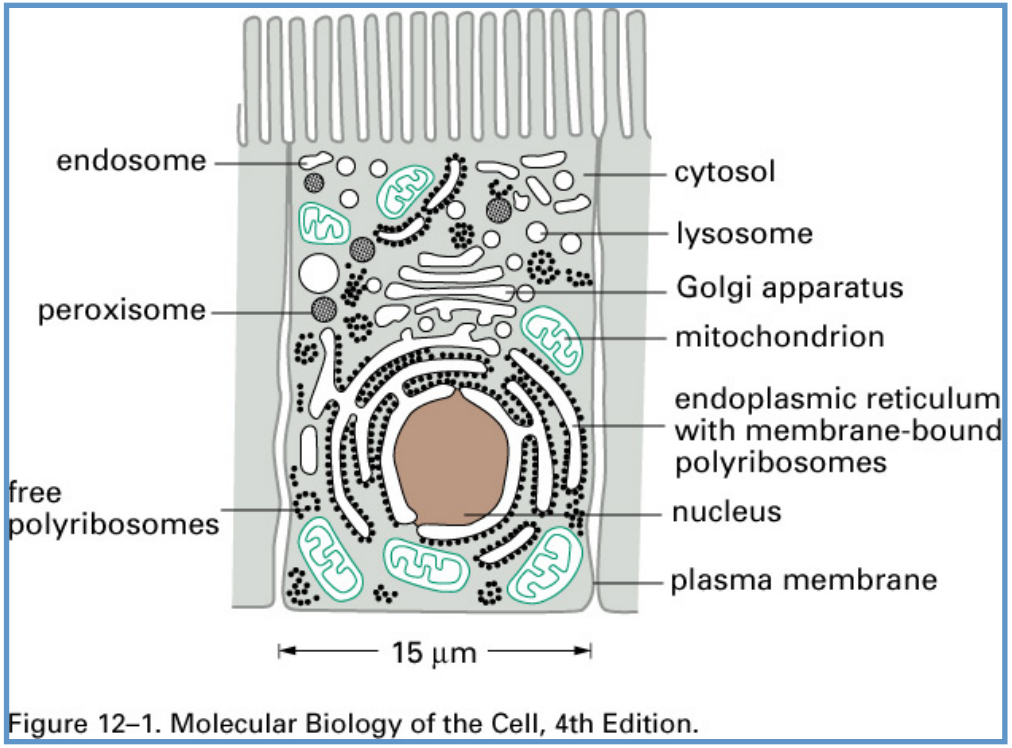


Figure 12–1. Molecular Biology of the Cell, 4th Edition.

Kompartmentalizacija celic

TABLE 12–1 Relative Volumes Occupied by the Major Intracellular Compartments in a Liver Cell (Hepatocyte)

INTRACELLULAR COMPARTMENT	PERCENTAGE OF TOTAL CELL VOLUME
Cytosol	54
Mitochondria	22
Rough ER cisternae	9
Smooth ER cisternae plus Golgi cisternae	6
Nucleus	6
Peroxisomes	1
Lysosomes	1
Endosomes	1

Celične membrane

TABLE 12–2 Relative Amounts of Membrane Types in Two Kinds of Eucaryotic Cells

MEMBRANE TYPE	PERCENTAGE OF TOTAL CELL MEMBRANE	
	LIVER HEPATOCYTE*	PANCREATIC EXOCRINE CELL*
Plasma membrane	2	5
Rough ER membrane	35	60
Smooth ER membrane	16	<1
Golgi apparatus membrane	7	10
Mitochondria		
Outer membrane	7	4
Inner membrane	32	17
Nucleus		
Inner membrane	0.2	0.7
Secretory vesicle membrane	not determined	3
Lysosome membrane	0.4	not determined
Peroxisome membrane	0.4	not determined
Endosome membrane	0.4	not determined

*These two cells are of very different sizes: the average hepatocyte has a volume of about 5000 μm^3 compared with 1000 μm^3 for the pancreatic exocrine cell. Total cell membrane areas are estimated at about 110,000 μm^2 and 13,000 μm^2, respectively.

Glavni celični organeli

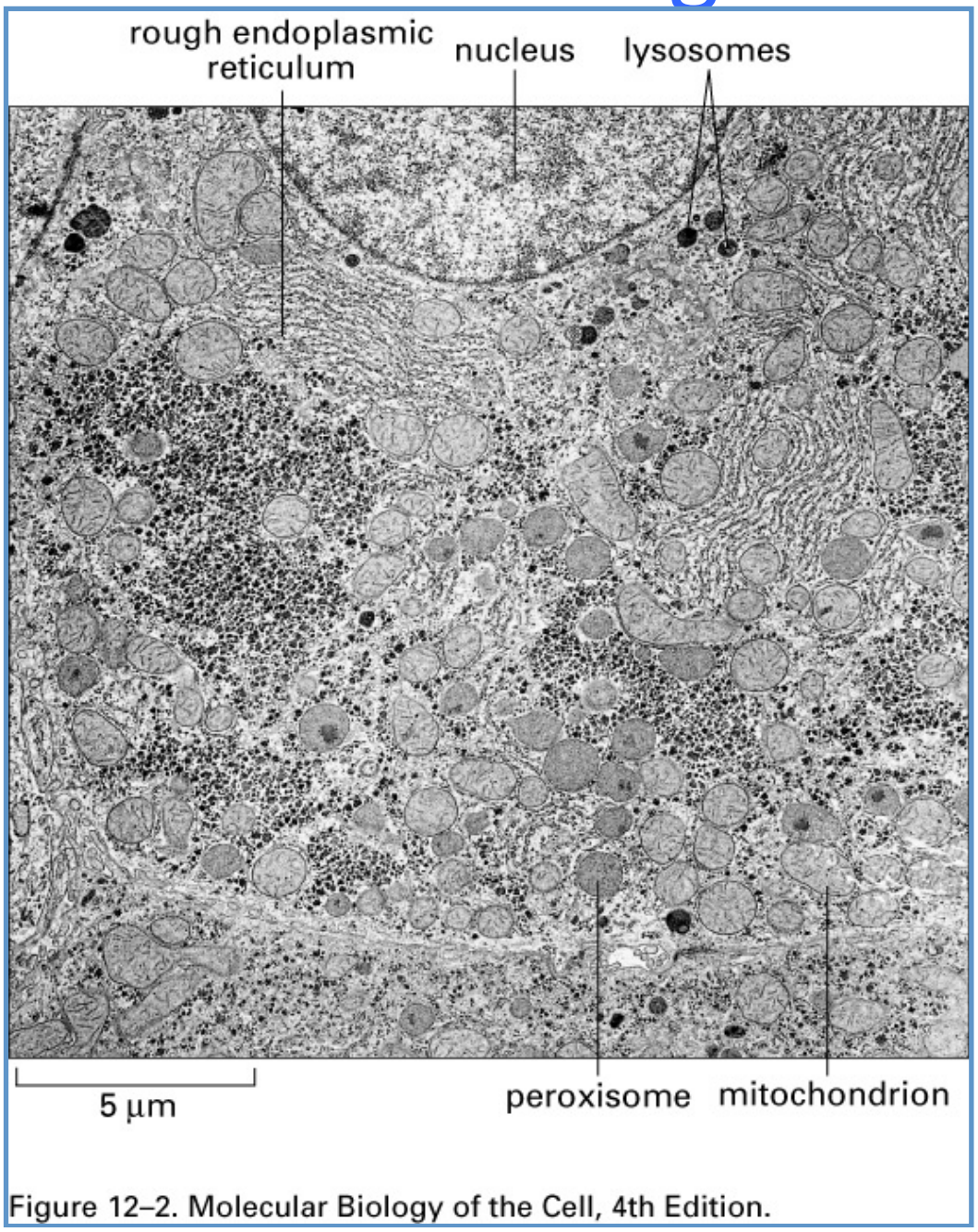


Figure 12–2. Molecular Biology of the Cell, 4th Edition.

Evolucijski izvor topologije celic

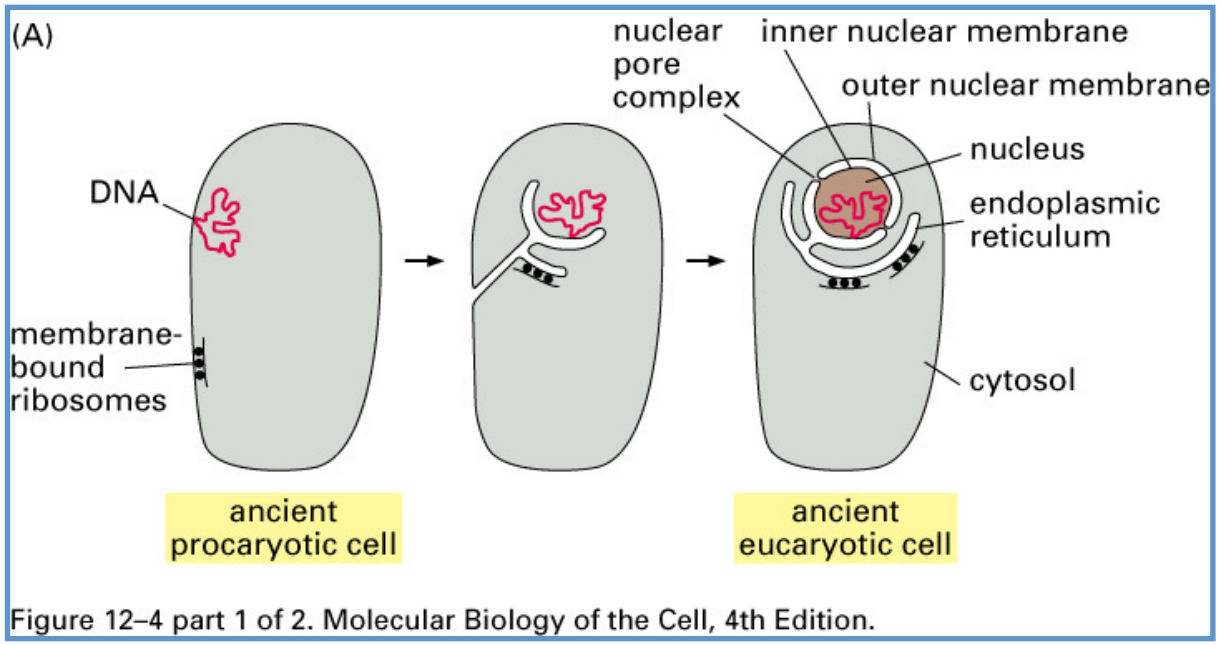


Figure 12–4 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

Topology governed by evolutionary origins

Invagination of pm creates organelles such as nucleus that are topologically equivalent to cytosol and communicate via pores

Evolucijski izvor topologije celic

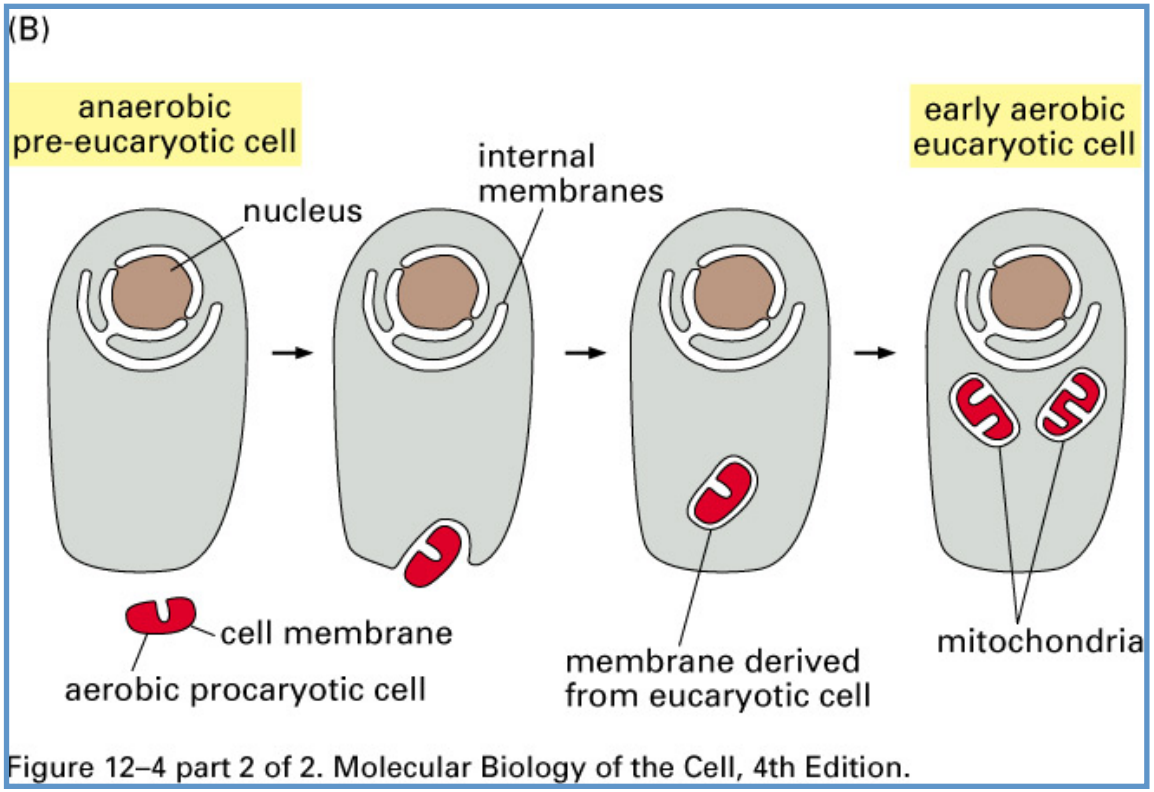
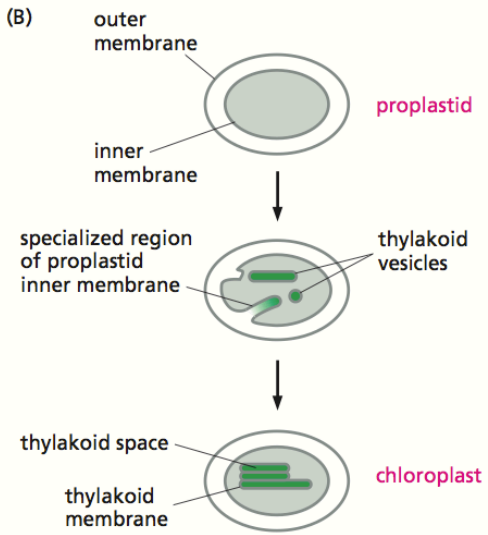


Figure 12–4 part 2 of 2. Molecular Biology of the Cell, 4th Edition.



<u>Topology governed by evolutionary origins</u>

Endosymbiosis of mito and plastids creates double membrane organelle (have own genome)

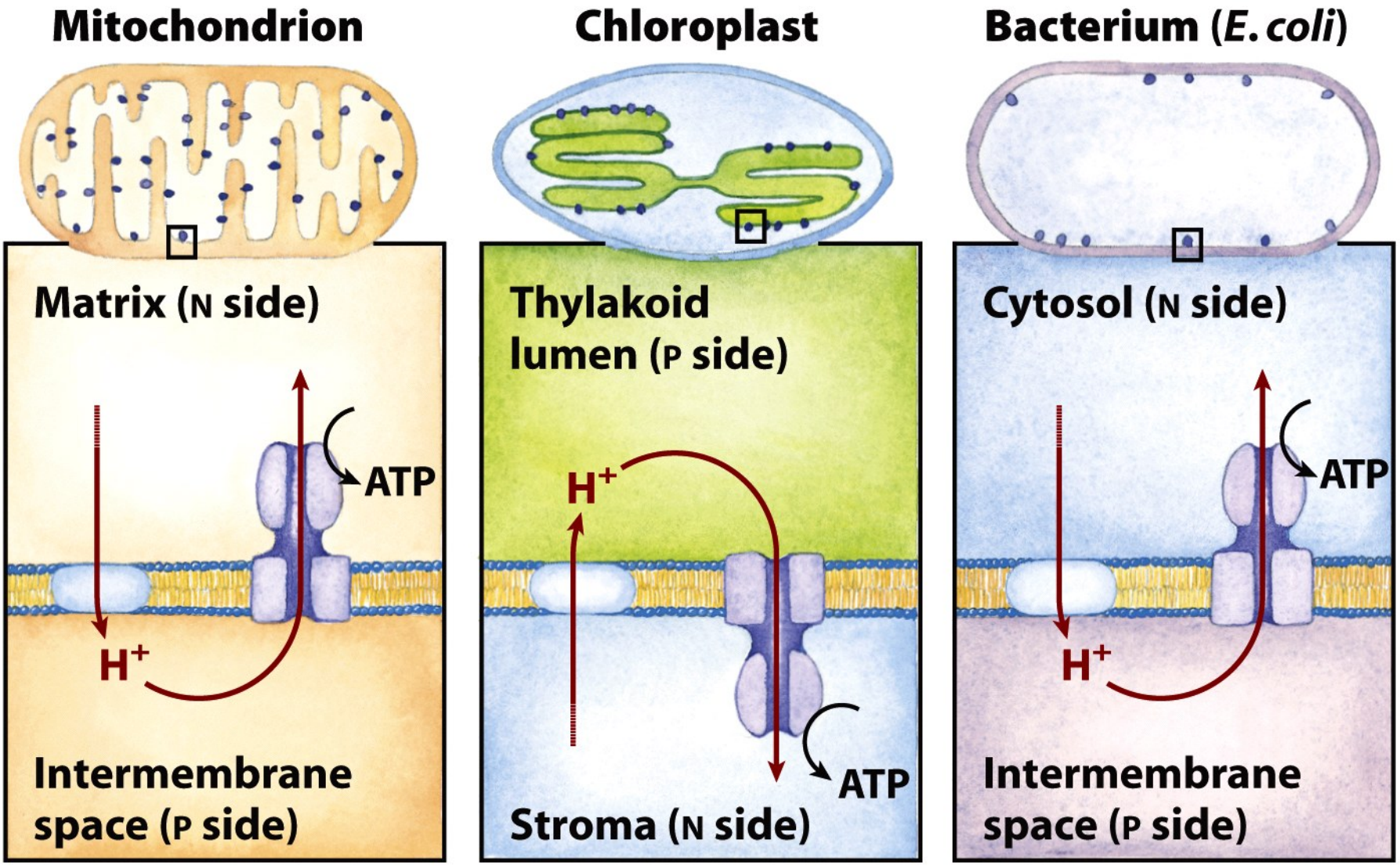


Figure 19-64
Lehninger Principles of Biochemistry, Fifth Edition

Evolucijski izvor topologije celic

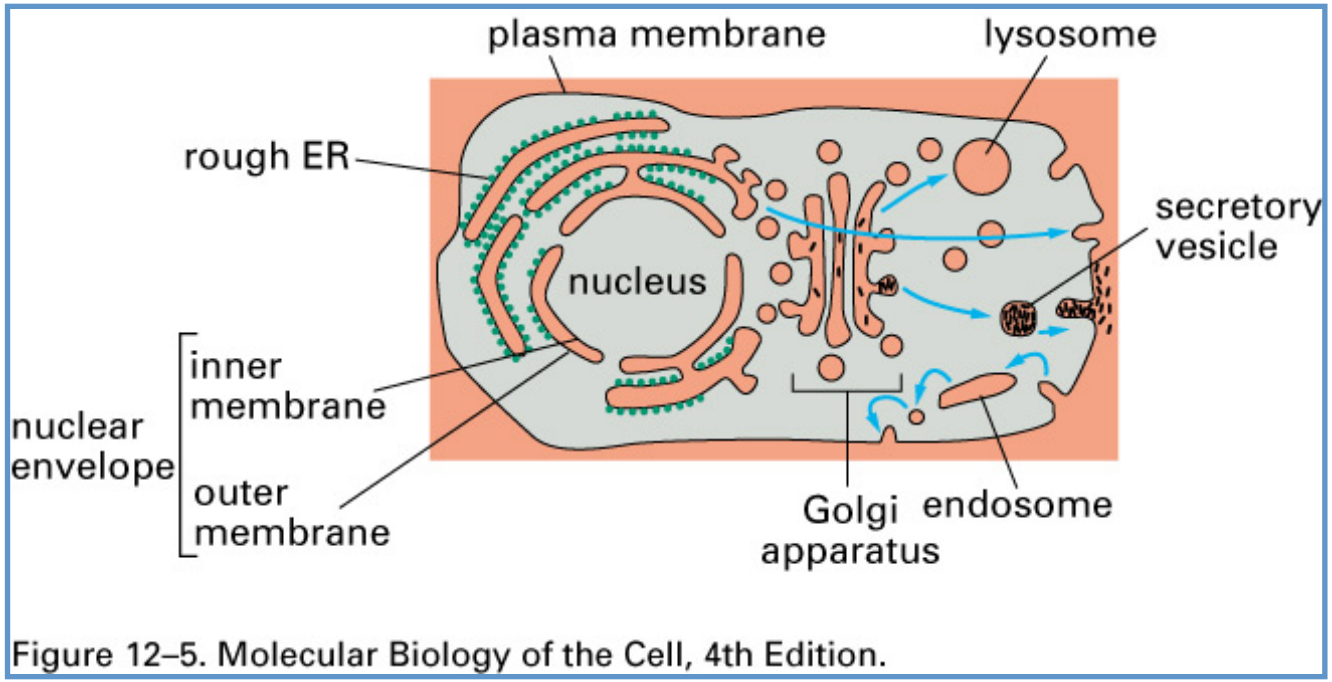


Figure 12–5. Molecular Biology of the Cell, 4th Edition.

