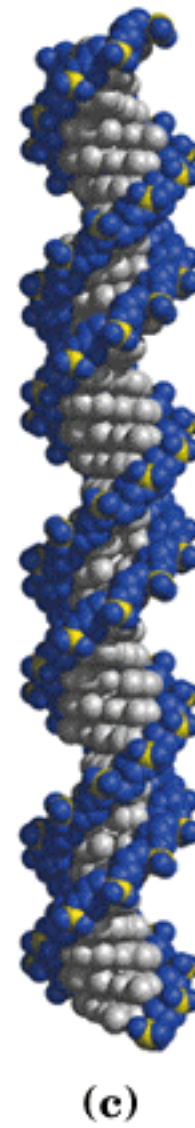
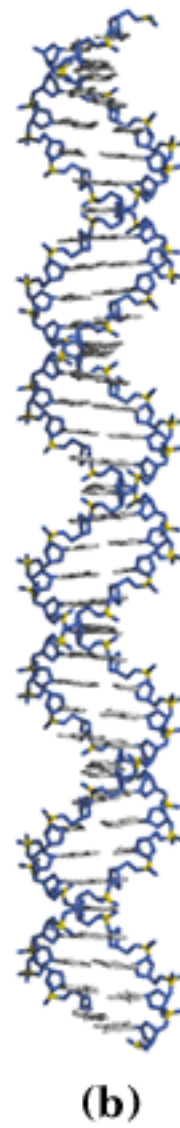
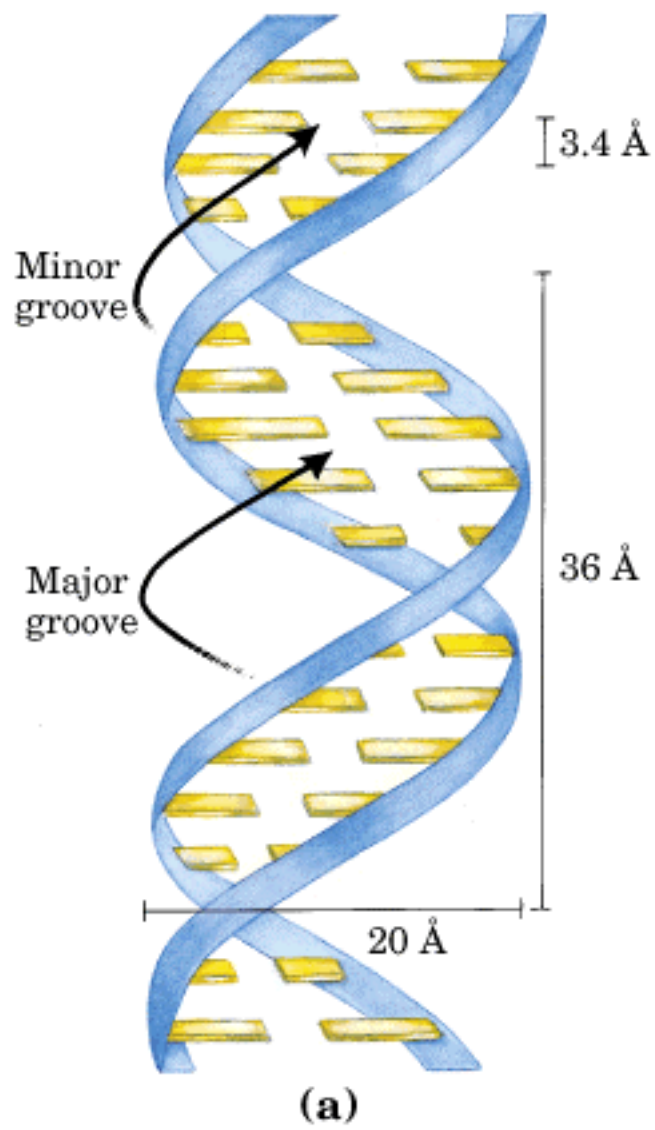
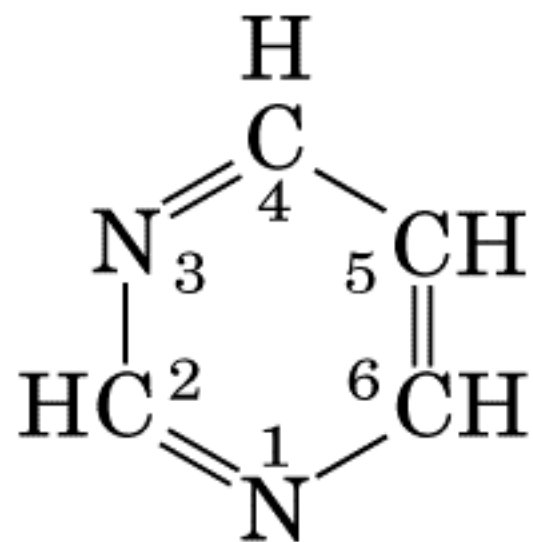
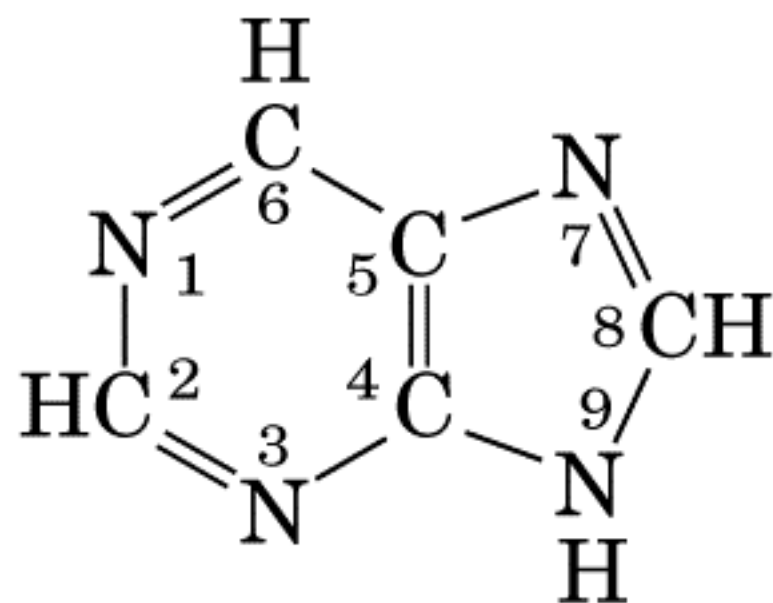


