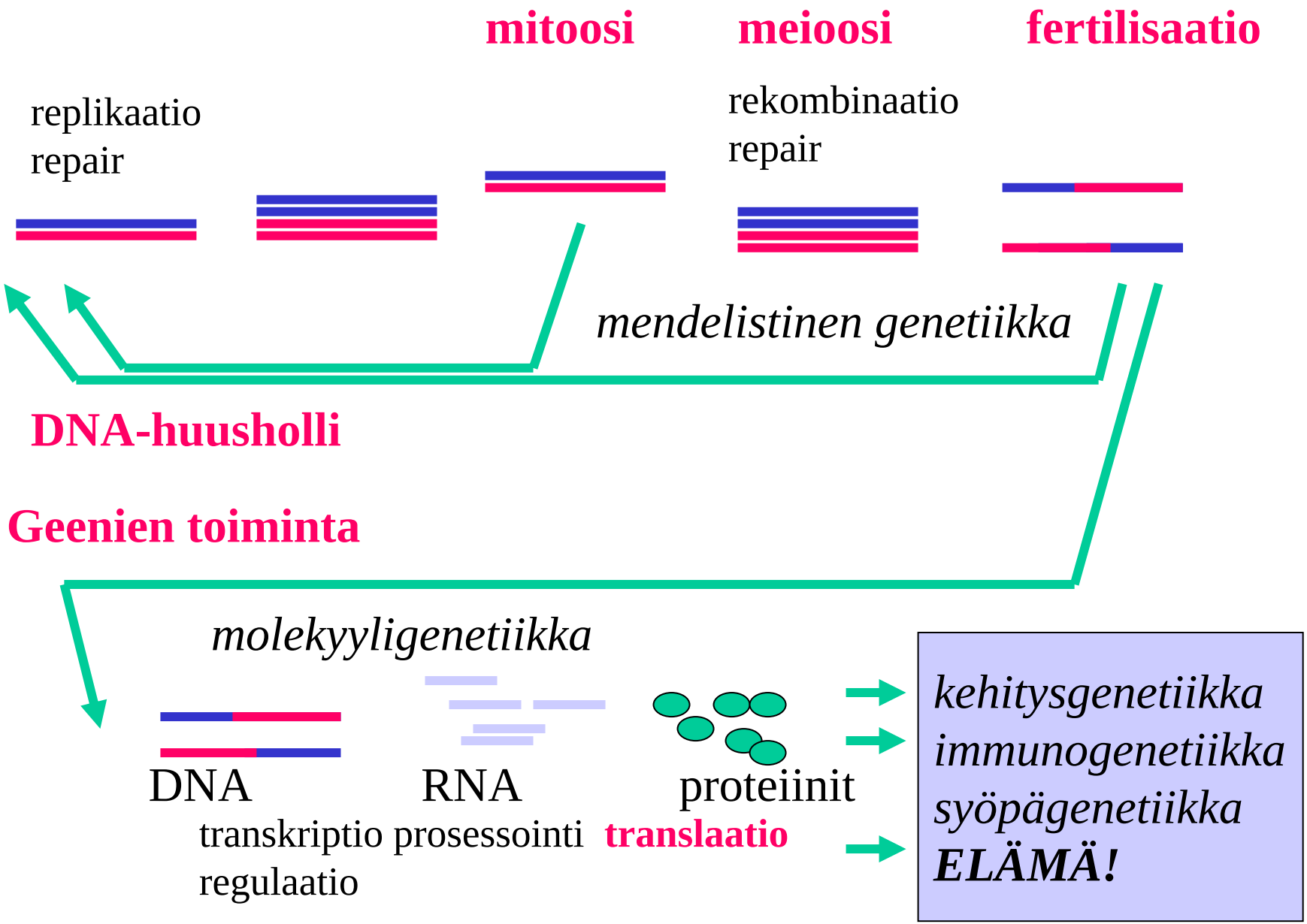
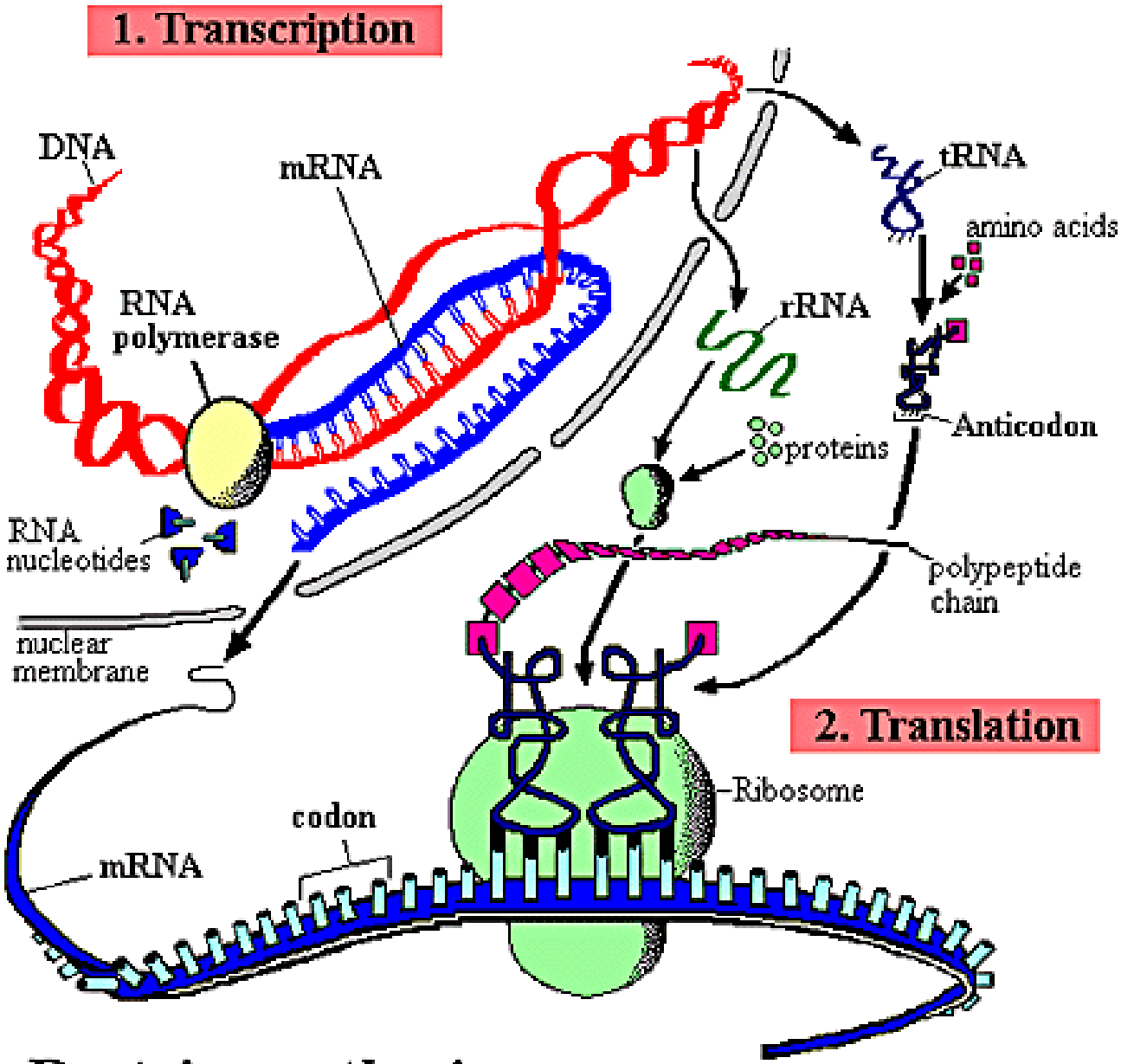


Genetiikan perusteiden miellekartta: translaatio

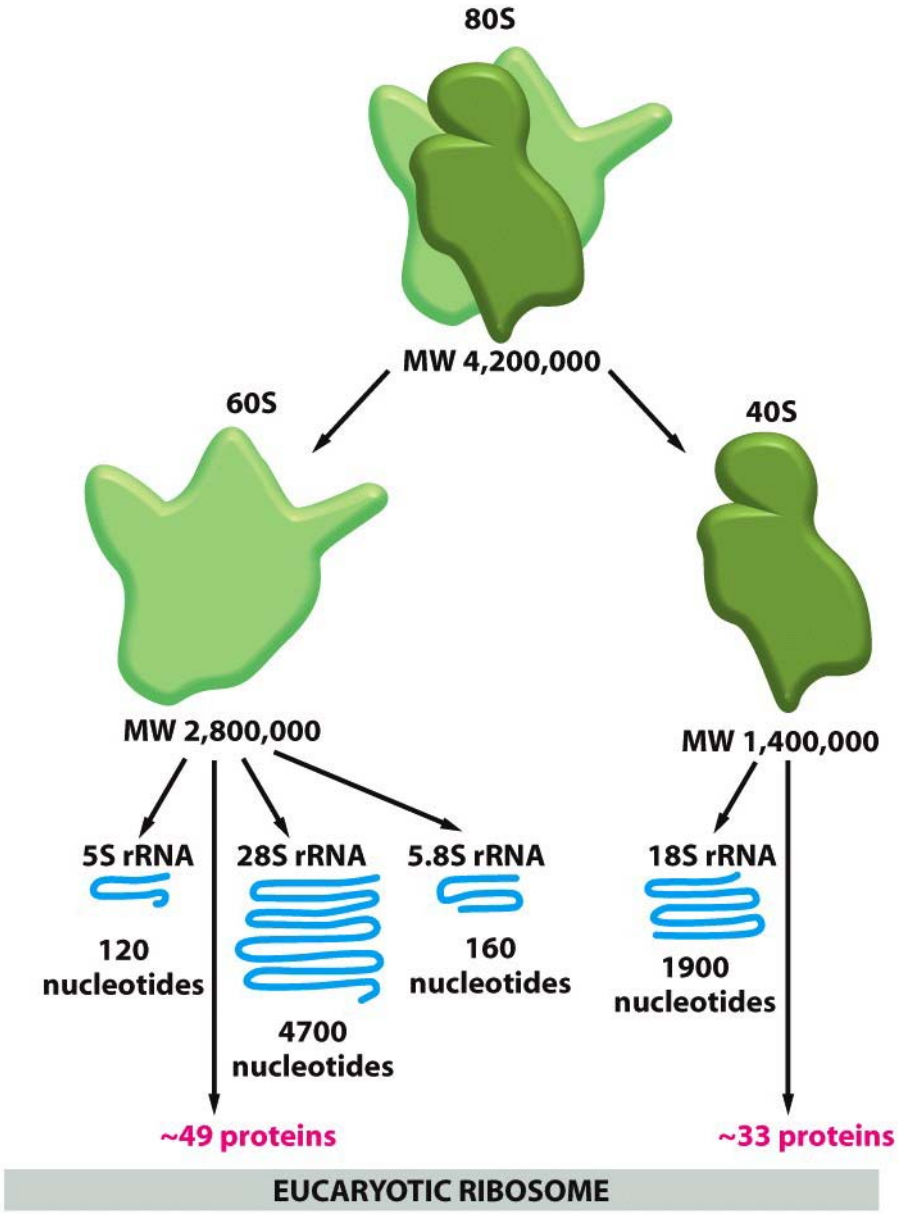


Protein synthesis

Proteiinisynteesi eli translaatio

Tarvikkeet:

ribosomeja, jotka on valmistettu tumajyväsessä ja roudattu ulos tumasta


80S
MW 4,200,000
60S
40S
MW 2,800,000
MW 1,400,000
5S rRNA
28S rRNA
5.8S rRNA
18S rRNA
120 nucleotides
4700 nucleotides
160 nucleotides
1900 nucleotides
~49 proteins
~33 proteins
EUCARYOTIC RIBOSOME

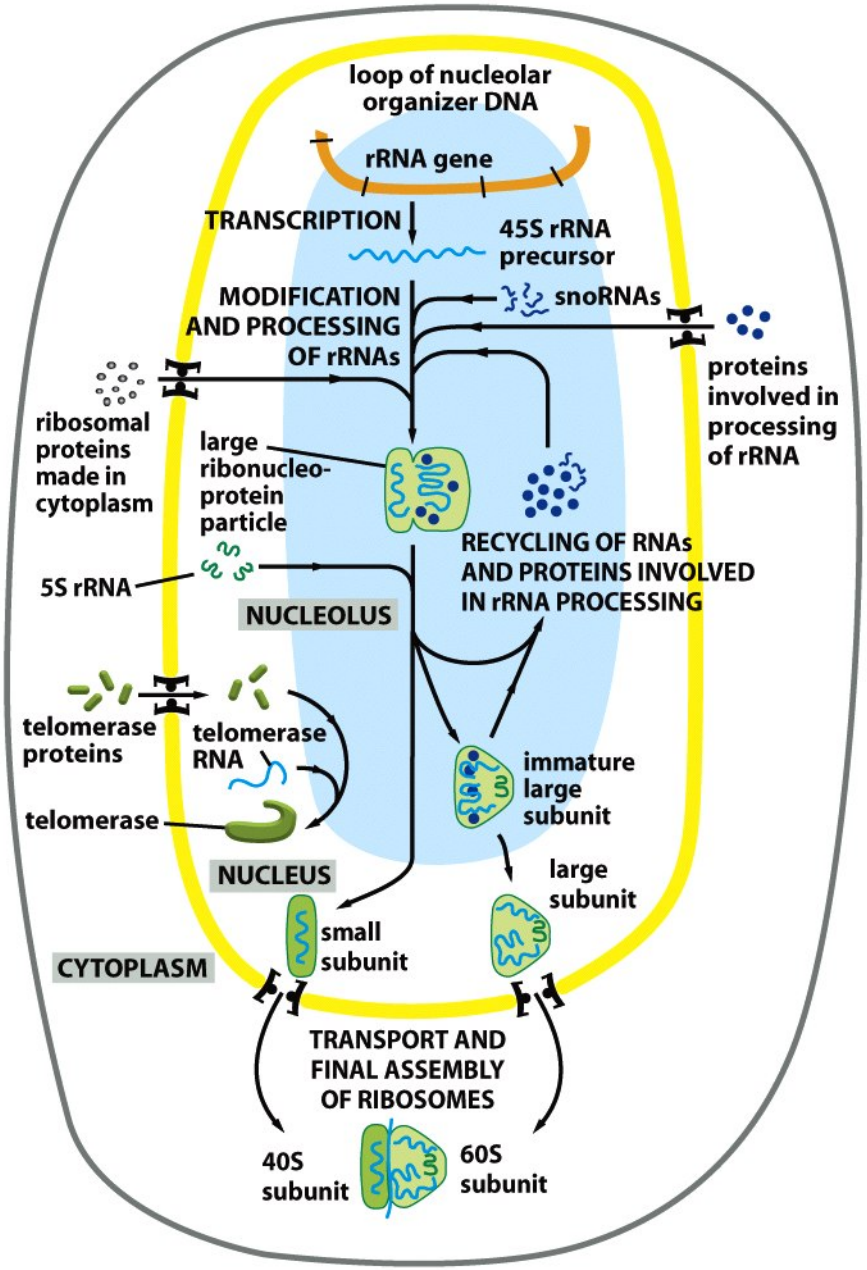


Figure 6-47 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Muistutus tehtaasta

Proteiinisynteesi eli translaatio

Tarvikkeet:

ribosomeja, jotka on valmistettu tumajyväsessä ja roudattu ulos tumasta

mRNA templaatiksi, tuotu tumasta ulos. Sen tekemistä ei nyt kerrata (transkriptio, silputus, pipottaminen, hännän asennus).

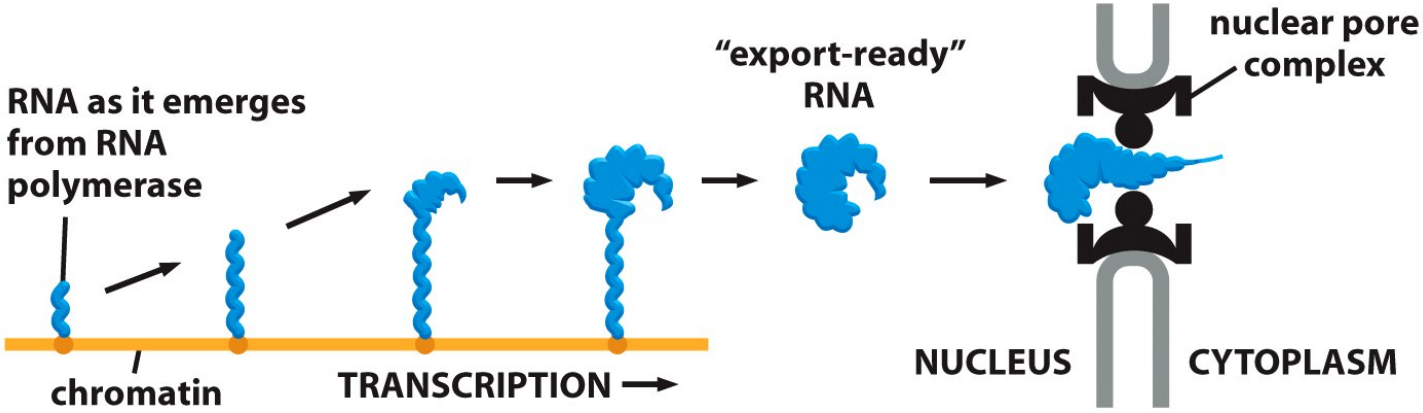


Figure 6-39a Molecular Biology of the Cell 5/e (© Garland Science 2008)

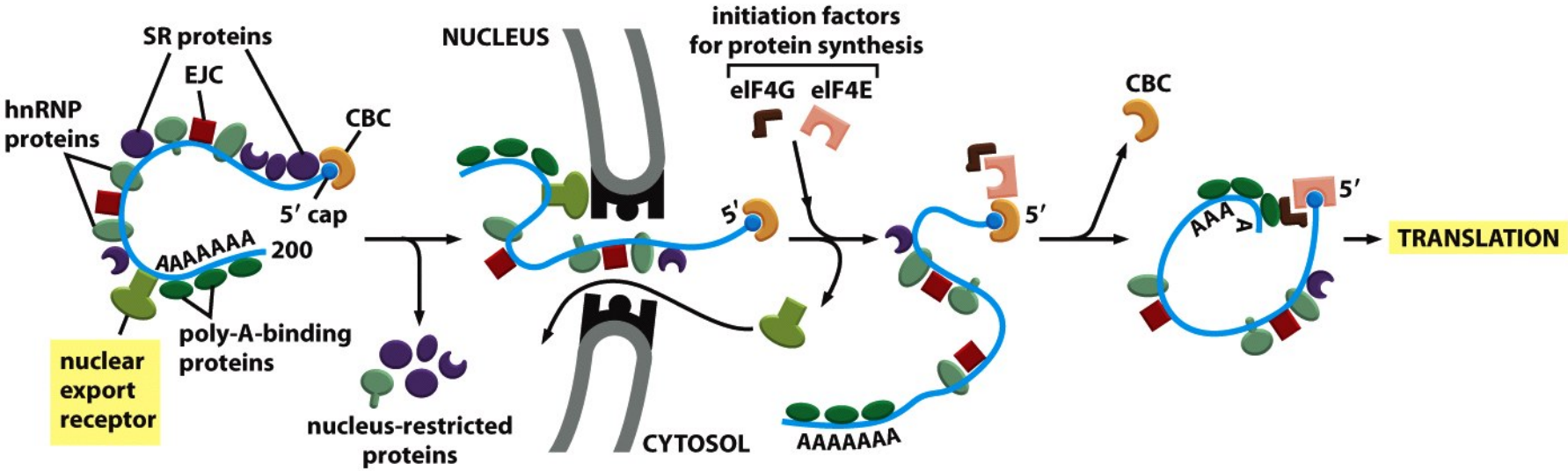


Figure 6-40 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Kuljetus tumasta ulos

Proteiinisynteesi eli translaatio

Tarvikkeet:

ribosomeja, jotka on valmistettu tumajyväsessä ja roudattu ulos tumasta

mRNA templaatiksi, tuotu tumasta ulos

tRNA -molekyylejä, joihin on liitetty oikeat aminohapot

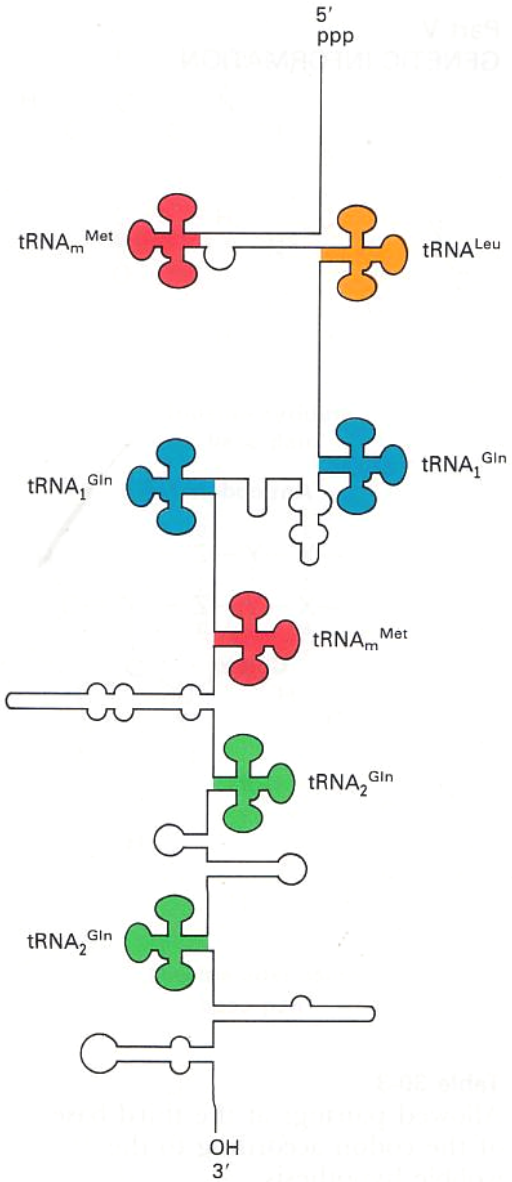
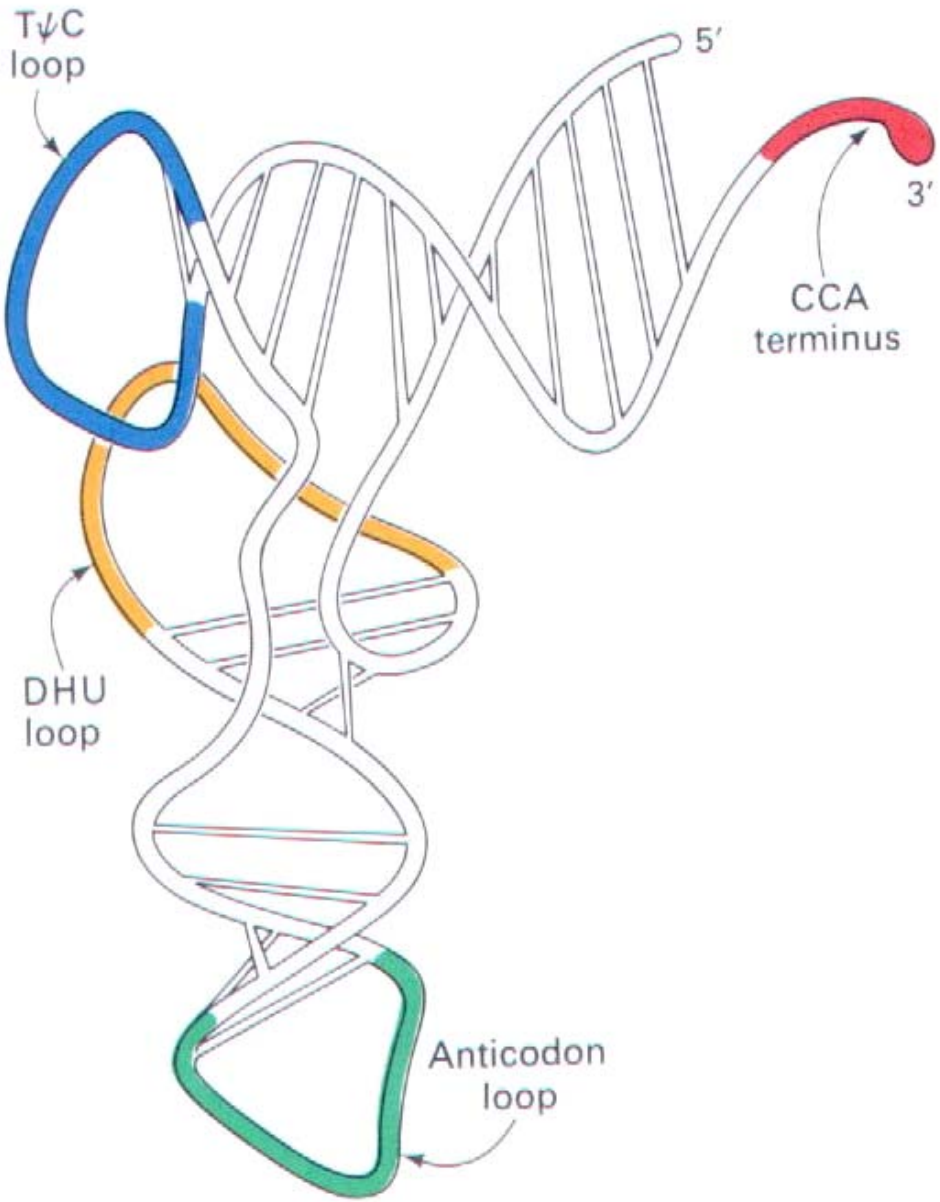


Figure 30-13
Seven tRNA molecules are formed by cleavage of this 950-nucleotide primary transcript. [After N. Nakajima, H. Ozeki, and Y. Shimura. *Cell* 23(1981):245.]

tRNA eli siirtäjäRNA geenejä transkriboidaan pitkinä hnRNA-laatuina, joista sitten silputaan varsinaisia tRNA molekyylejä