Notranjost organel, ki so nastale z invaginacijo in odcepitvijo plazemske membrane je topološko ekvivalentna zunanjosti celice

Večina organel se ne more zgraditi *de novo*

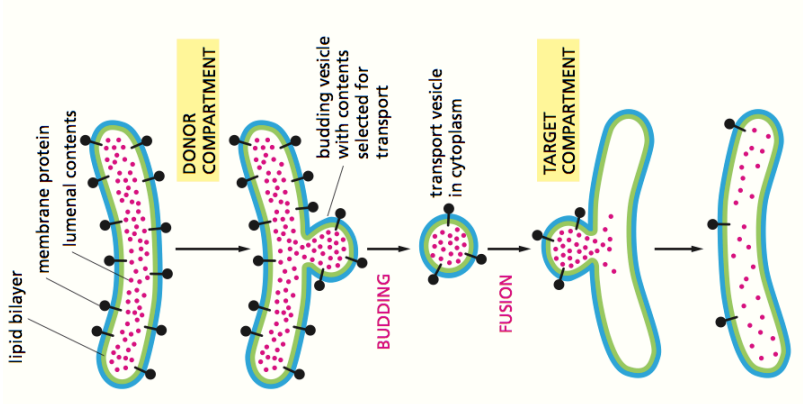
Različni načini transporta proteinov

Trije mehanizmi

1. Kanalčki z vrati- topološko ekvivalenten prostor

2. Transmembranski trasport: proteinski translokatorju, topološko drug prostor

3. Transport z vezikli: z membrano ločeni intermediati, topološko ekvivalenten prostor



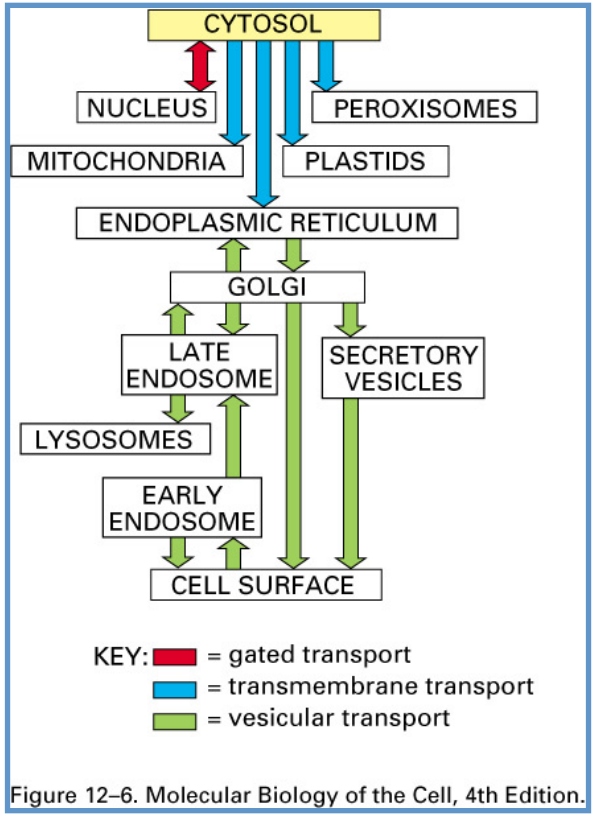
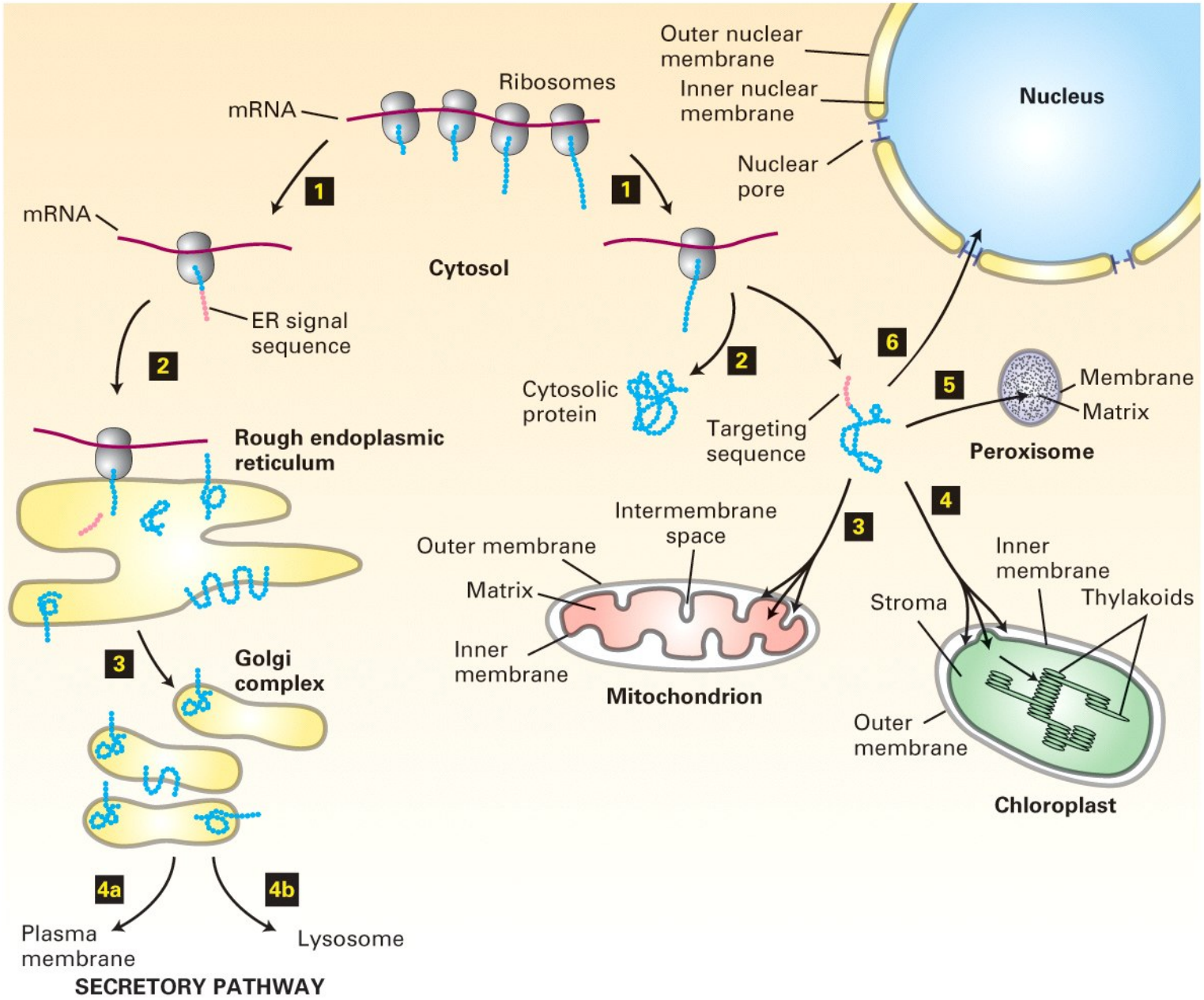


Figure 12–6. Molecular Biology of the Cell, 4th Edition.


Outer nuclear membrane
Inner nuclear membrane
Nuclear pore
Nucleus
Ribosomes
mRNA
1
1
mRNA
Cytosol
ER signal sequence
2
2
Cytosolic protein
6
5
Membrane
Matrix
Peroxisome
Targeting sequence
Rough endoplasmic reticulum
3
4
Intermembrane space
Outer membrane
Matrix
Inner membrane
Mitochondrion
Inner membrane
Thylakoids
Stroma
Outer membrane
Chloroplast
3
Golgi complex
4a
4b
Plasma membrane
Lysosome
SECRETORY PATHWAY

Tipi sortirnih signalov

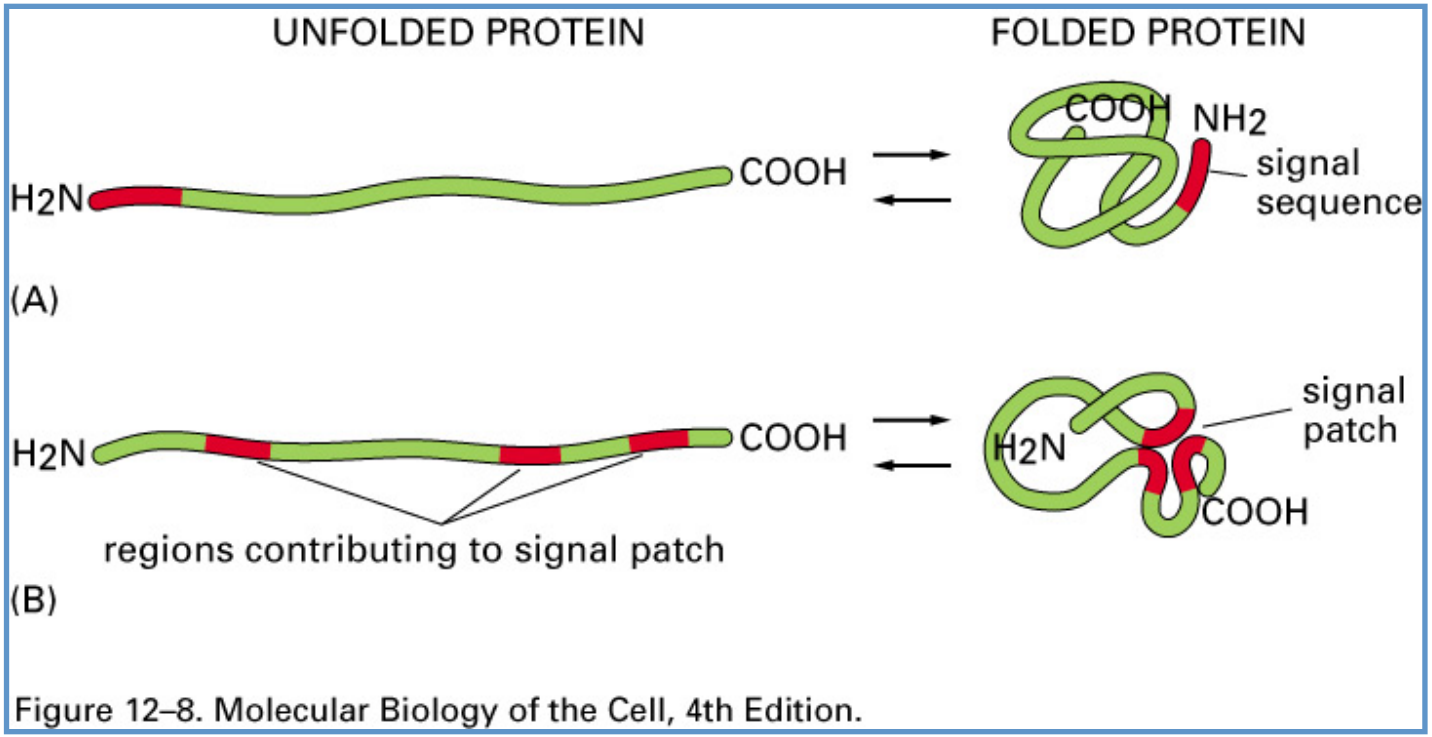


Figure 12–8. Molecular Biology of the Cell, 4th Edition.

Tipična signalna AK zaporedja

Table 12–3 Some Typical Signal Sequences

FUNCTION OF SIGNAL SEQUENCE	EXAMPLE OF SIGNAL SEQUENCE
Import into nucleus	-Pro-Pro-Lys-Lys-Lys-Arg-Lys-Val-
Export from nucleus	-Leu-Ala-Leu-Lys-Leu-Ala-Gly-Leu-Asp-Ile-
Import into mitochondria	$^{+}H_3N$-Met-Leu-Ser-Leu-Arg-Gln-Ser-Ile-Arg-Phe-Phe-Lys-Pro-Ala-Thr-Arg-Thr-Leu-Cys-Ser-Ser-Arg-Tyr-Leu-Leu-
Import into plastid	$^{+}H_3N$-Met-Val-Ala-Met-Ala-Met-Ala-Ser-Leu-Gln-Ser-Ser-Met-Ser-Ser-Leu-Ser-Leu-Ser-Ser-Asn-Ser-Phe-Leu-Gly-Gln-Pro-Leu-Ser-Pro-Ile-Thr-Leu-Ser-Pro-Phe-Leu-Gln-Gly-
Import into peroxisomes	-Ser-Lys-Leu-COO^{-}
Import into ER	$^{+}H_3N$-Met-Met-Ser-Phe-Val-Ser-Leu-Leu-Leu-Val-Gly-Ile-Leu-Phe-Trp-Ala-Thr-Glu-Ala-Glu-Gln-Leu-Thr-Lys-Cys-Glu-Val-Phe-Gln-
Return to ER	-Lys-Asp-Glu-Leu-COO^{-}

Jedrna membrana

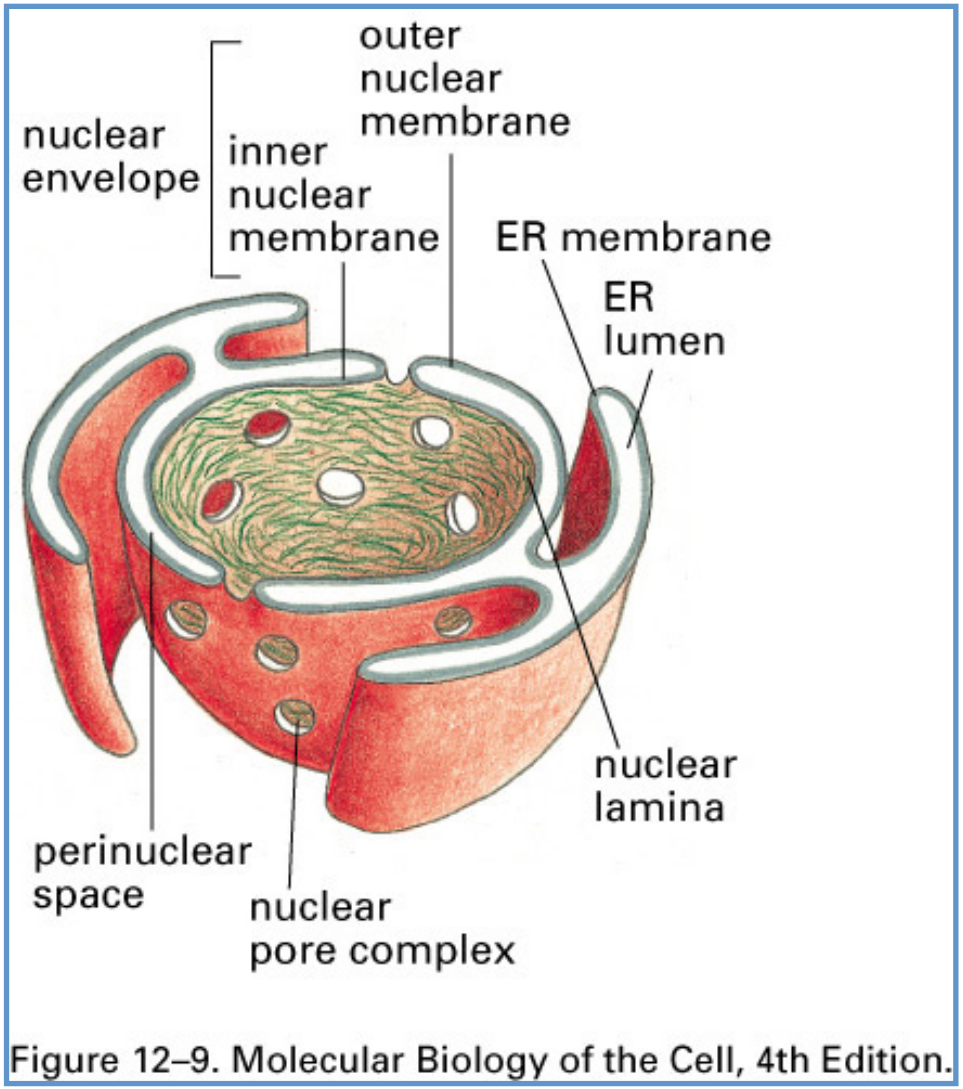


Figure 12–9. Molecular Biology of the Cell, 4th Edition.

Transport proteinov med jedrom in citosolom

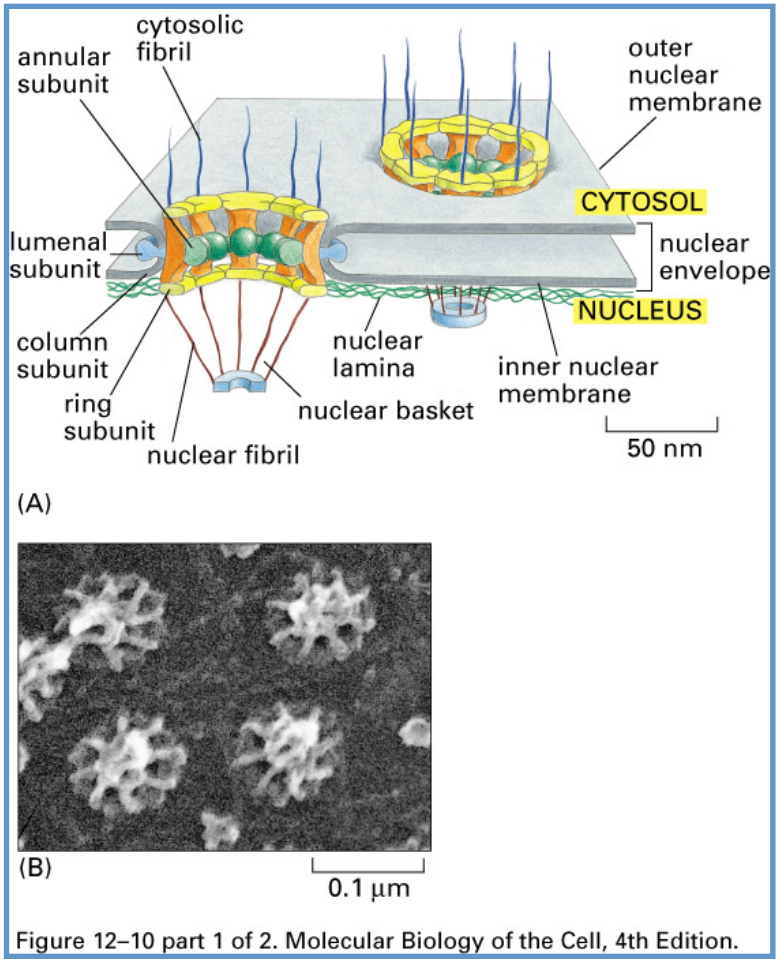


Figure 12–10 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

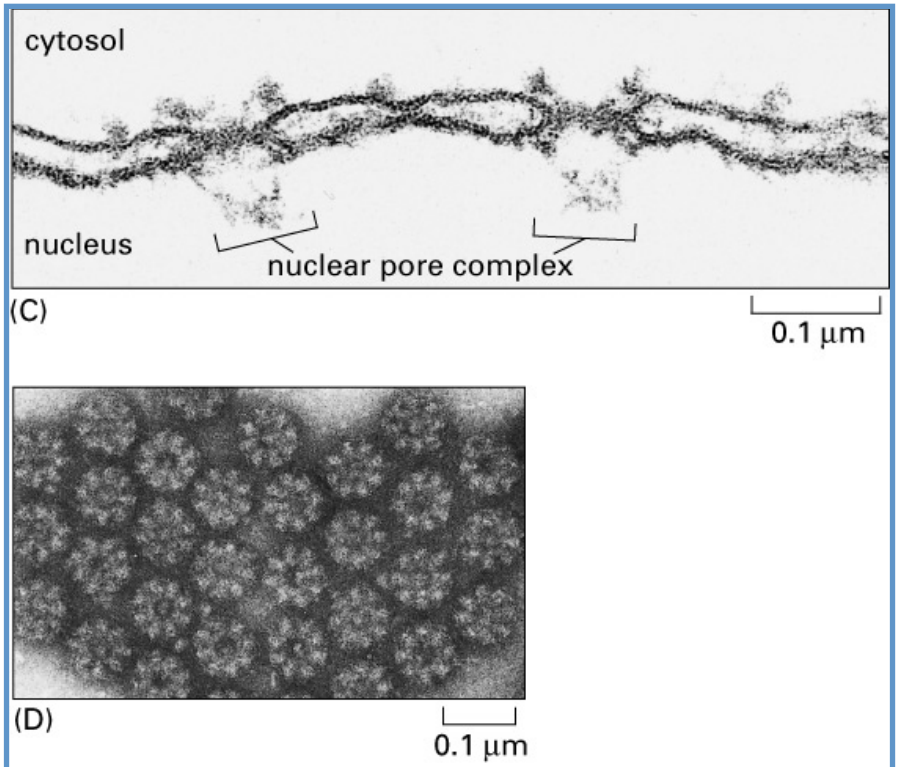


Figure 12–10 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

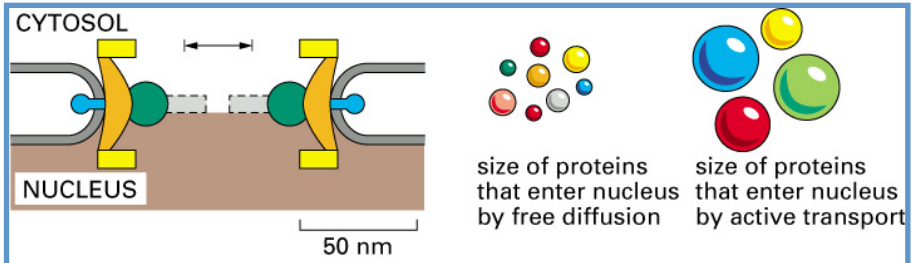
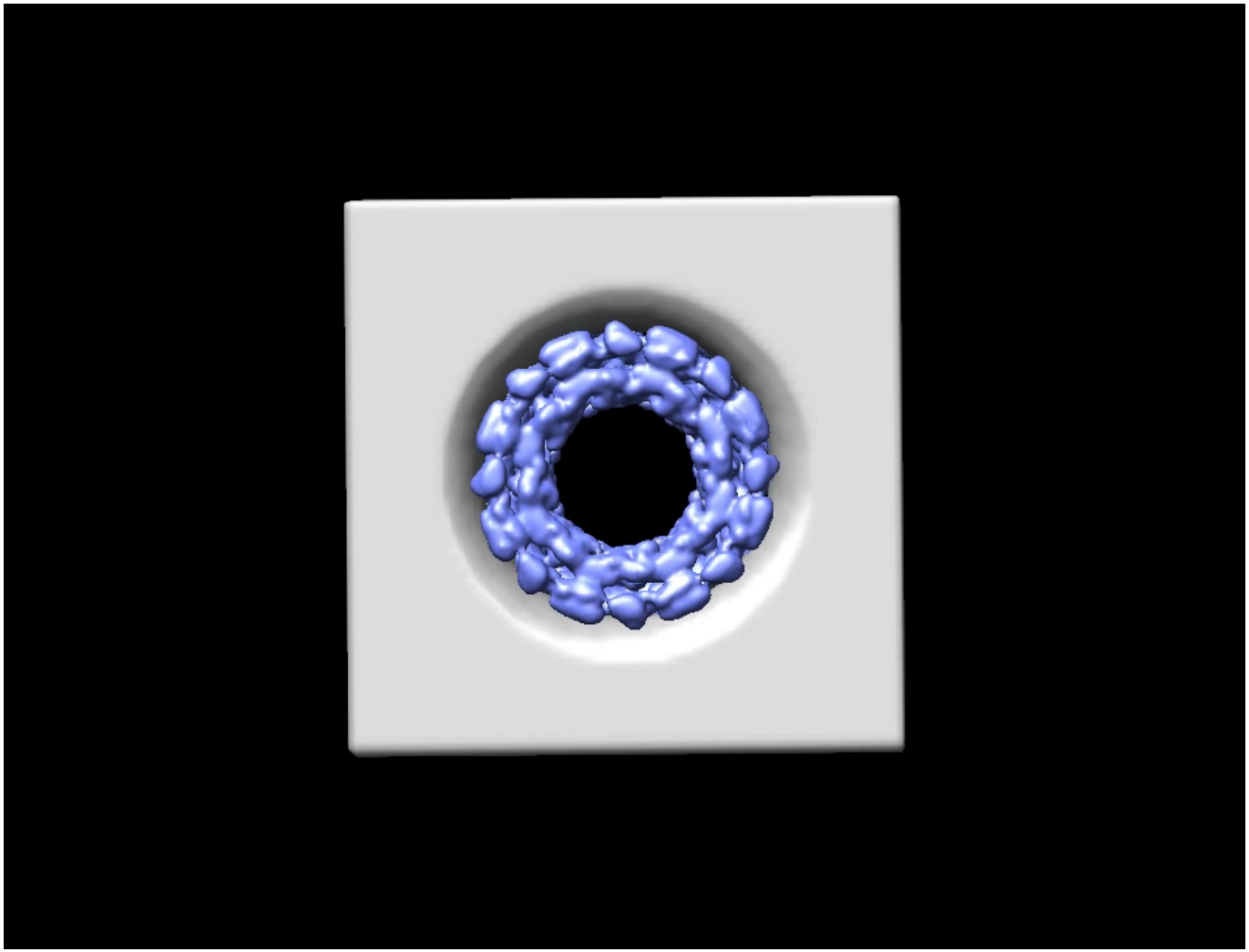
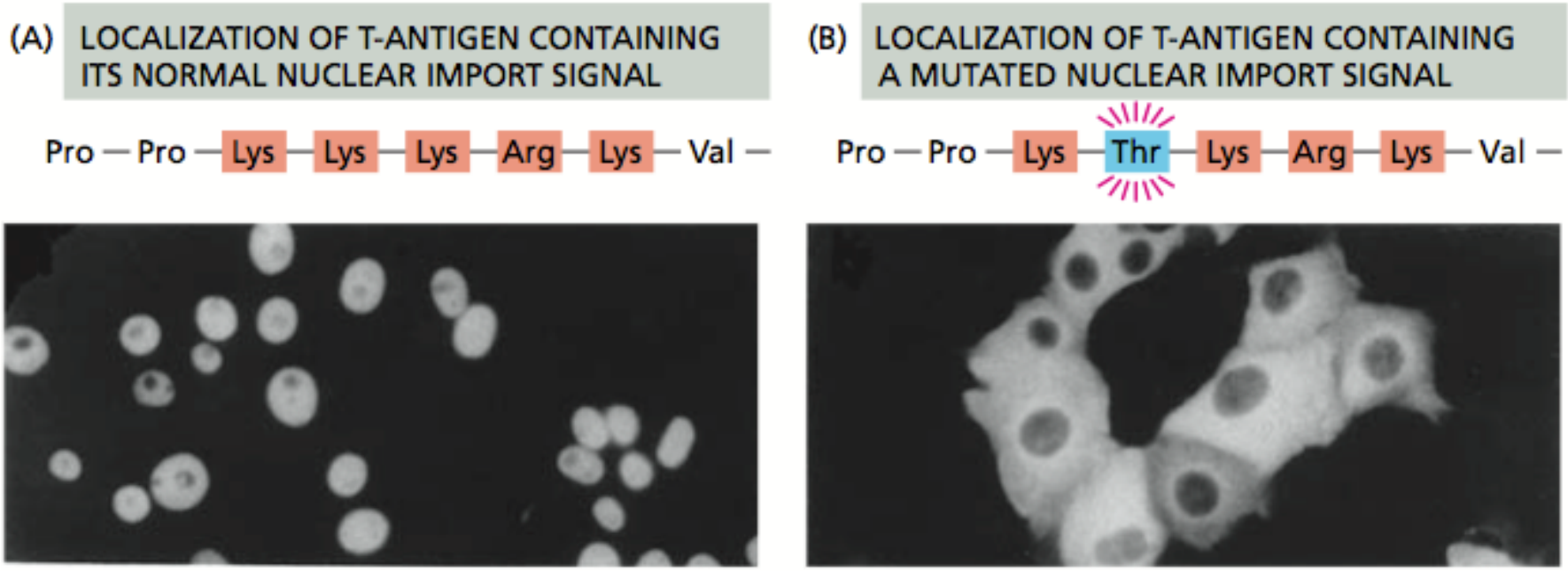