# Del Genotipo al Fenotipo



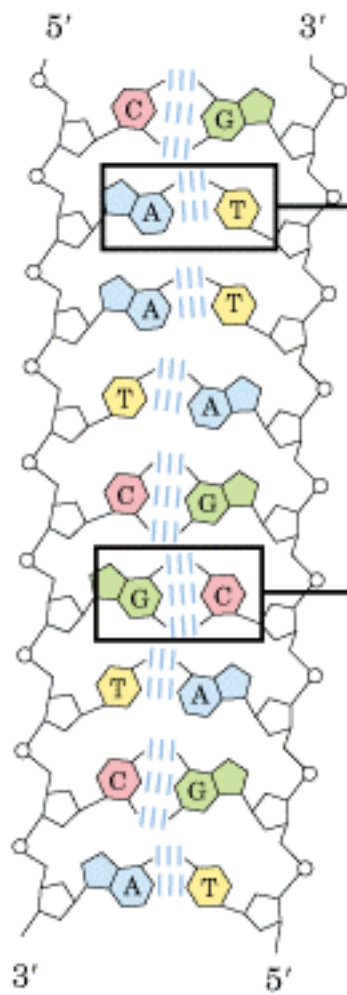


Pyrimidine



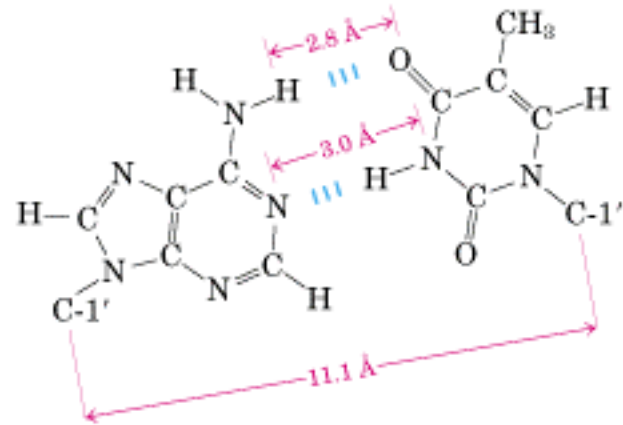
Purine

**(b)**

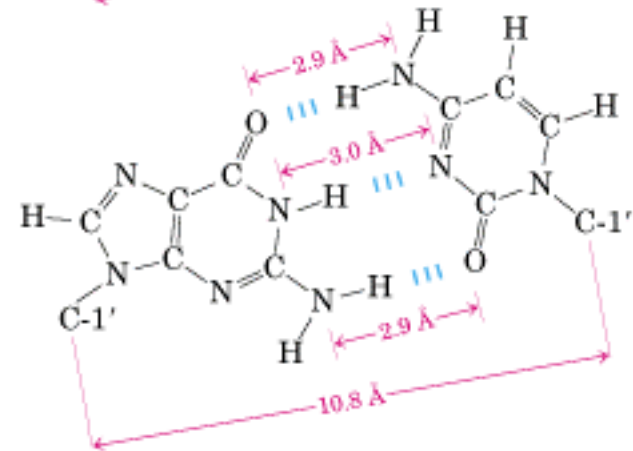


Adenine

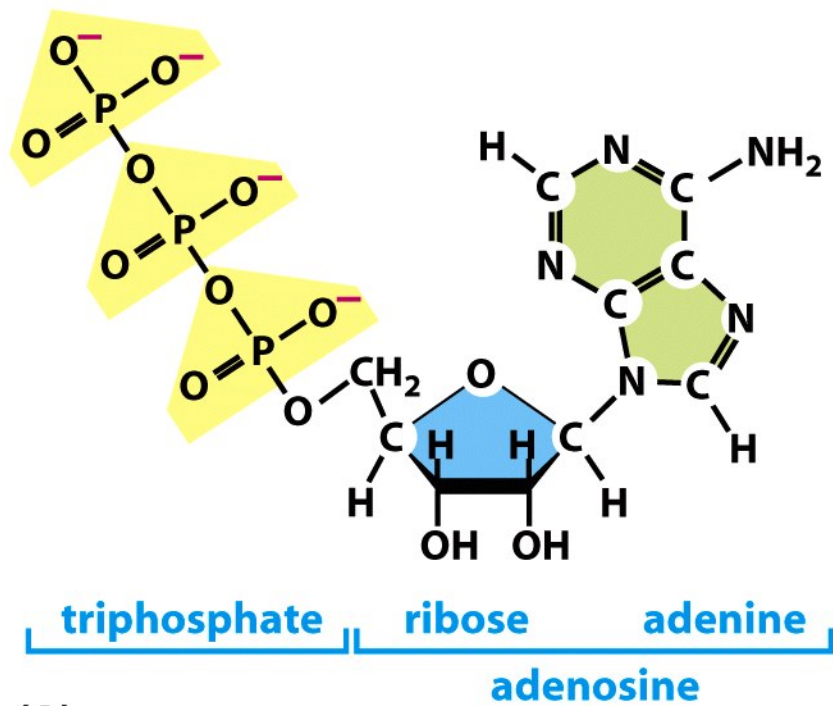
Guanine



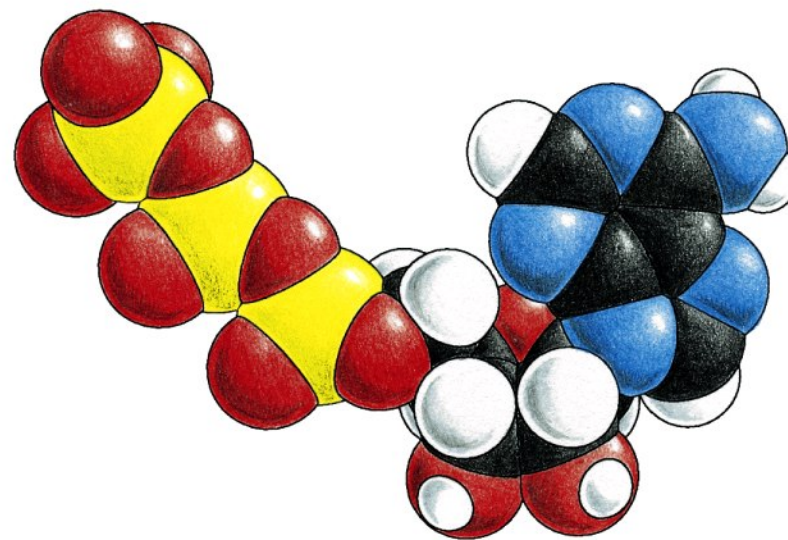
Thymine



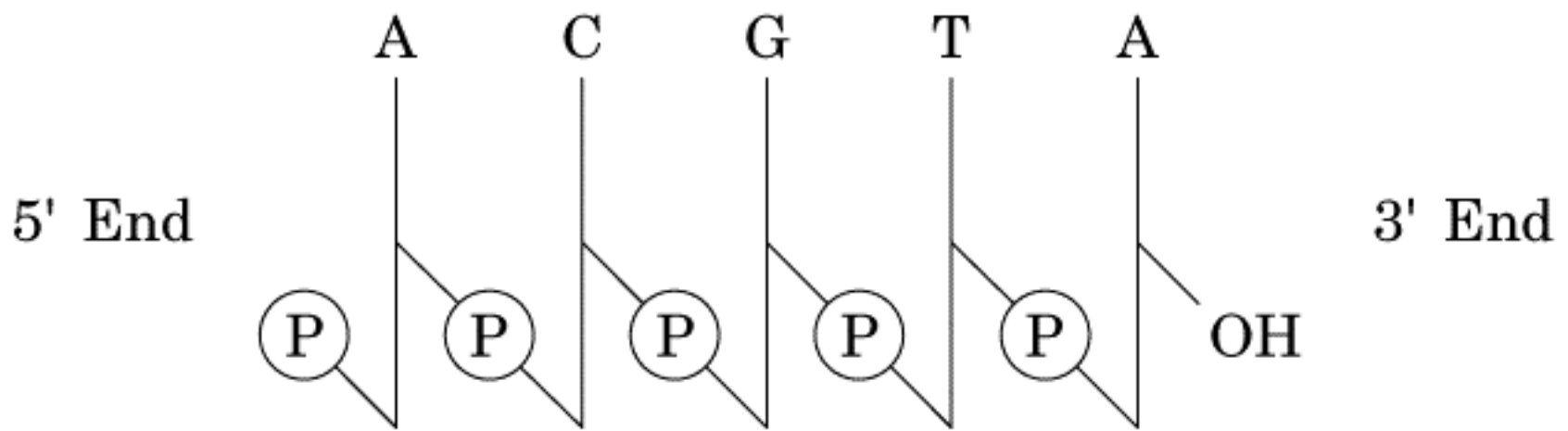
Cytosine