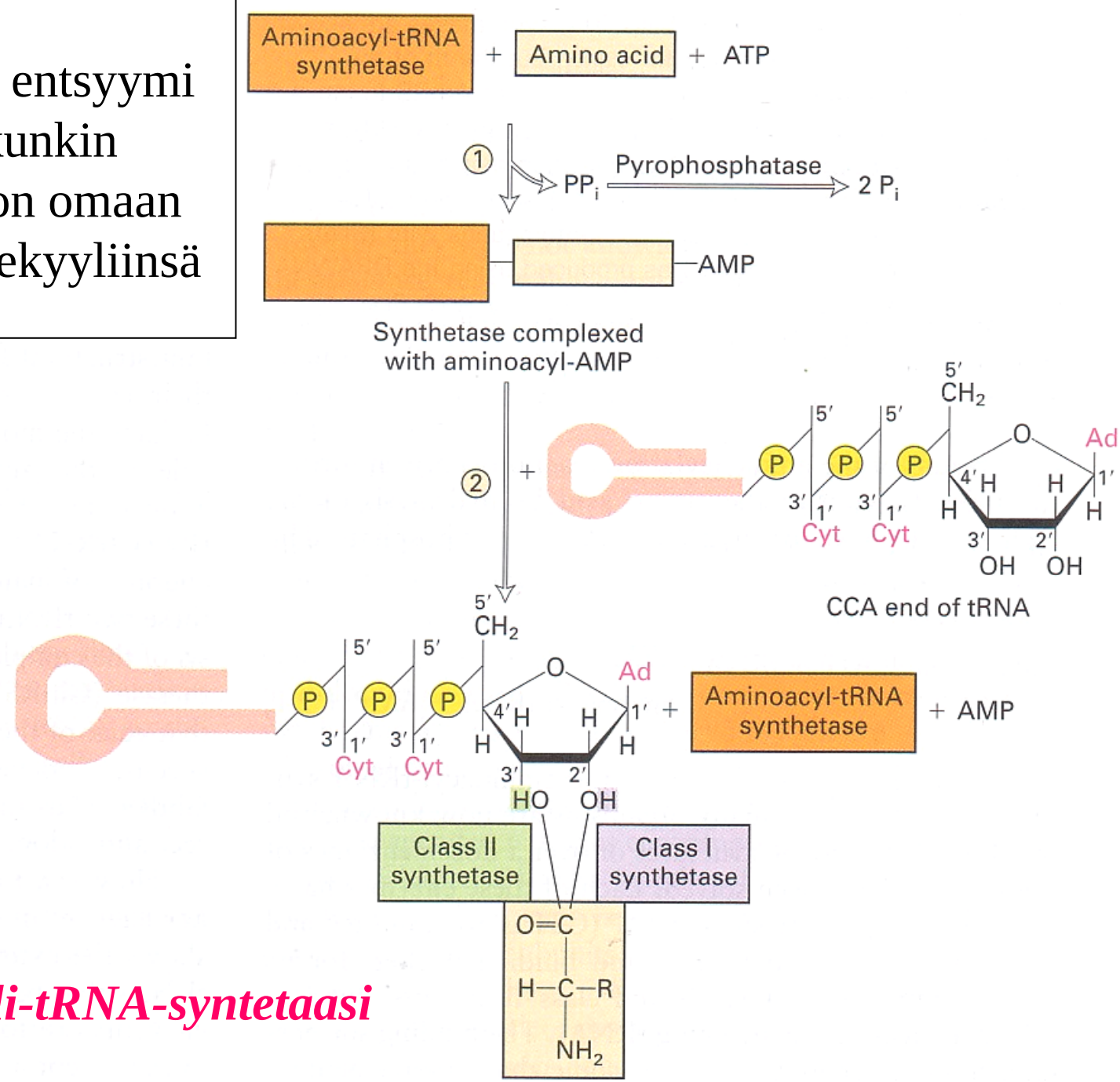


tRNA:n kolmiulotteinen rakenne

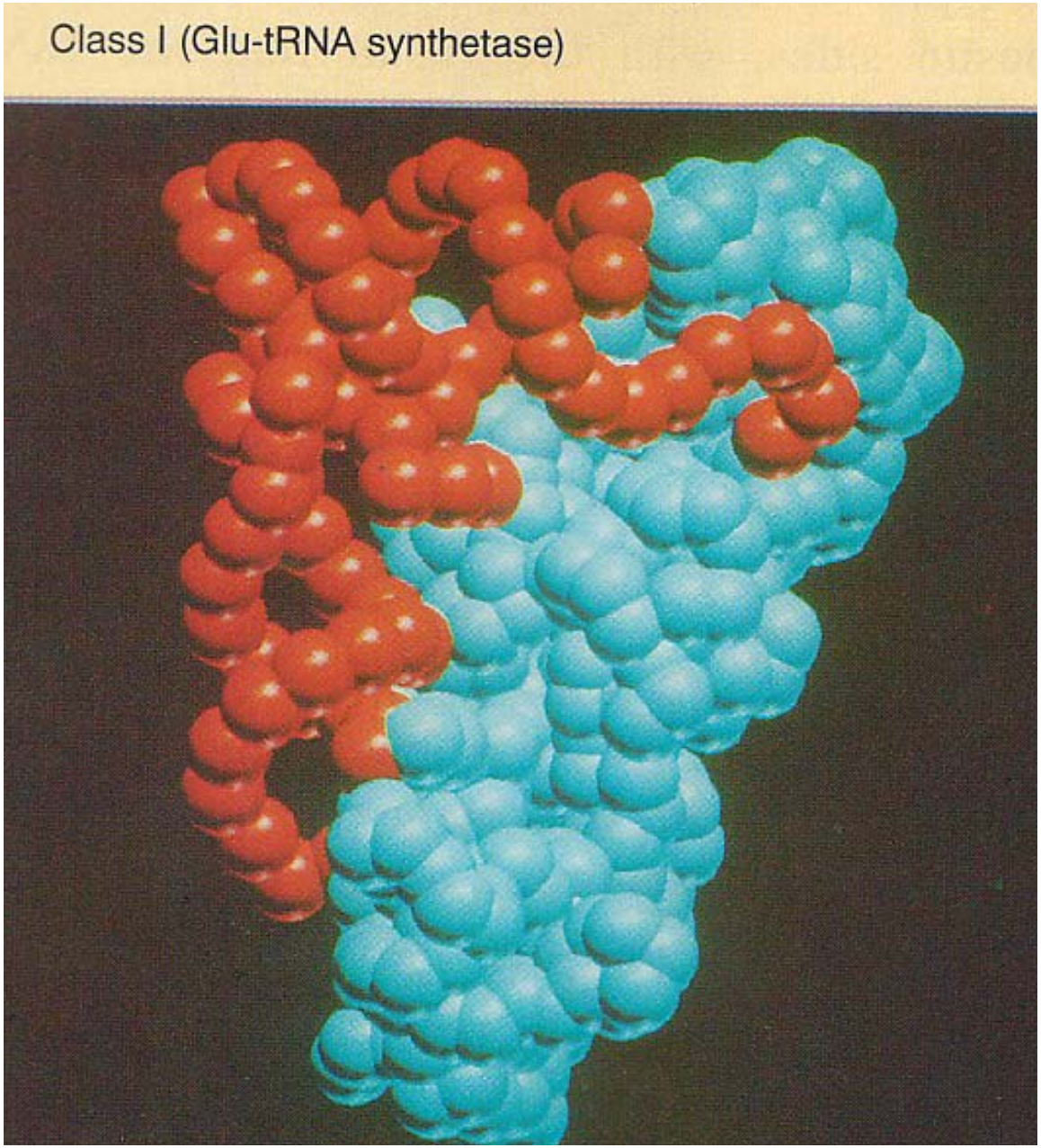
Aminohappo sitoutuu CCA-päähän, joka on kaikilla tRNA-laaduilla samanlainen. Miten se aminohappo sitten voi olla oikea?

aminoasyyli-tRNA-syntetaasi

Spesifinen entsyymi liittää kunkin aminohapon omaan tRNA-molekyyliinsä



Aminoasyyli-tRNA-syntetaasi



$tRNA^{Gln}$

CELL 341

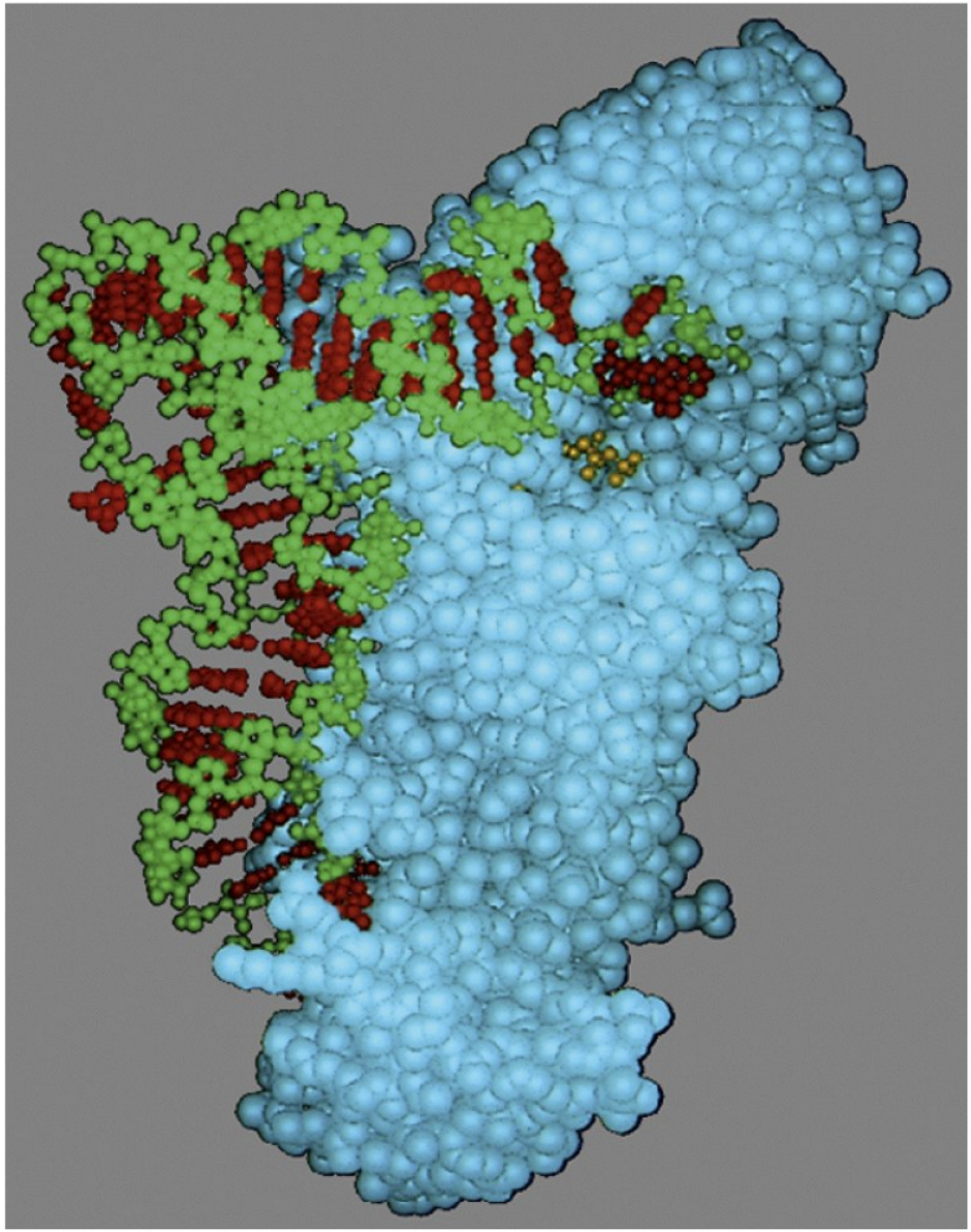


Figure 6-60 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 373

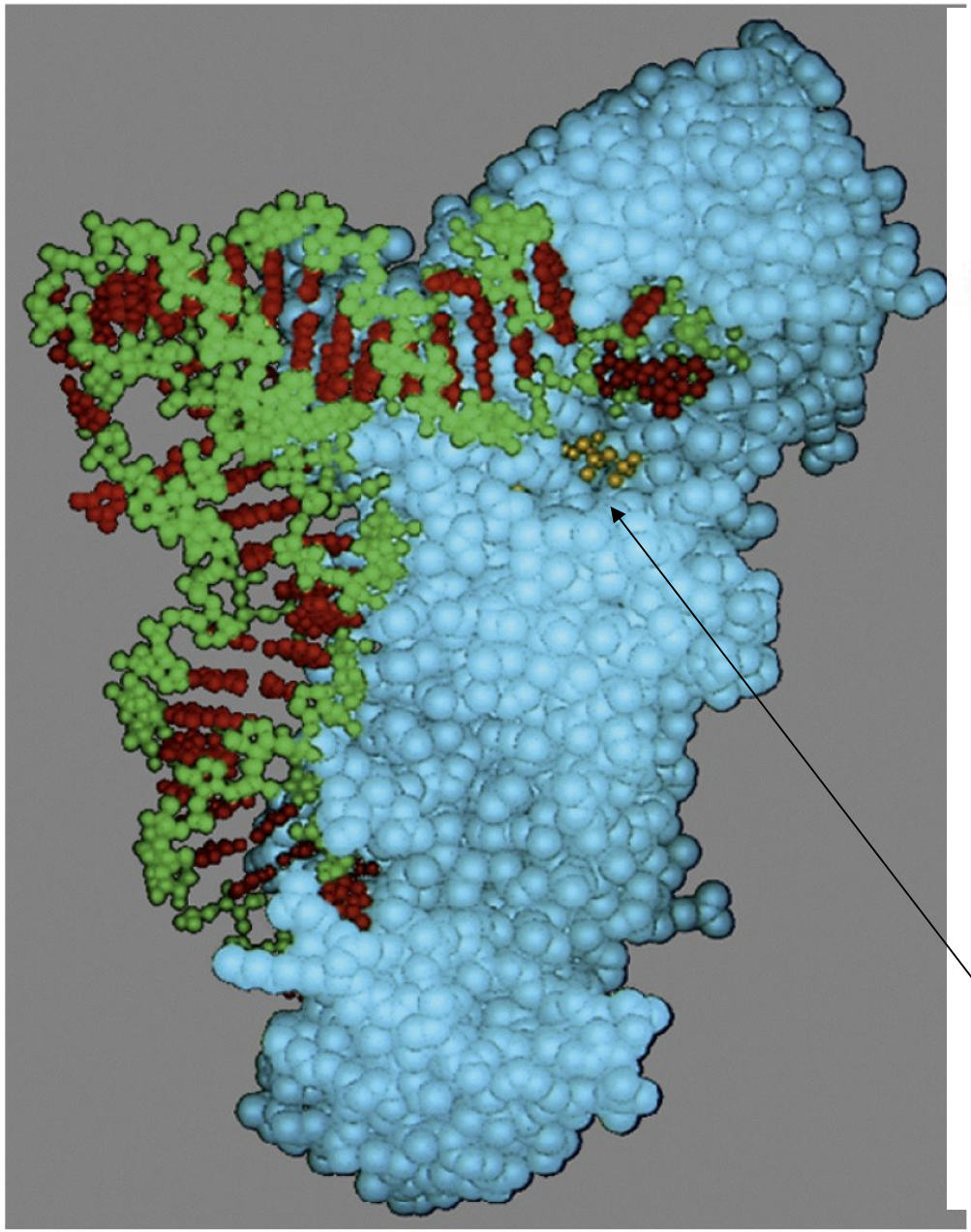
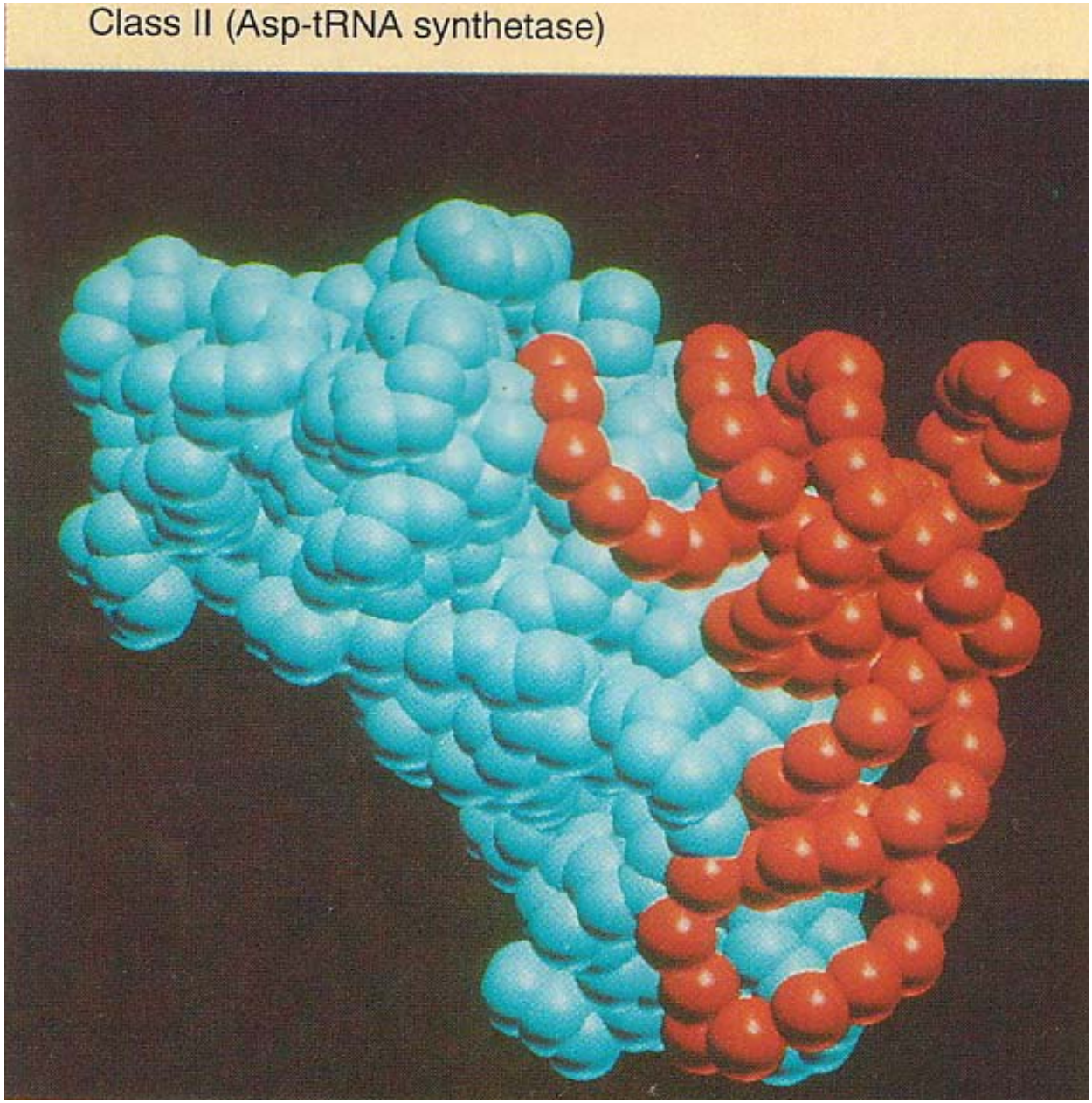


Figure 6-60 Molecular Biology of the Cell 5/e (© Garland Science 2008)

glutaminyyli-AMP

CELL 373



$tRNA^{Asp}$

CELL 373

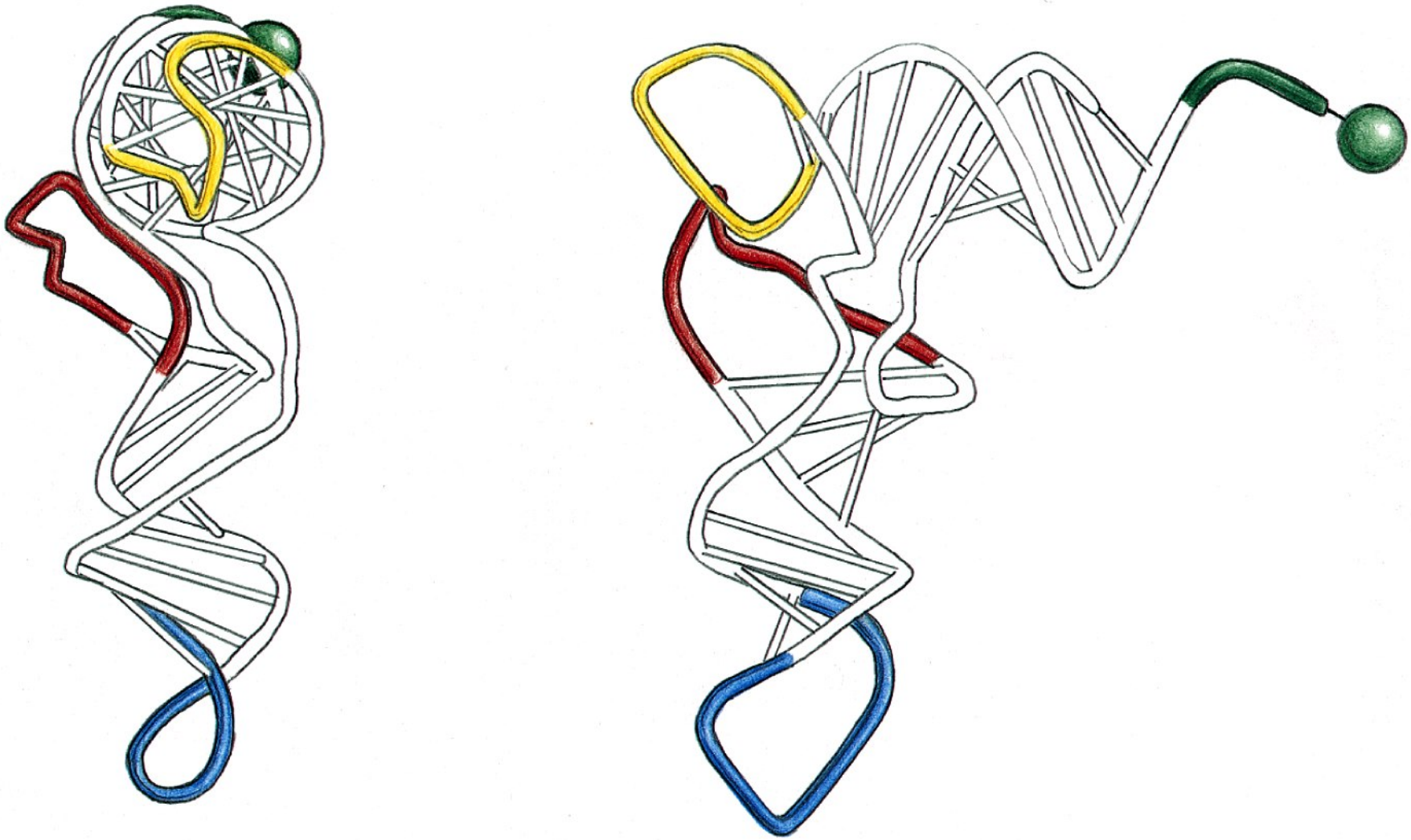
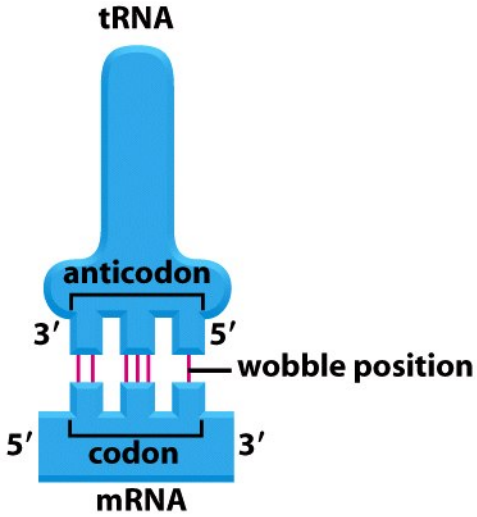


Figure 6-52bc Molecular Biology of the Cell 5/e (© Garland Science 2008)

5′ GCGGAUUUAGCUCAGDDGGGAGAGCGCCAGACUGAAYAΨCUGGAGGUCCUGUGTΨCGAUCCACAGAAUUCGCACCA 3′

anticodon

Figure 6-52d Molecular Biology of the Cell 5/e (© Garland Science 2008)



bacteria

wobble codon base	possible anticodon bases
U	A, G, or I
C	G or I
A	U or I
G	C or U

eucaryotes

wobble codon base	possible anticodon bases
U	A, G, or I
C	G or I
A	U
G	C

Figure 6-53 Molecular Biology of the Cell 5/e (© Garland Science 2008)