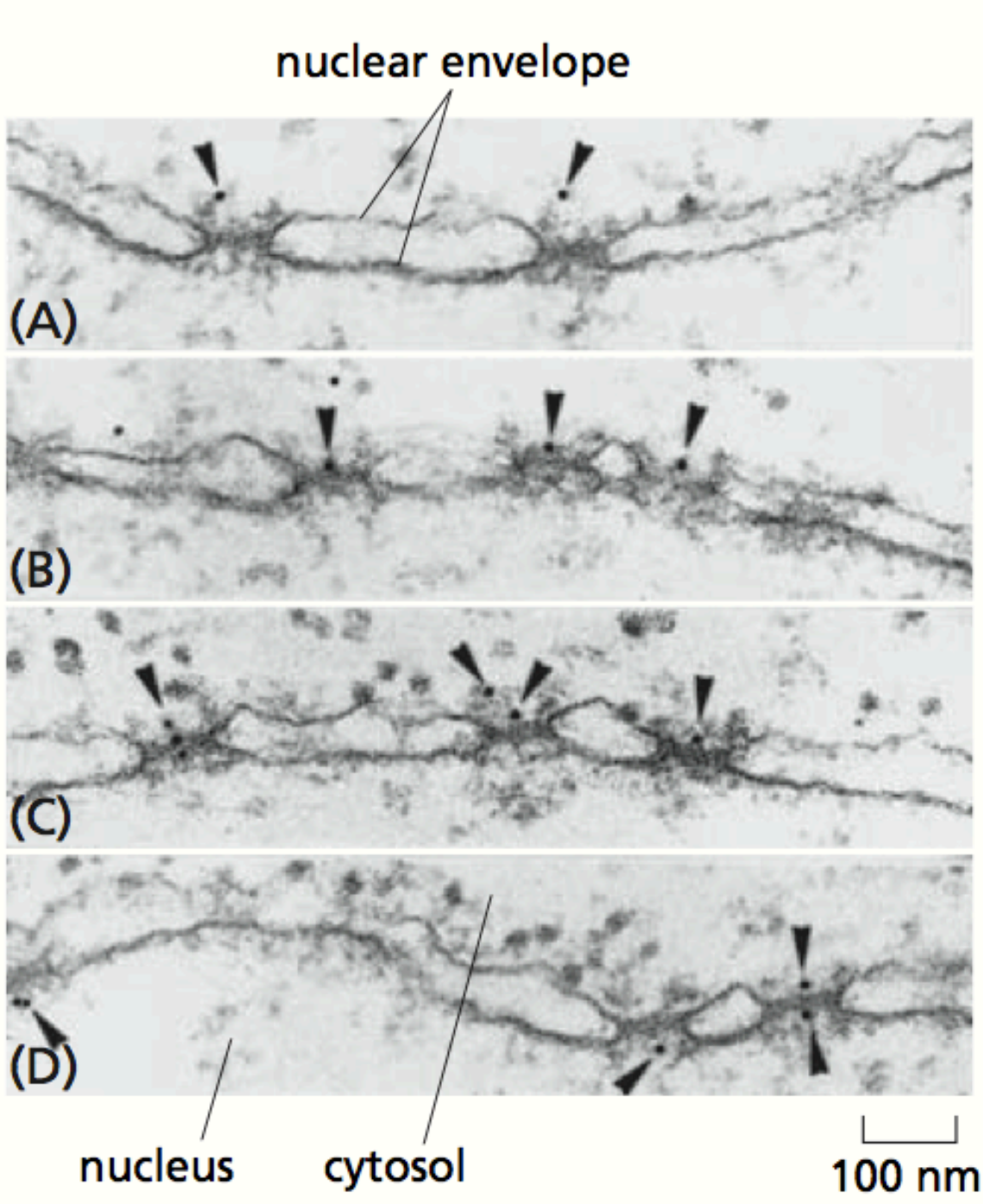
Figure 12–11. Molecular Biology of the Cell, 4th Edition.

Kompleks jedrne pore (NPC)



Transport proteinov med jedrom in citosolom




nuclear envelope
(A)
(B)
(C)
(D)
nucleus
cytosol
100 nm

Transport proteinov med jedrom in citosolom

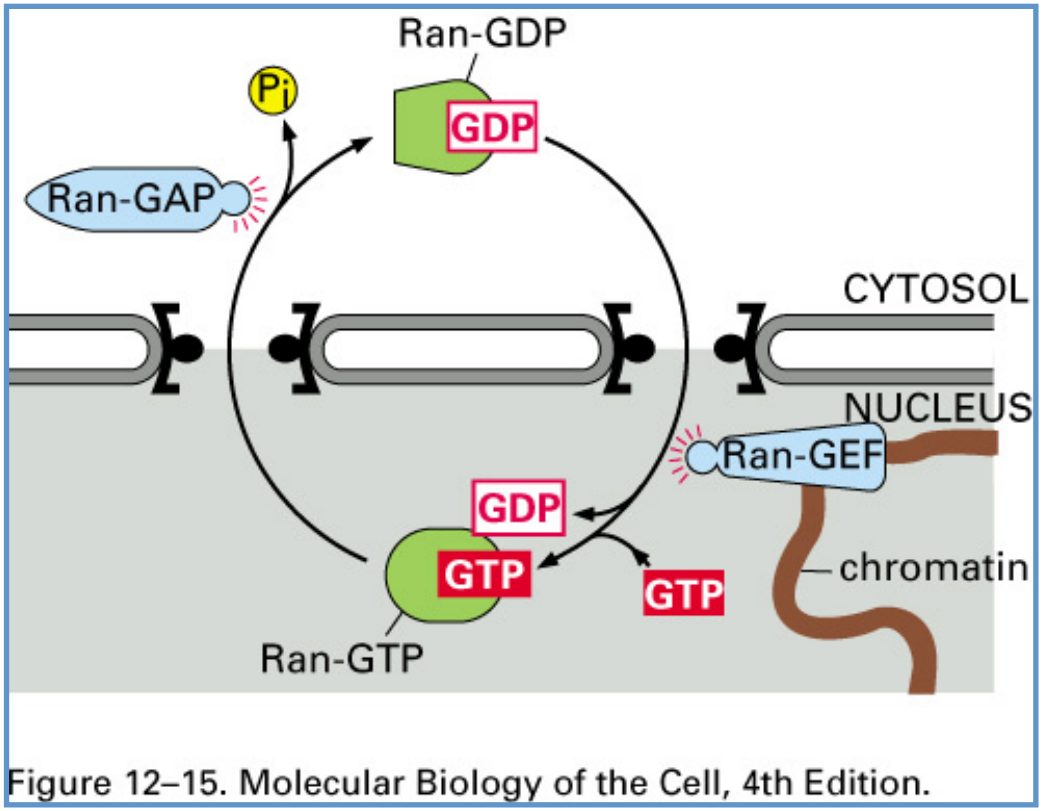
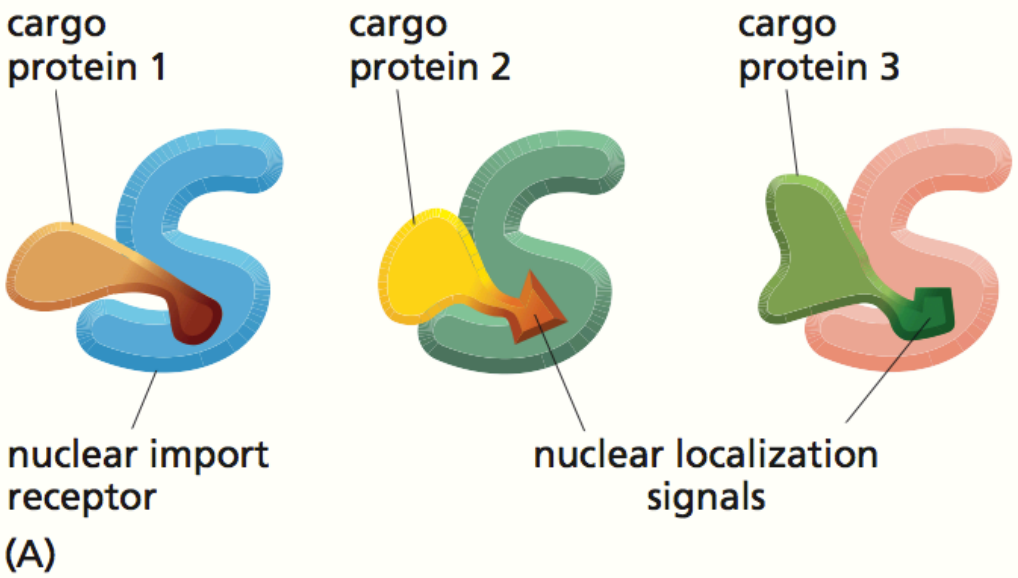
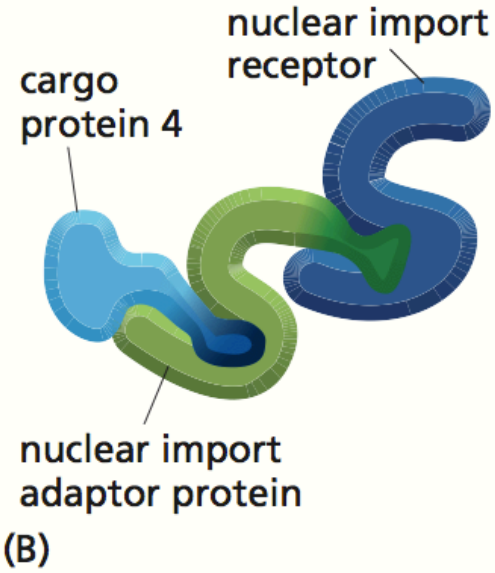


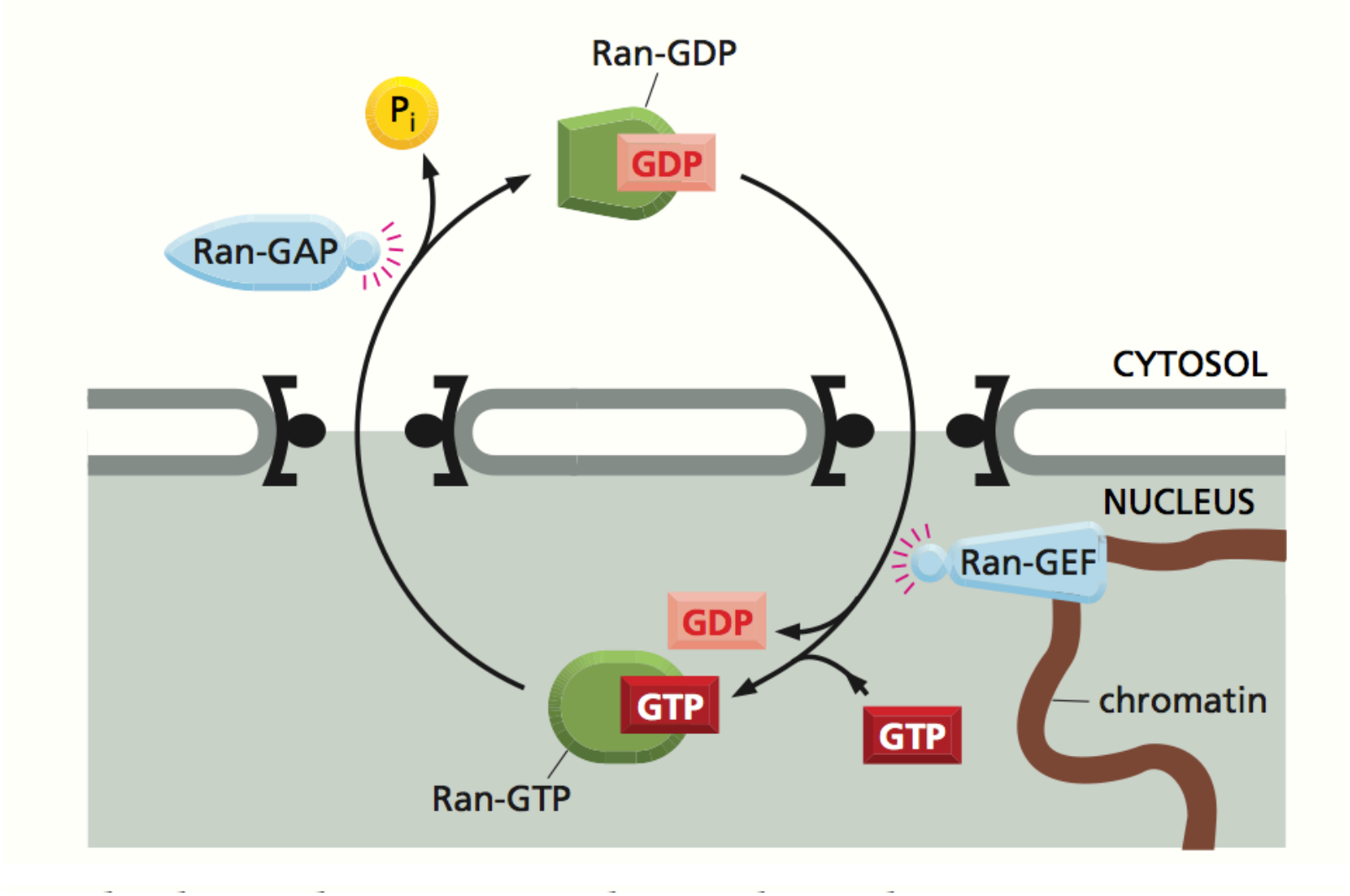
Figure 12–15. Molecular Biology of the Cell, 4th Edition.

Prenašalni jedrni receptorski proteini





Transport proteinov med jedrom in citosolom



Transport proteinov med jedrom in citosolom

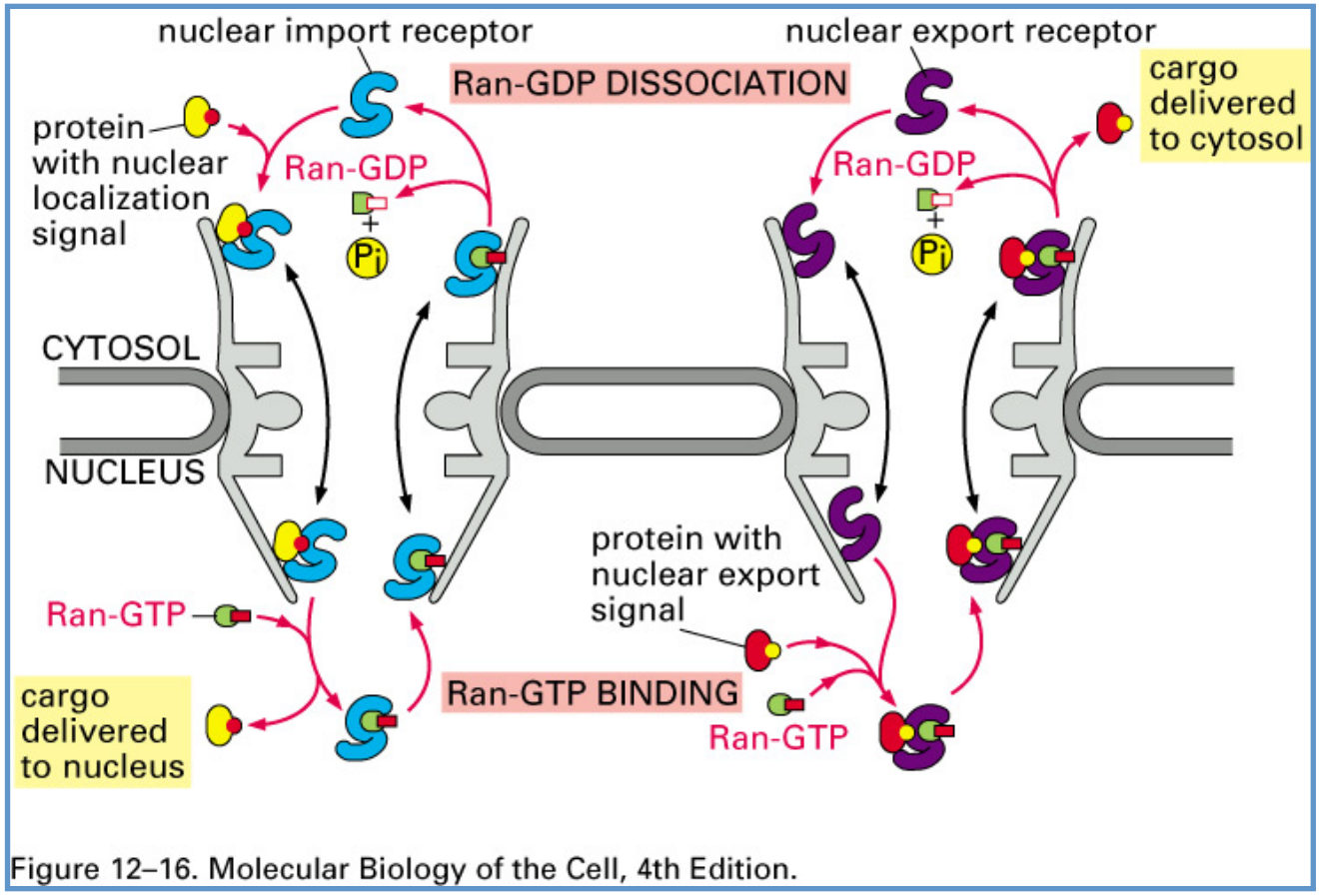


Figure 12–16. Molecular Biology of the Cell, 4th Edition.

Regulacija transkripcije z NT

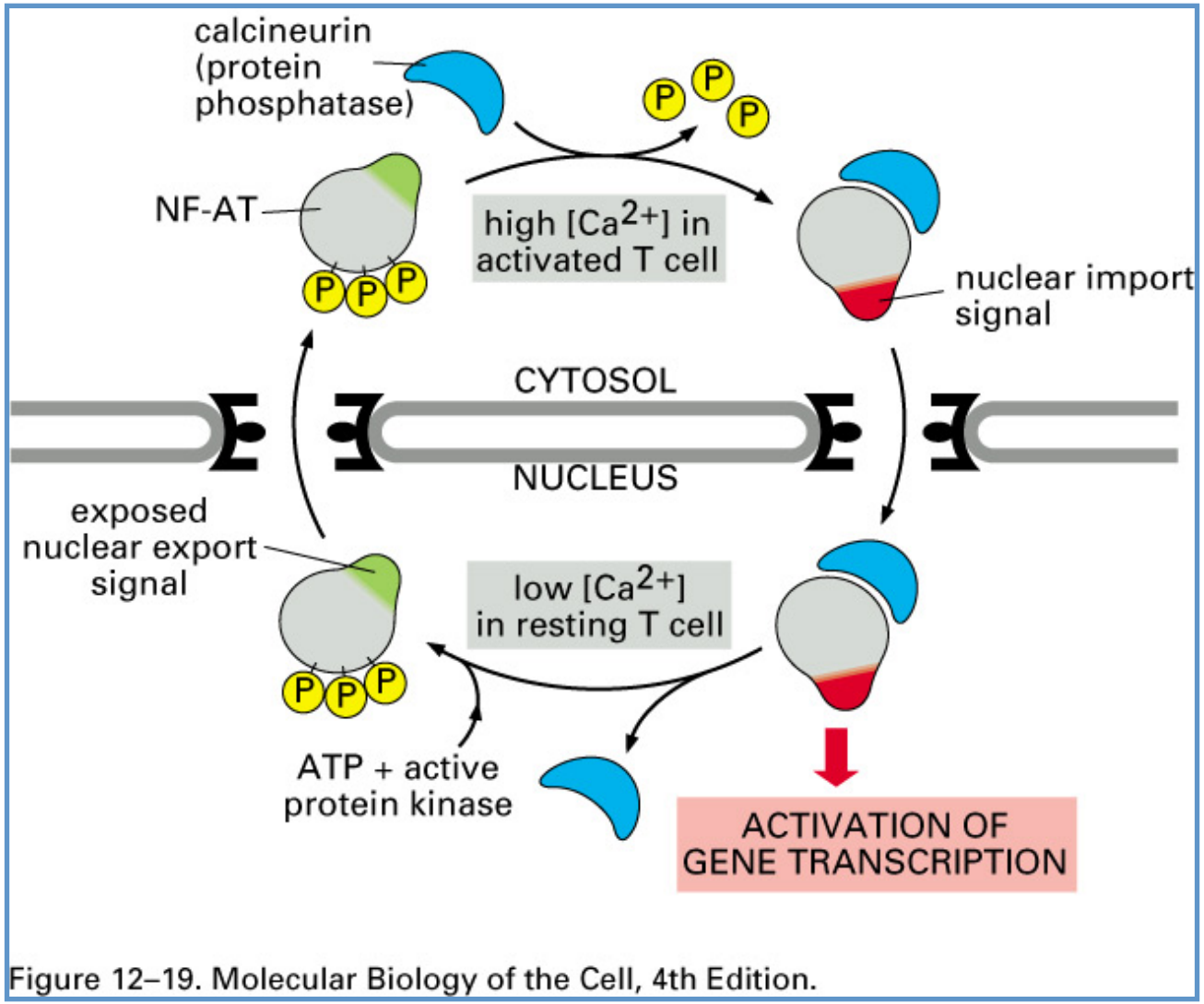
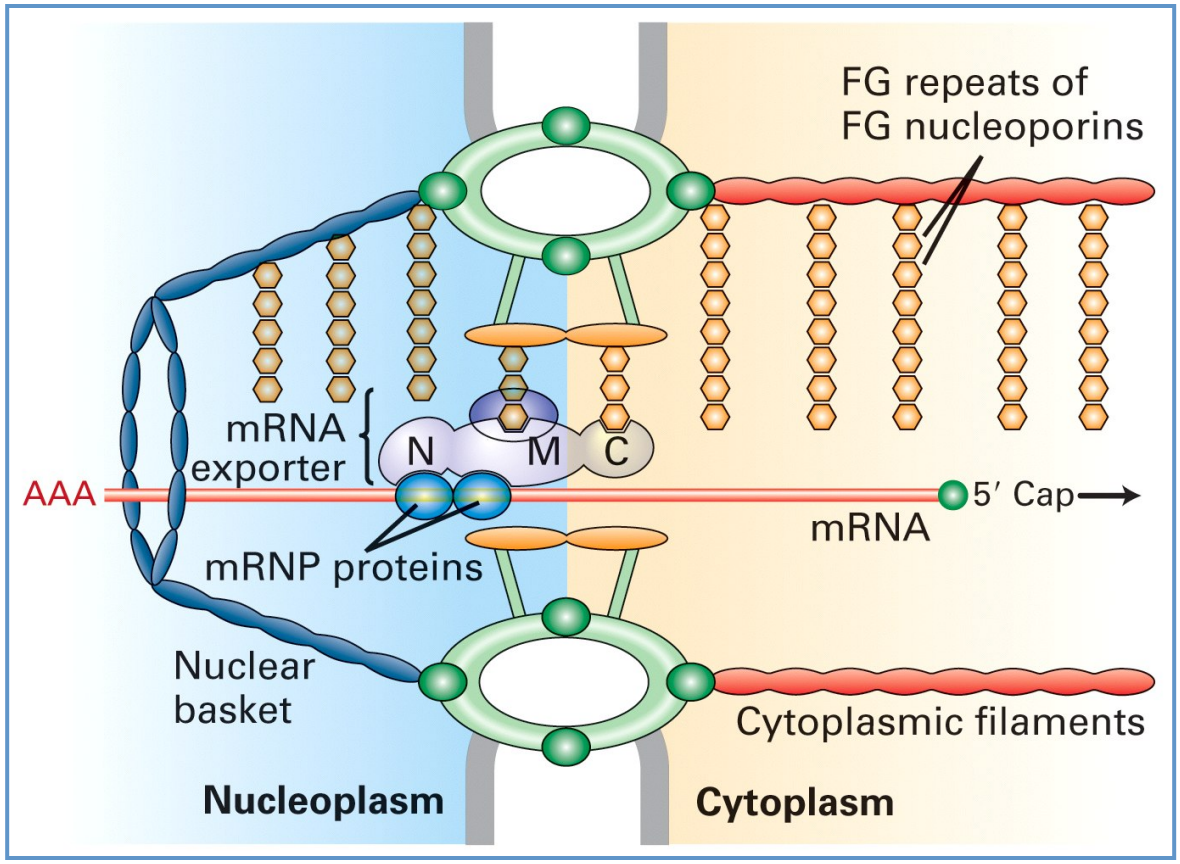


Figure 12–19. Molecular Biology of the Cell, 4th Edition.