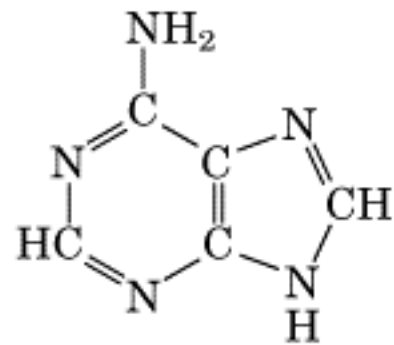


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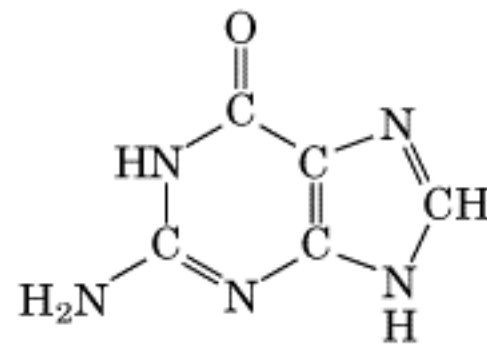


(B)



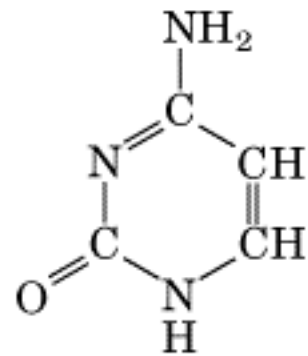


Adenine

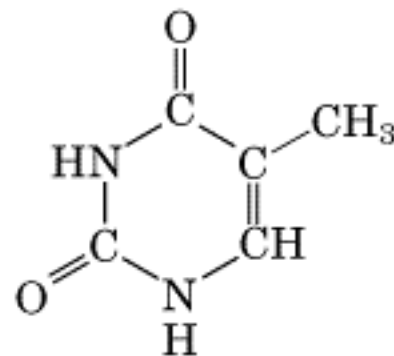


Guanine

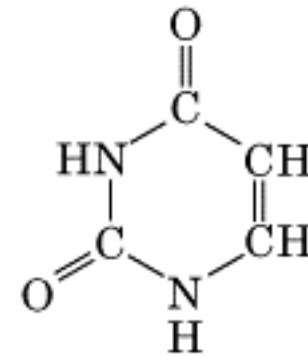
**Purines**



Cytosine

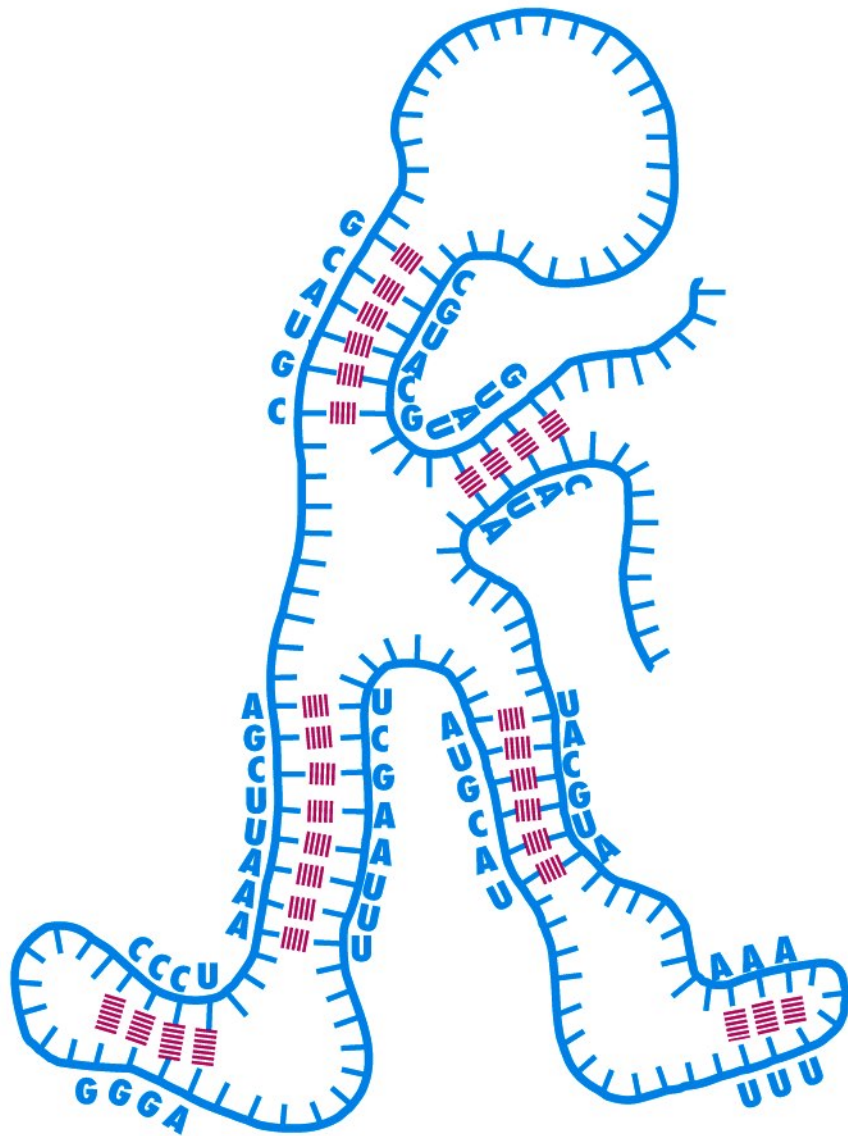


Thymine  
(DNA)