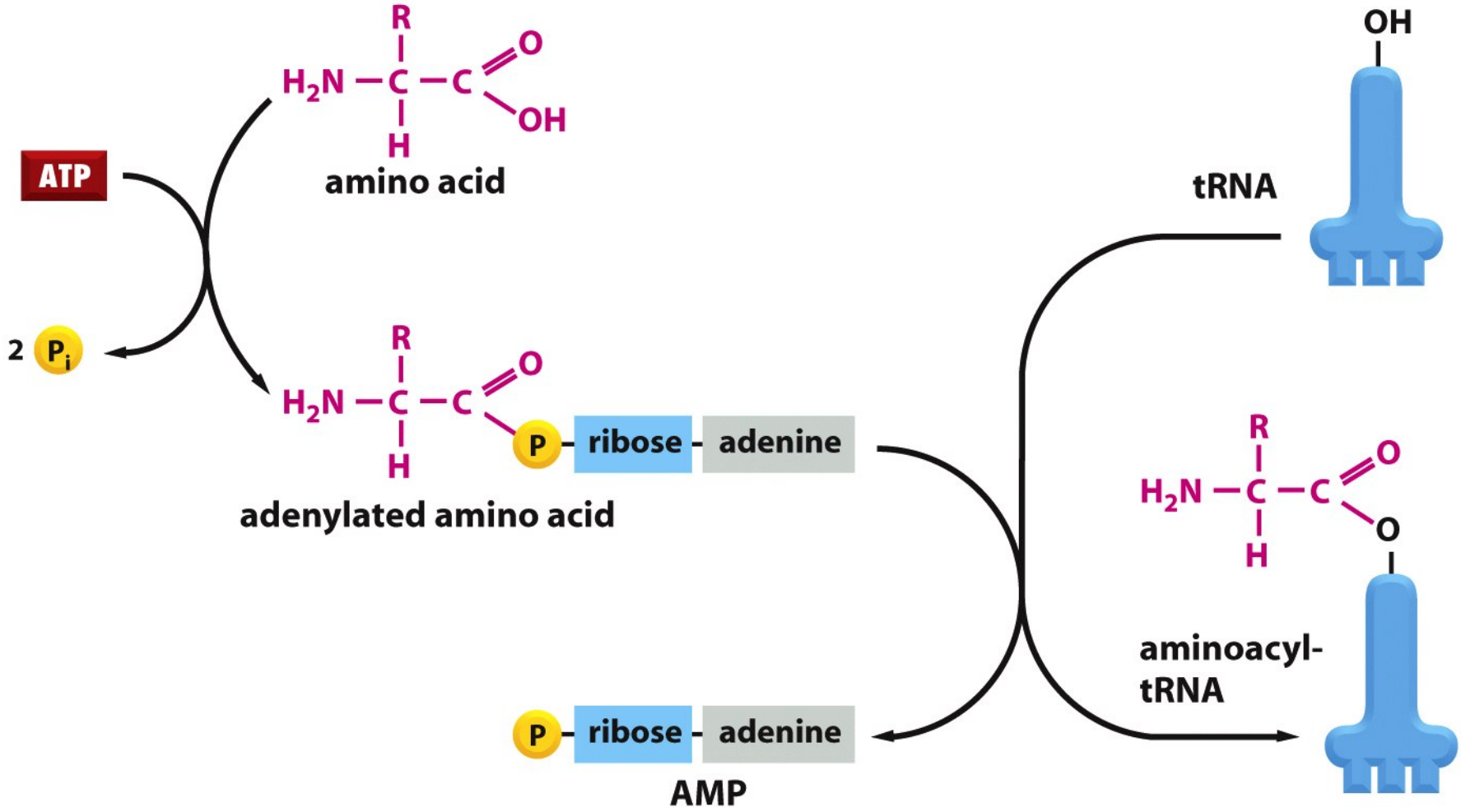


Figure 6-56 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 371

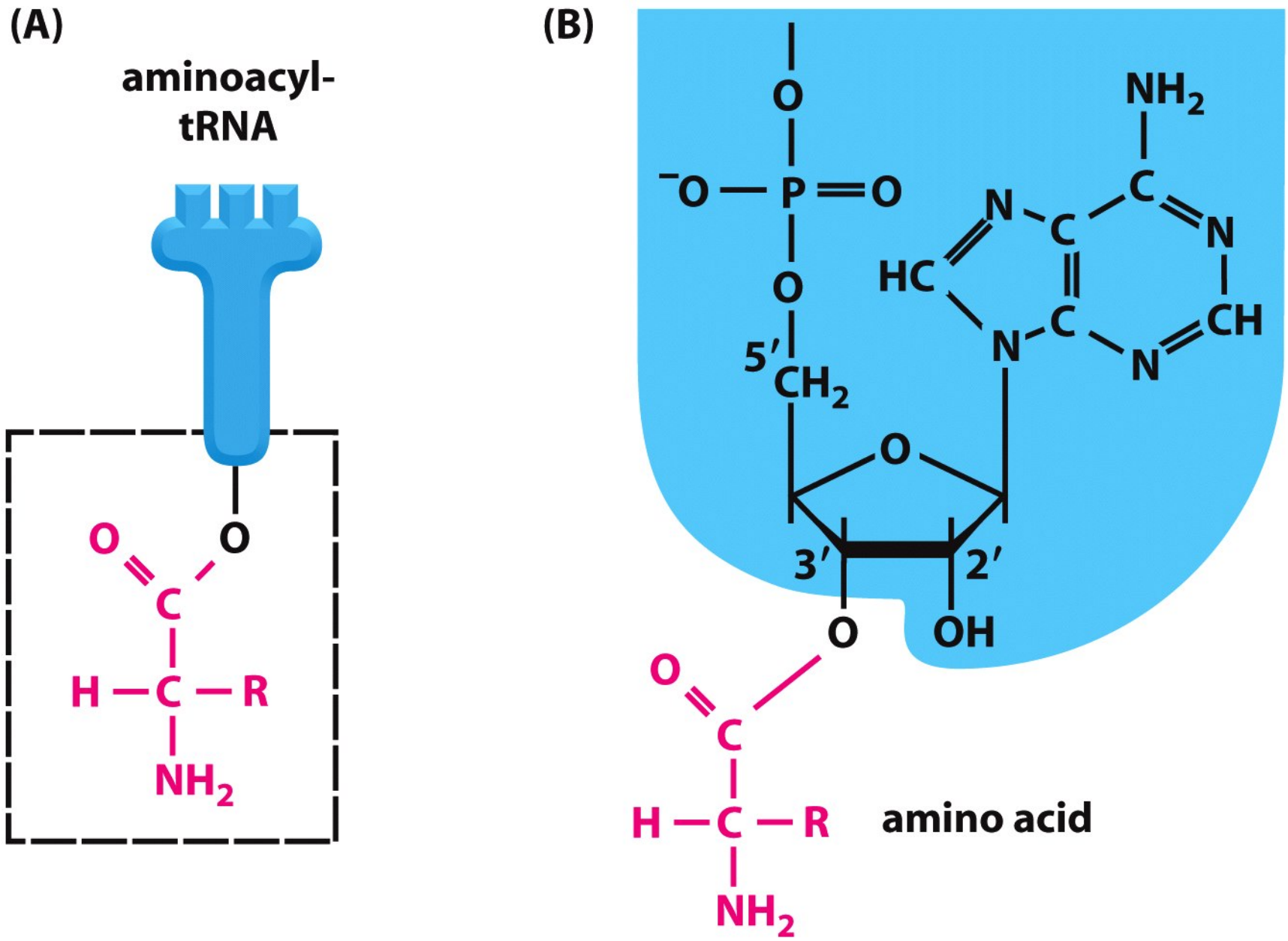


Figure 6-57 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 371

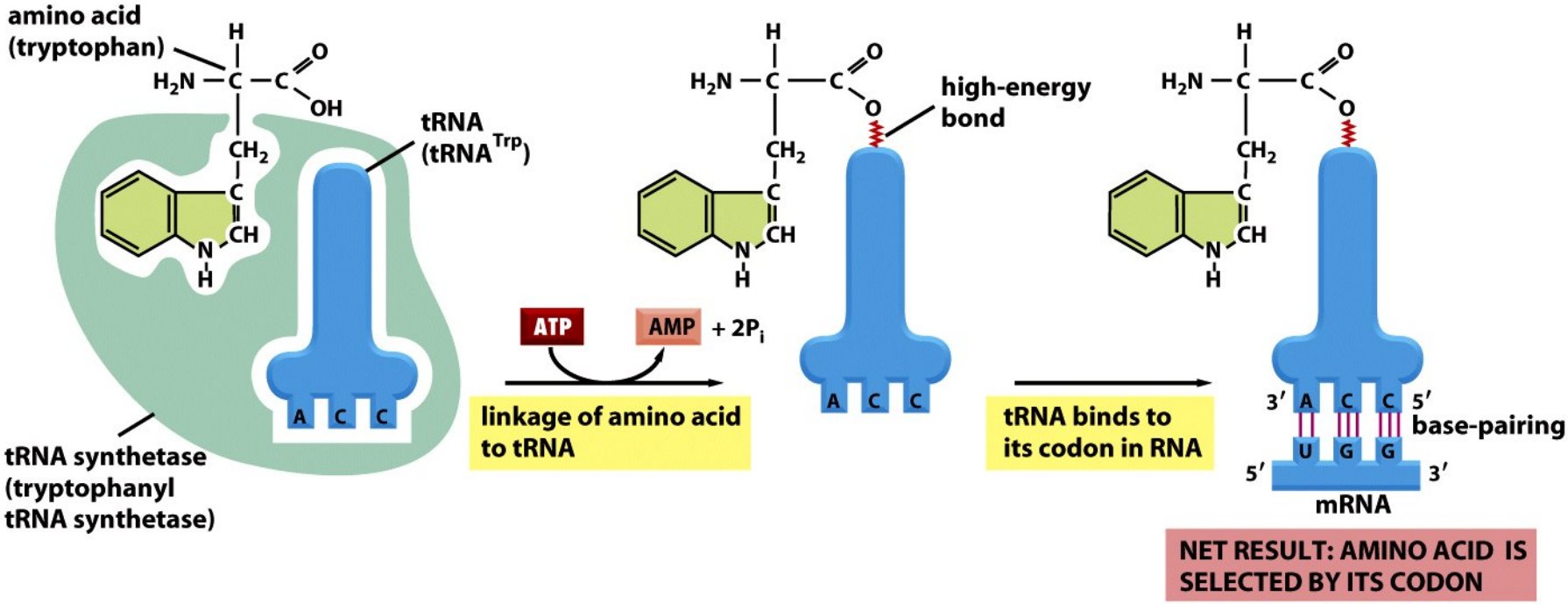


Figure 6-58 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 372

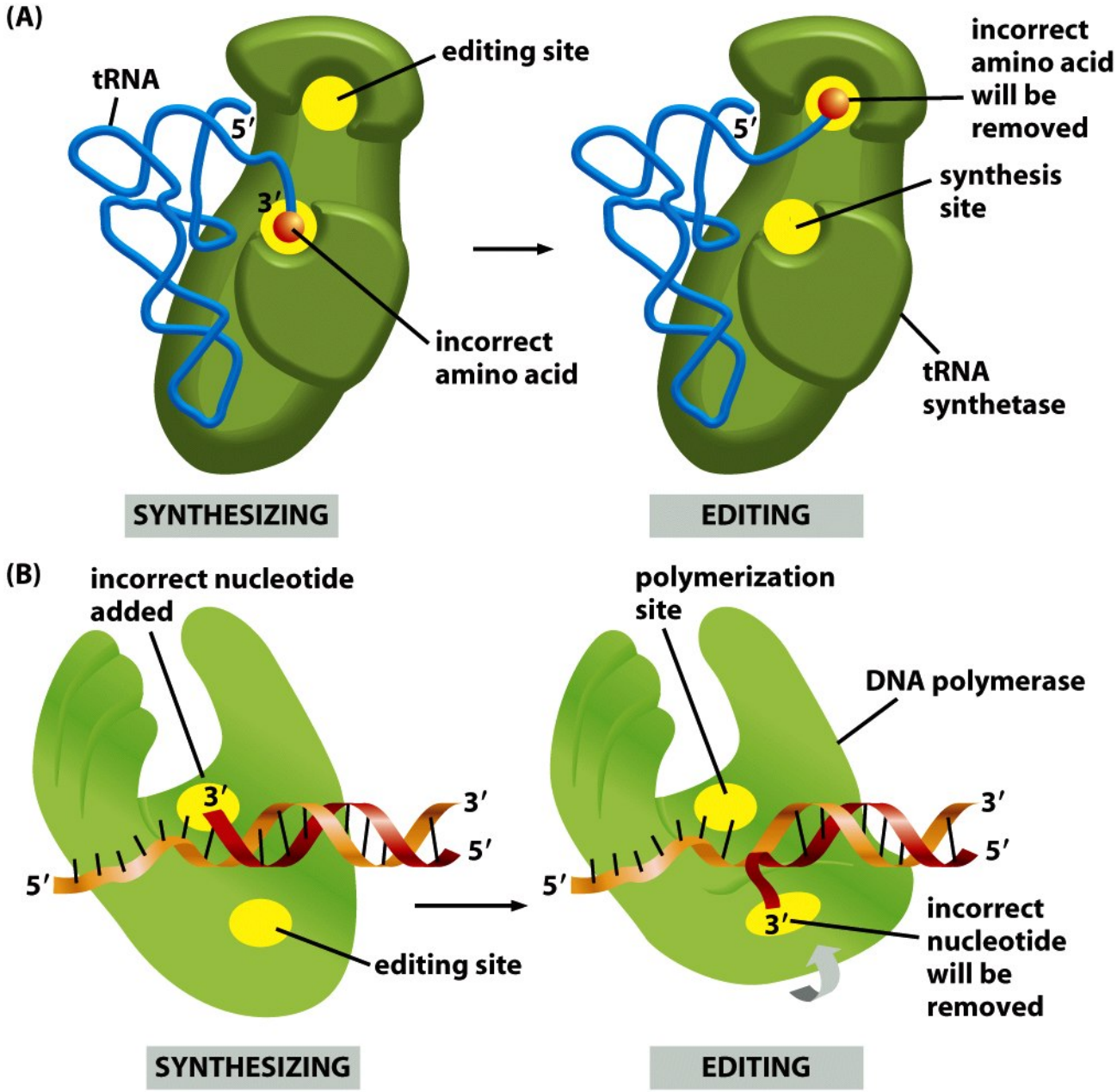


Figure 6-59 Molecular Biology of the Cell 5/e (© Garland Science 2008)

aa-tRNA-syntetaasi

DNA-polymeraasi on tässä vertailun vuoksi

CELL 372

Proteiinisynteesi eli translaatio

Tarvikkeet:

ribosomeja, jotka on valmistettu tumajyväsessä ja roudattu ulos tumasta

mRNA templaatiksi, tuotu tumasta ulos

tRNA -molekyylejä, joihin on liitetty oikeat aminohapot

Ja vielä vähän ohjausjuttuja, vauhdin ja proteiinin sijoituksen junailemiseksi!

Aloitus, piteneminen ja lopetus täytyy selvittää erikseen

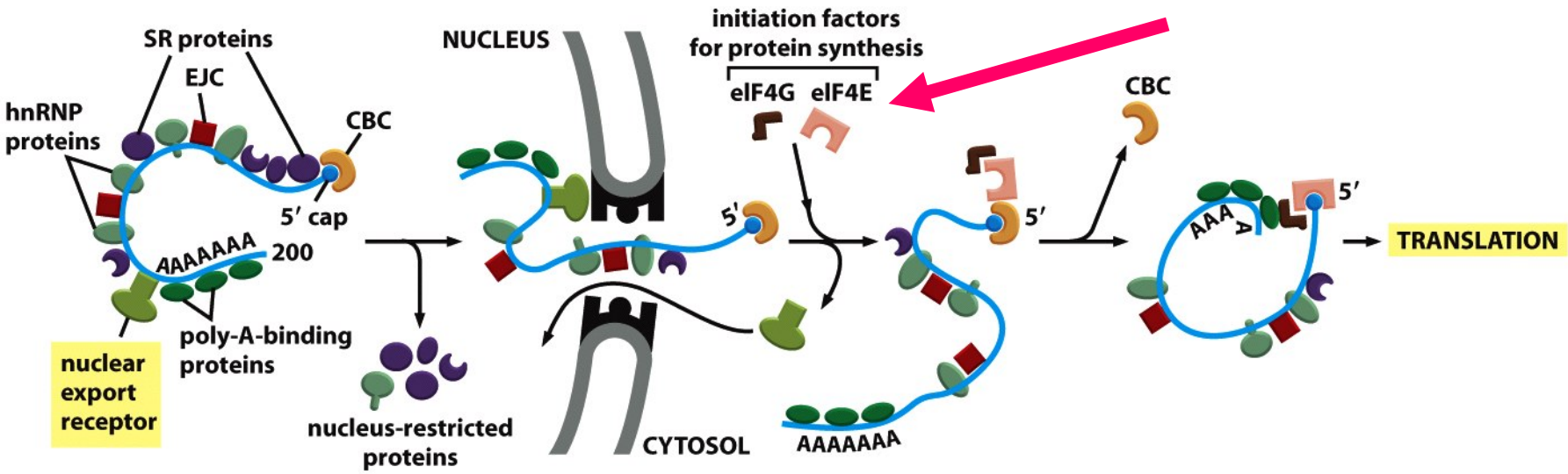


Figure 6-40 Molecular Biology of the Cell 5/e (© Garland Science 2008)

ALOITUSVAIHE

CELL 359, 380

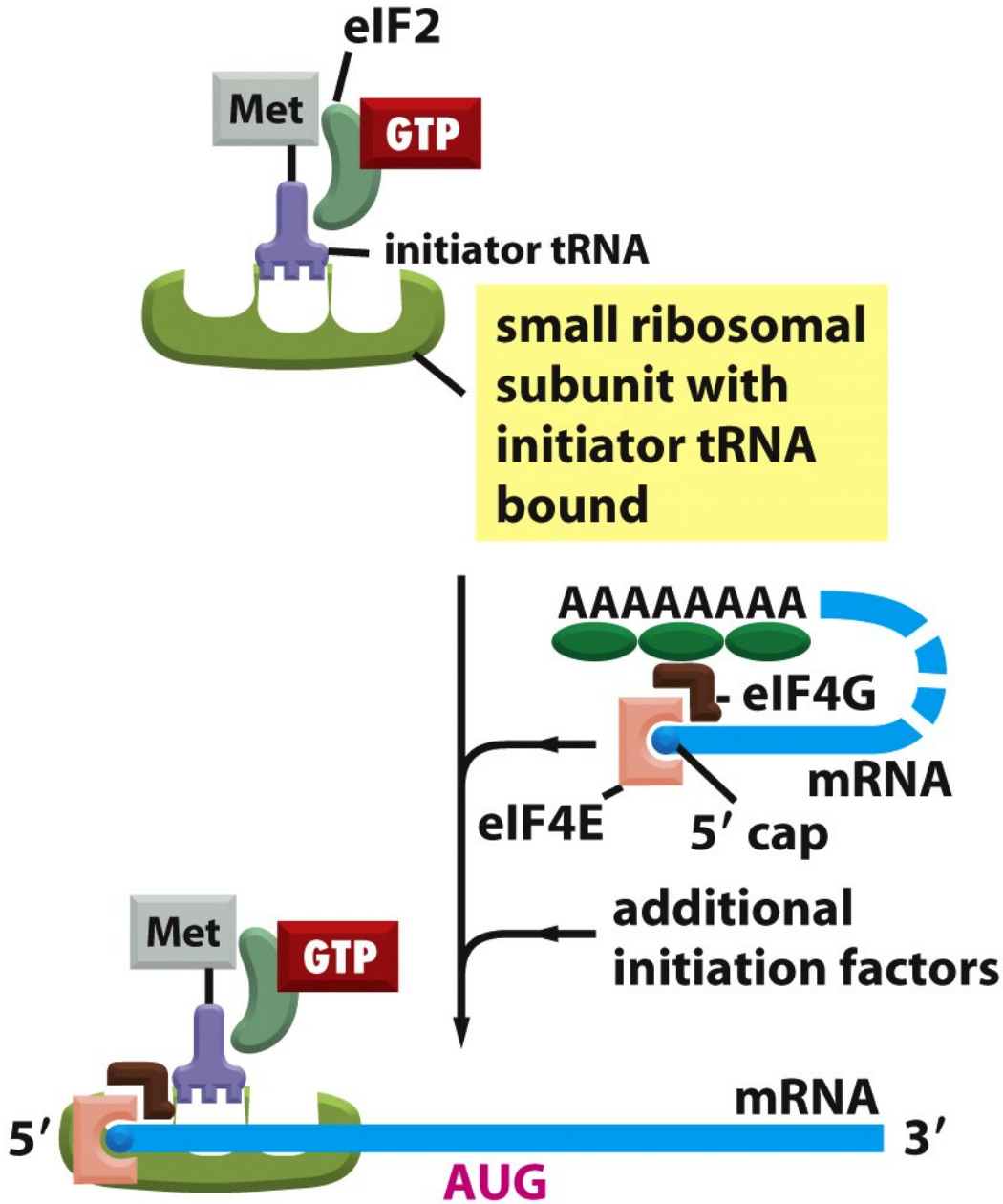


Figure 6-72 part 1 of 5 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 380

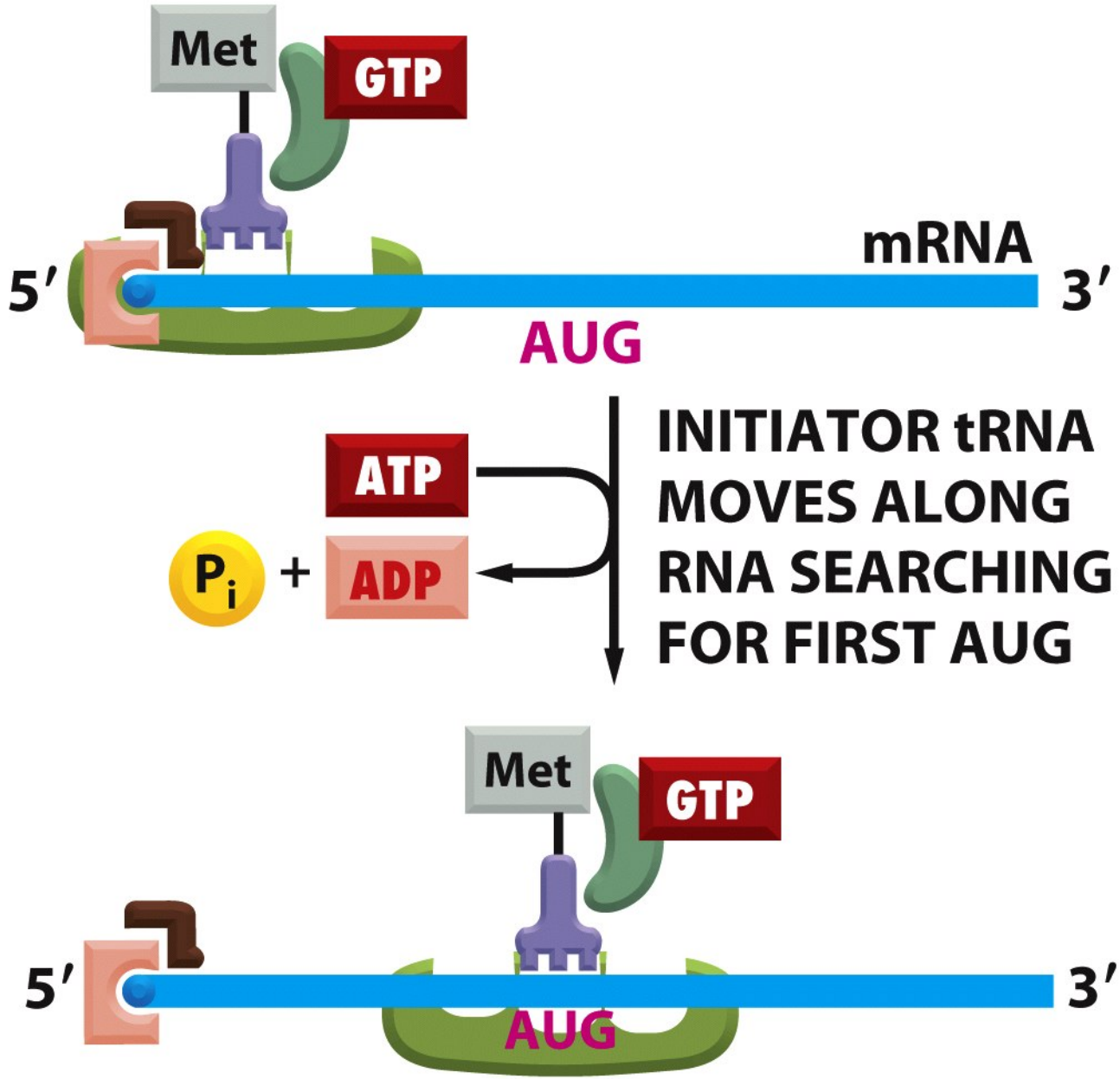


Figure 6-72 part 2 of 5 Molecular Biology of the Cell 5/e (© Garland Science 2008)

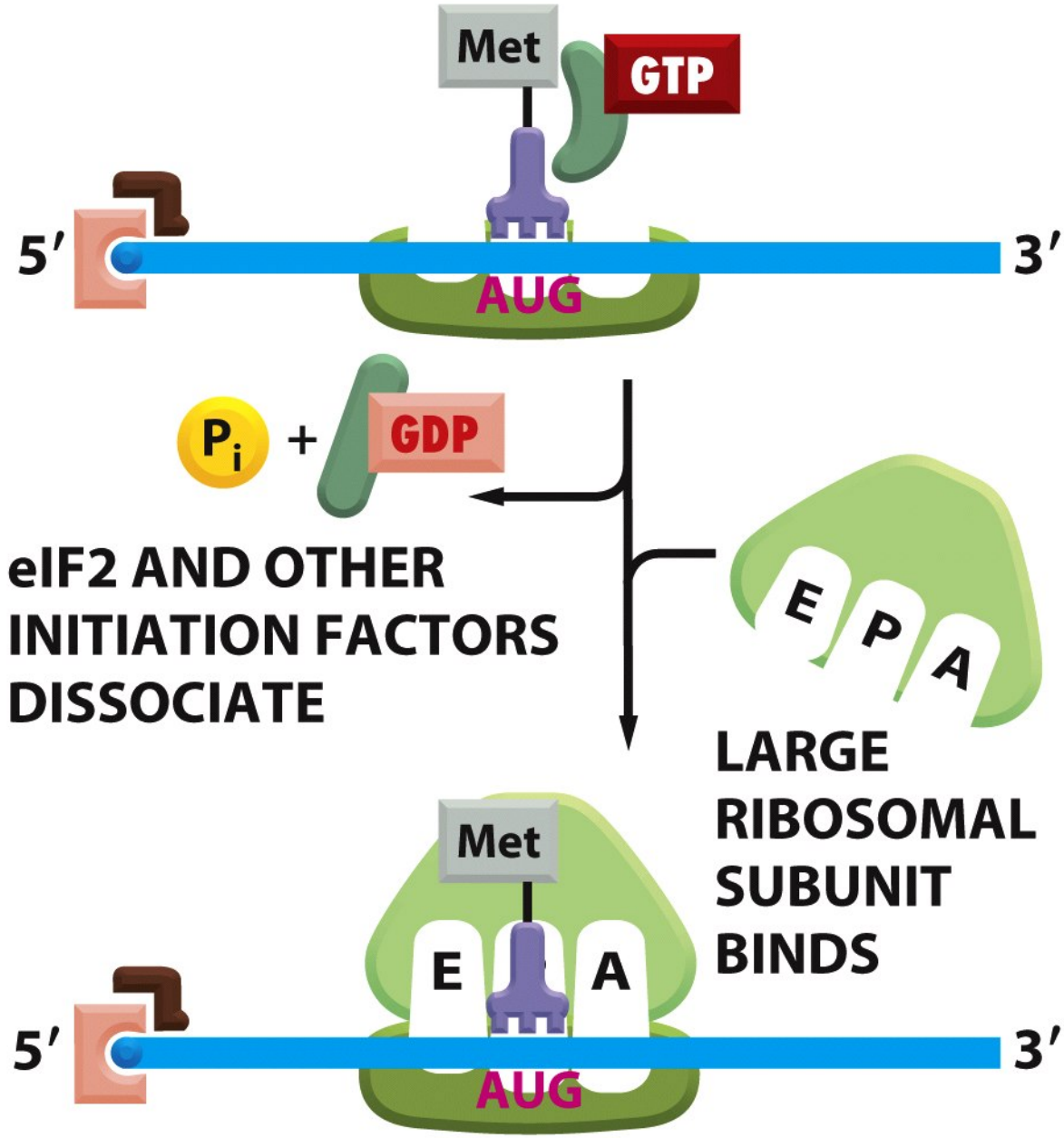


Figure 6-72 part 3 of 5 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 380