Izvoz mRNA


FG repeats of
FG nucleoporins
mRNA
exporter
N
M
C
AAA
5′ Cap
mRNA
mRNP proteins
Nuclear
basket
Cytoplasmic filaments
Nucleoplasm
Cytoplasm

Jedrna membrana med mitozo

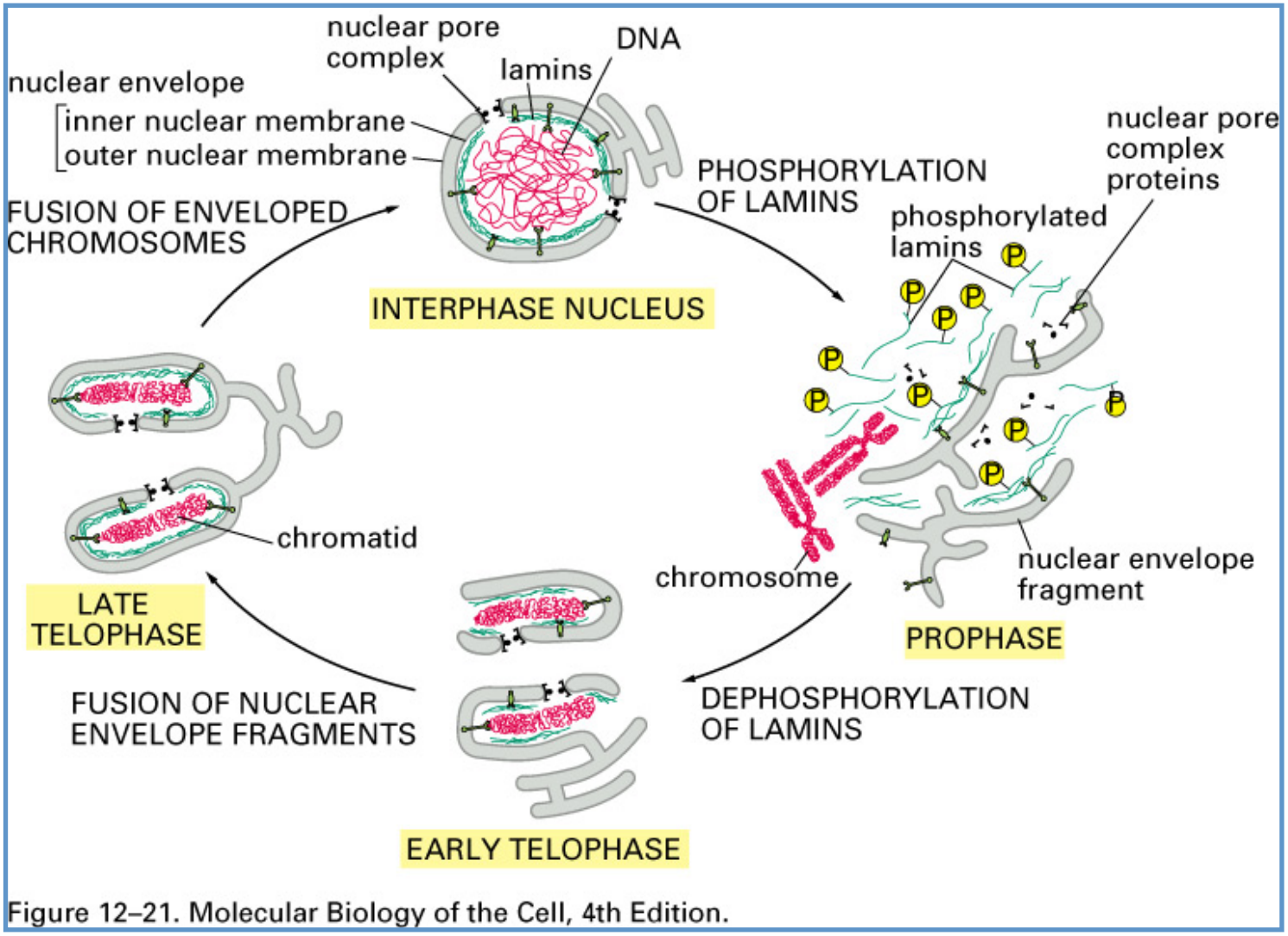


Figure 12–21. Molecular Biology of the Cell, 4th Edition.

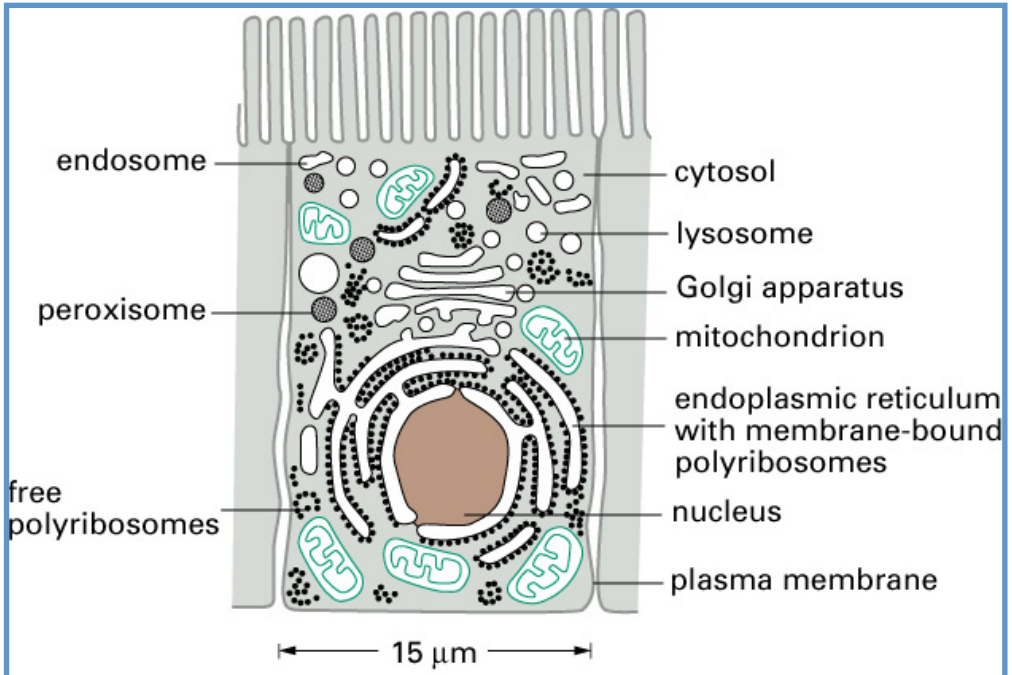


Figure 12–1. Molecular Biology of the Cell, 4th Edition.

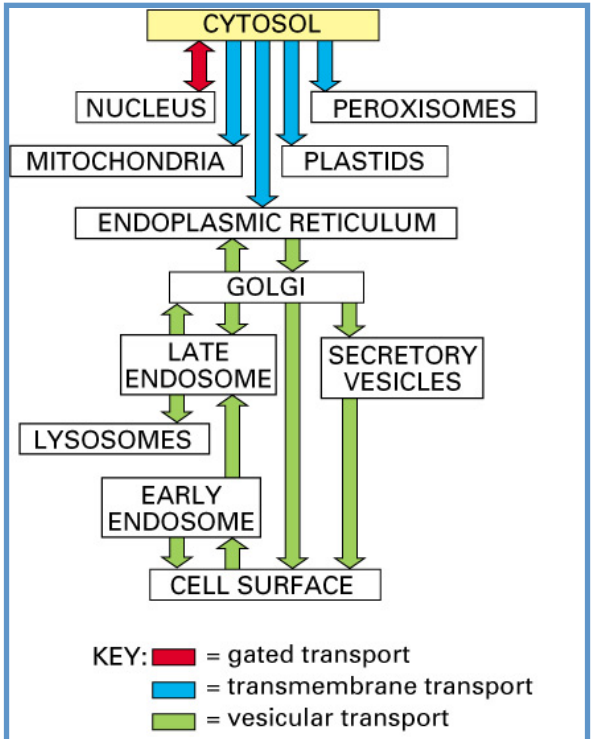


Figure 12–6. Molecular Biology of the Cell, 4th Edition.

Transport v mitohondrije in kloroplaste

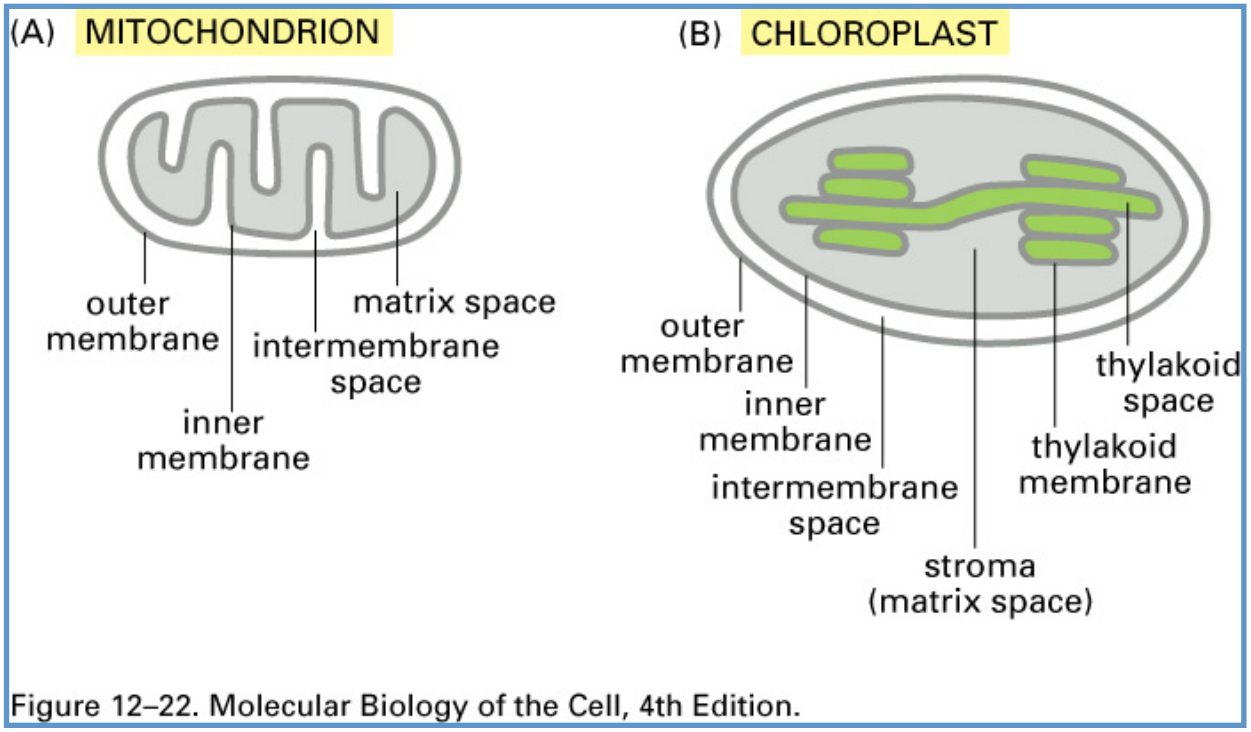


Figure 12–22. Molecular Biology of the Cell, 4th Edition.

Transport v mitohondrije- signalna sekvenca je amfipatična alfa vijačnica

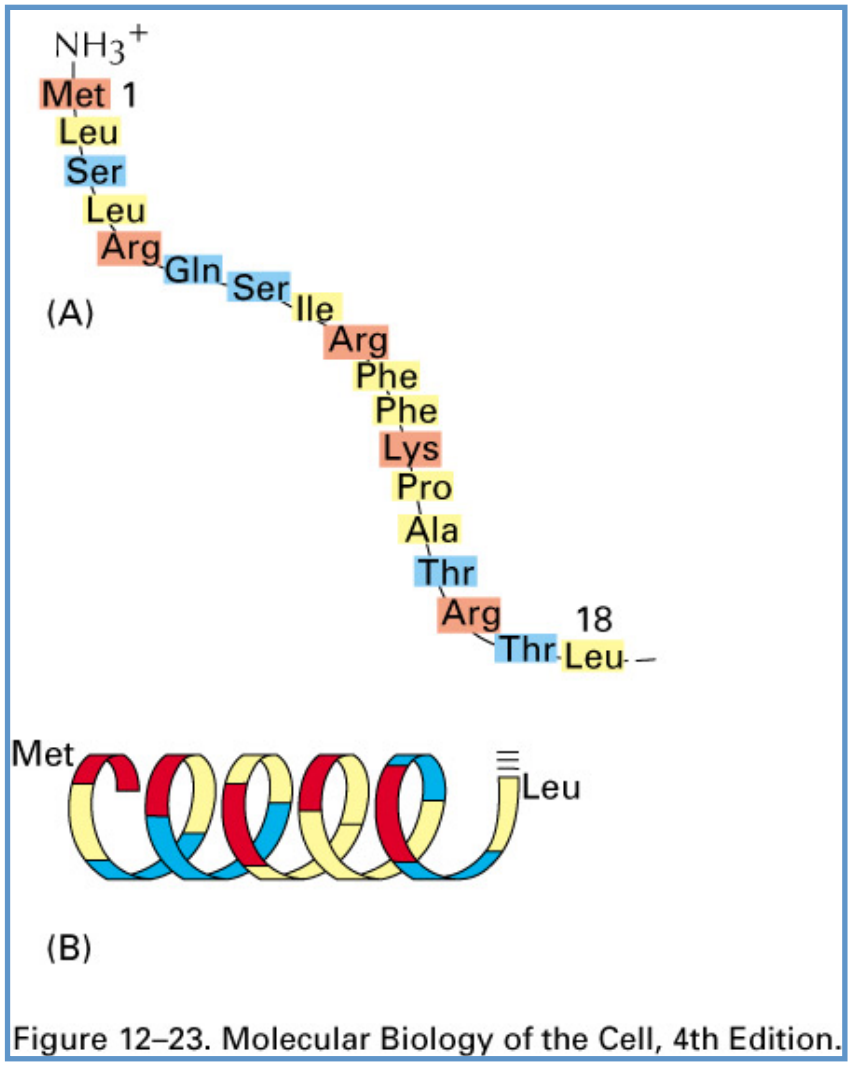


Figure 12–23. Molecular Biology of the Cell, 4th Edition.

Transport v mitohondrije

- TOM- translokator proteinov v zunanji membrani
- TIM- v notranji membrani
- OXA- insercija proteinov, ki se sintetizirajo v MT in tistih, ki so se transportirali v matriks, v notranjo membrano

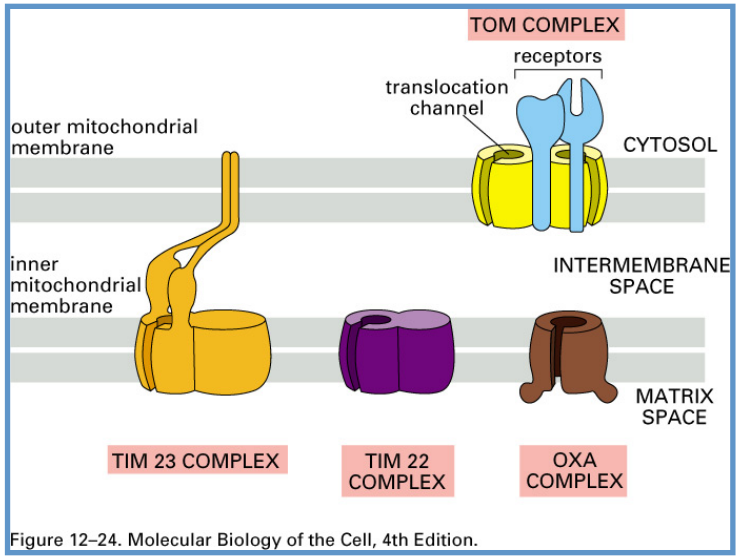


Figure 12–24. Molecular Biology of the Cell, 4th Edition.

Transport proteinov v mitohondrije

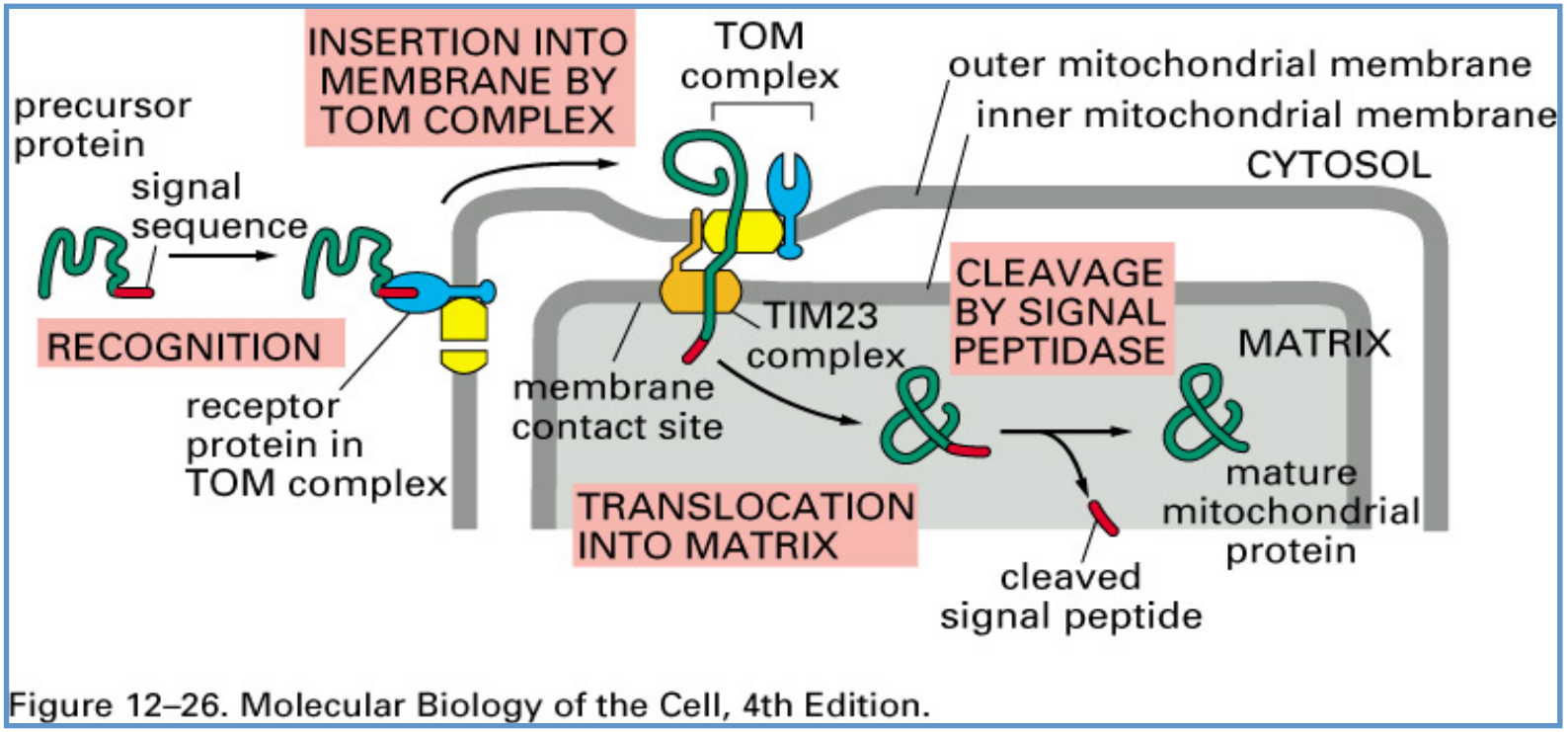


Figure 12–26. Molecular Biology of the Cell, 4th Edition.

Za transport proteinov v mitohondrije je potrebna energija

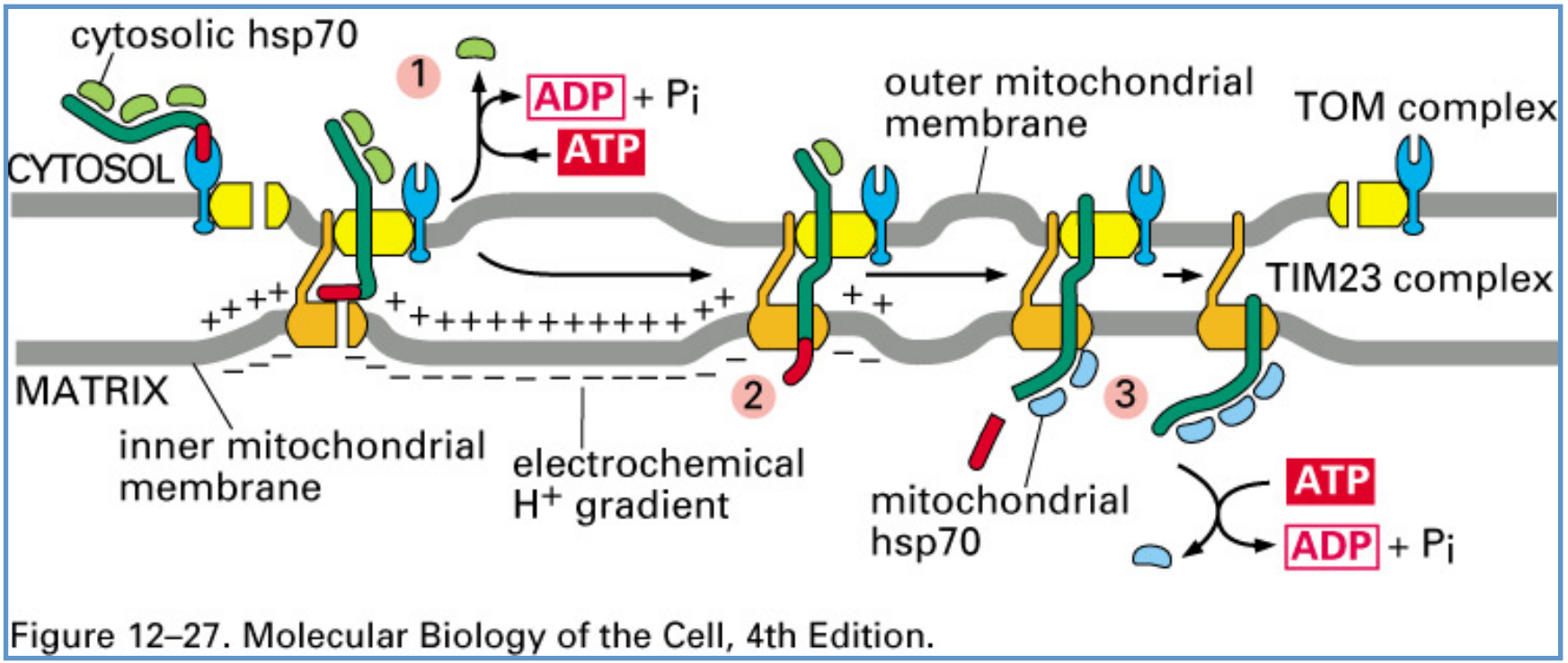
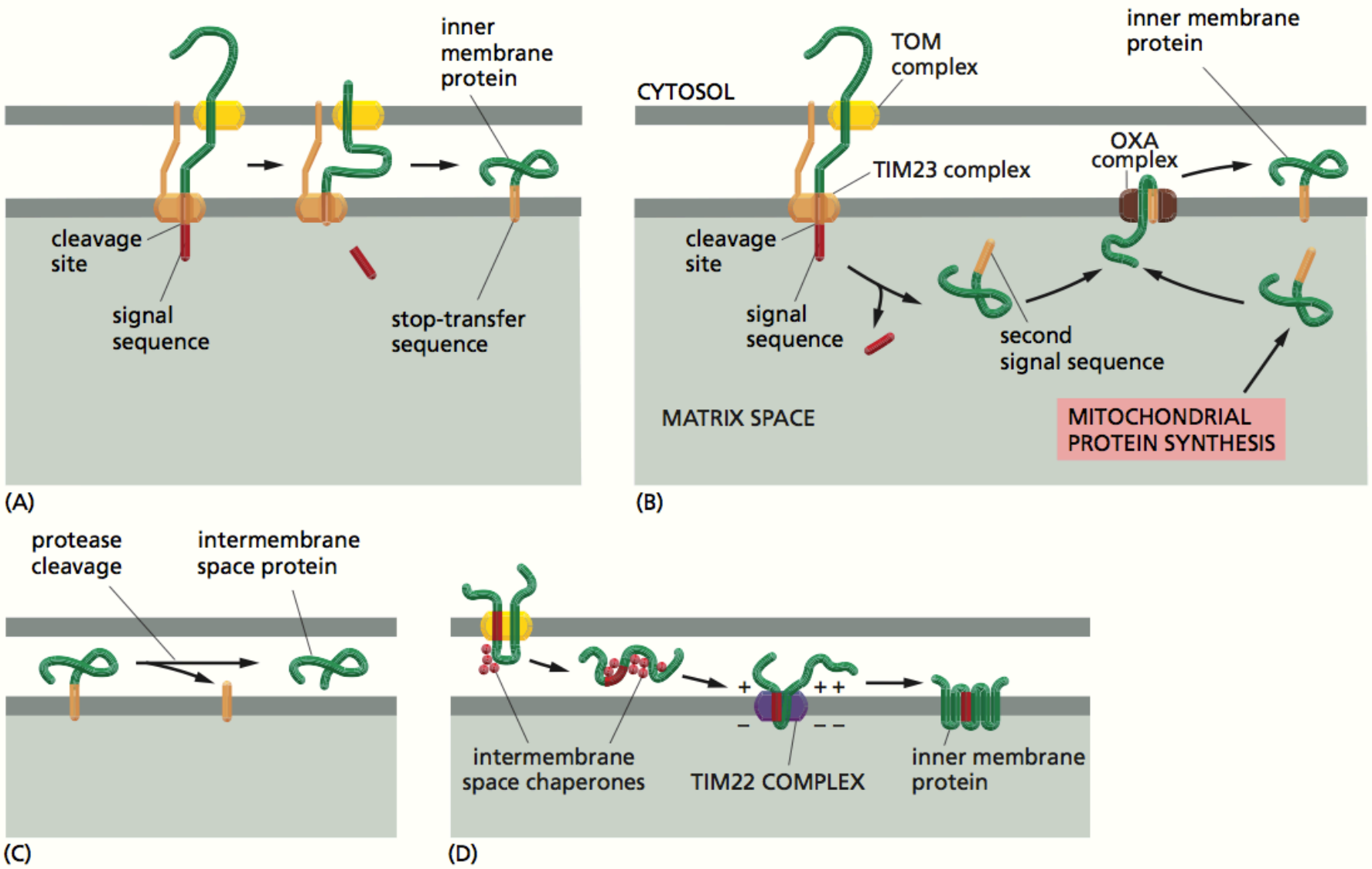
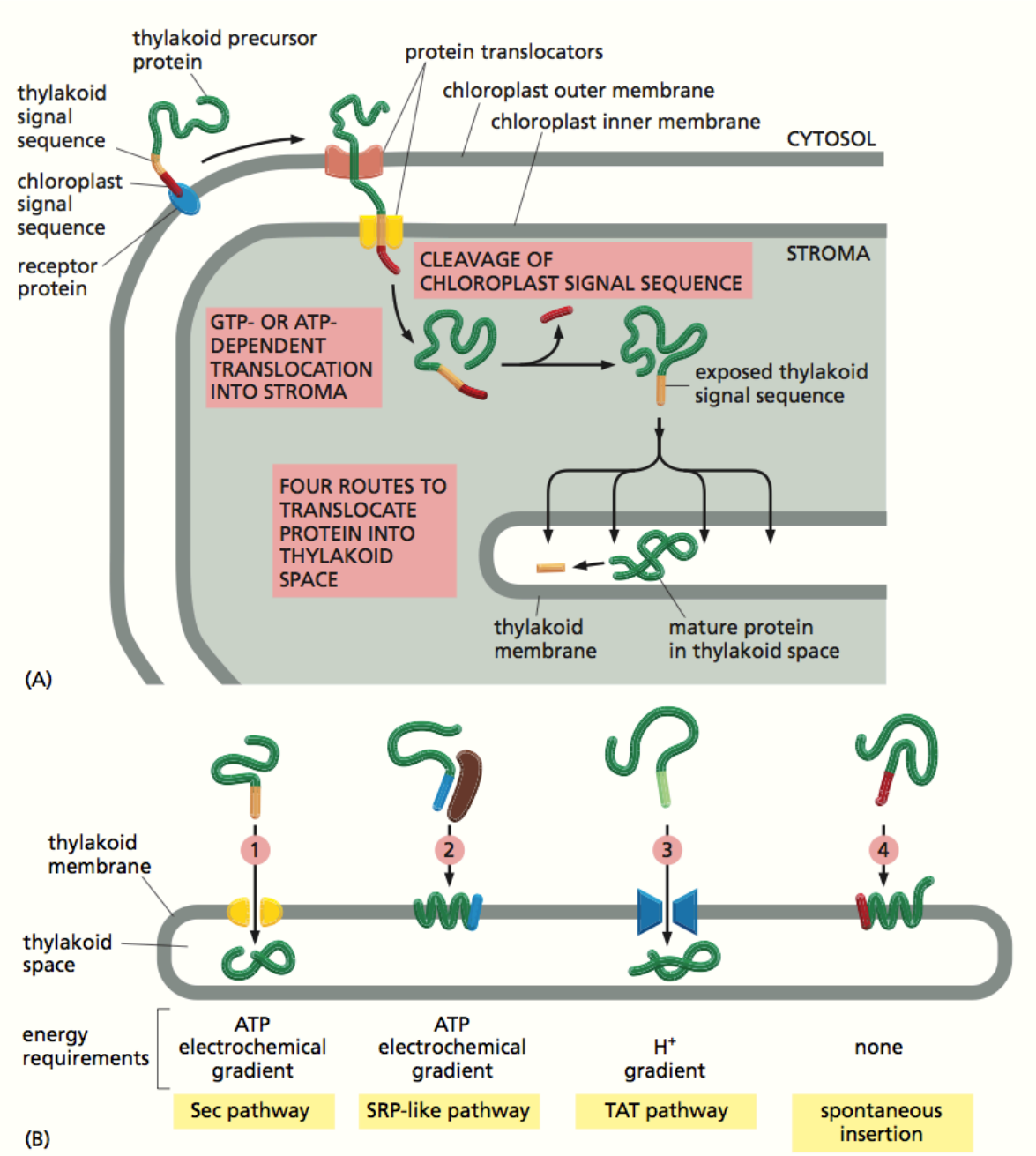