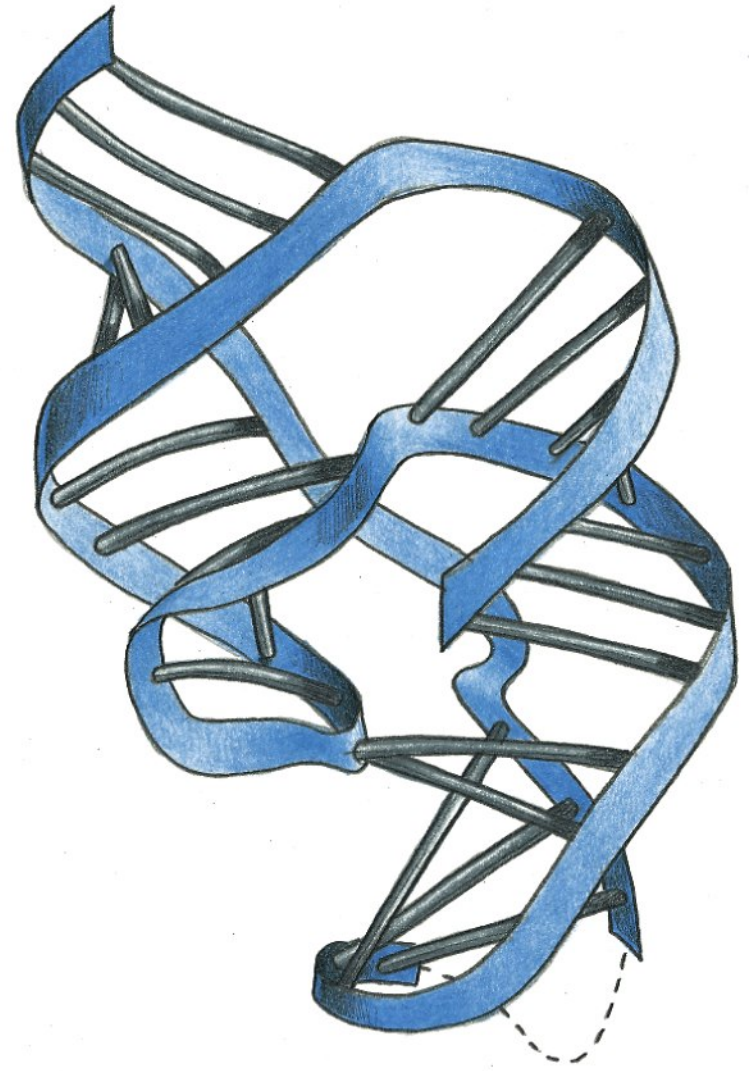


Uracil  
(RNA)