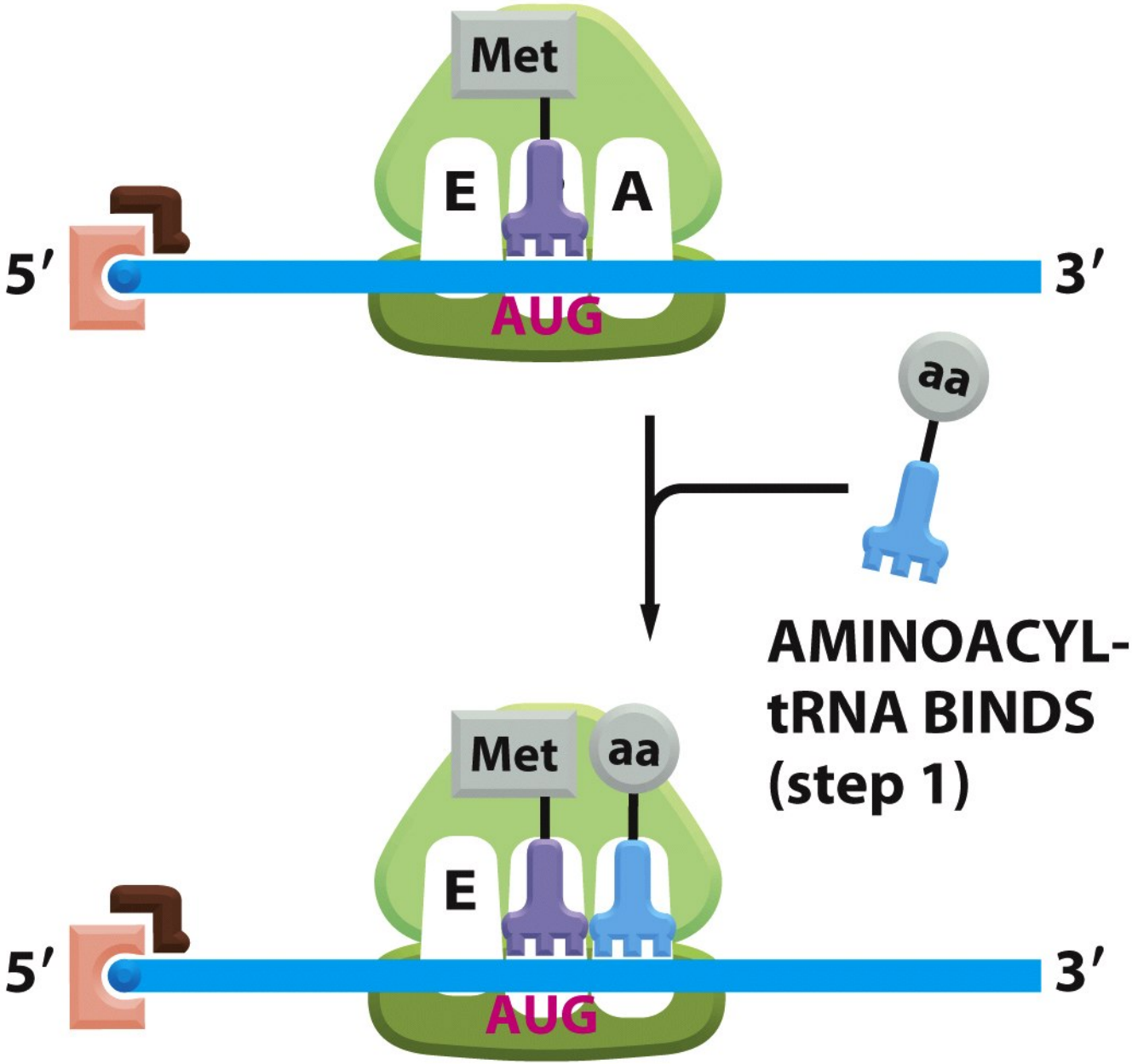


Figure 6-72 part 4 of 5 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 380

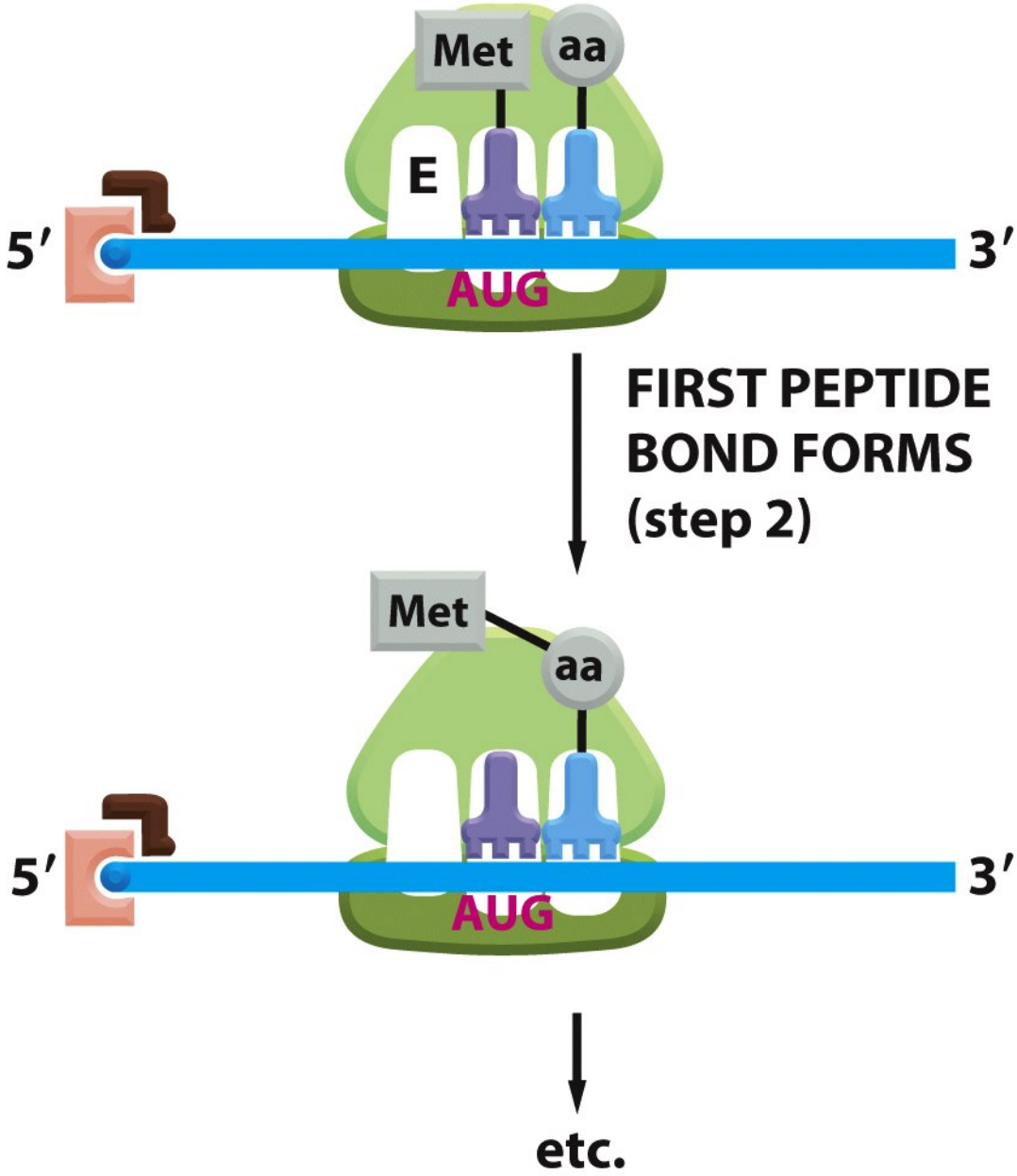


Figure 6-72 part 5 of 5 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 380

koko aloitus yhdessä

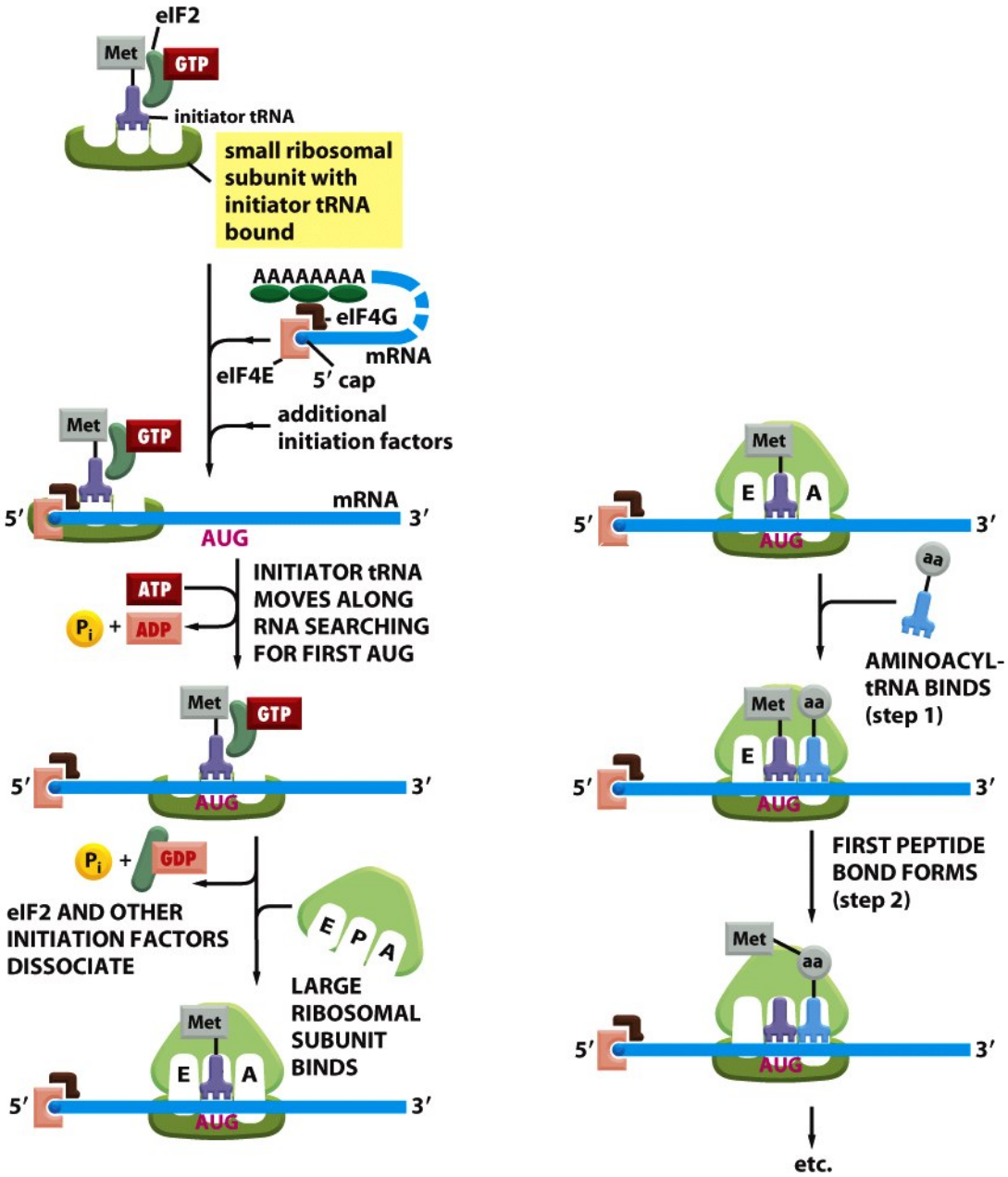


Figure 6-72 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 380

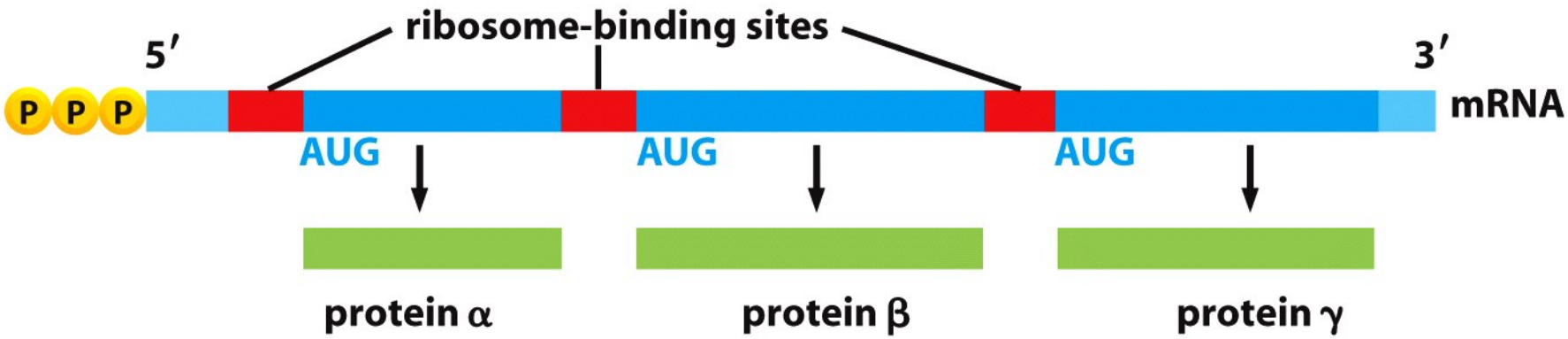


Figure 6-73 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Pitenemisvaihe

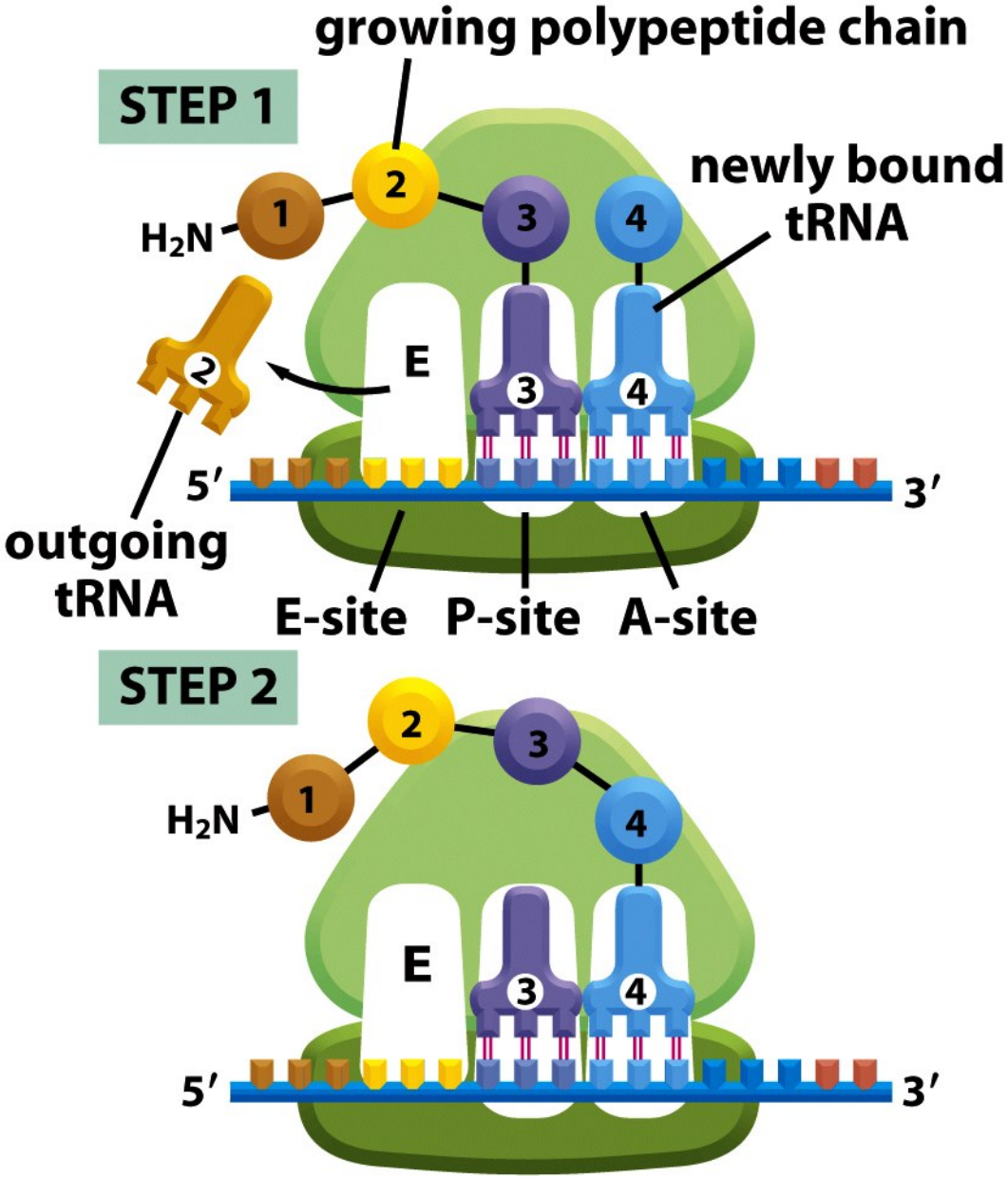


Figure 6-66 part 1 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Pitenemisvaihe