Figure 12–27. Molecular Biology of the Cell, 4th Edition.

Dve signalni zaporedji sta potrebni za transport proteinov v medmembranski prostor ali v notranjo MT membrano



Transport proteinov v kloroplaste



Peroksisomi

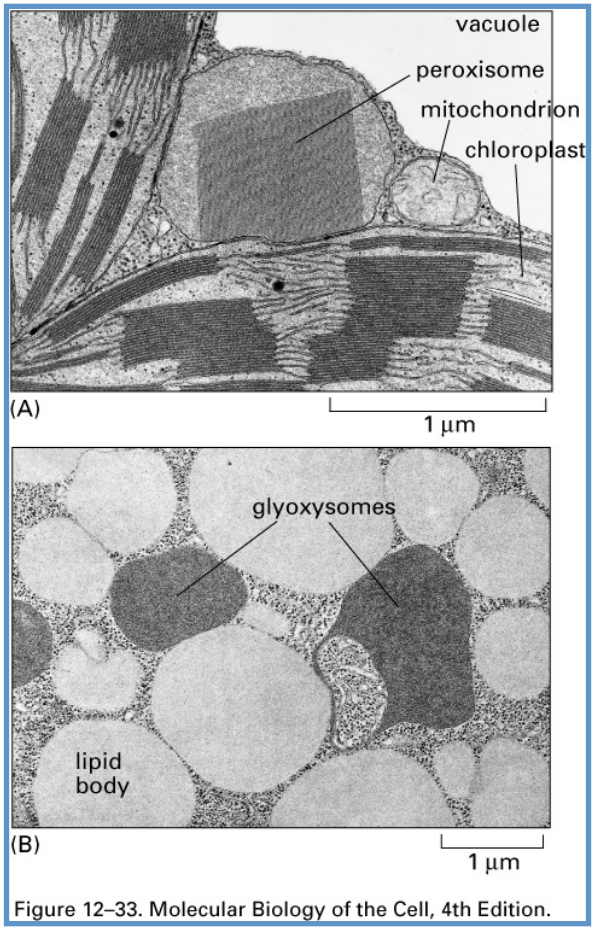
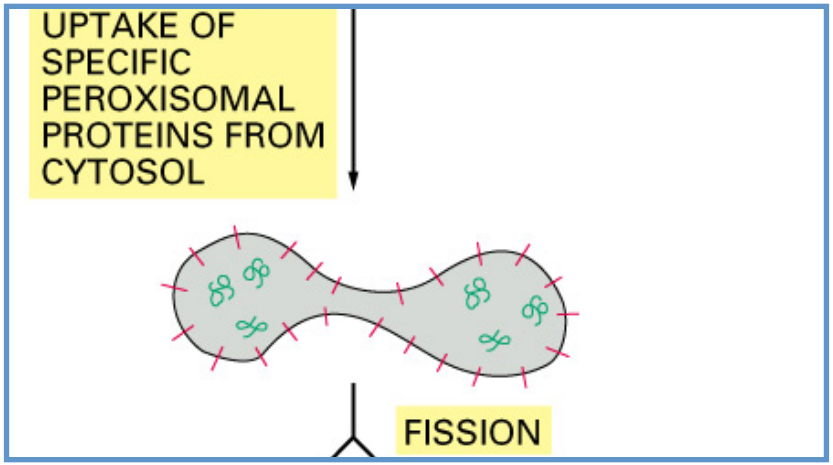


Figure 12–33. Molecular Biology of the Cell, 4th Edition.



- -Ser-Lys-Leu-COO^-
- peroksini- transportni proteini

Endoplazemski retikulum

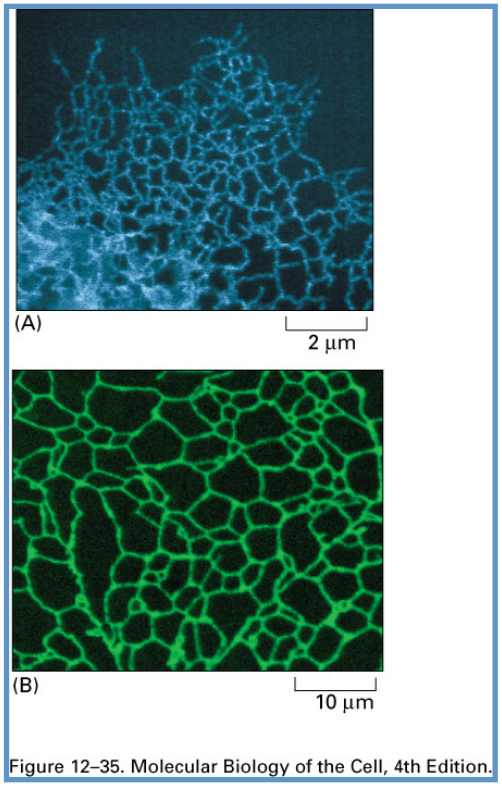


Figure 12–35. Molecular Biology of the Cell, 4th Edition.

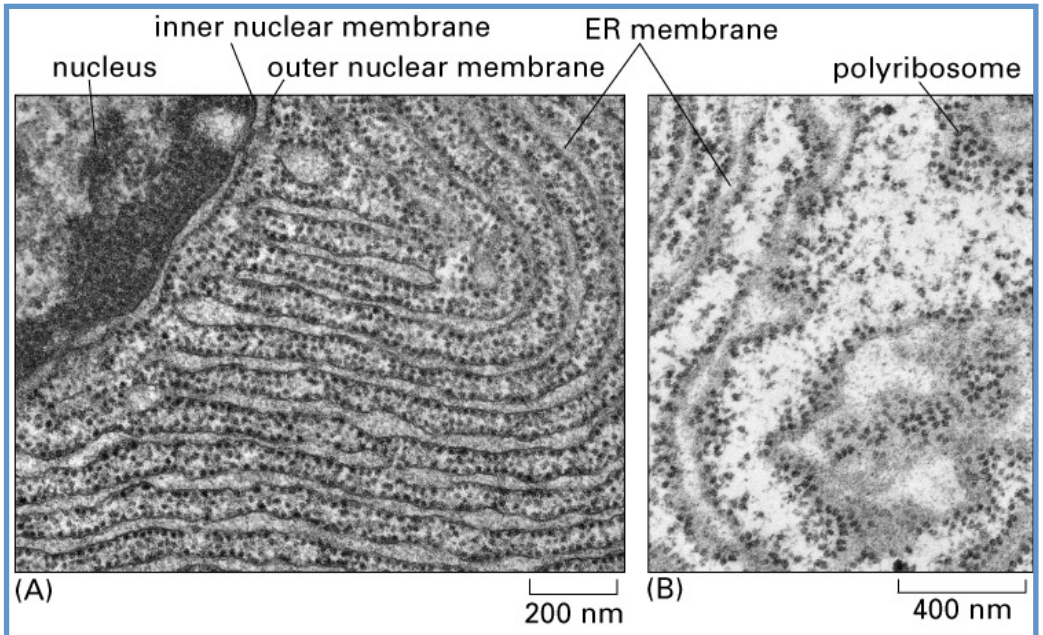


Figure 12–36. Molecular Biology of the Cell, 4th Edition.

- zavzema >= 50% vse membranske površine v celici in ~10% celičnega volumna
- kontinuirana membrana z jedrno membrano
- centralna vloga pri sintezi proteinov in lipidov

ER in transport proteinov

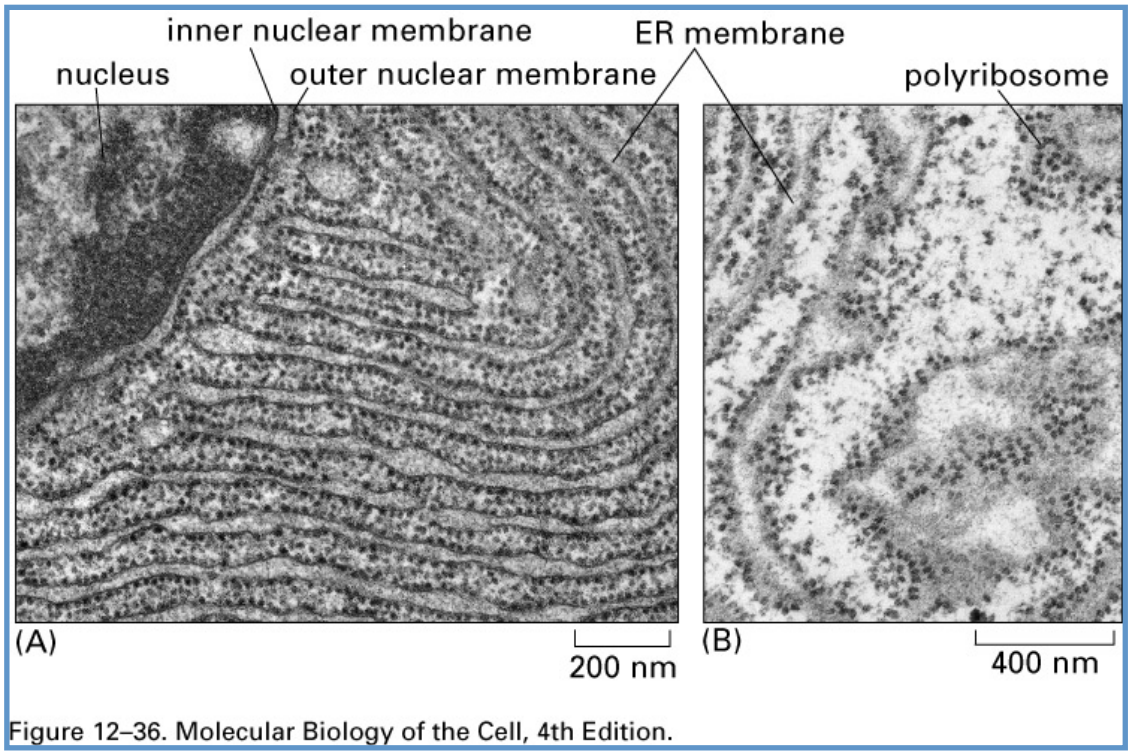


Figure 12–36. Molecular Biology of the Cell, 4th Edition.

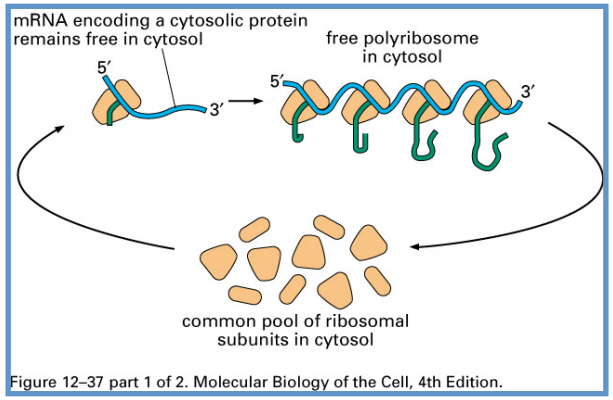


Figure 12–37 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

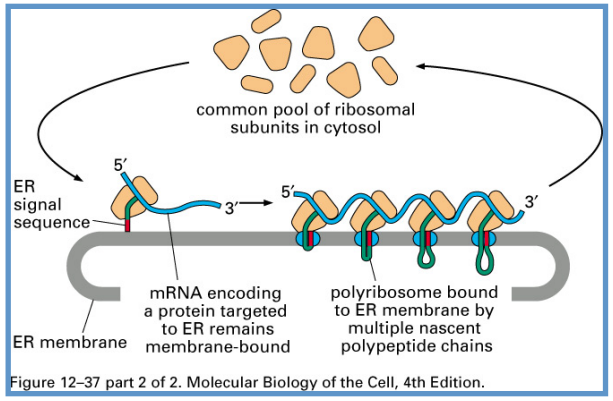


Figure 12–37 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

- vsi transmembranski proteini, skoraj vsi ekstracelularni proteini ter proteini, ki gredo v lumen ER, Golgijev aparat in lizosome se najprej prenesejo v lumen ER
- proteini se prenašajo v lumen ER že med sintezo (kotranslacijsko)- ribosom je pritrjen na ER membrano (grobi ER)

Gladki in grobi ER

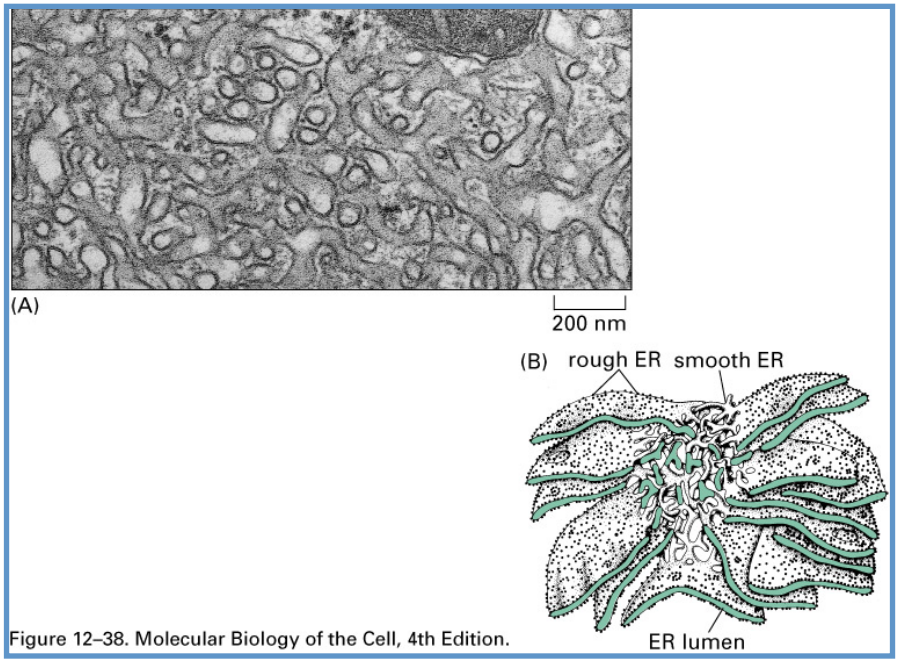


Figure 12–38. Molecular Biology of the Cell, 4th Edition.

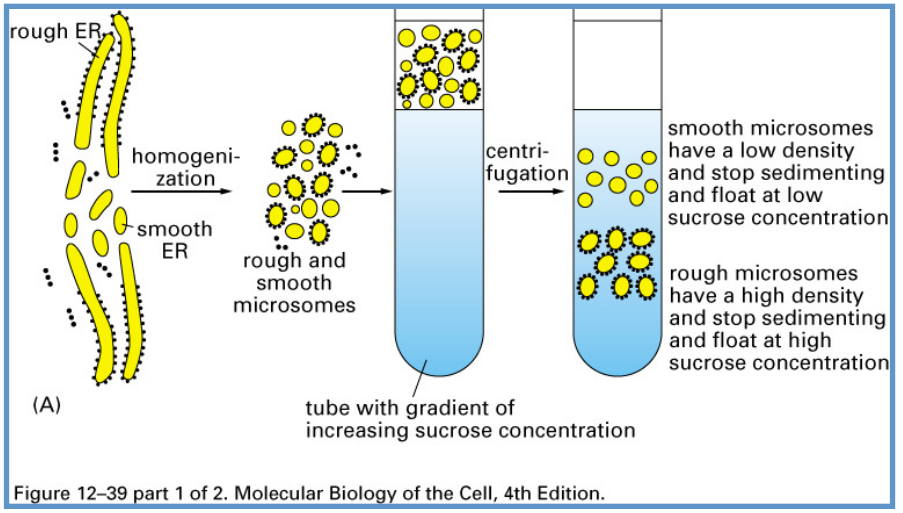
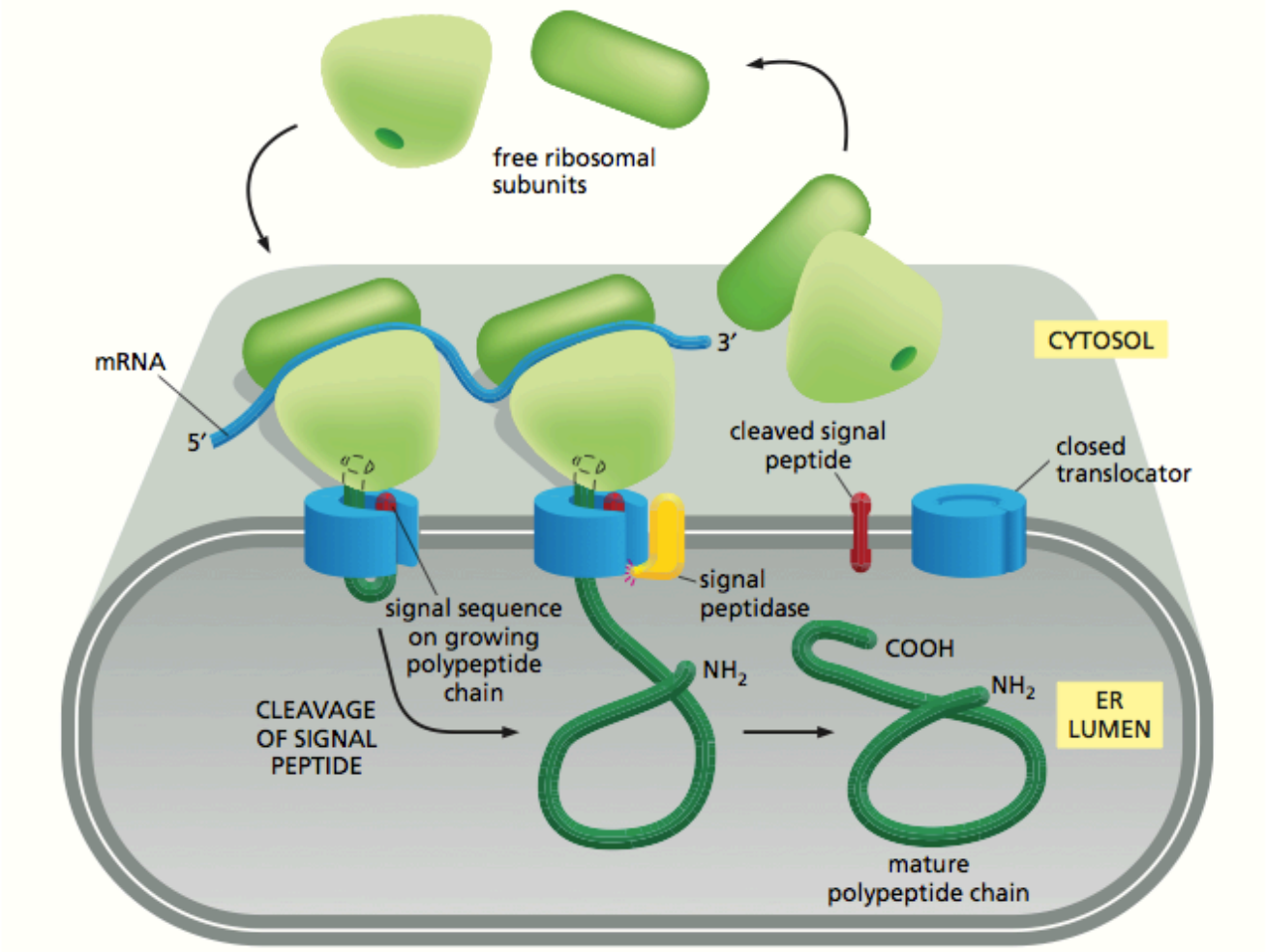