**Pyrimidines**

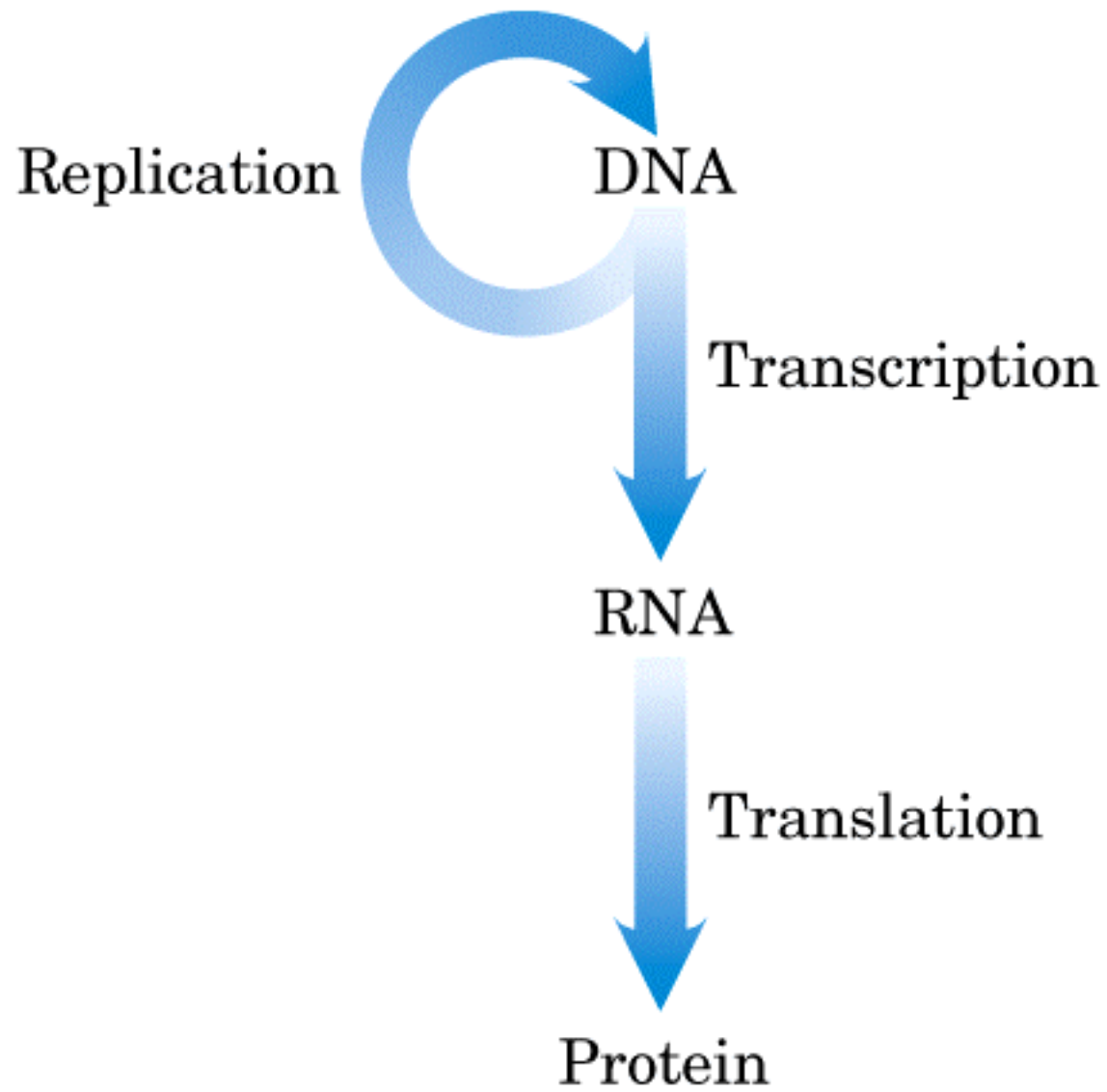


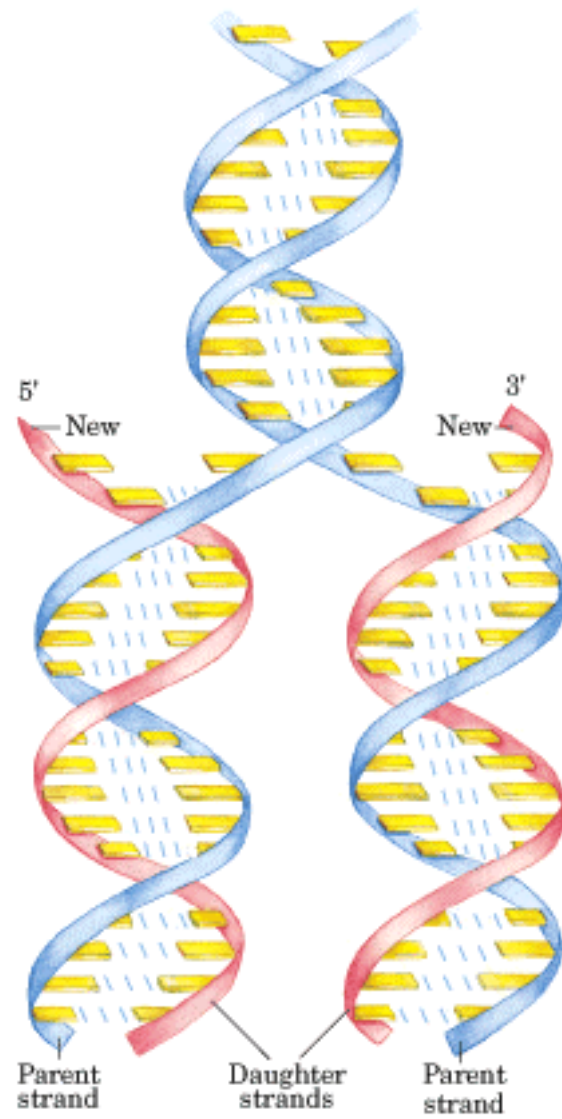
**(A)**



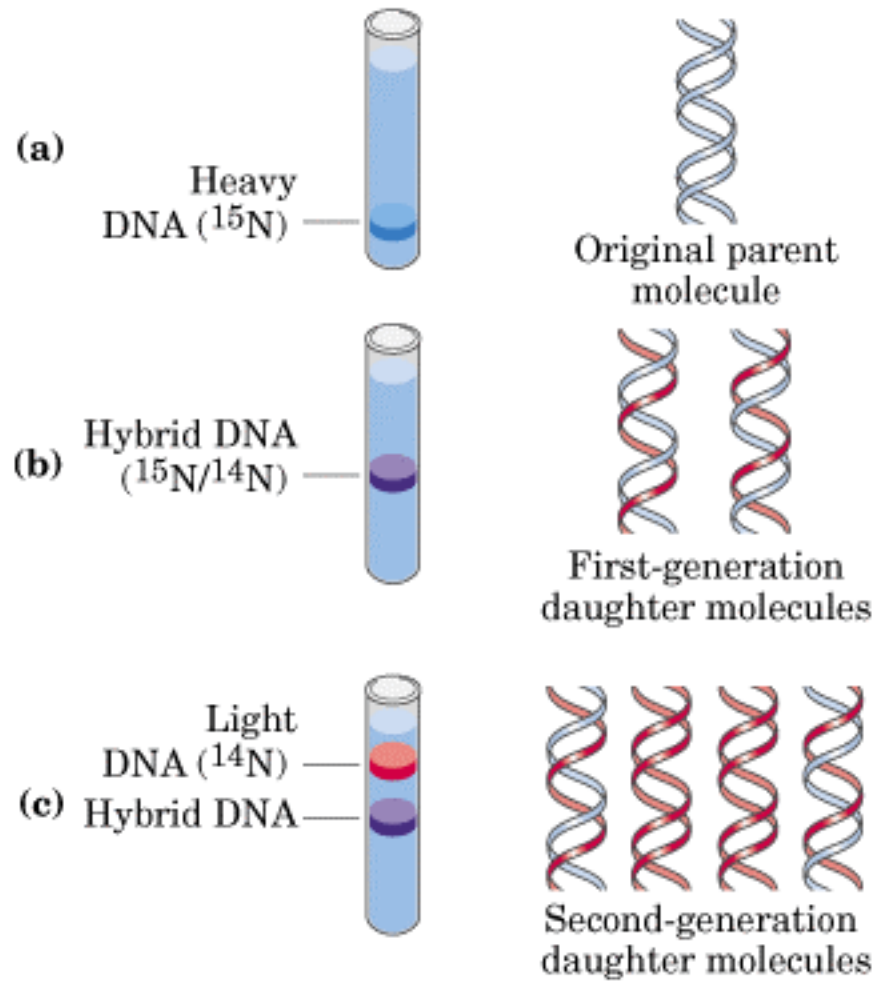
**(B)**

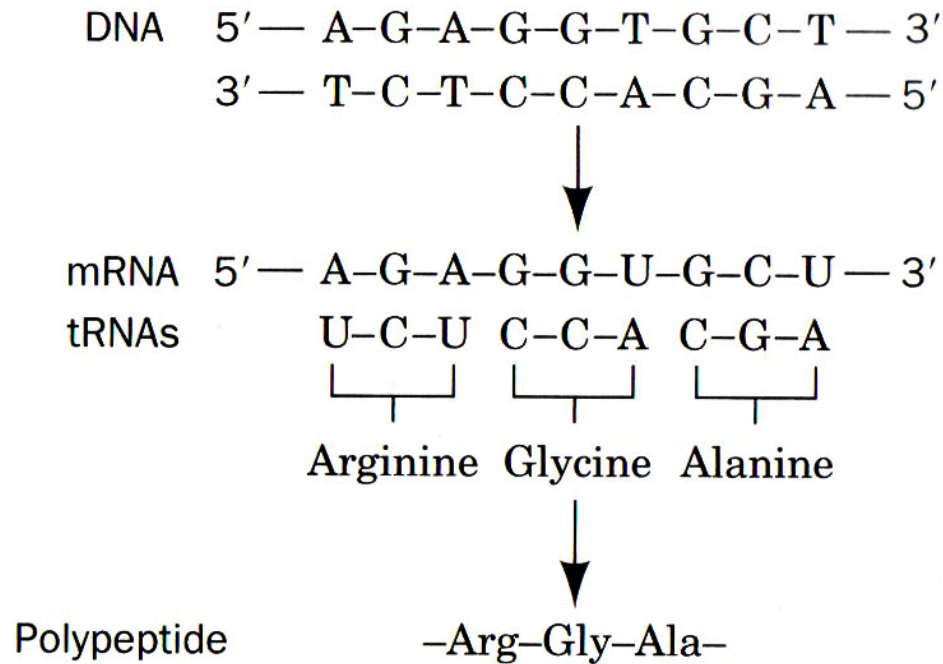






DNA extracted and centrifuged  
to equilibrium in CsCl  
density gradient

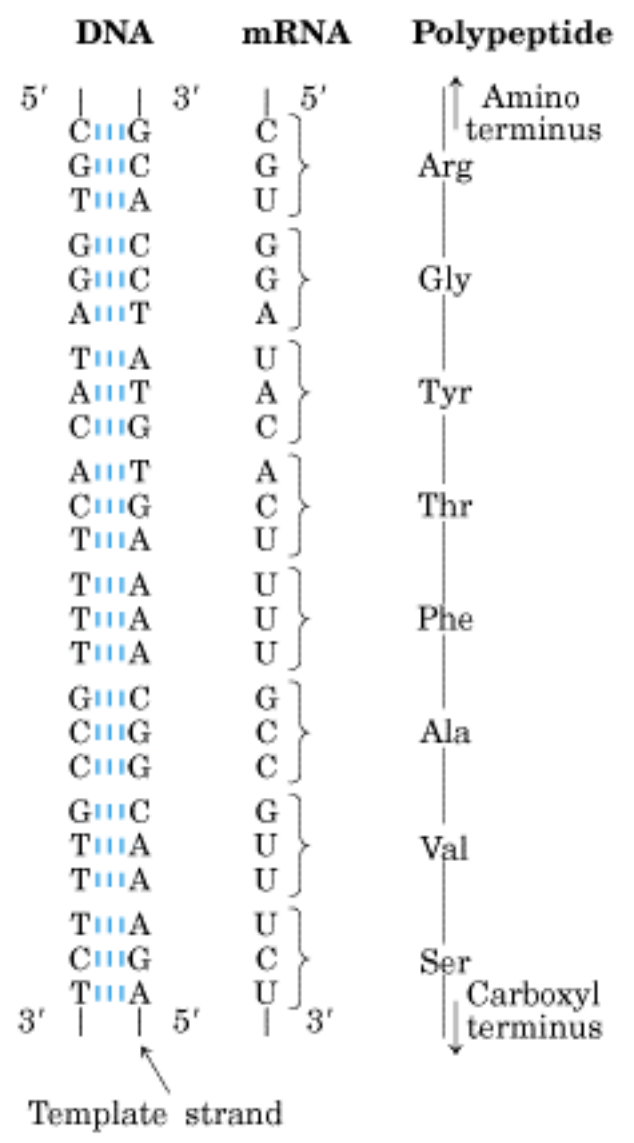


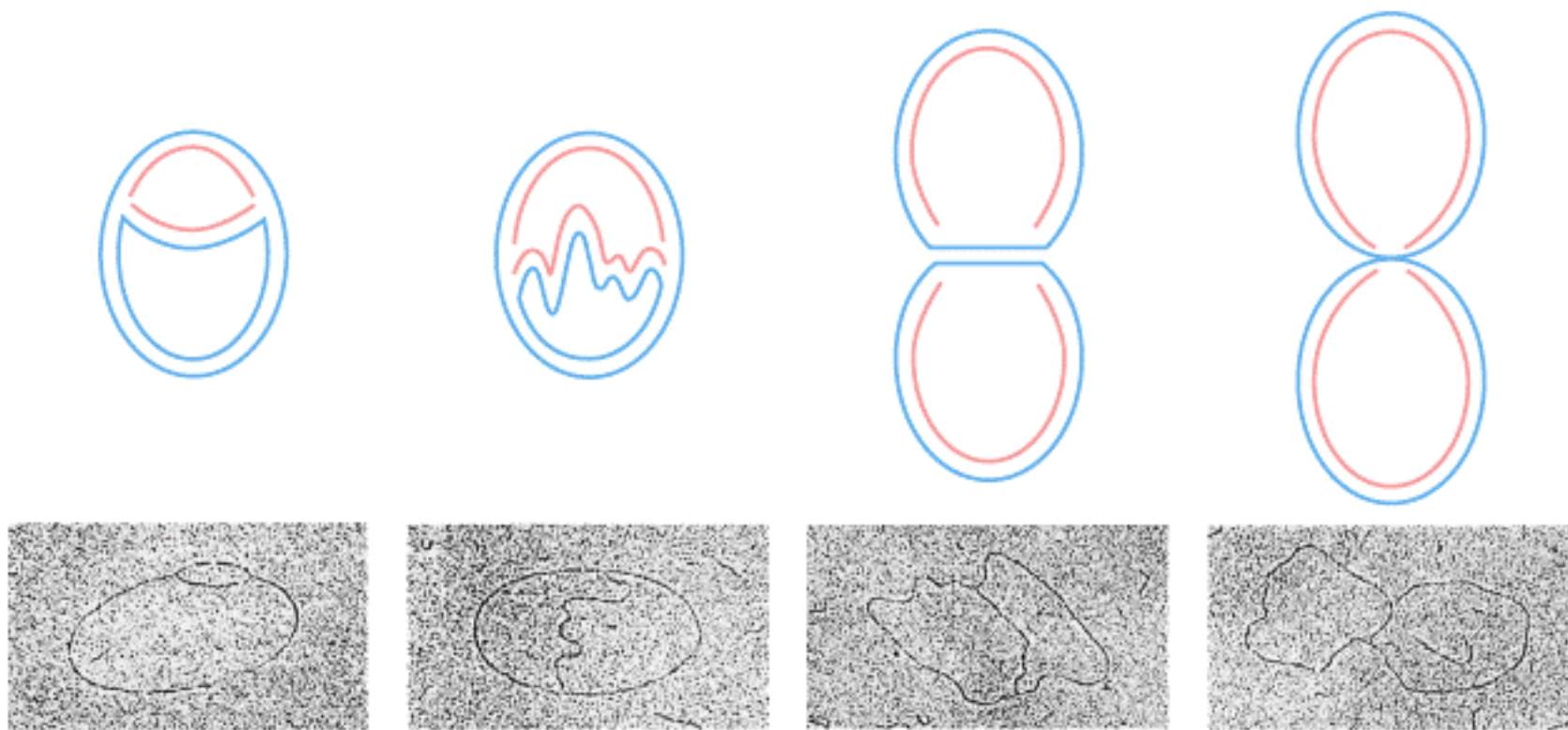


**FIGURE 5-22 Gene expression.** One strand of DNA directs the synthesis of RNA, a process known as transcription. The base sequence of the transcribed RNA is complementary to that of the DNA strand. The RNAs known as **messenger RNAs (mRNAs)** are translated when molecules of **transfer RNA (tRNA)** align with the mRNA via complementary base pairing between 3-nucleotide segments known as codons. Each type of tRNA carries a specific amino acid. These amino acids are covalently joined by the ribosome to form a polypeptide. Thus, the sequence of bases in DNA specifies the sequence of amino acids in a protein.

1. <sup>a</sup> posición (extremo 5') ↓	2. <sup>a</sup> posición				3. <sup>a</sup> posición (extremo 3') ↓