CELL 376

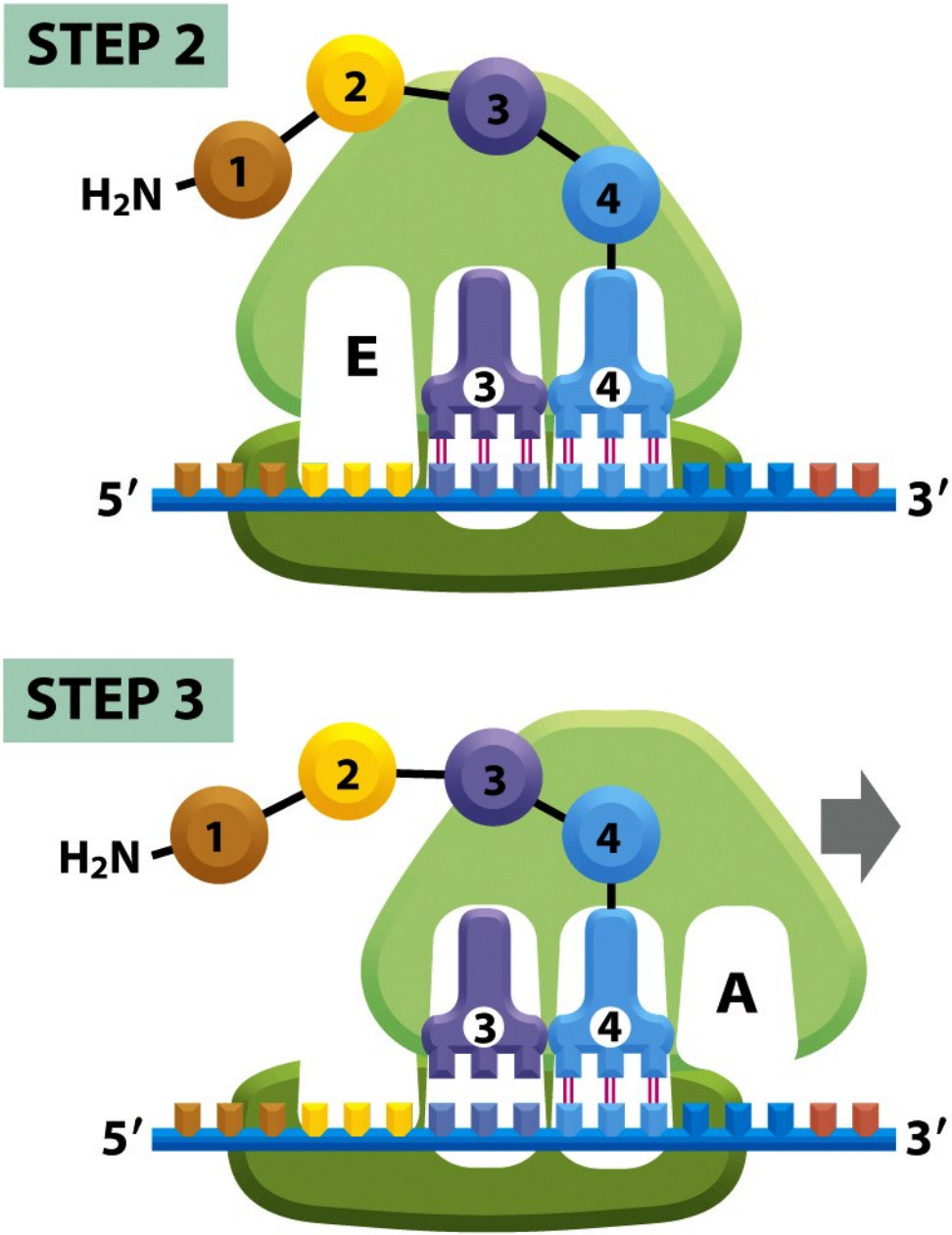


Figure 6-66 part 2 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 376

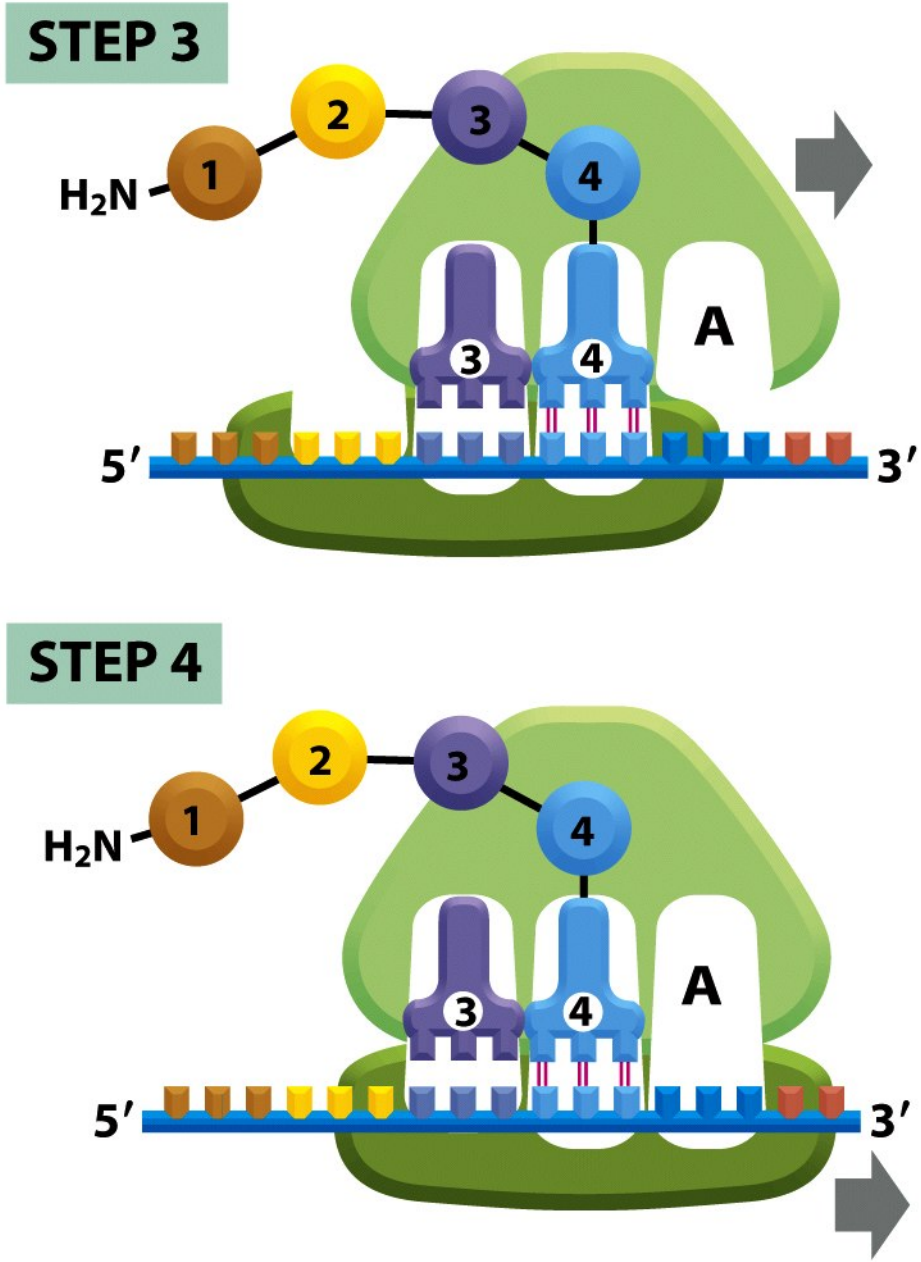


Figure 6-66 part 3 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 376

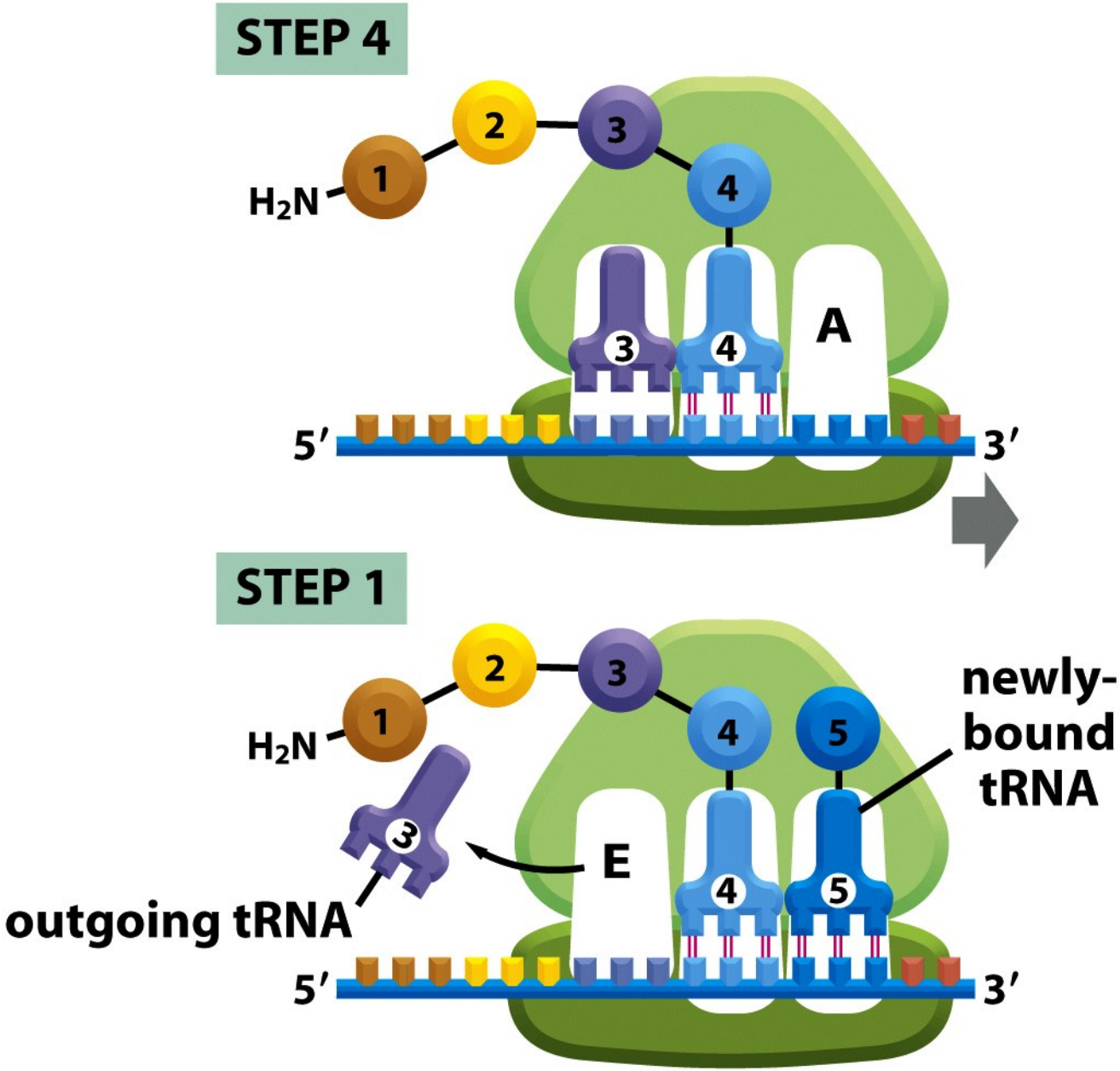


Figure 6-66 part 4 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 376

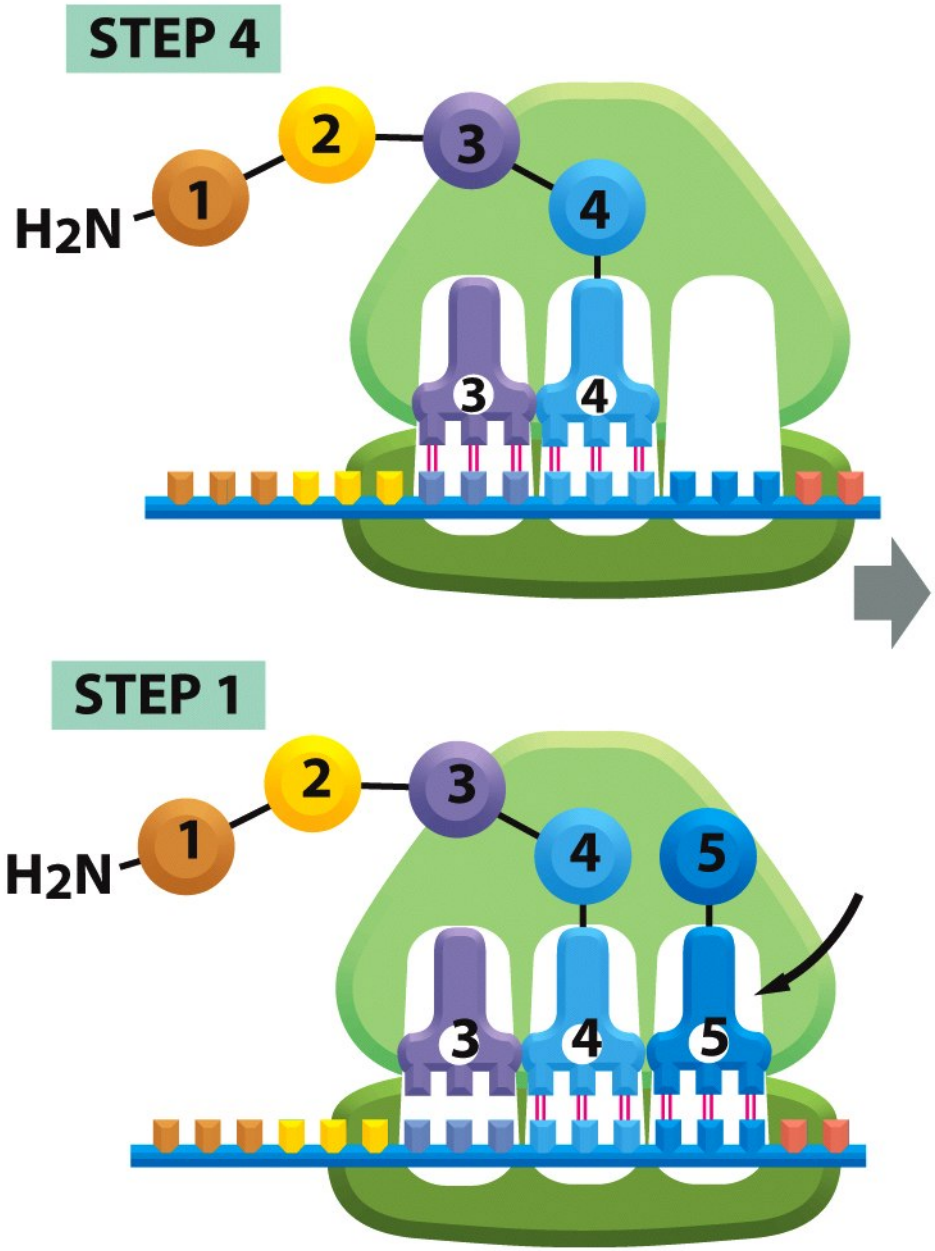


Figure 6-66 part 5 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 376

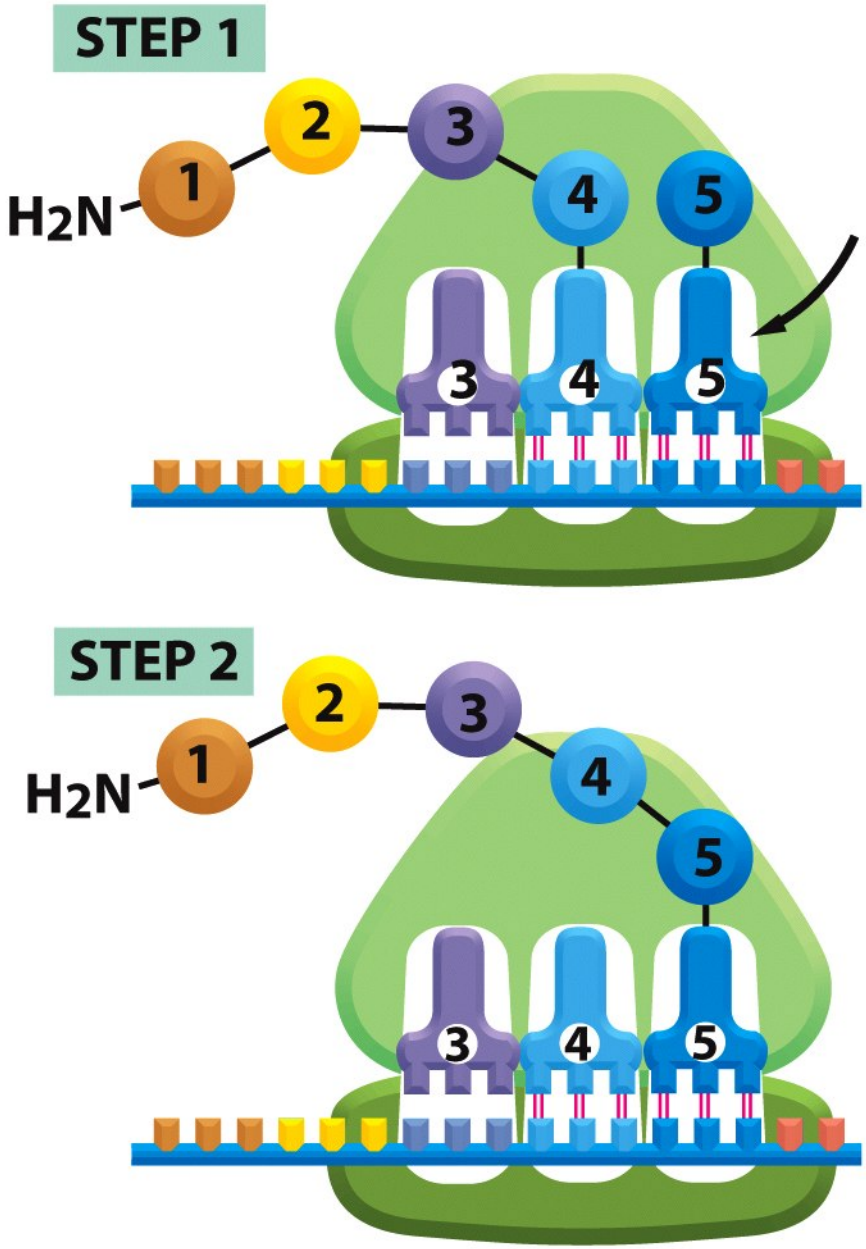


Figure 6-66 part 6 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 376

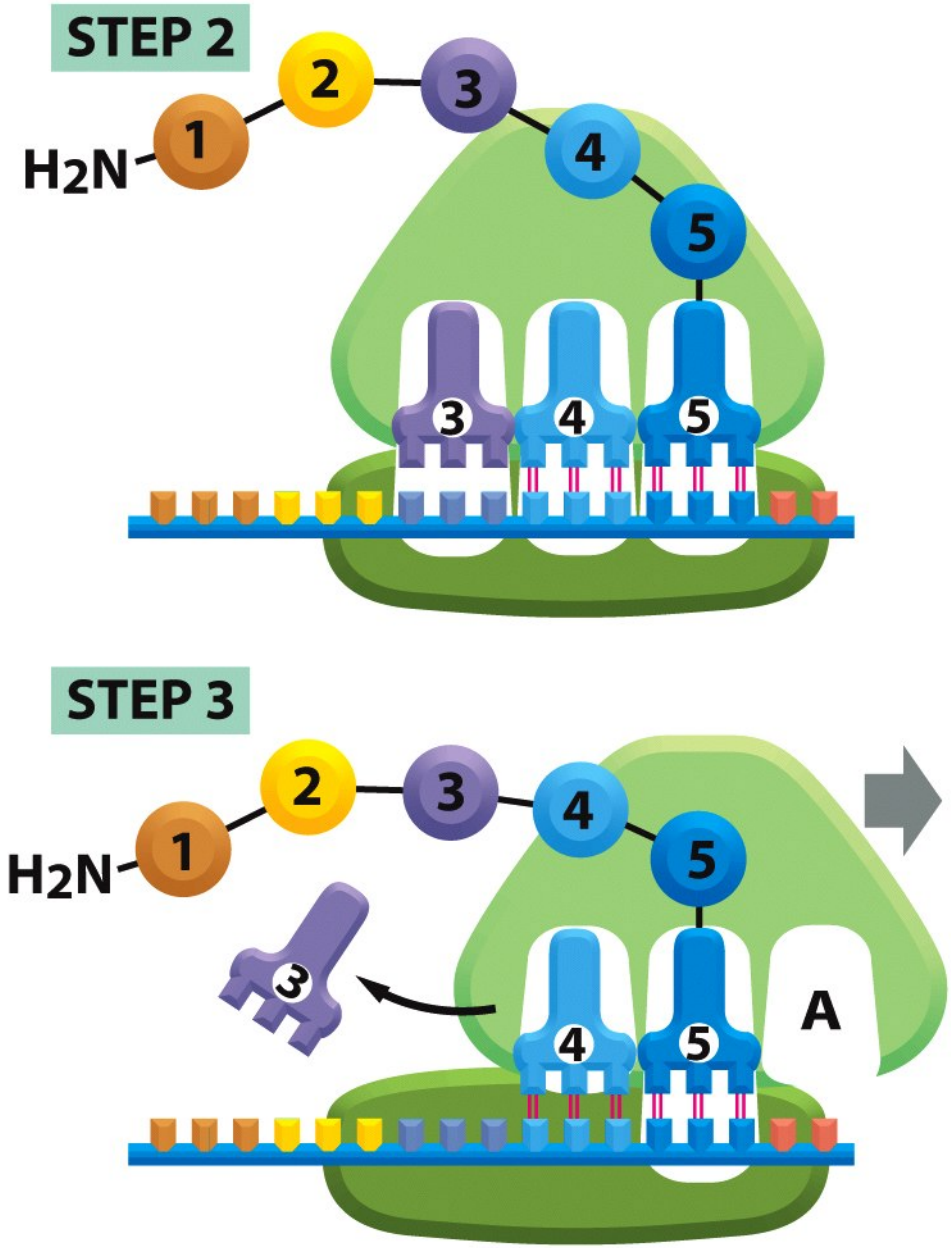


Figure 6-66 part 7 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 376

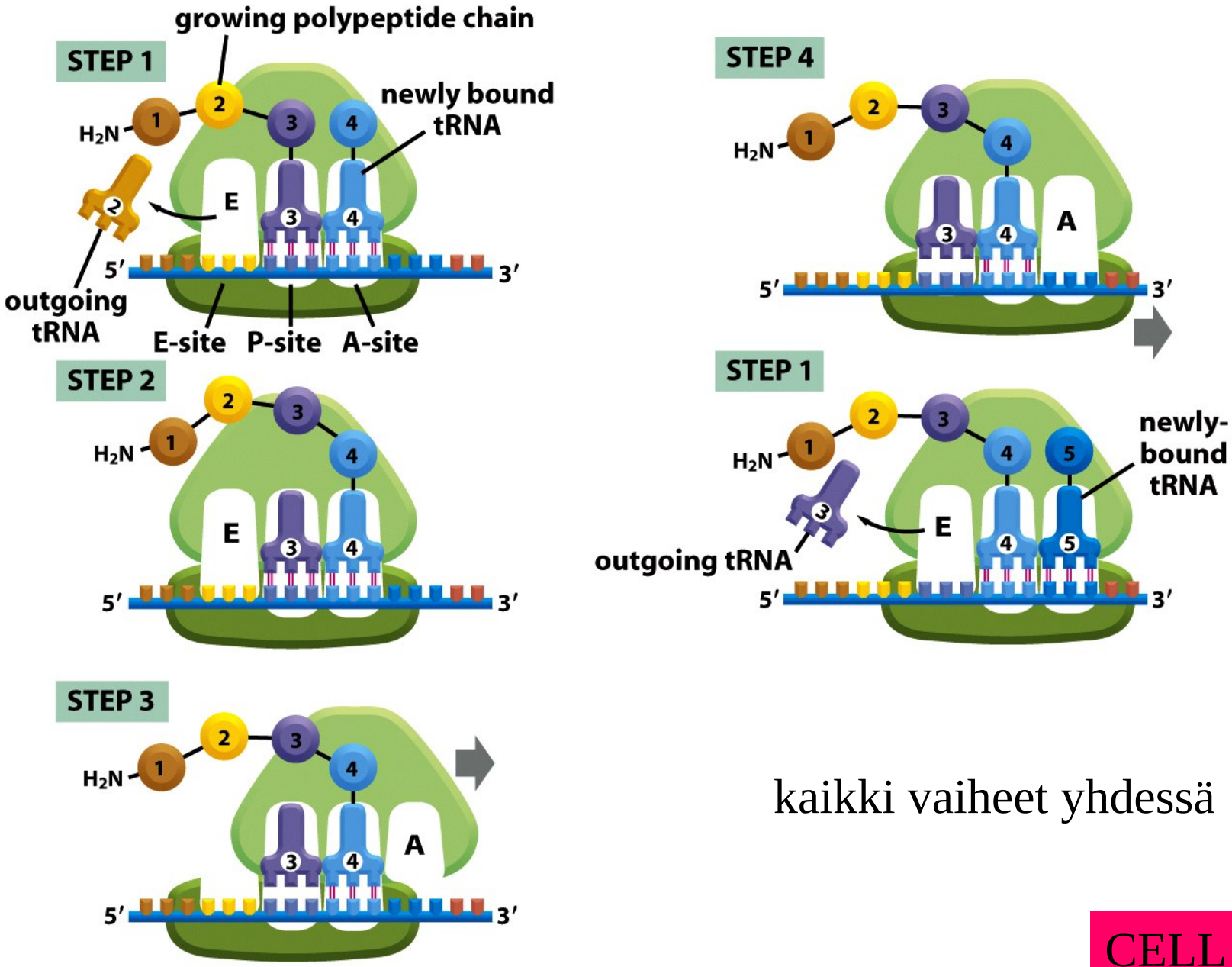


Figure 6-66 Molecular Biology of the Cell 5/e (© Garland Science 2008)

kaikki vaiheet yhdessä

CELL 376

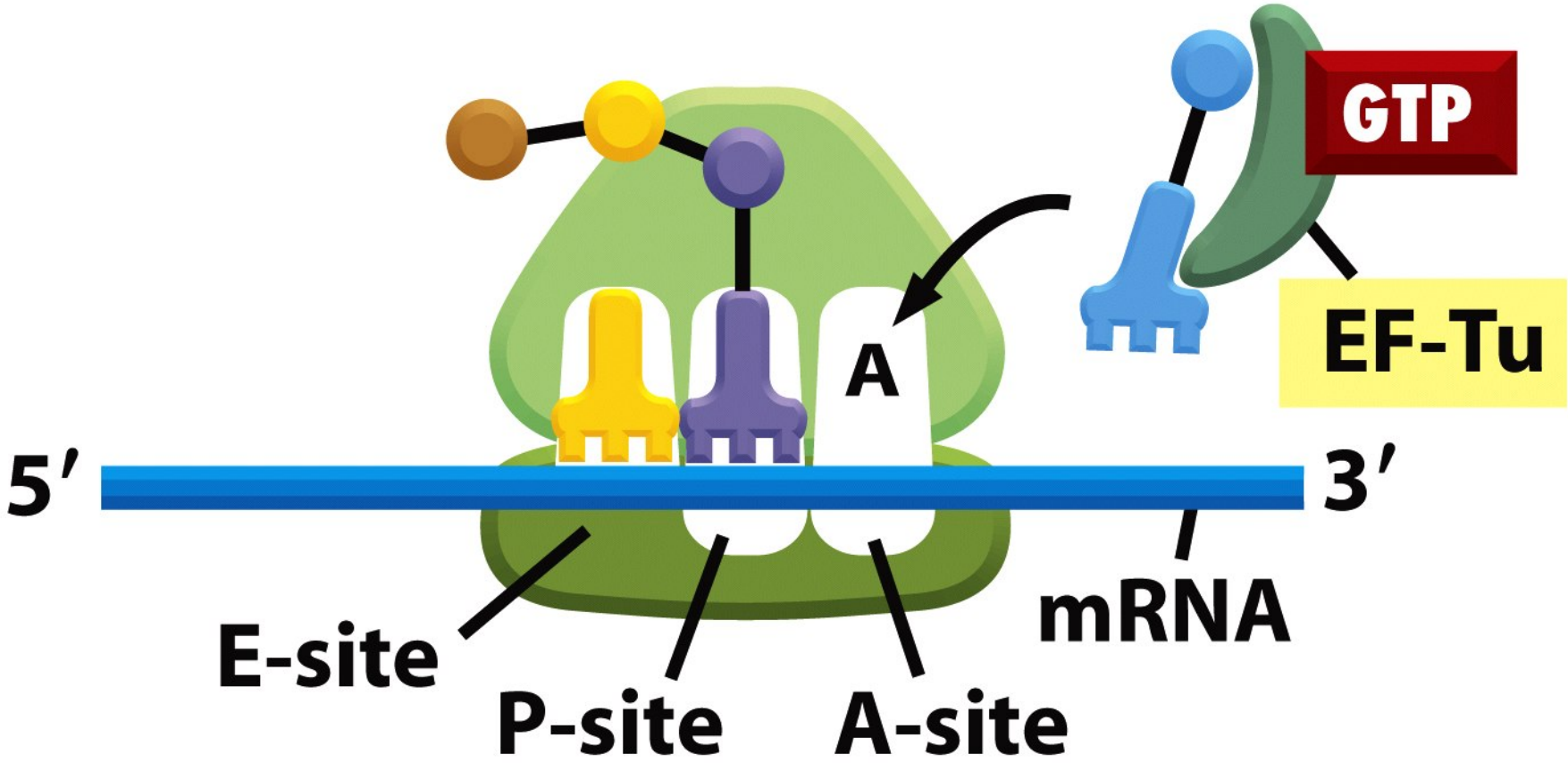


Figure 6-67 part 1 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Yksityiskohtaisemmat kuvat