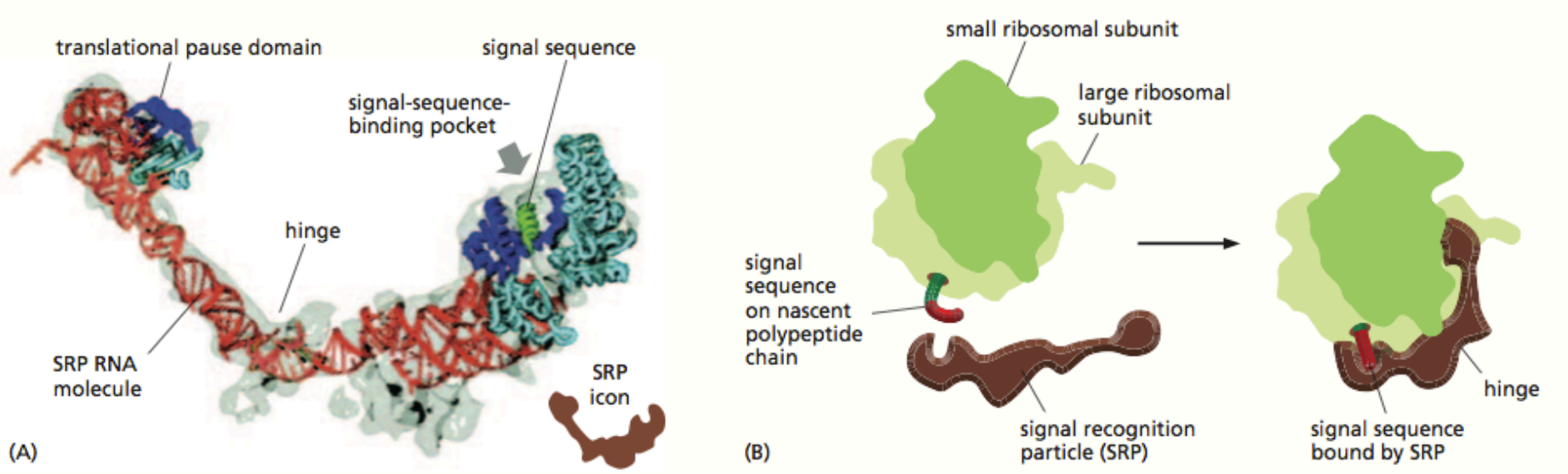
Figure 12–39 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

ER in transport proteinov- hipoteza

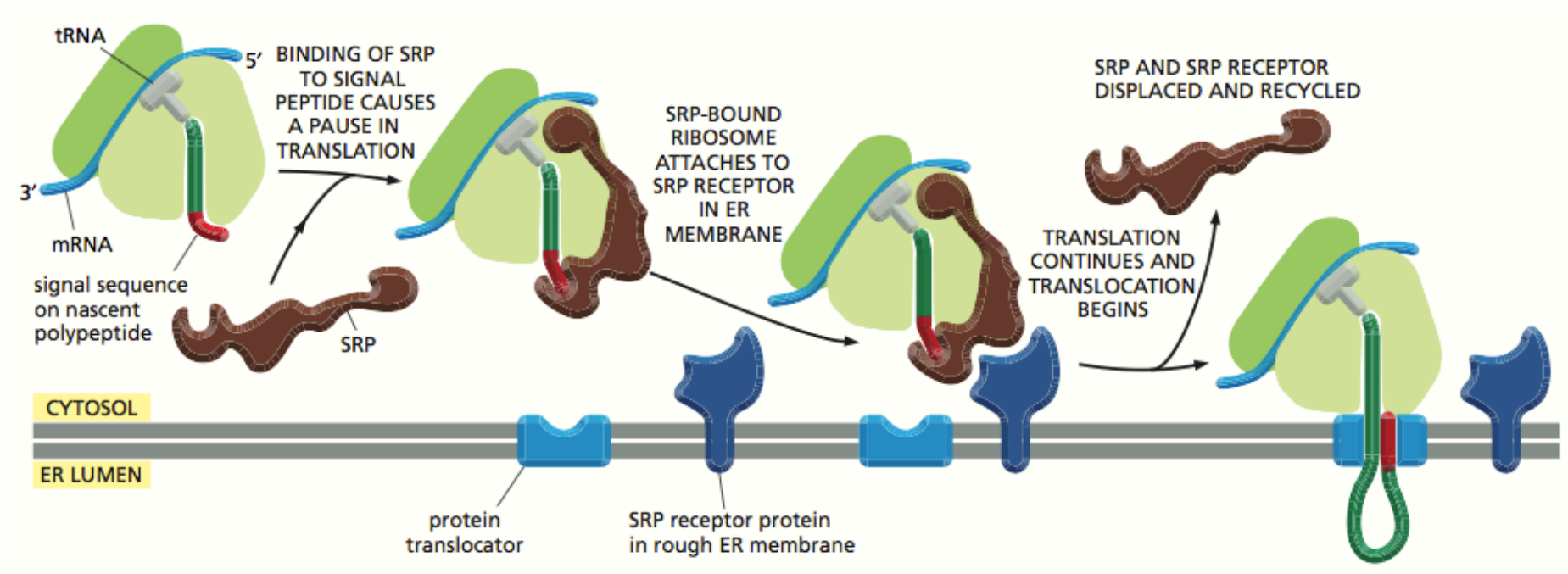


Delec, ki prepozna signalno zaporedje (SRP)

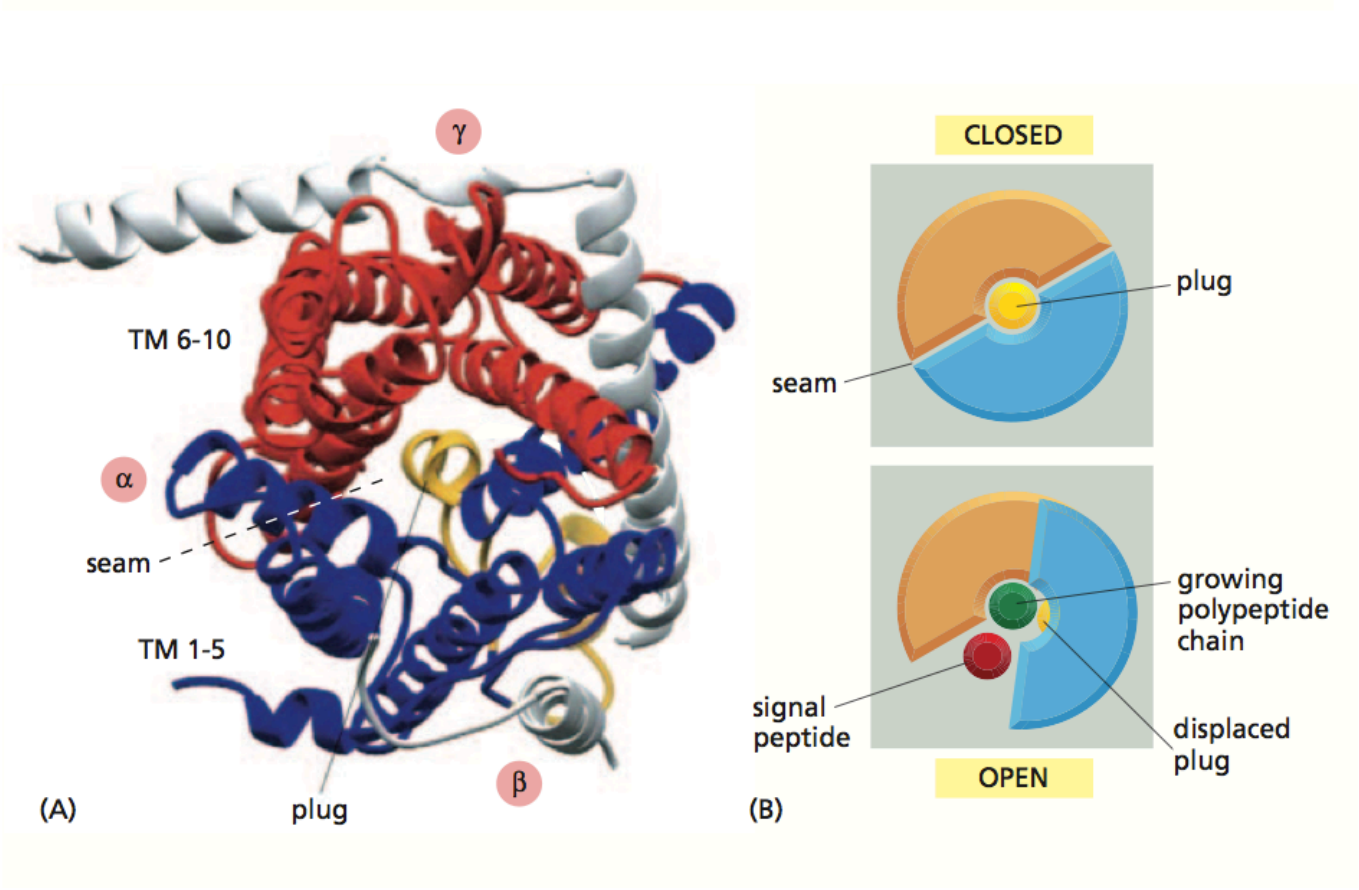
- hidrofobna signalna sekvenca – 8 ali več AK
- SRP ima hidrofobni žep
- vezava SRP zaustavi sintezo proteina, dokler se ribosom ne veže na SRP receptor v ER membrani
- protein se podaljšuje v ER



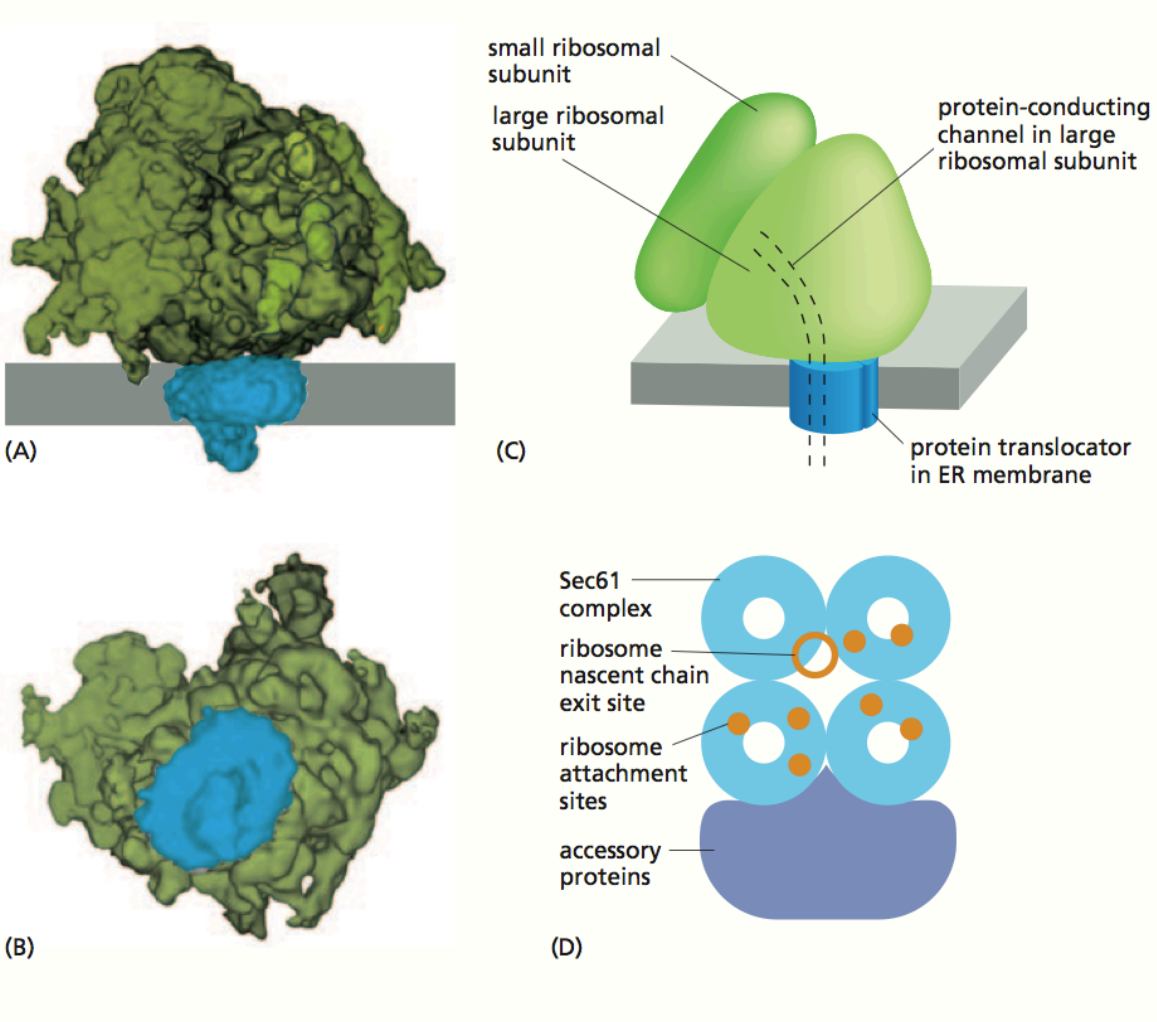
ER in transport proteinov



ER in transport proteinov - translokator



ER in transport proteinov



Nekateri proteini se tudi v ER prenesejo post-translacijsko

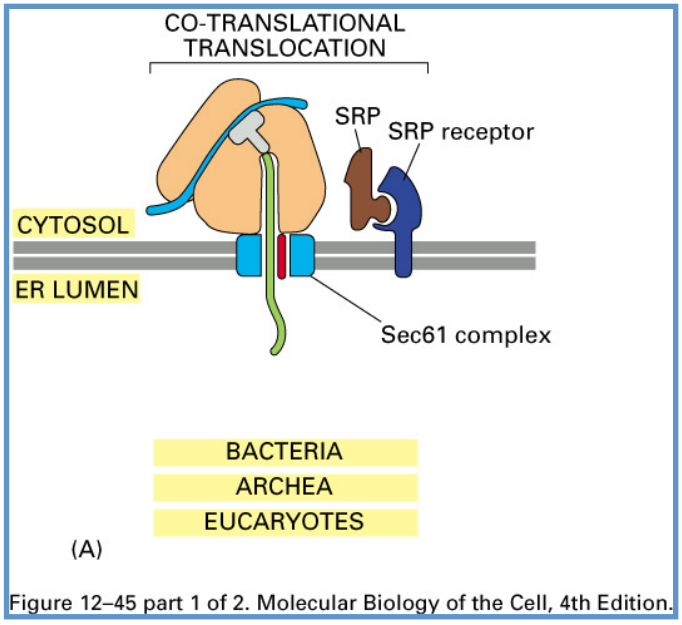


Figure 12–45 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

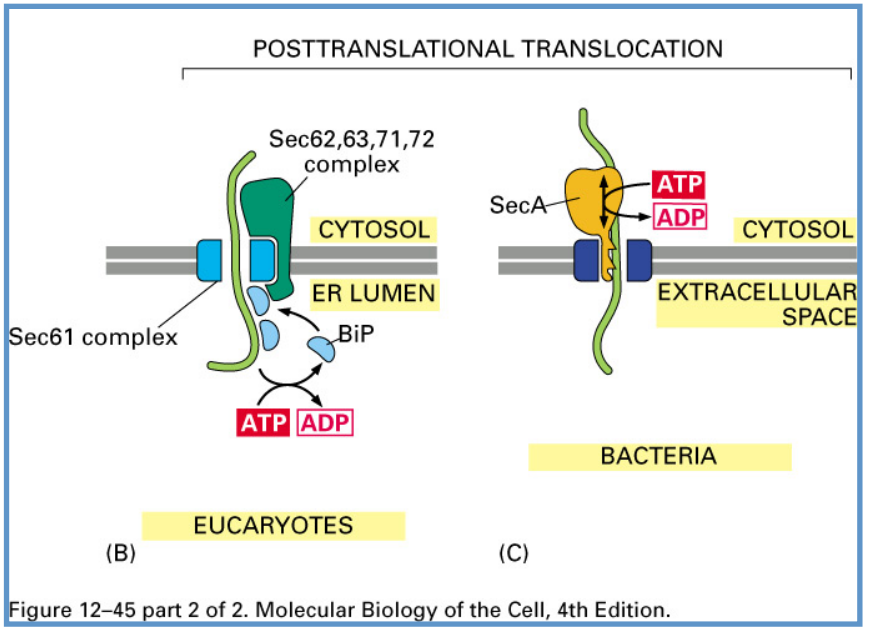


Figure 12–45 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

V lumnu ER se signalno zaporedje odstrani

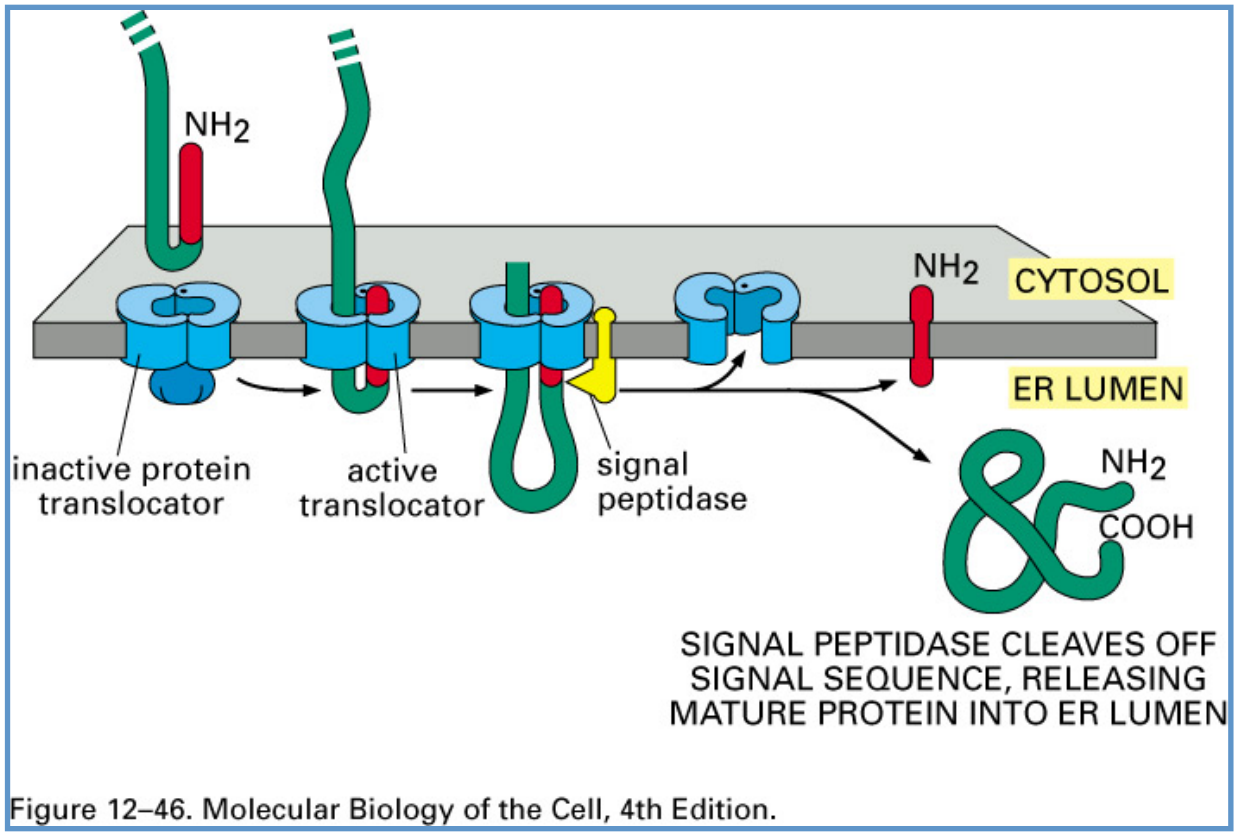


Figure 12–46. Molecular Biology of the Cell, 4th Edition.

Transmembranski proteini

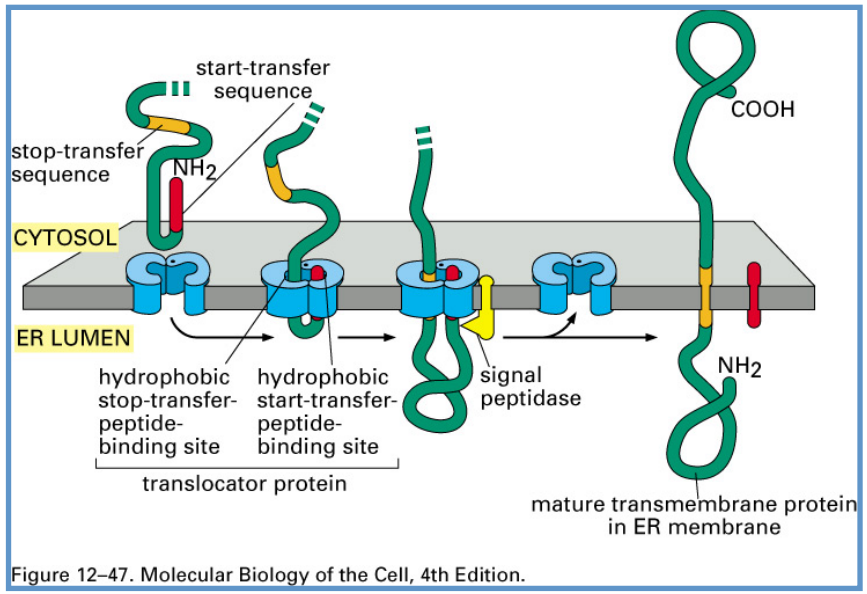


Figure 12–47. Molecular Biology of the Cell, 4th Edition.