	U	C	A	G	
U	Phe Phe Leu Leu	Ser Ser Ser Ser	Tyr Tyr <b>STOP</b> <b>STOP</b>	Cys Cys <b>STOP</b> Trp	U C A G
C	Leu Leu Leu Leu	Pro Pro Pro Pro	His His Gln Gln	Arg Arg Arg Arg	U C A G
A	Ile Ile Ile Met	Thr Thr Thr Thr	Asn Asn Lys Lys	Ser Ser Arg Arg	U C A G
G	Val Val Val Val	Ala Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	U C A G

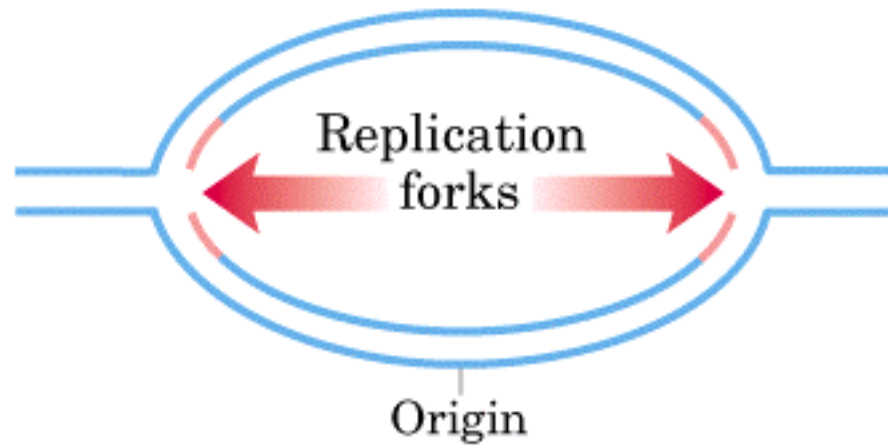
**Figura 3-16 El código genético.** En el transcurso de la síntesis proteica, los grupos de tres nucleótidos (*codones*) de una molécula de mRNA son traducidos a aminoácidos de acuerdo con las reglas indicadas aquí. Los codones GUG y GAG, por ejemplo, se traducen a valina y a ácido glutámico respectivamente. Obsérvese que los codones que presentan U o C como segundo nucleótido tienden a codificar los aminoácidos más hidrofóbicos (compárese con el Panel 2-5, págs. 58-59).