CELL 377

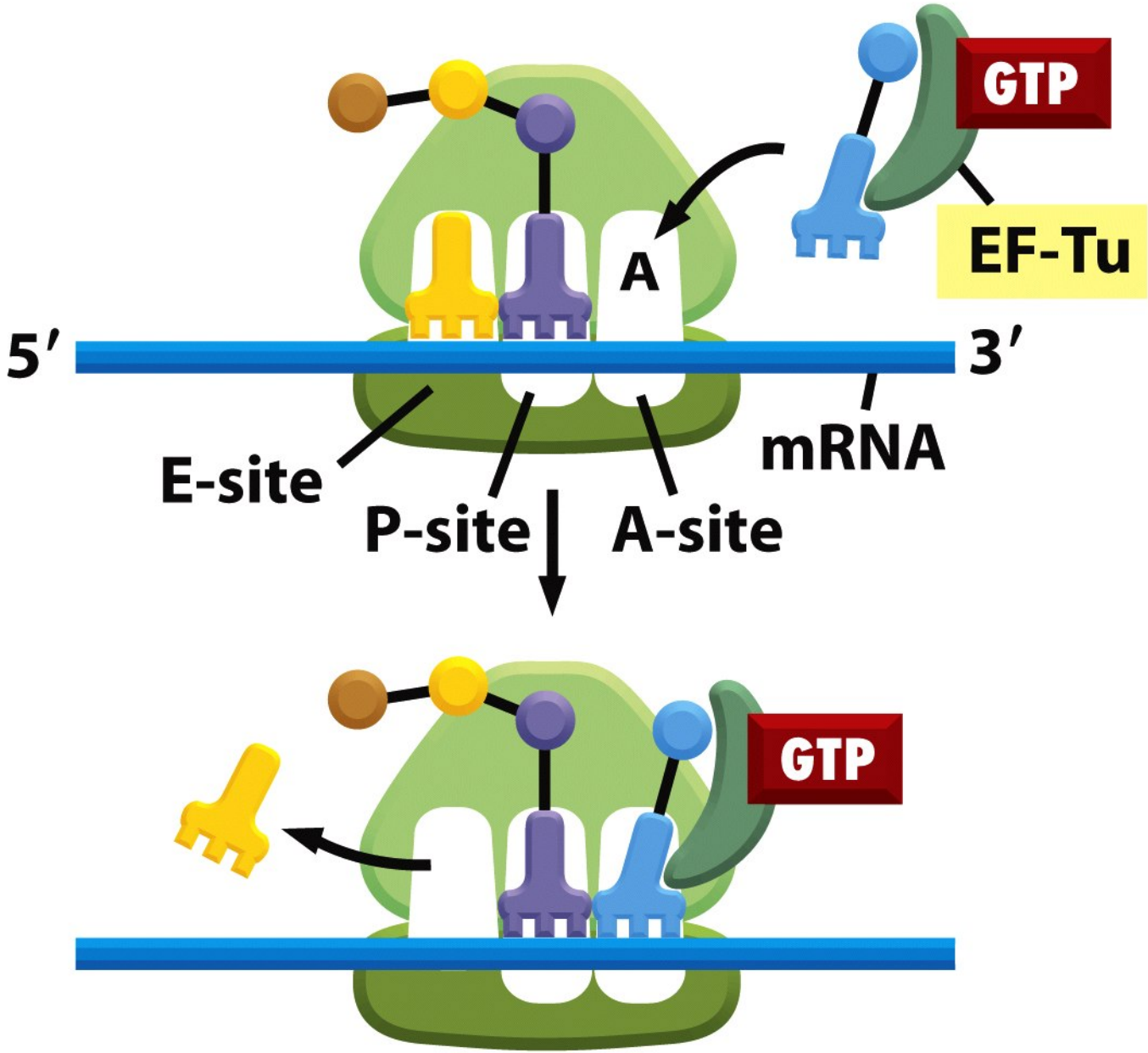


Figure 6-67 part 2 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 377

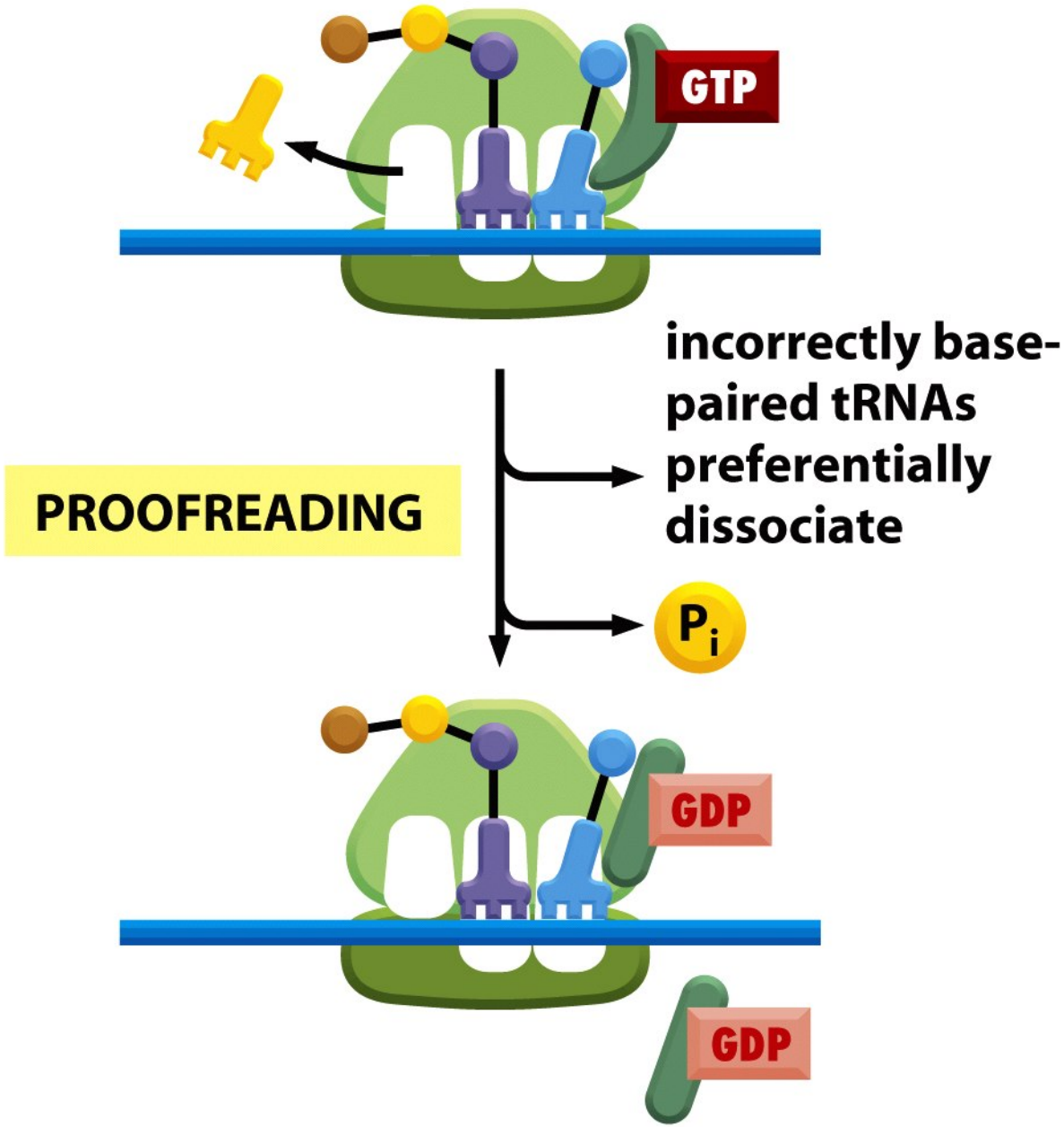
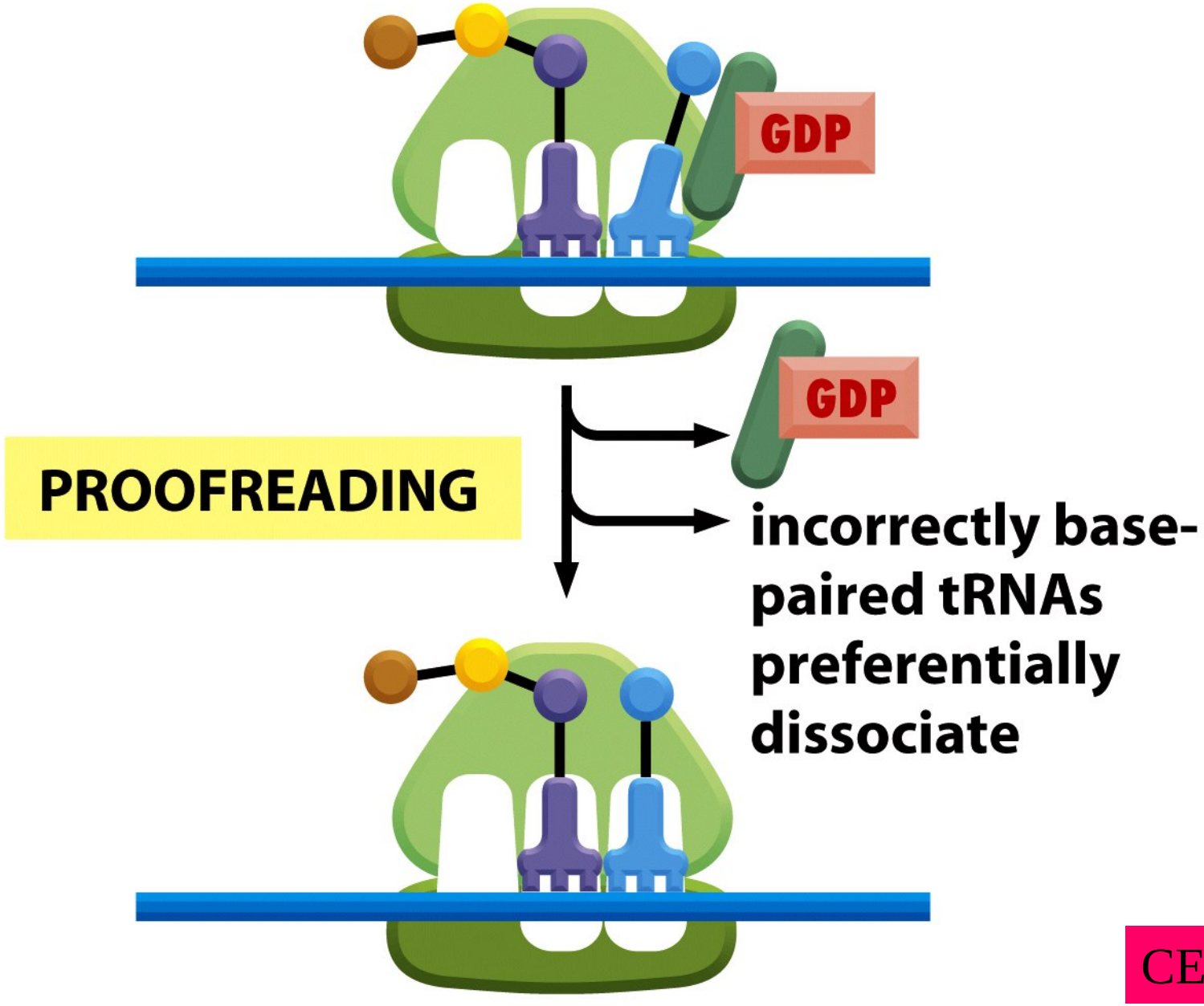


Figure 6-67 part 3 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 377



CELL 377

Figure 6-67 part 4 of 7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

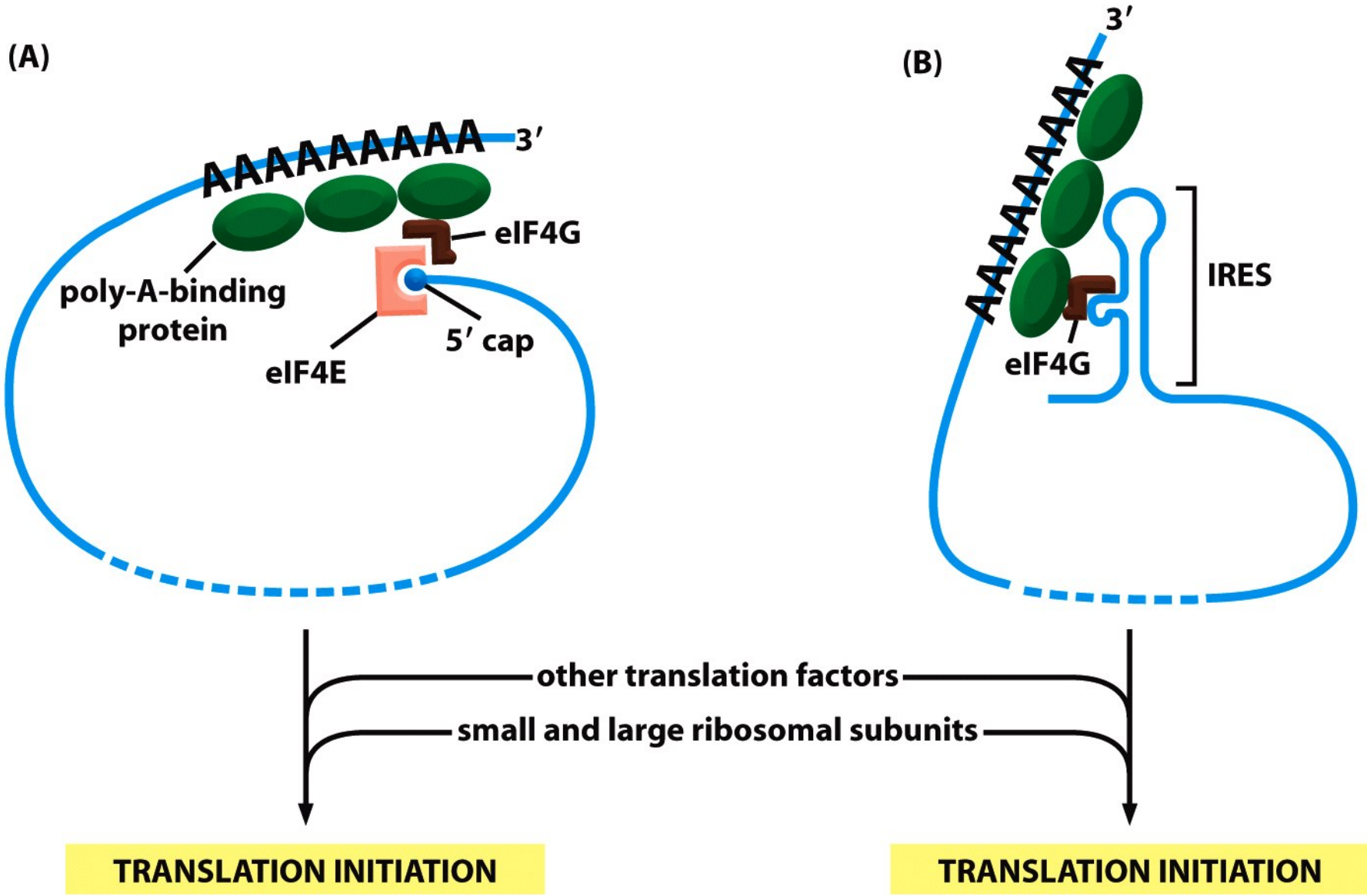
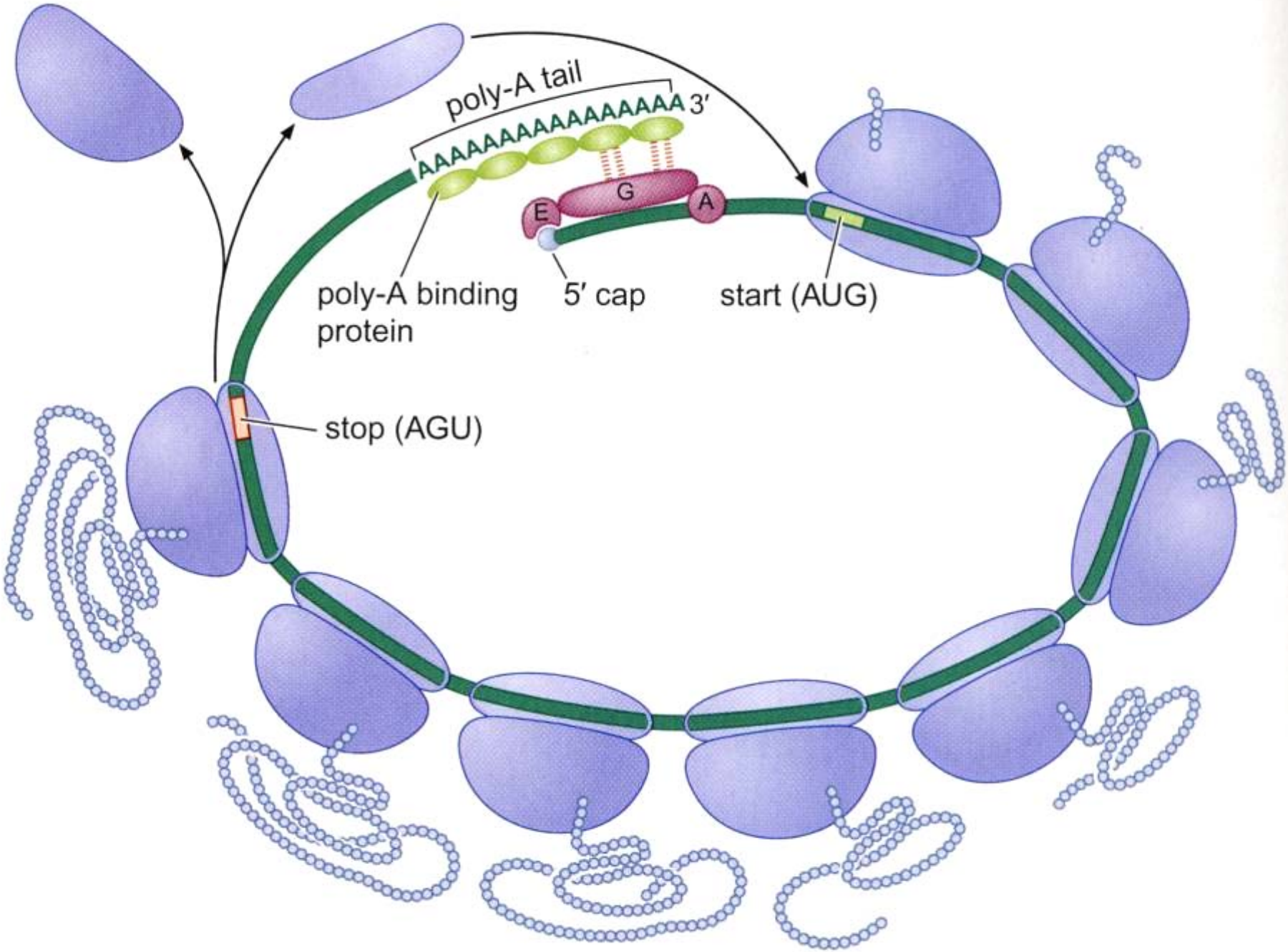


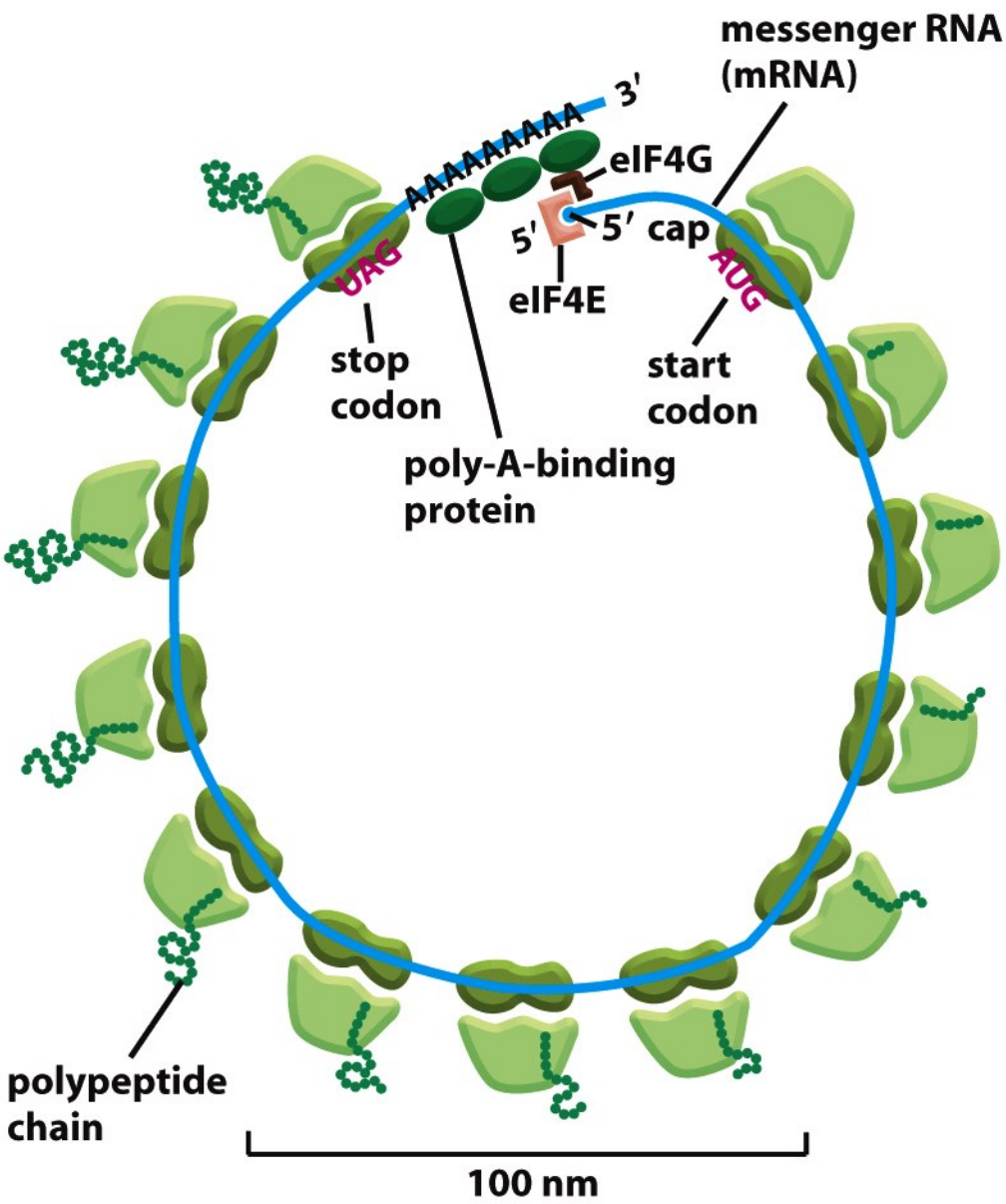
Figure 7-108 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 491

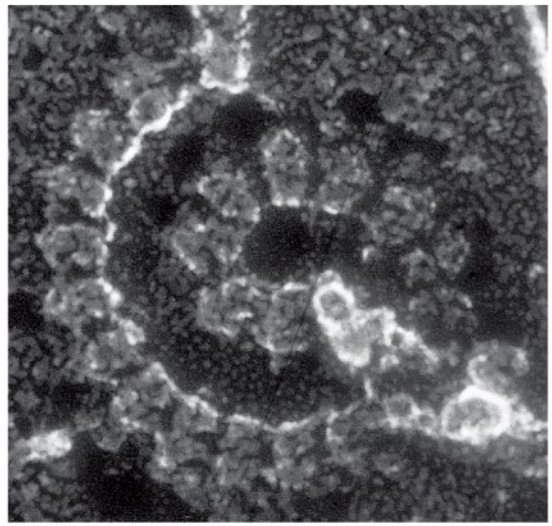
Ribosomi - mRNA - ynnä muuta -kompleksi voi nyt toimia eri tavoin

- sirkulaarisena polyribosomikompleksina


poly-A tail
AAAAAAAAAAAAAAA 3′
G
E
A
poly-A binding protein
5′ cap
start (AUG)
stop (AGU)



(A)



(B)

Figure 6-76 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Ribosomi - mRNA - ynnä muuta -kompleksi voi nyt toimia eri tavoin

- sirkulaarisena polyribosomikompleksina

tai

- yhteistoiminnassa solun membraanien kanssa, syntyvän polypeptidin sijoittamiseksi oikein

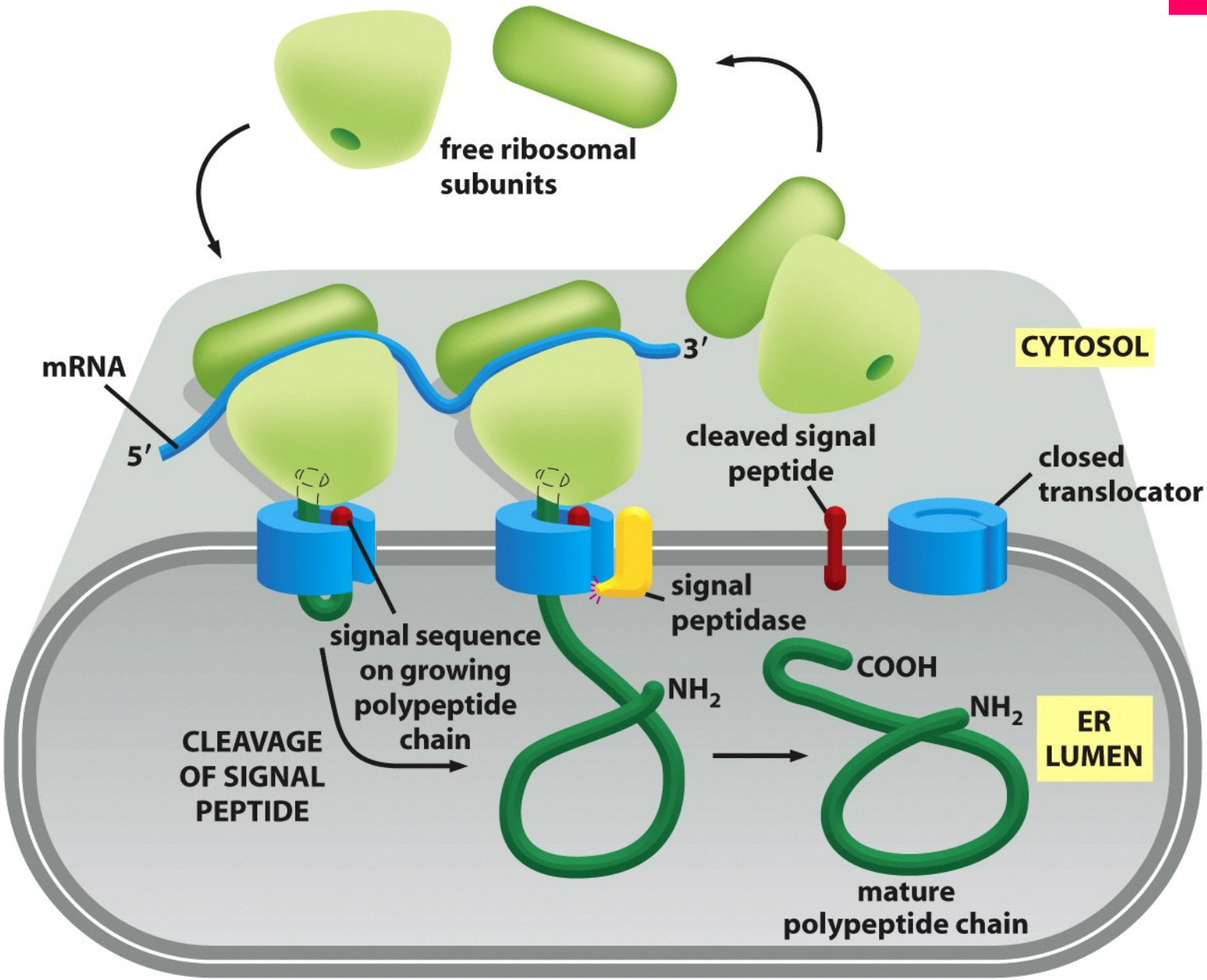


Figure 12-38 Molecular Biology of the Cell 5/e (© Garland Science 2008)

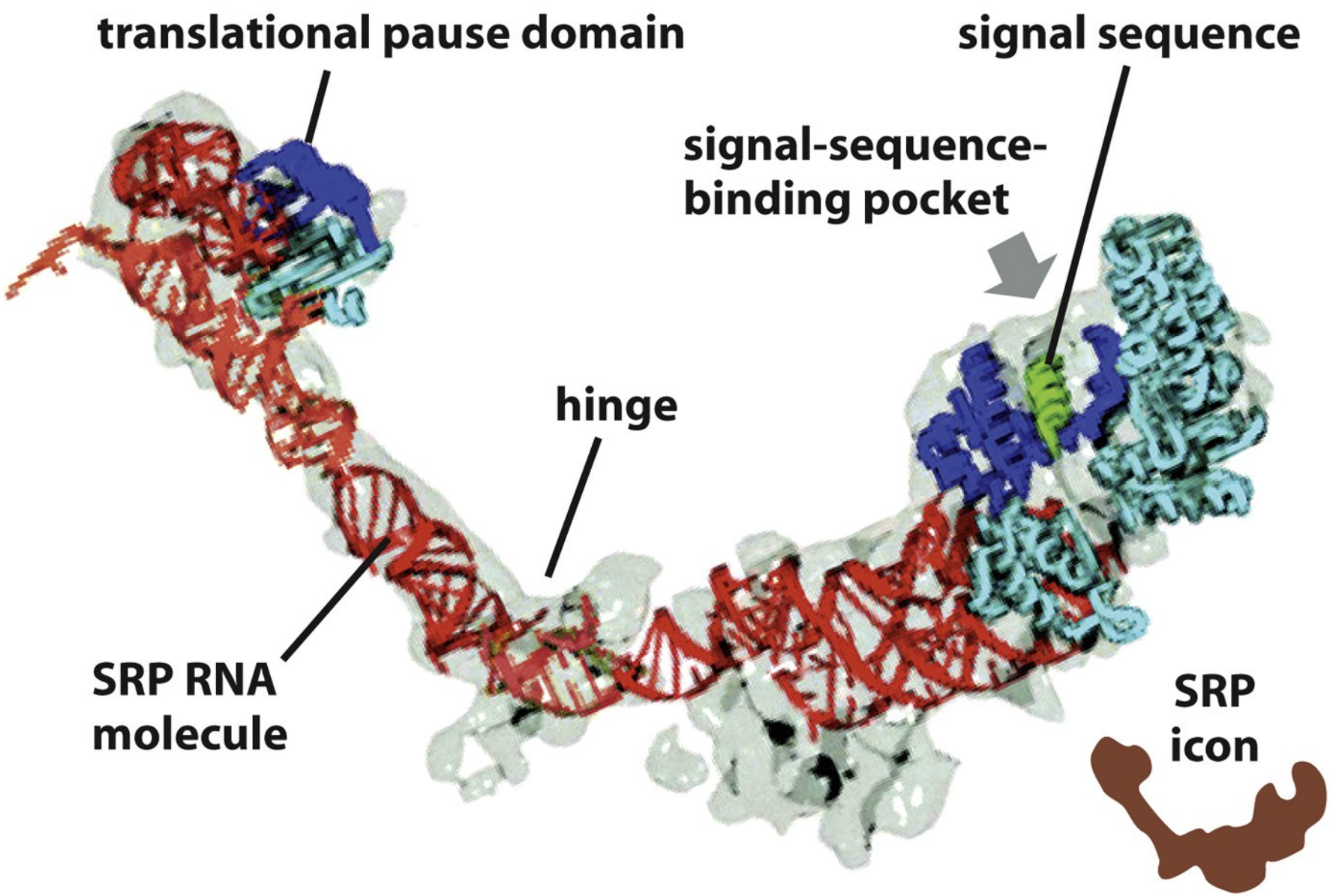


Figure 12-39a Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 728

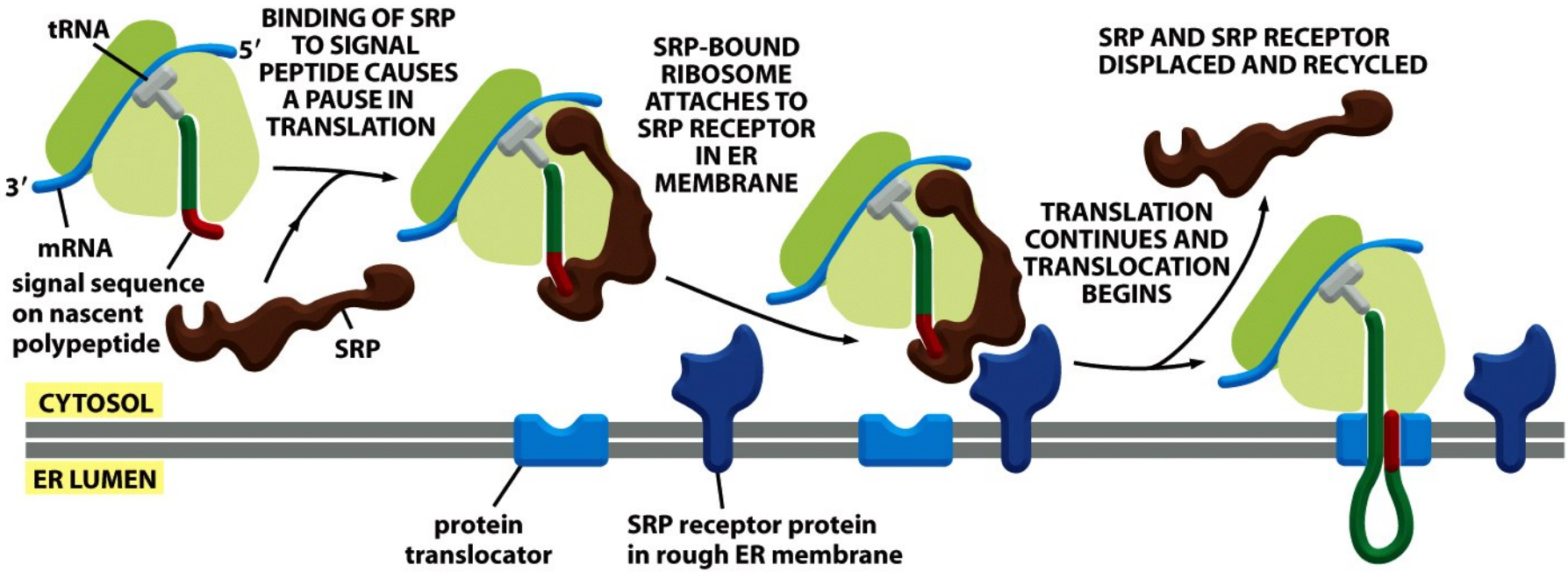


Figure 12-40 Molecular Biology of the Cell 5/e (© Garland Science 2008)