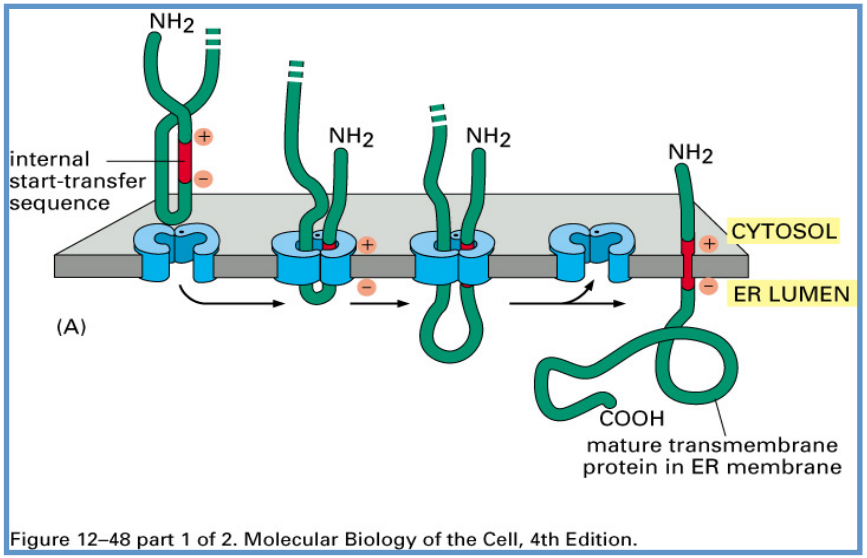


Figure 12–48 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

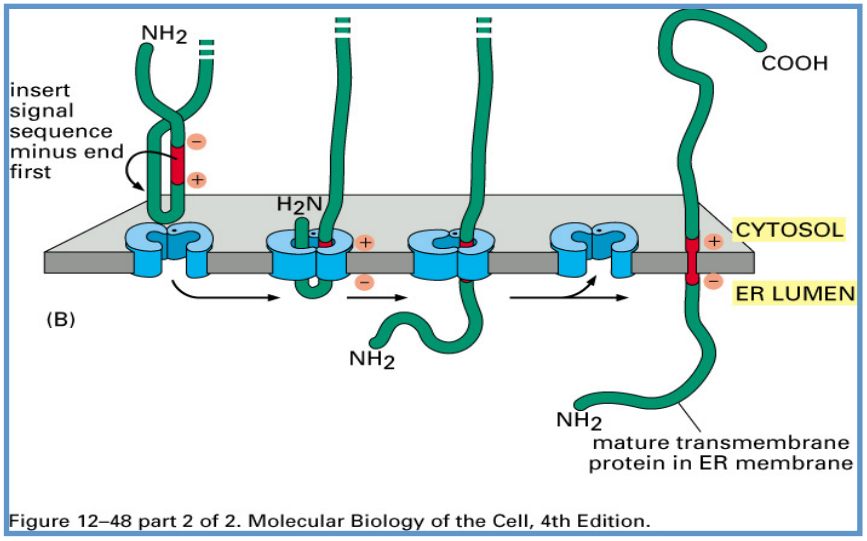
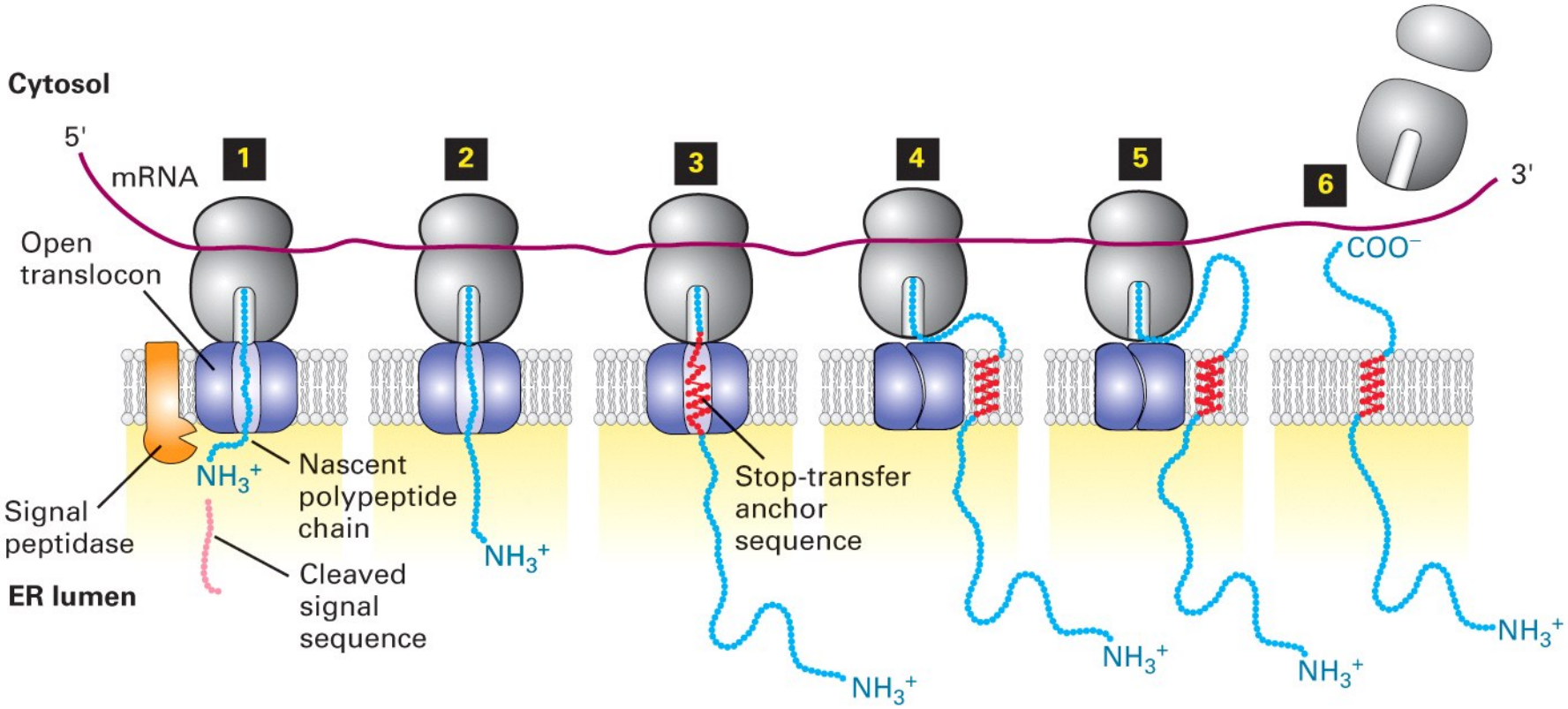
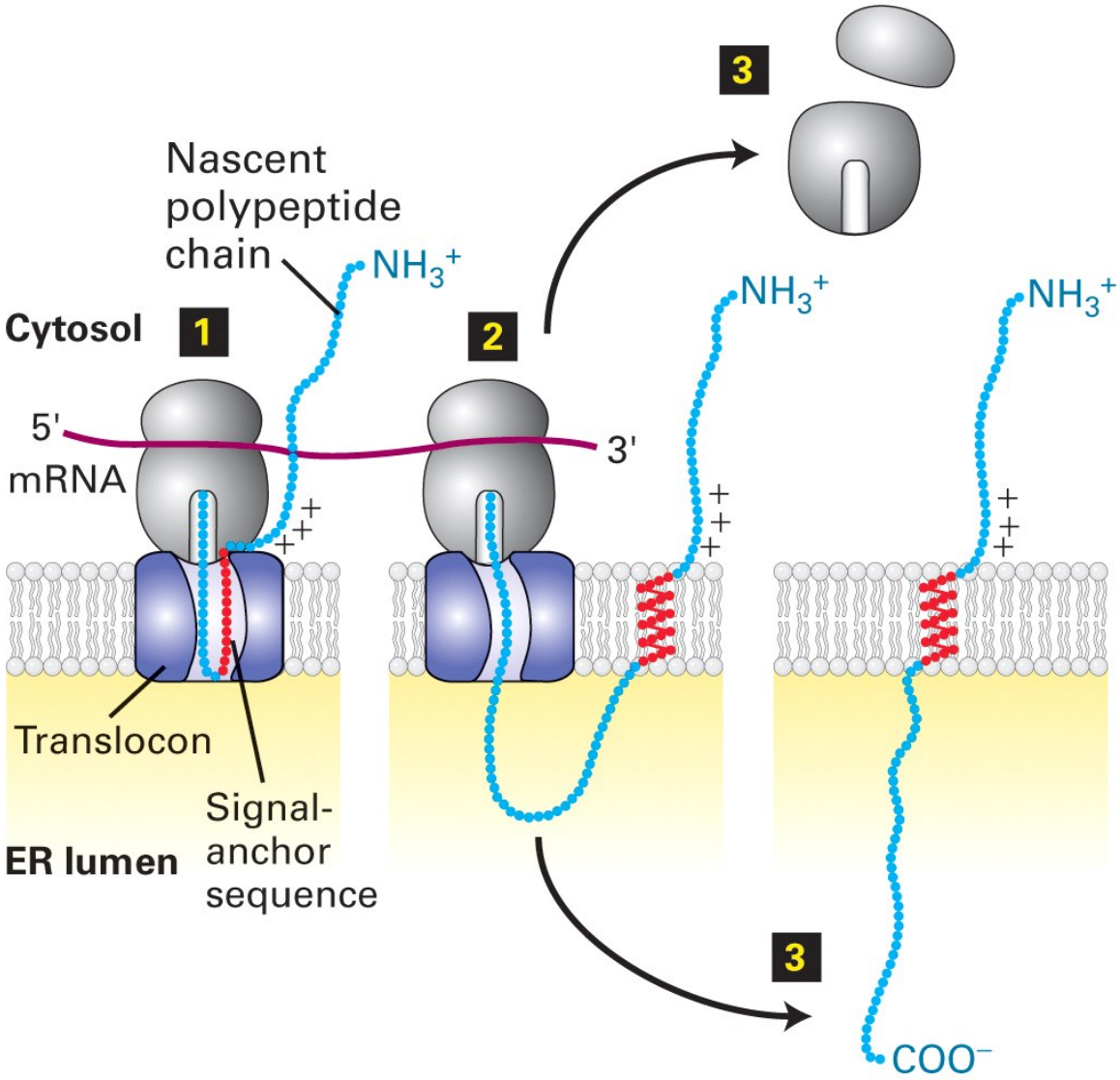


Figure 12–48 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

Transmembranski proteini



Transmembranski proteini



Transmembranski proteini 2

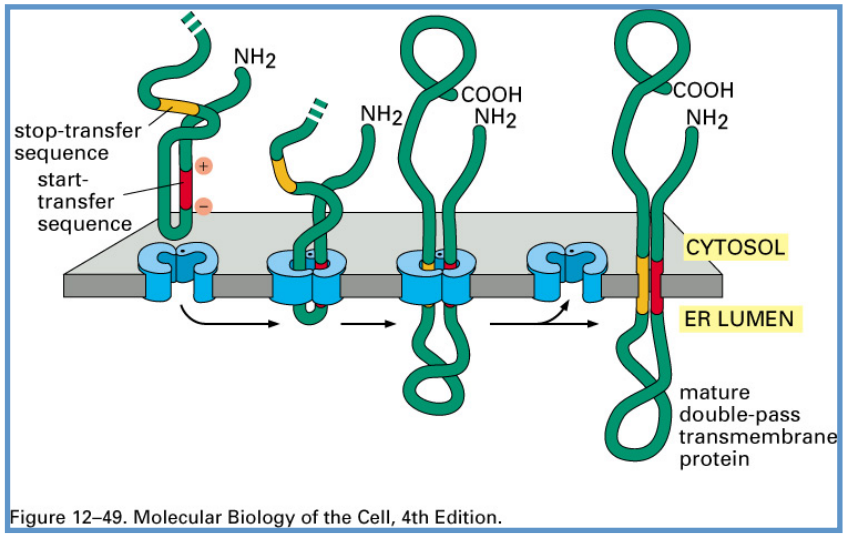


Figure 12–49. Molecular Biology of the Cell, 4th Edition.

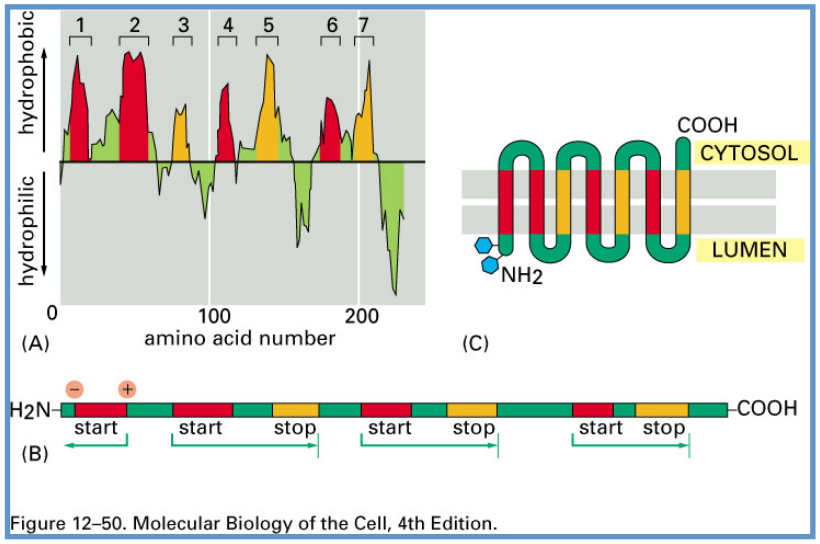
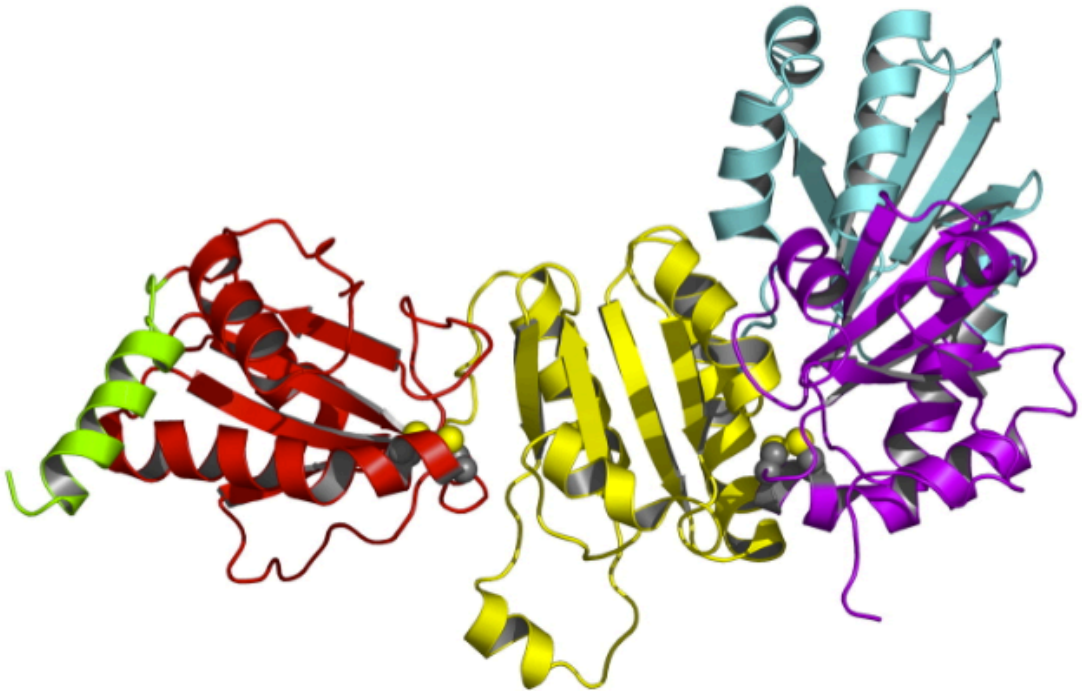


Figure 12–50. Molecular Biology of the Cell, 4th Edition.

ER in transport proteinov

- proteini, ki ostanejo v ER vsebujejo ER zadrževalni signal- 4AK na C-koncu (npr. PDI, BiP šaperone ...)



Tipična signalna AK zaporedja

Table 12–3 Some Typical Signal Sequences

FUNCTION OF SIGNAL SEQUENCE	EXAMPLE OF SIGNAL SEQUENCE
Import into nucleus	-Pro-Pro-Lys-Lys-Lys-Arg-Lys-Val-
Export from nucleus	-Leu-Ala-Leu-Lys-Leu-Ala-Gly-Leu-Asp-Ile-
Import into mitochondria	$^{+}H_3N$-Met-Leu-Ser-Leu-Arg-Gln-Ser-Ile-Arg-Phe-Phe-Lys-Pro-Ala-Thr-Arg-Thr-Leu-Cys-Ser-Ser-Arg-Tyr-Leu-Leu-
Import into plastid	$^{+}H_3N$-Met-Val-Ala-Met-Ala-Met-Ala-Ser-Leu-Gln-Ser-Ser-Met-Ser-Ser-Leu-Ser-Leu-Ser-Ser-Asn-Ser-Phe-Leu-Gly-Gln-Pro-Leu-Ser-Pro-Ile-Thr-Leu-Ser-Pro-Phe-Leu-Gln-Gly-
Import into peroxisomes	-Ser-Lys-Leu-COO^{-}
Import into ER	$^{+}H_3N$-Met-Met-Ser-Phe-Val-Ser-Leu-Leu-Leu-Val-Gly-Ile-Leu-Phe-Trp-Ala-Thr-Glu-Ala-Glu-Gln-Leu-Thr-Lys-Cys-Glu-Val-Phe-Gln-
Return to ER	-Lys-Asp-Glu-Leu-COO^{-}

Glikozilacija proteinov v ER

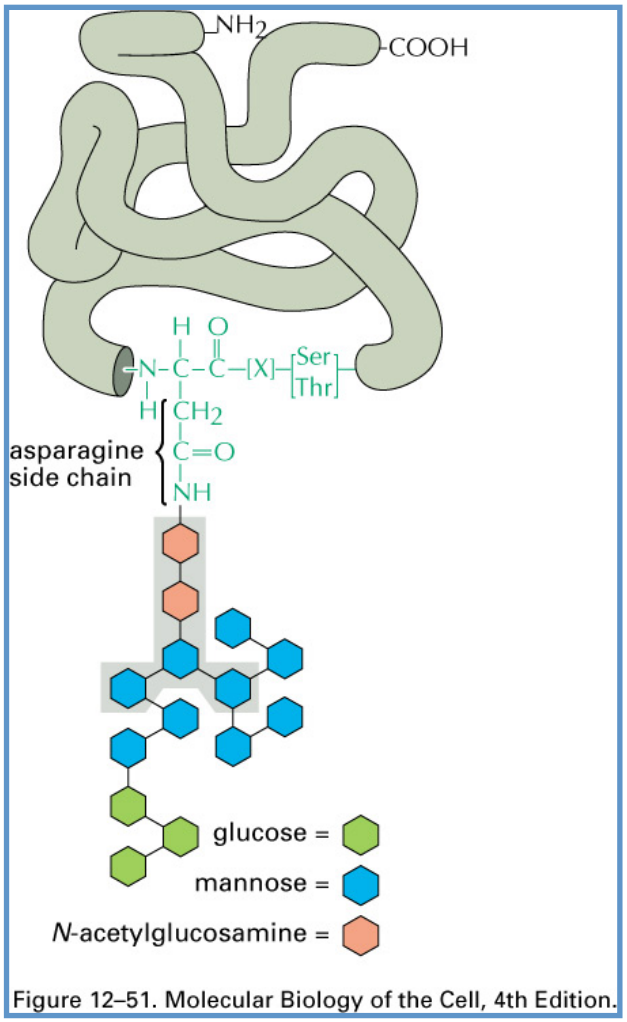


Figure 12–51. Molecular Biology of the Cell, 4th Edition.

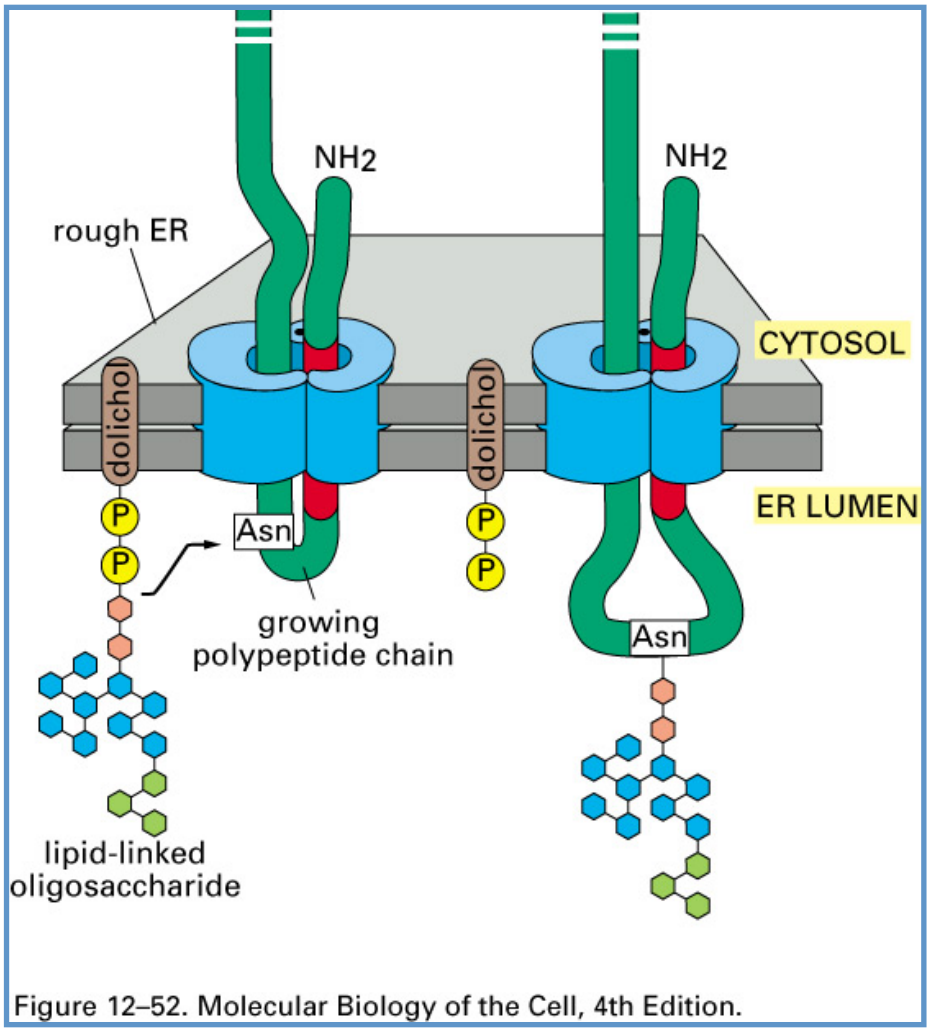
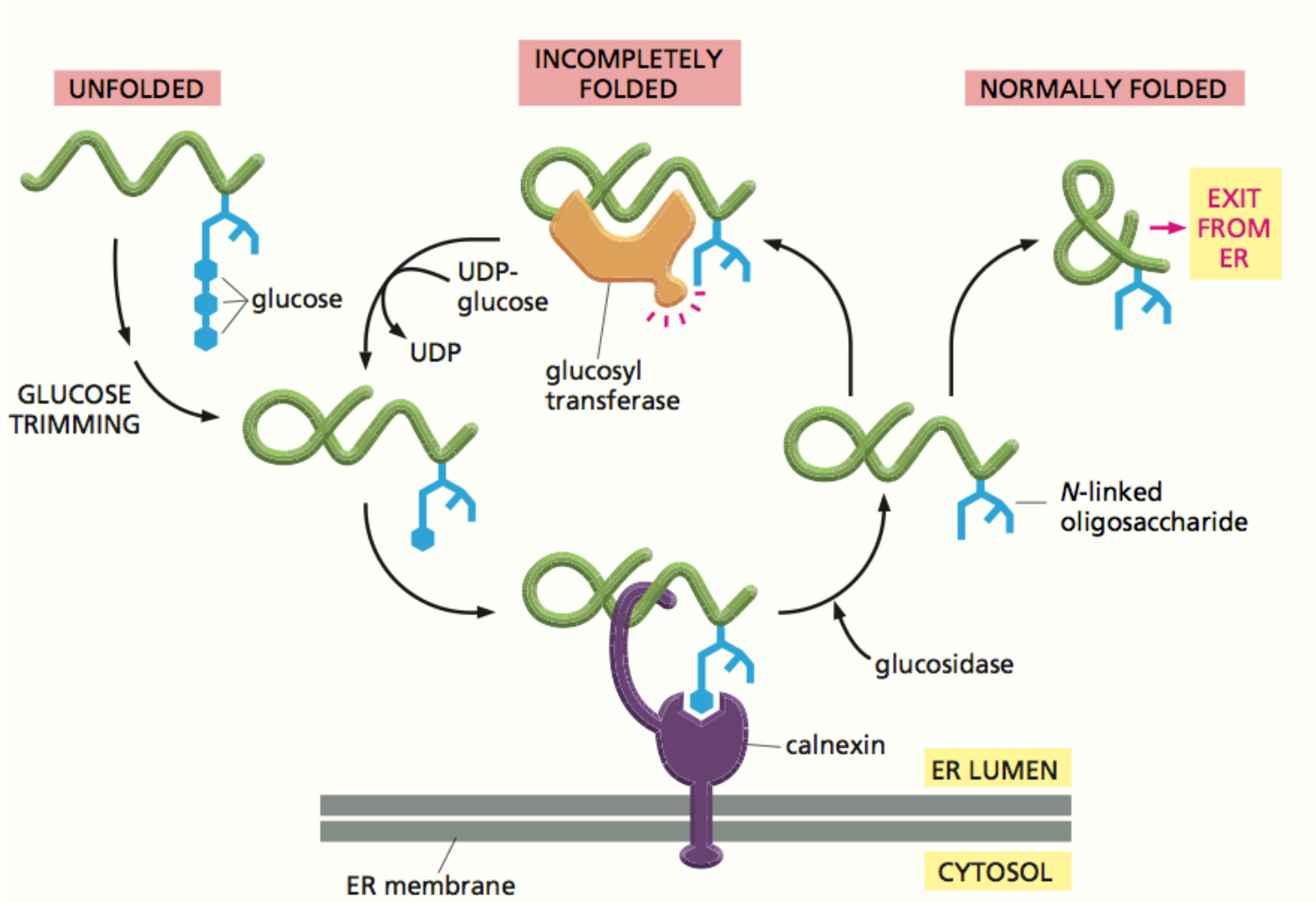


Figure 12–52. Molecular Biology of the Cell, 4th Edition.