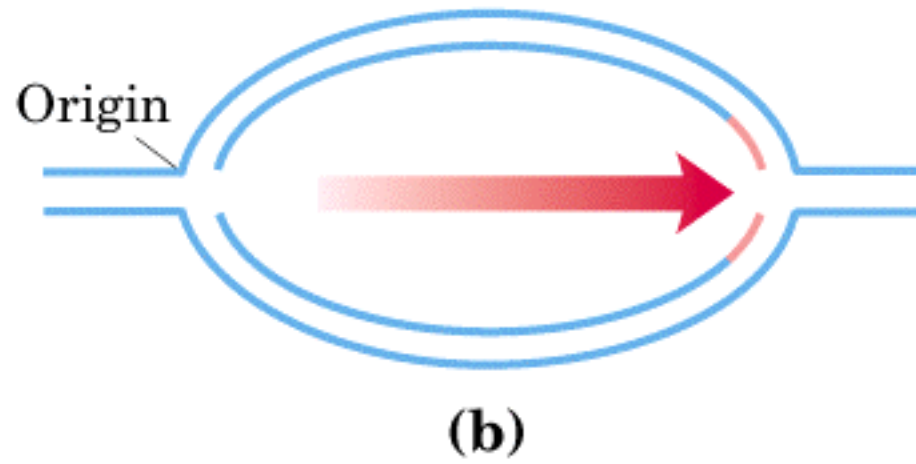


(a)