CELL 729

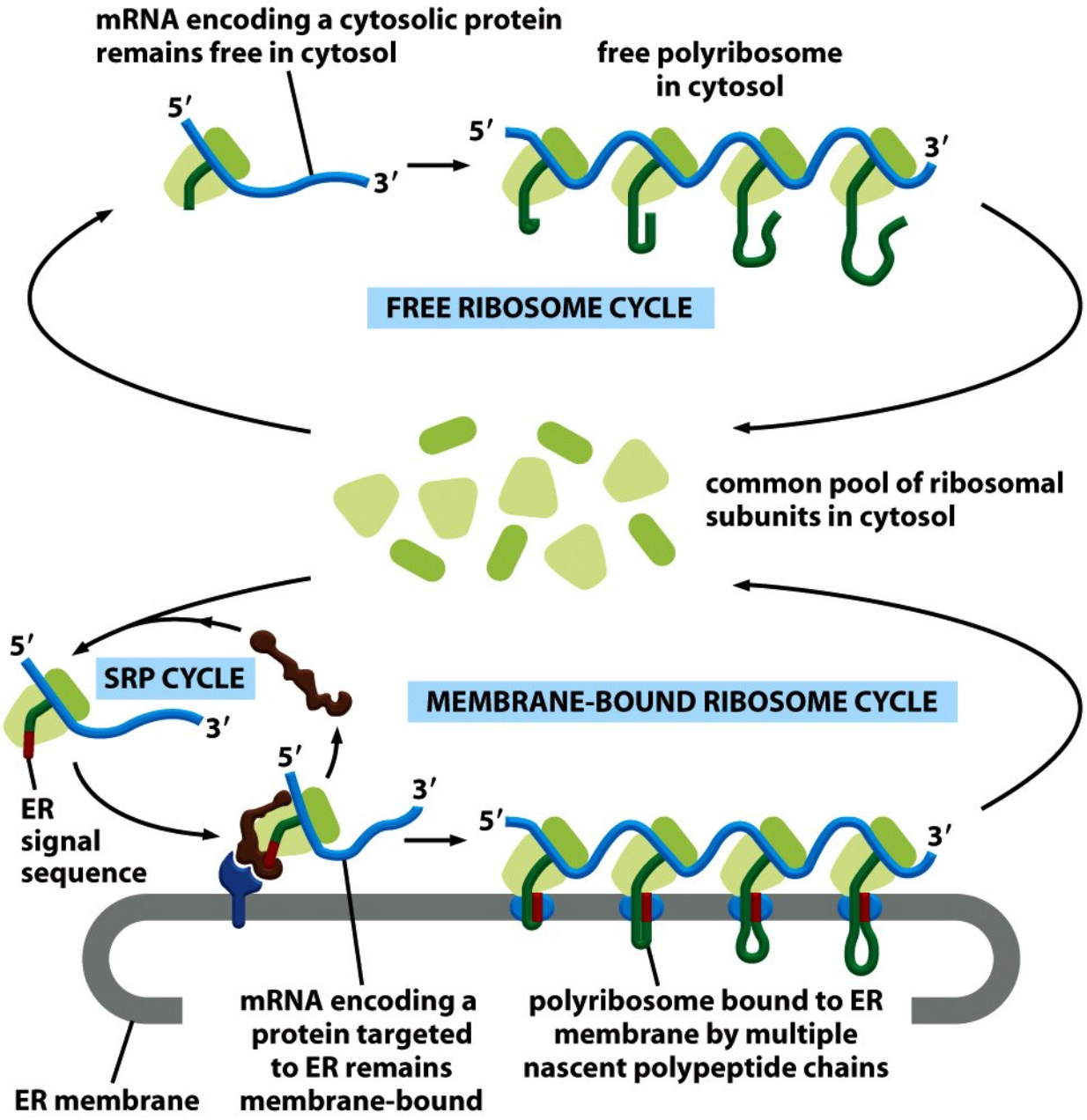


Figure 12-41a Molecular Biology of the Cell 5/e (© Garland Science 2008)

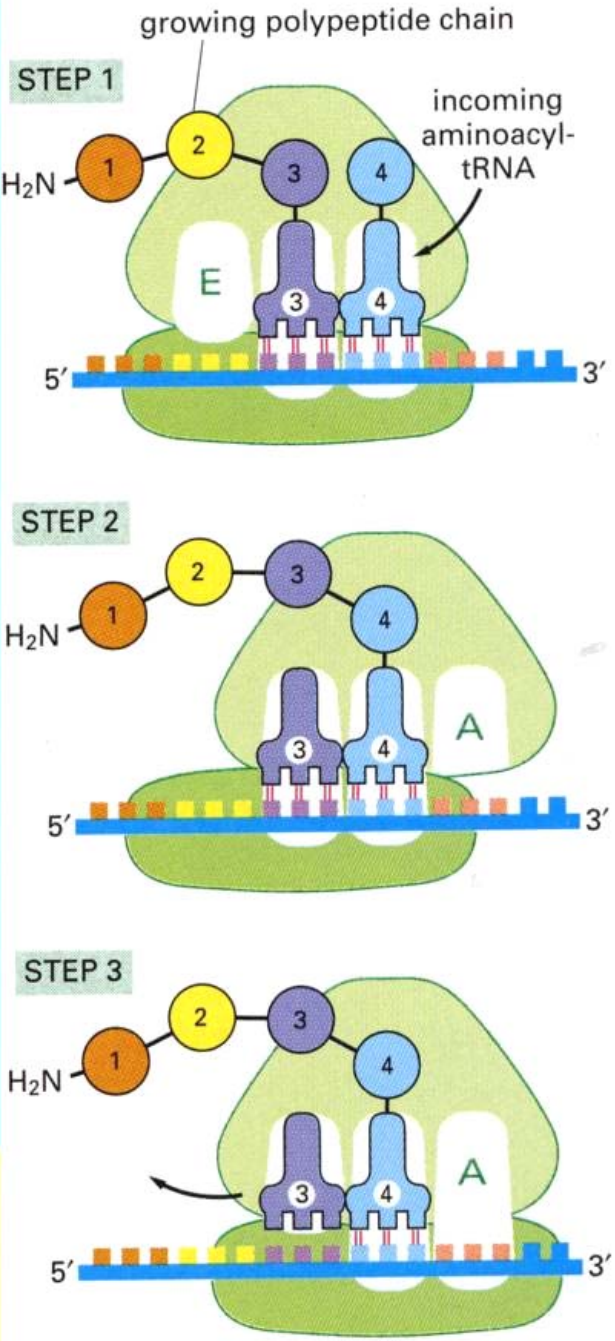
CELL 729

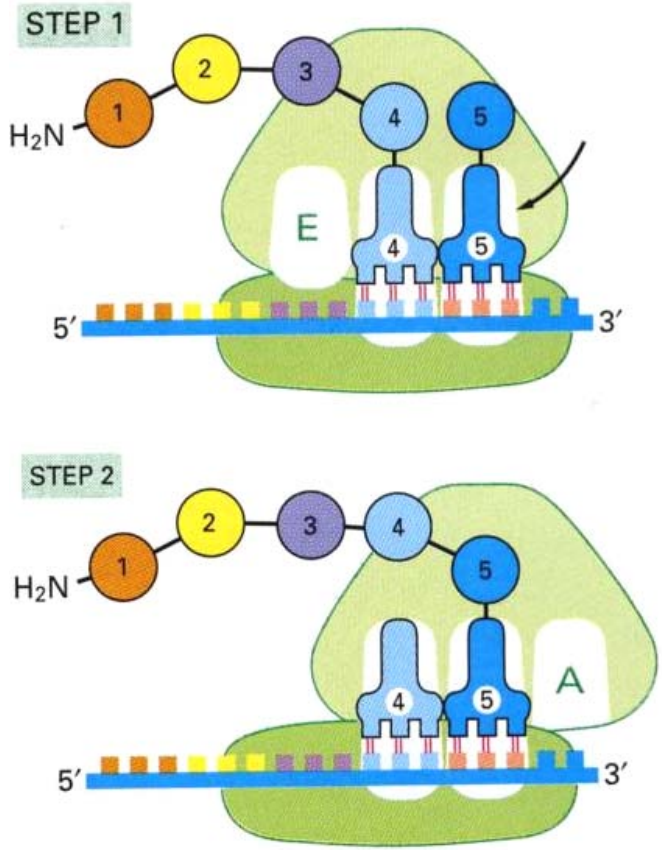
Yleensä antibiootit löydetään vaikutustensa kautta, mutta mekanismi on usein osoittautunut puuttumiseksi bakteerien. RNA-proteiini –reaktioketjuun. Huomautus alla: ihmisenkin *mitokondrio on bakteeri*, joten se voi kärsiä.

Table 6–4 Inhibitors of Protein or RNA Synthesis

INHIBITOR	SPECIFIC EFFECT
Acting only on bacteria	
Tetracycline	blocks binding of aminoacyl-tRNA to A-site of ribosome
Streptomycin	prevents the transition from translation initiation to chain elongation and also causes miscoding
Chloramphenicol	blocks the peptidyl transferase reaction on ribosomes (step 2 in Figure 6–66)
Erythromycin	binds in the exit channel of the ribosome and thereby inhibits elongation of the peptide chain
Rifamycin	blocks initiation of RNA chains by binding to RNA polymerase (prevents RNA synthesis)
Acting on bacteria and eucaryotes	
Puromycin	causes the premature release of nascent polypeptide chains by its addition to the growing chain end
Actinomycin D	binds to DNA and blocks the movement of RNA polymerase (prevents RNA synthesis)
Acting on eucaryotes but not bacteria	
Cycloheximide	blocks the translocation reaction on ribosomes (step 3 in Figure 6–66)
Anisomycin	blocks the peptidyl transferase reaction on ribosomes (step 2 in Figure 6–66)
α-Amanitin	blocks mRNA synthesis by binding preferentially to RNA polymerase II

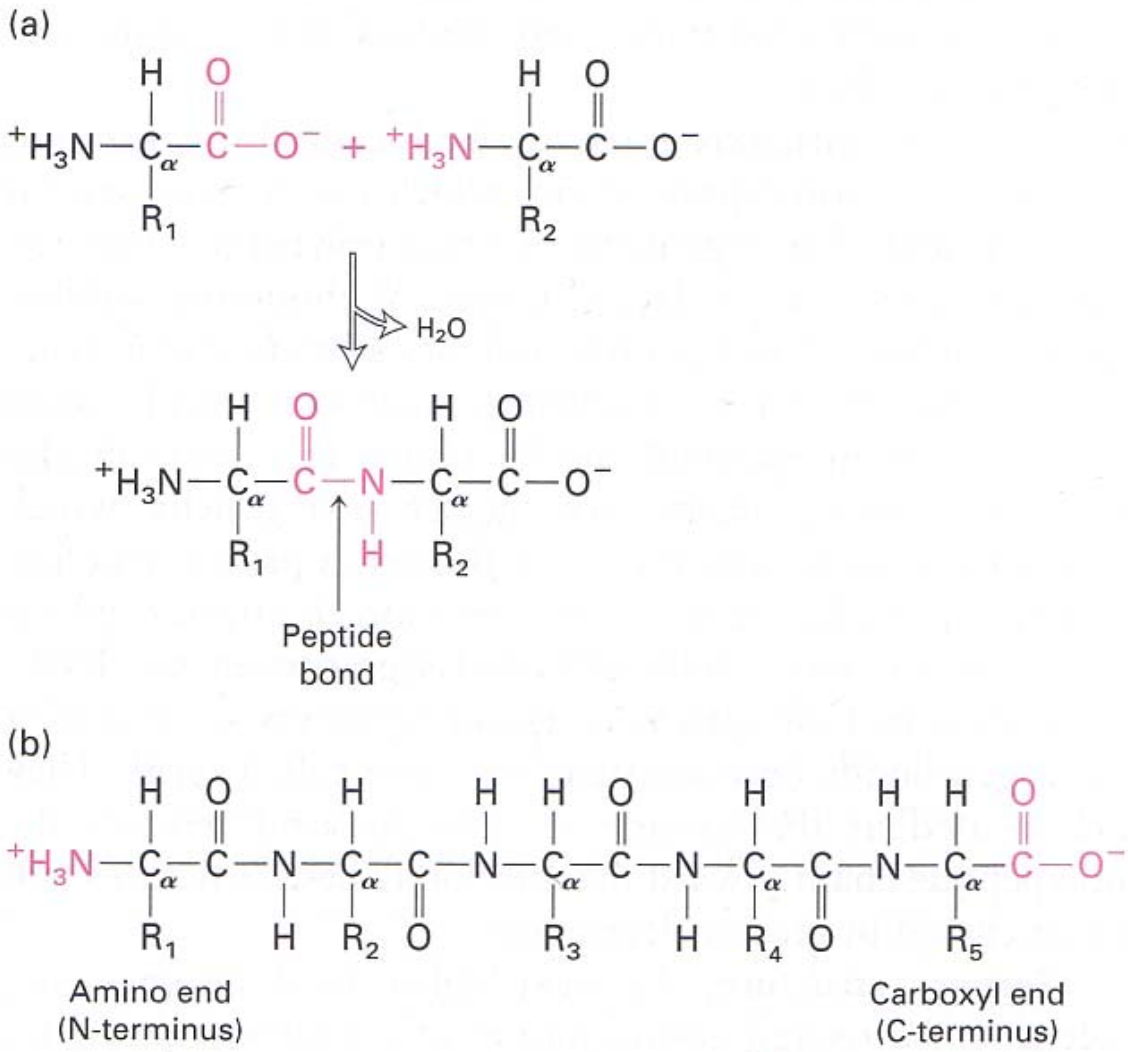
The ribosomes of eucaryotic mitochondria (and chloroplasts) often resemble those of bacteria in their sensitivity to inhibitors. Therefore, some of these antibiotics can have a deleterious effect on human mitochondria.





A-site aminoacyl-tRNA
P peptidyl
E exit

CELL 344-5



▲ **FIGURE 3-3 The peptide bond.** (a) A condensation reaction between two amino acids forms the peptide bond, which links all the adjacent residues in a protein chain. (b) Side-chain groups (R) extend from the backbone of a protein chain, in which the amino N, α carbon, carbonyl carbon sequence is repeated throughout.

Translaatiossa aminohapot liittyvät lineaariseksi ketjuksi *peptidisidoksin*

Silläkin on suunta! *Ketju ei voi tekovaiheessa haarautua!*

Sekundaarisesti polypeptidiketju voi tehdä vaikka mitä silmukoita ja liitoksia

CELL 126

Lopetus (stop-kodoni)

UAG
UAA
UGA

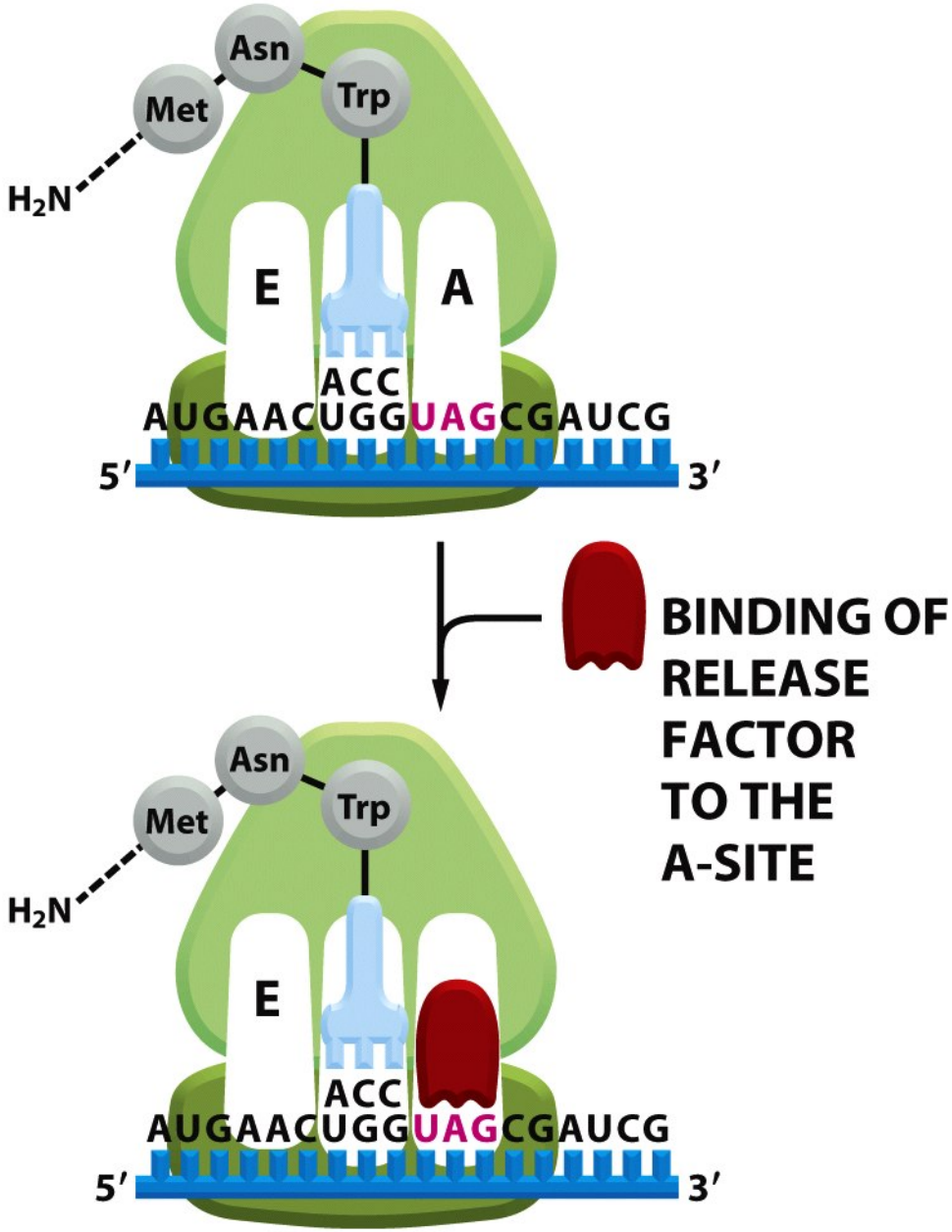


Figure 6-74 part 1 of 3 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Lopetusprosessissa tarvitaan erityinen release-faktori eRFI.
Se muistuttaa tRNA-molekyyliä ja istuu lopetuskodoniin

Se on proteiini eikä RNA:ta

CELL 381

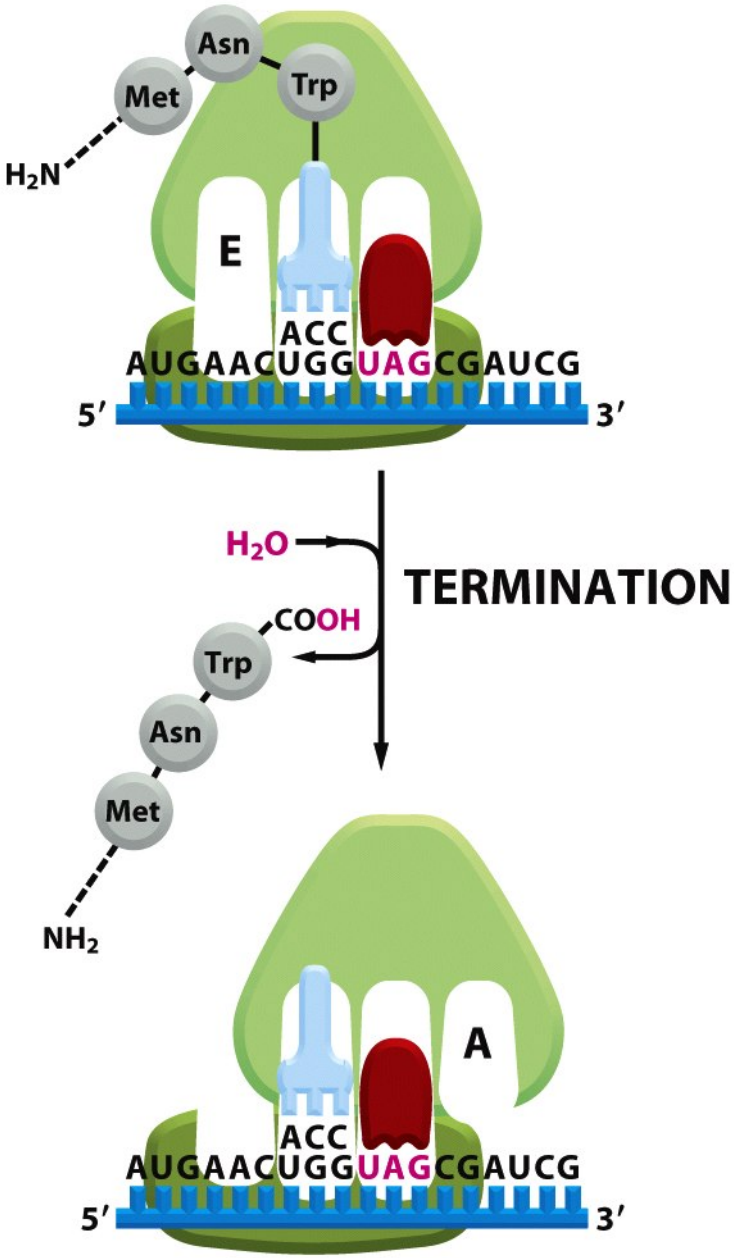


Figure 6-74 part 2 of 3 Molecular Biology of the Cell 5/e (© Garland Science 2008)

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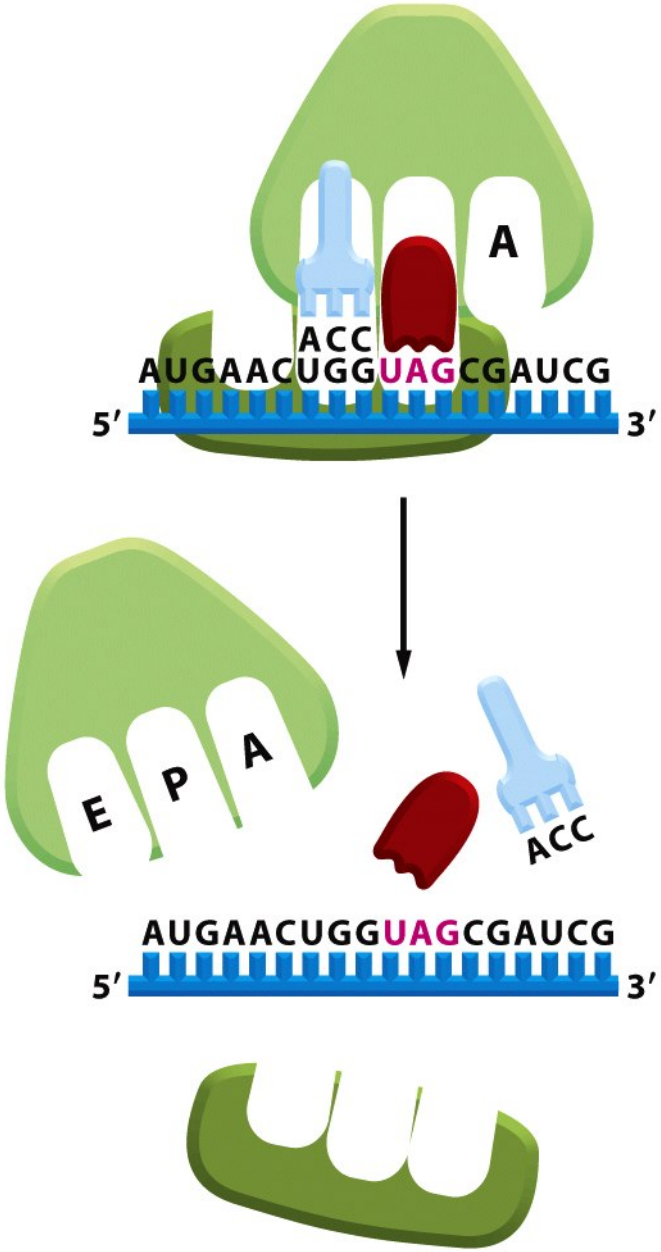

Figure 6-74 part 3 of 3 Molecular Biology of the Cell 5/e (© Garland Science 2008)