Vloga N-glikozilacije pri kontroli zvijanja proteinov



Nepravilno zviti proteini se prenesejo nazaj v citosol- retrotranslokacija

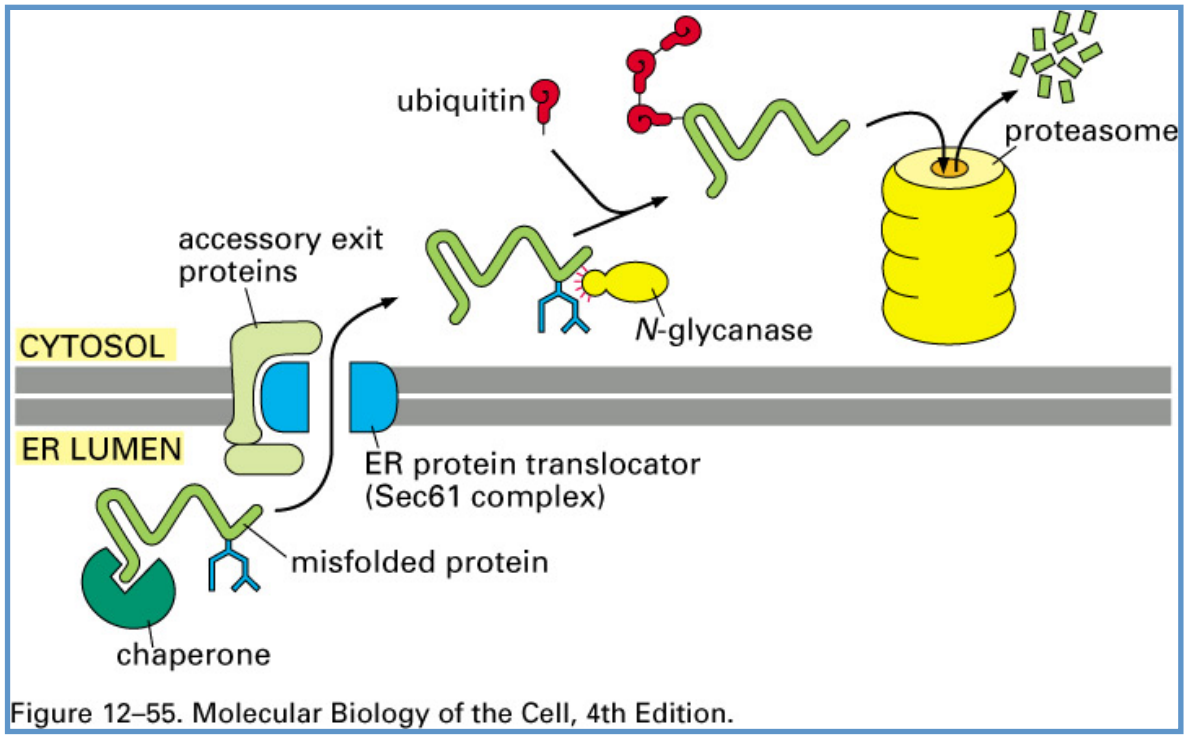


Figure 12–55. Molecular Biology of the Cell, 4th Edition.

ER in lipidni dvosloj

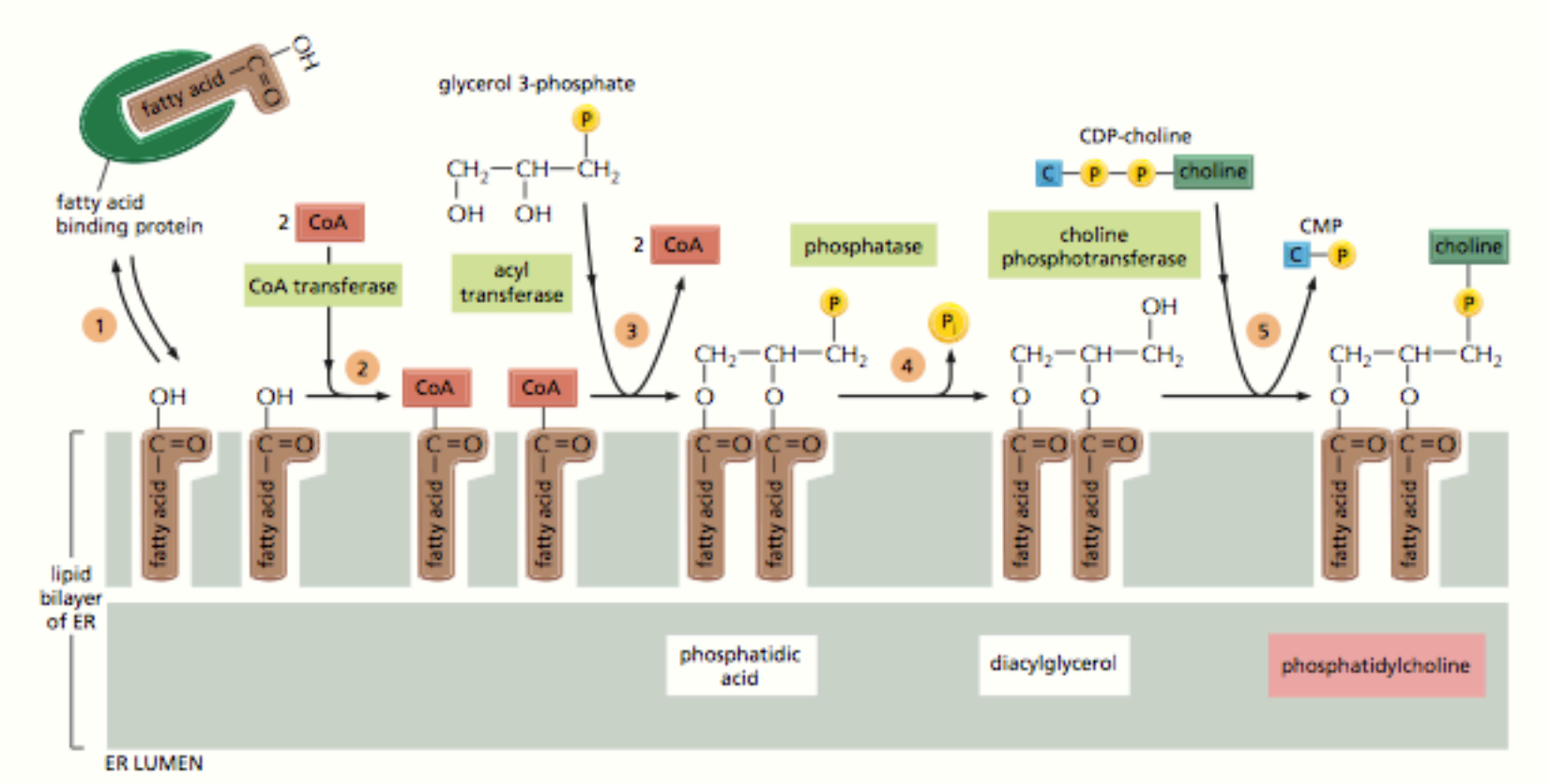


Figure 12–57 The synthesis of phosphatidylcholine. As illustrated, this phospholipid is synthesized from glycerol 3-phosphate, cytidine-diphosphocholine (CDP-choline), and fatty acids delivered to the ER by fatty acid binding protein.

ER in lipidni dvosloj

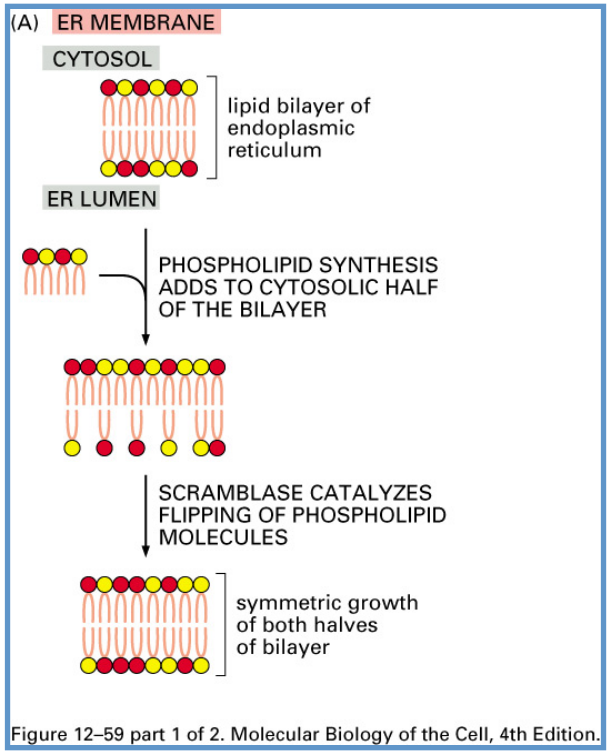


Figure 12–59 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

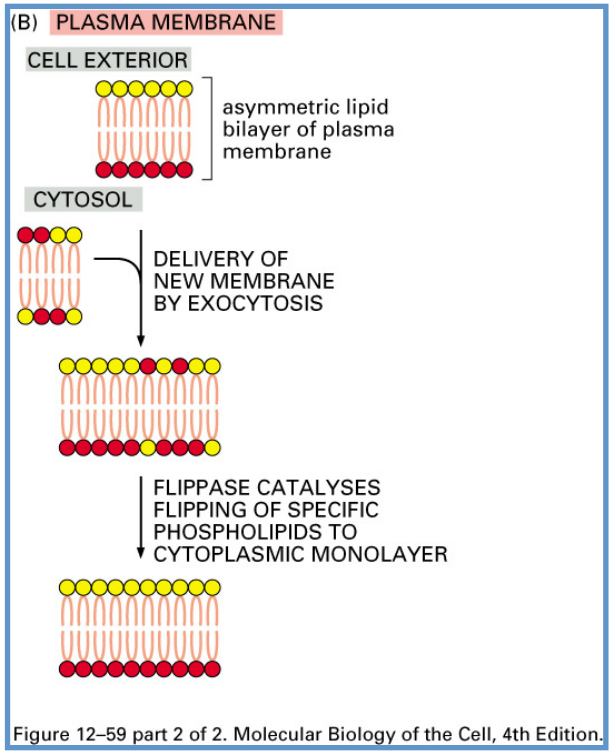
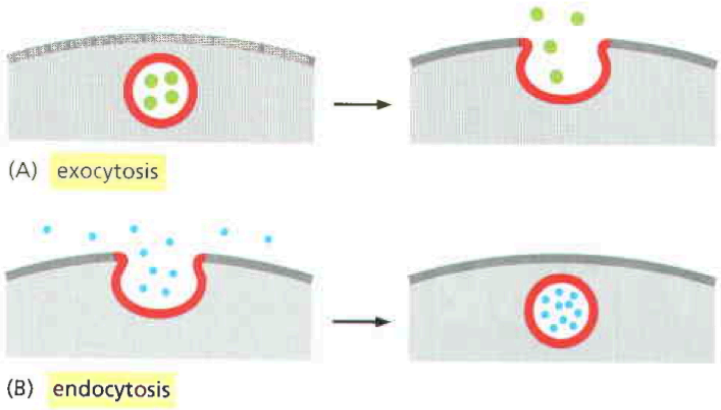
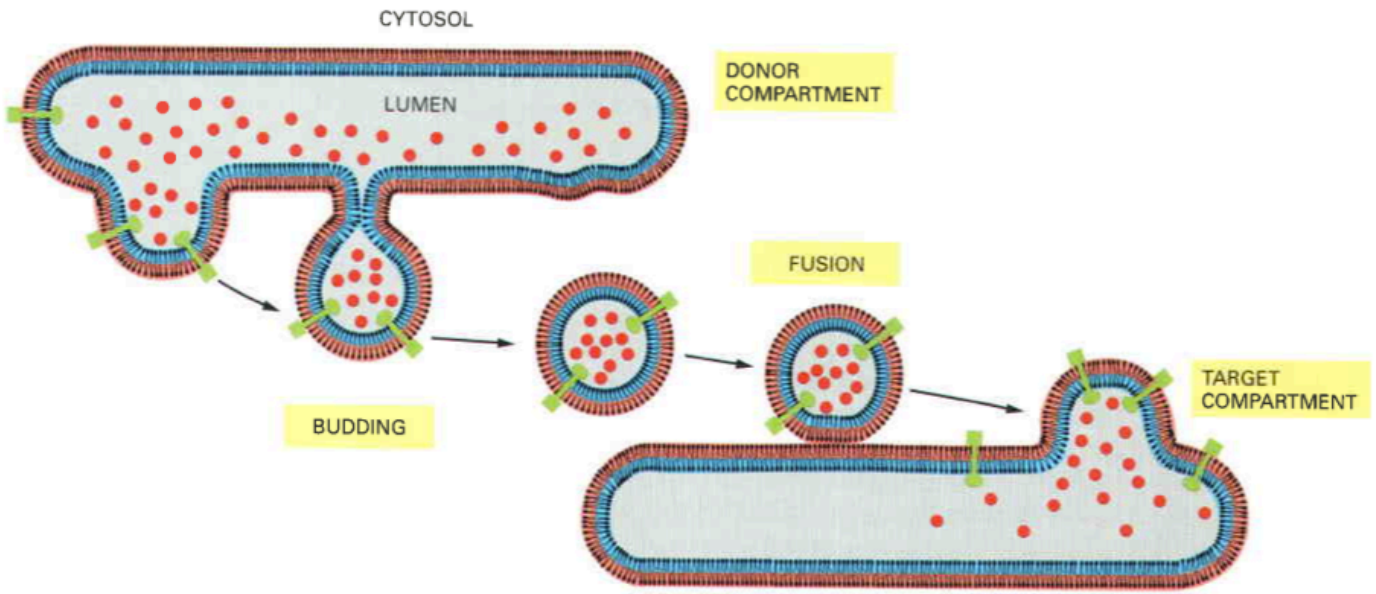


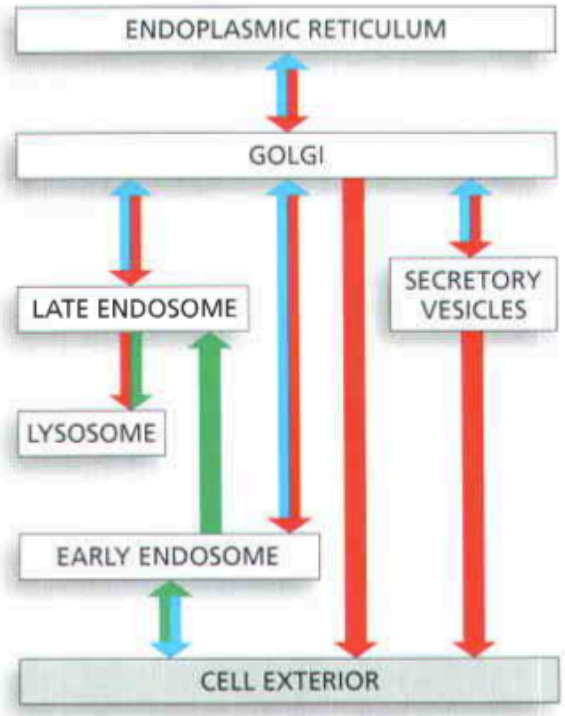
Figure 12–59 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

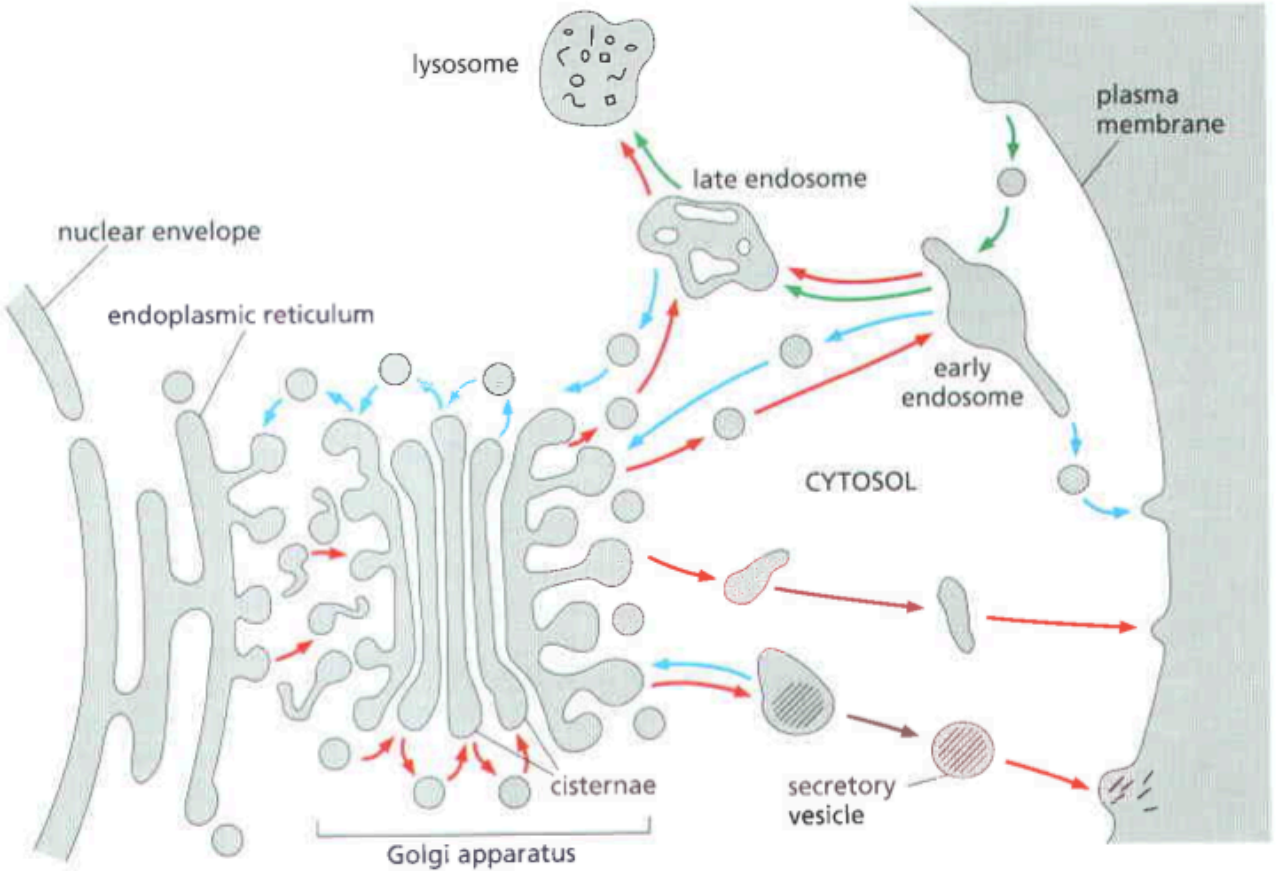
Vezikularni transport





Vezikularni transport

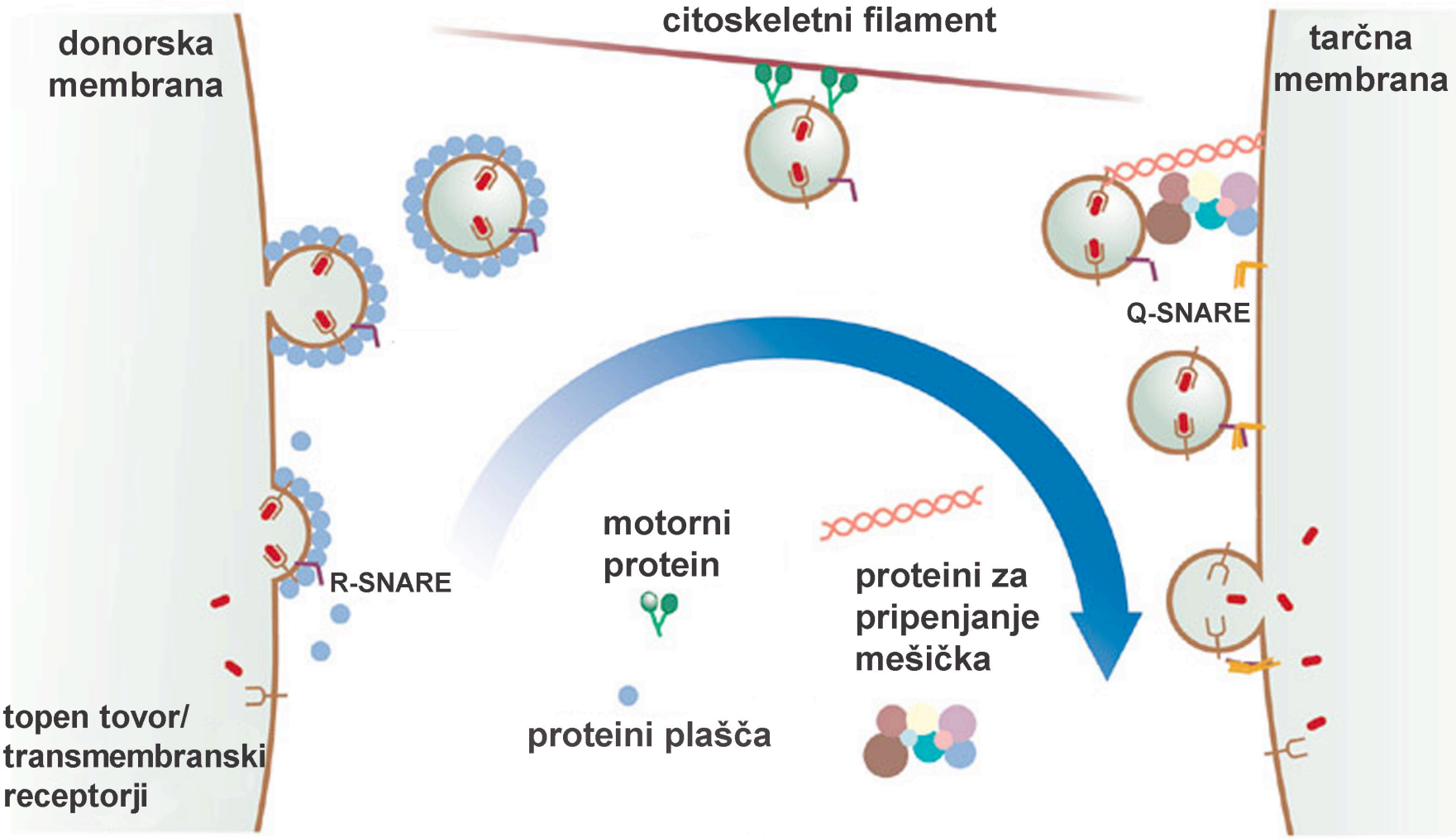




BRSTENJE MEŠIČKOV
(proteinski plašči, dinamin)

TRANSPORT MEŠIČKOV
(citoskeletni filamenti in
motorni proteini, proteini Rab)

FUZIJA MEŠIČKOV
(proteini SNARE)



Povzeto po: Behnia, R. in Munro, S. (*Nature*, 2005 (438) str. 597-604)

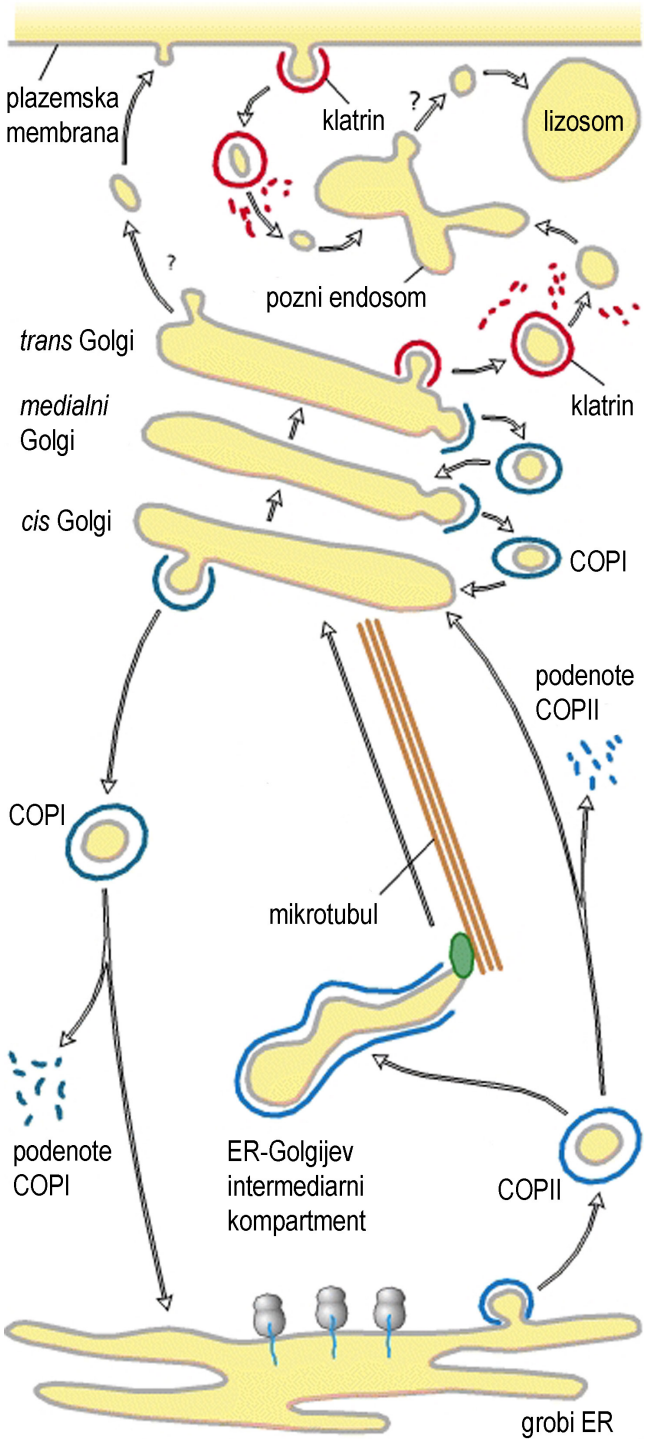
Nastanek mešička

I. Fagocitoza in makropinocitoza

II. Brstenje mešičkov iz plazemske membrane ali endocitoza

III. Brstenje mešičkov iz membran endoplazemskega retikuluma (ER)

IV. Brstenje mešičkov iz membran Golgijevega aparata (GA)



Povzeto po: Lodish, H. in sod. (Molecular Cell Biology, 4th edition, New York: W. H. Freeman, 2000)

Vezikularni transport