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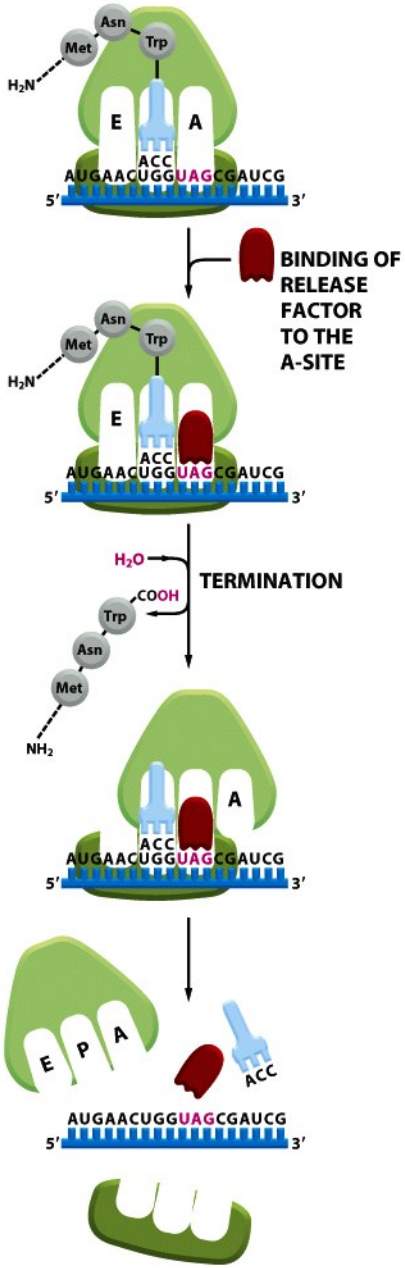

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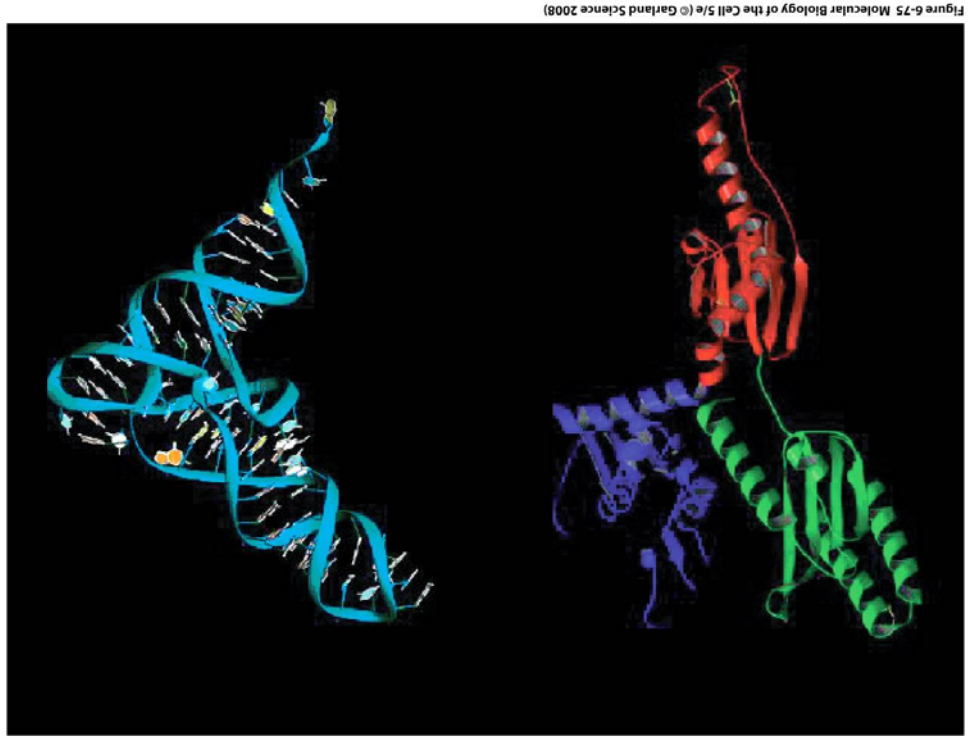
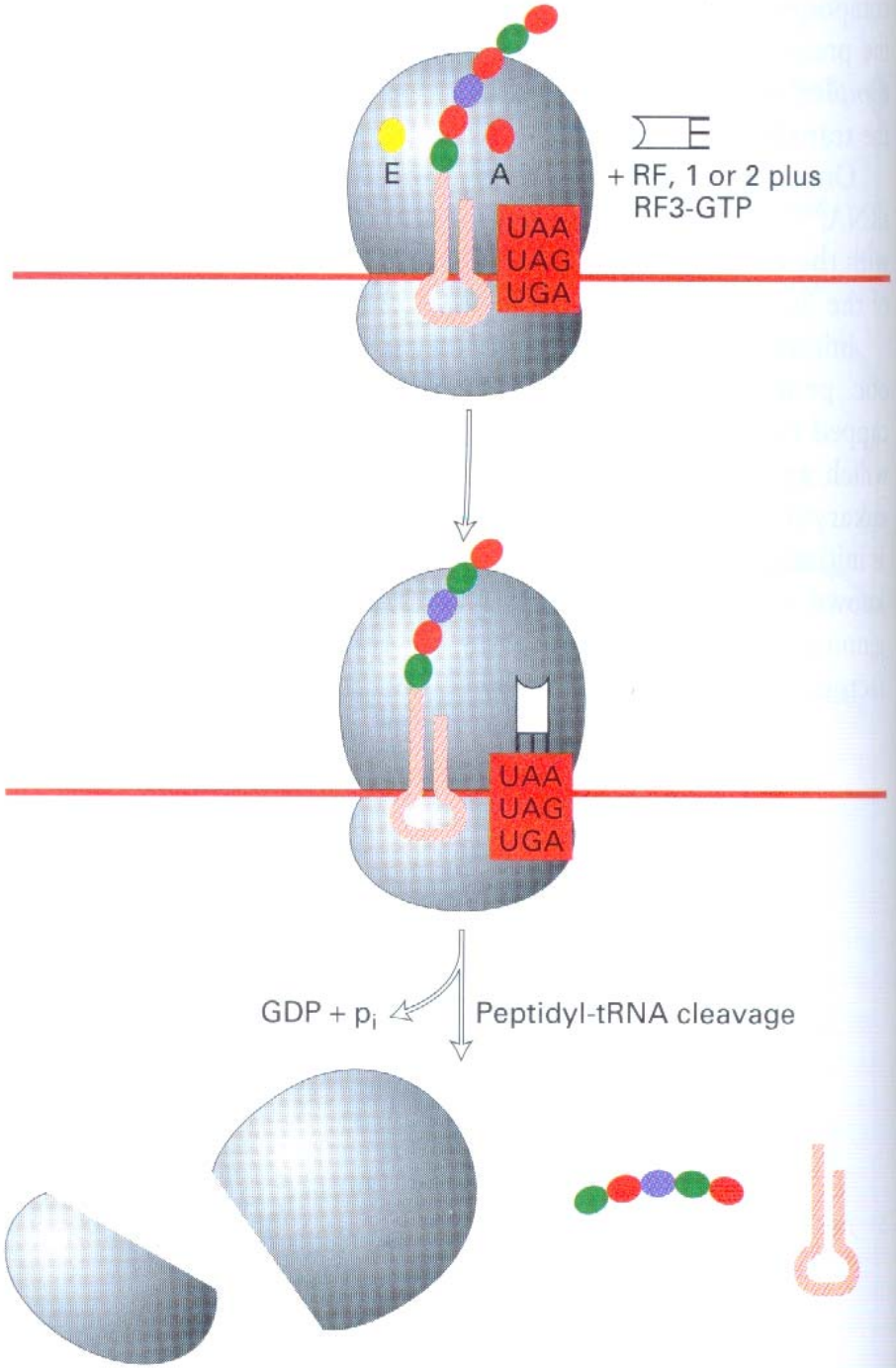


Figure 6-75 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Ihmisen eRF1 (oikealla) verrattuna tRNA –molekyyliin CELL 382

CELL 381



Toinen versio

Bakteereista: Jos mRNA on viallinen, eikä lopetuskodonia ole, prosessi juuttuu. Sellaista ongelmatilannetta varten soluissa on erityinen tmRNA (transfer ja messenger, >300 nukleotidia), joka tulee paikalle ja jatkaa translaatiota, lisääpä vielä tekeillä olleen polypeptidin päähän tuhoamissignaalin (Science 4 Apr 2003, p. 127),
CELL 352

CELL 387

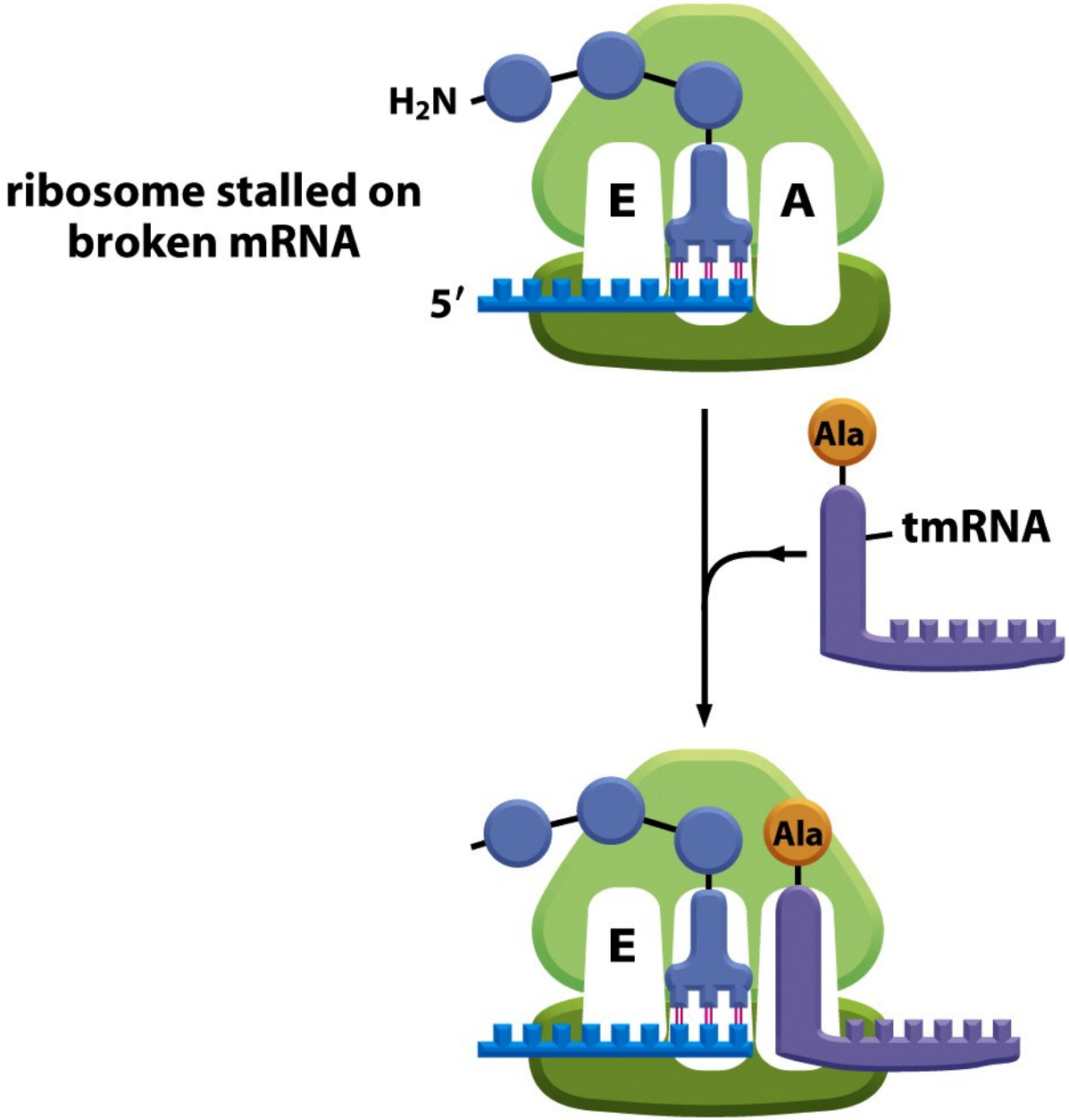


Figure 6-81 part 1 of 3 Molecular Biology of the Cell 5/e (© Garland Science 2008)

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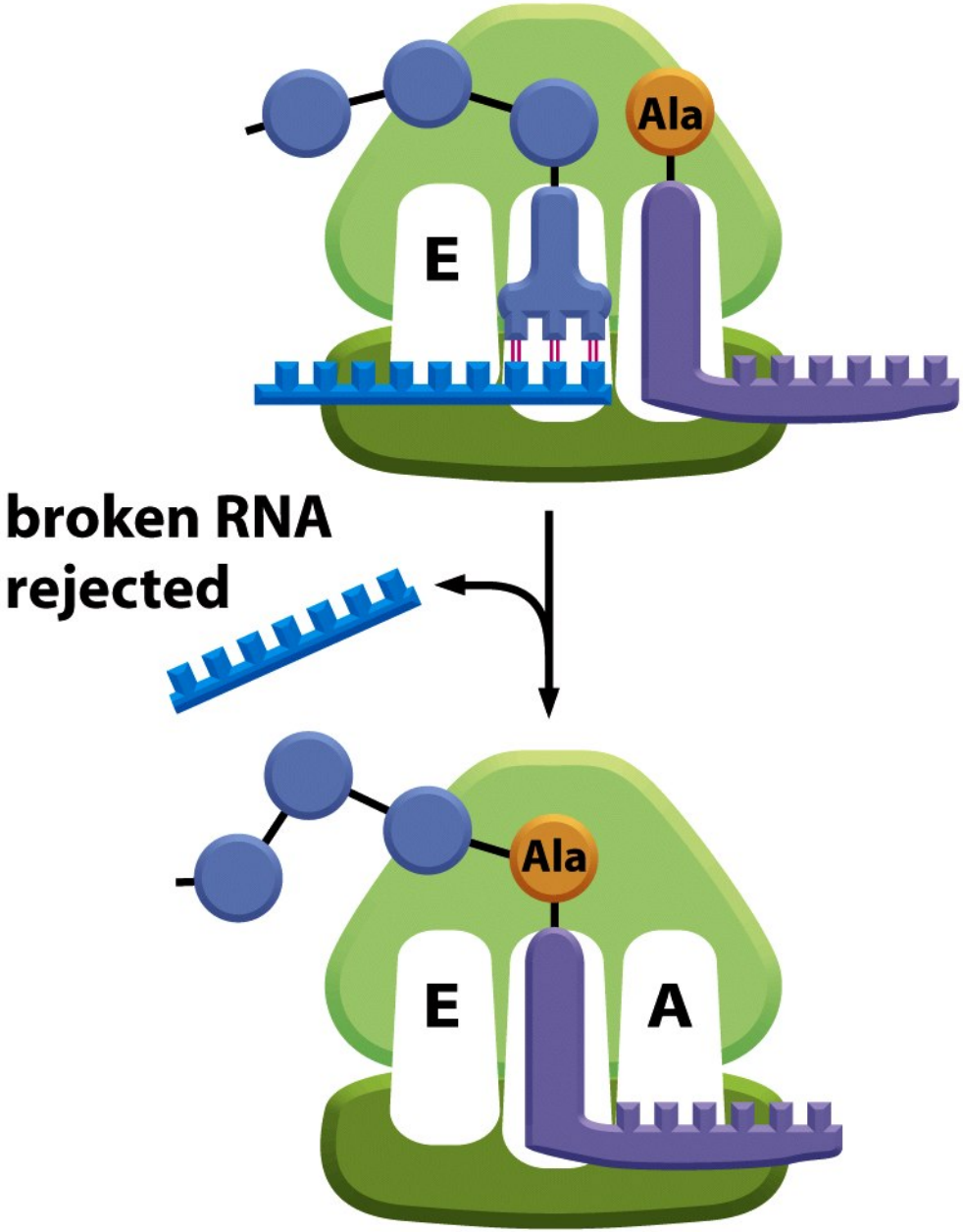

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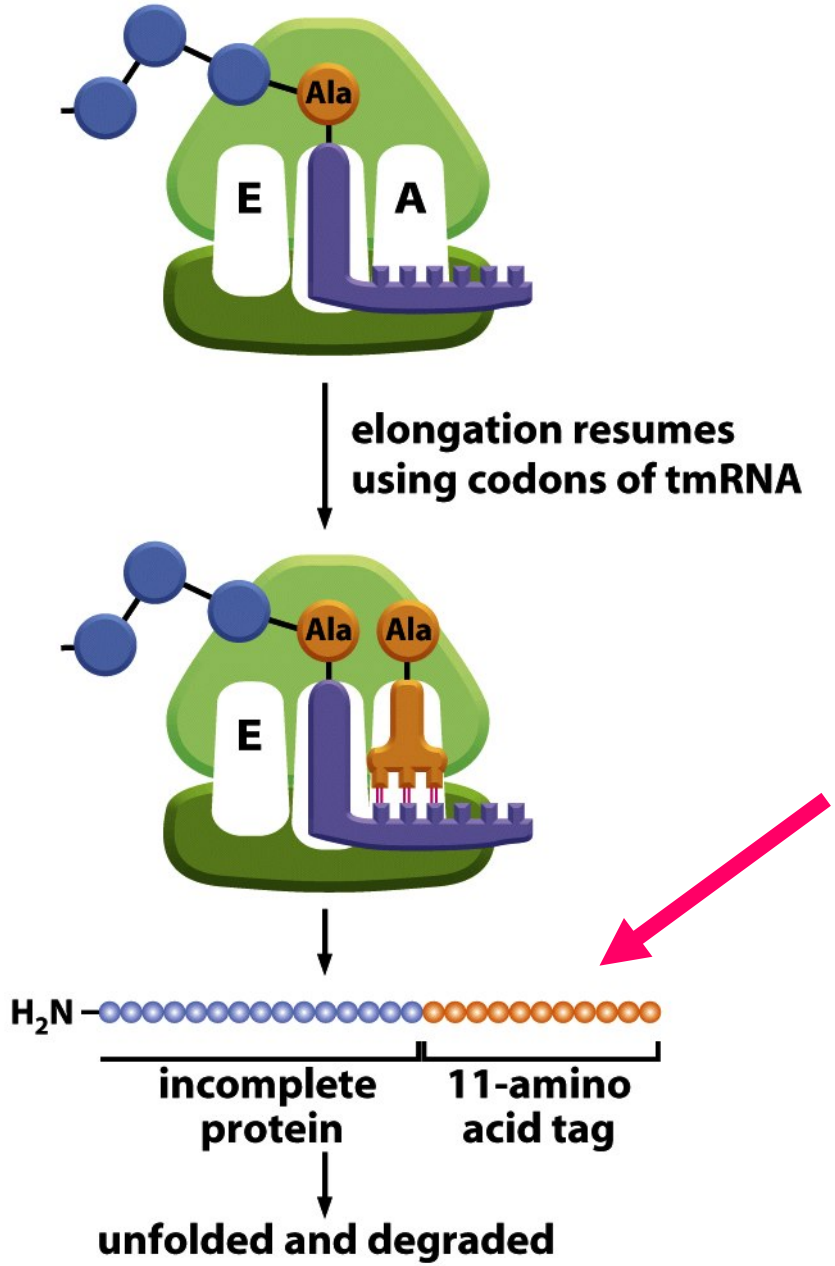

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hävitettäväksi!

CELL 387

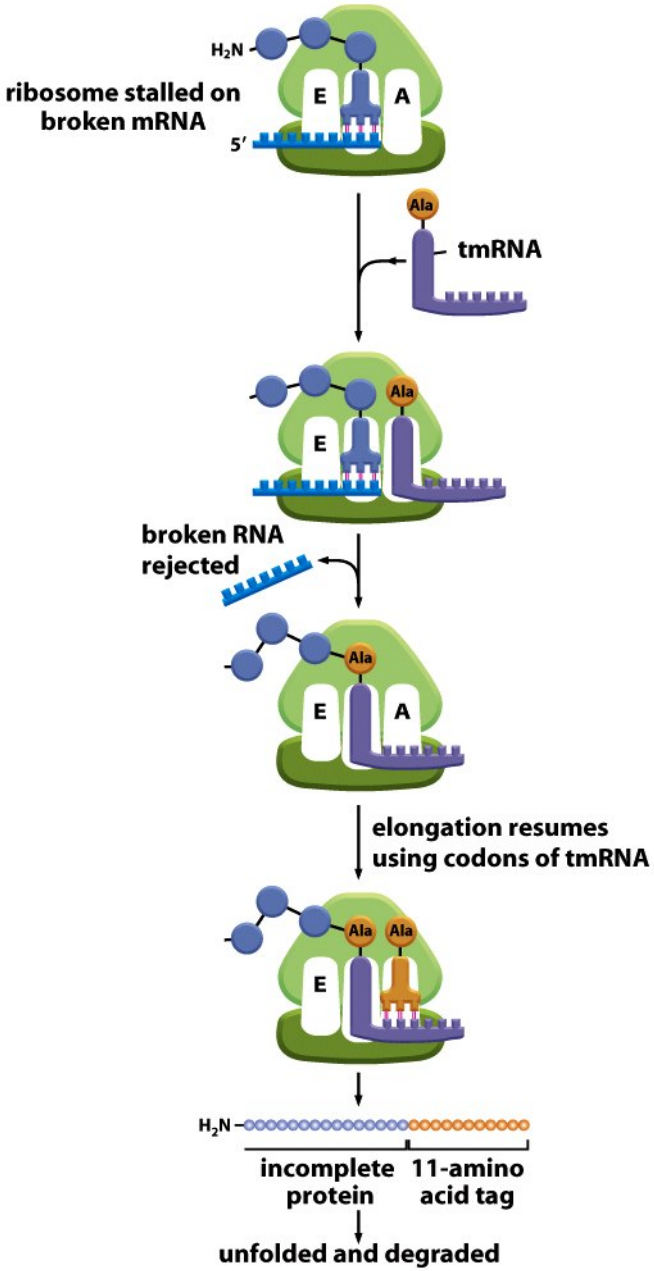

Figure 6-81 Molecular Biology of the Cell 5/e (© Garland Science 2008)

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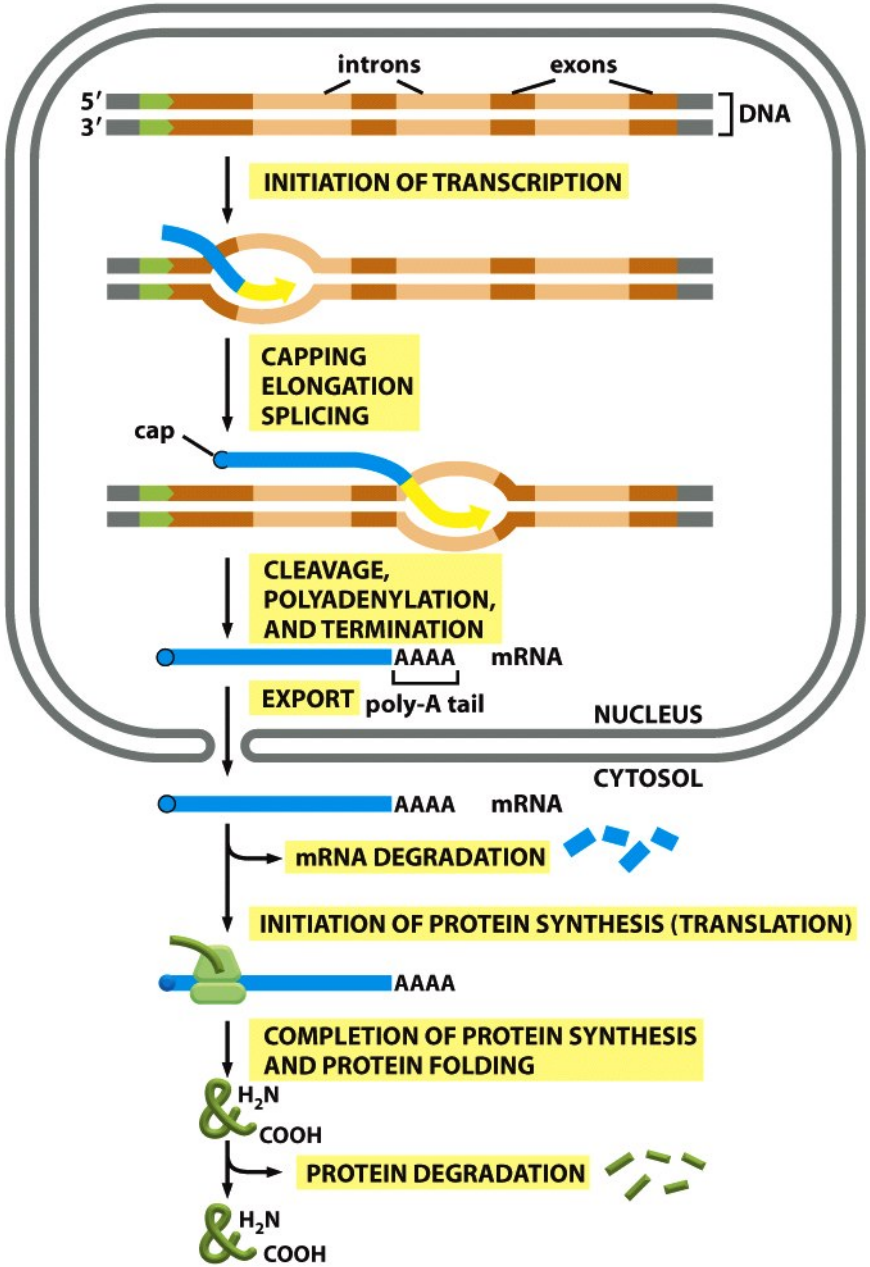

Figure 6-97 Molecular Biology of the Cell 5/e (© Garland Science 2008)

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Proteiinin jälkikäsittely

Synteesin jälkeen aminohappoketju hankkii itselleen sekundaarisen ja tertiaarisen rakenteen, muodostaa tarpeelliset dimeeri-, tetrameeri- tai polymeeriliitot sekä hankkii kofaktorit eli yhteistyökumppanit, raudat, sinkit, hemit yms. Apuna voi olla chaperoneja eli kaitsijoita

CELL sivulta 387 alkaen selostaa näitä tärkeitä prosesseja, jotka liittyvät vaikka mihin: hullun lehmän tautiin, Alzheimeriin ja autoimmuunisairauksiin (**396**).

Lopulta proteiinit jauhetaan säädellysti tohjoksi ja kierrätetään. Proteiinin määrä riippuu tuotannon ja hävityksen tasapainosta.