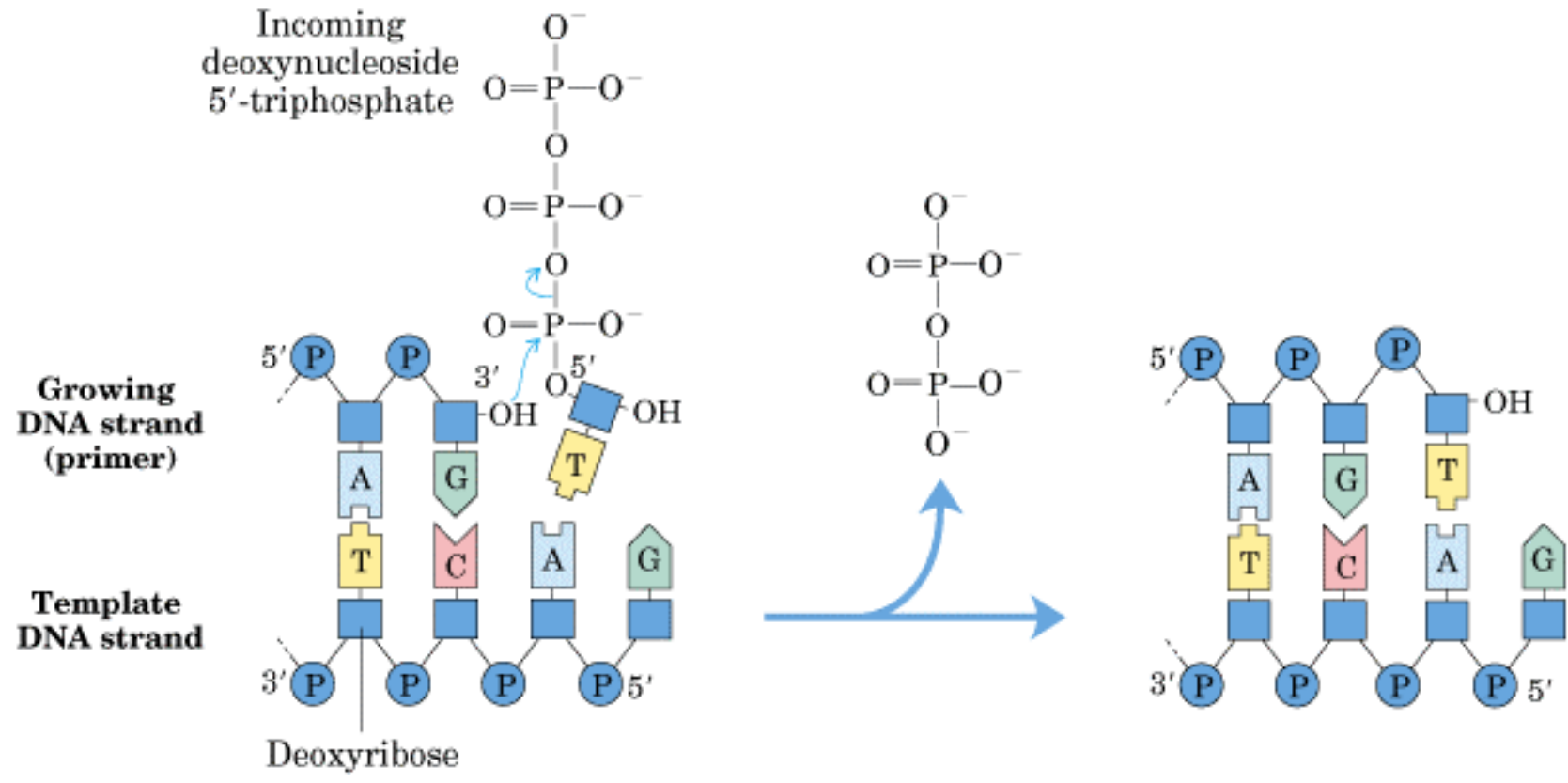
Bidirectional

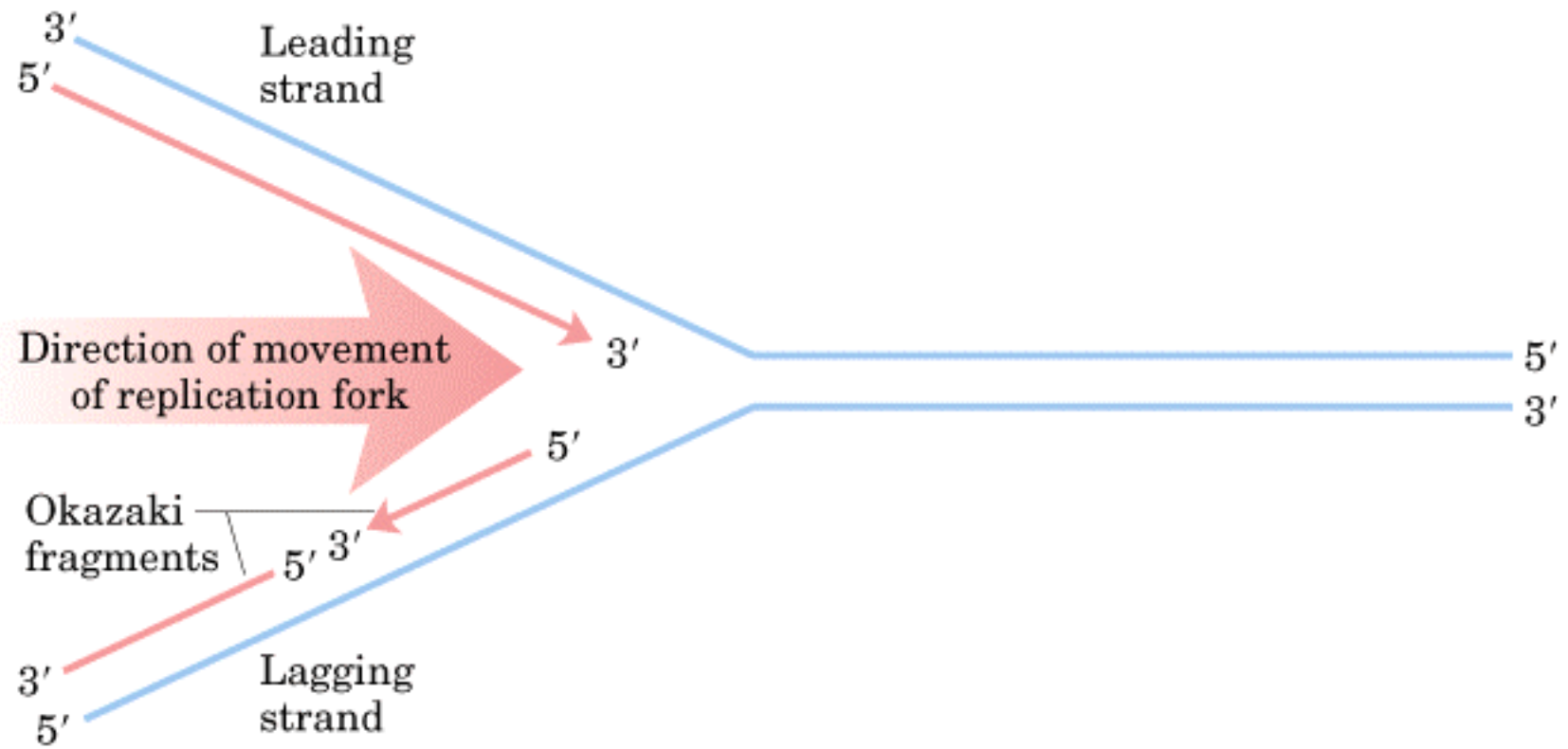


Unidirectional

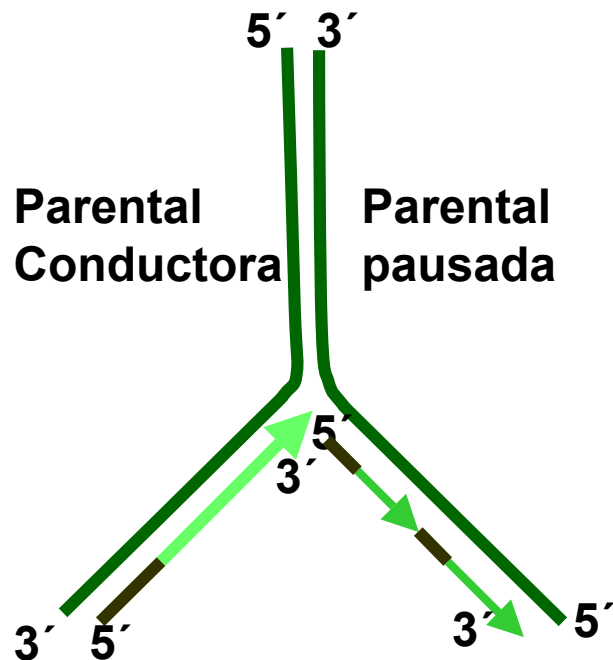




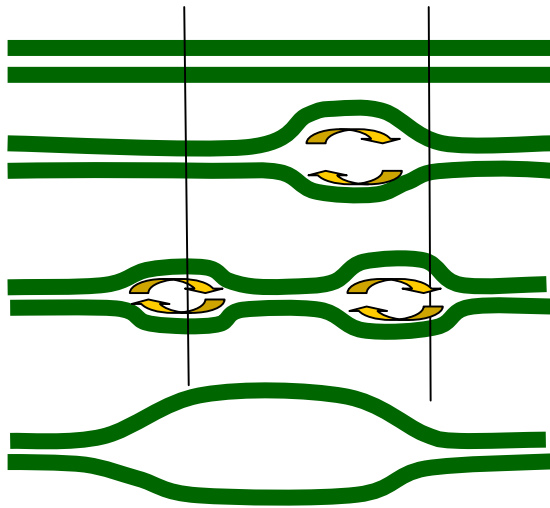




Las células eucariontes tienen un gran número de moléculas de DNA polimerasas. La enzima inicia la síntesis bidireccional del DNA, desde varios sitios de origen de replicación, ubicados de 5 a 300 kb de distancia en el cromosoma, según la célula y la especie. Estos sitios se llaman horquillas de iniciación. El segmento entre ellas es un replicon.



La DNA polimerasa no puede iniciar la síntesis de la cadena de DNA, sólo puede alargar una hebra partidora pre-existente de RNA o DNA. Todas las DNA polimerasas agregan nucleótidos al extremo 3'OH del partidor, dirigiendo el crecimiento en la dirección 5' → 3'. La replicación del DNA está ligada con la reparación.



**La replicación se inicia en las secuencias de replicación autónomas (SRA), a las que se unen proteínas para formar el complejo de origen de replicación (COR) que ayuda a desenrollar el DNA. Otras proteínas estabilizan la forma desenrollada y entra la DNA polimerasa. La copia se inicia en cientos de distintos orígenes, algunos al inicio de S y otros mas tarde.**

**Durante la replicación hay disociación incompleta y ordenada de la cromatina y reasociación del DNA con octámeros de histona para formar nucleosomas.**

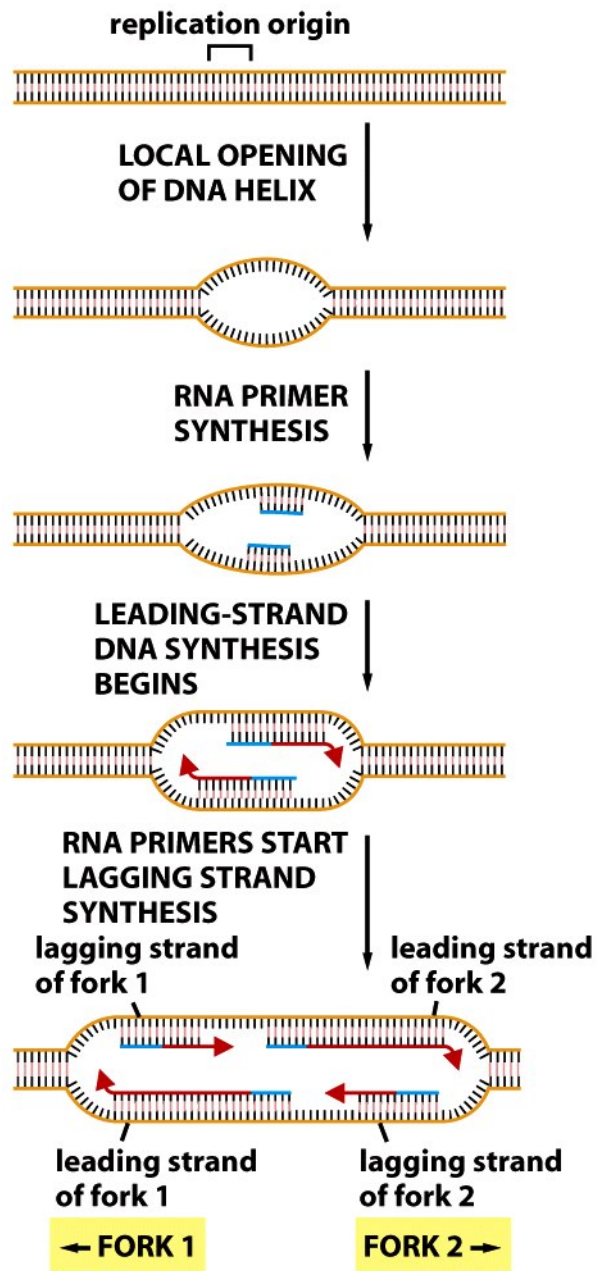


Figure 5-25 *Molecular Biology of the Cell* (© Garland Science 2008)

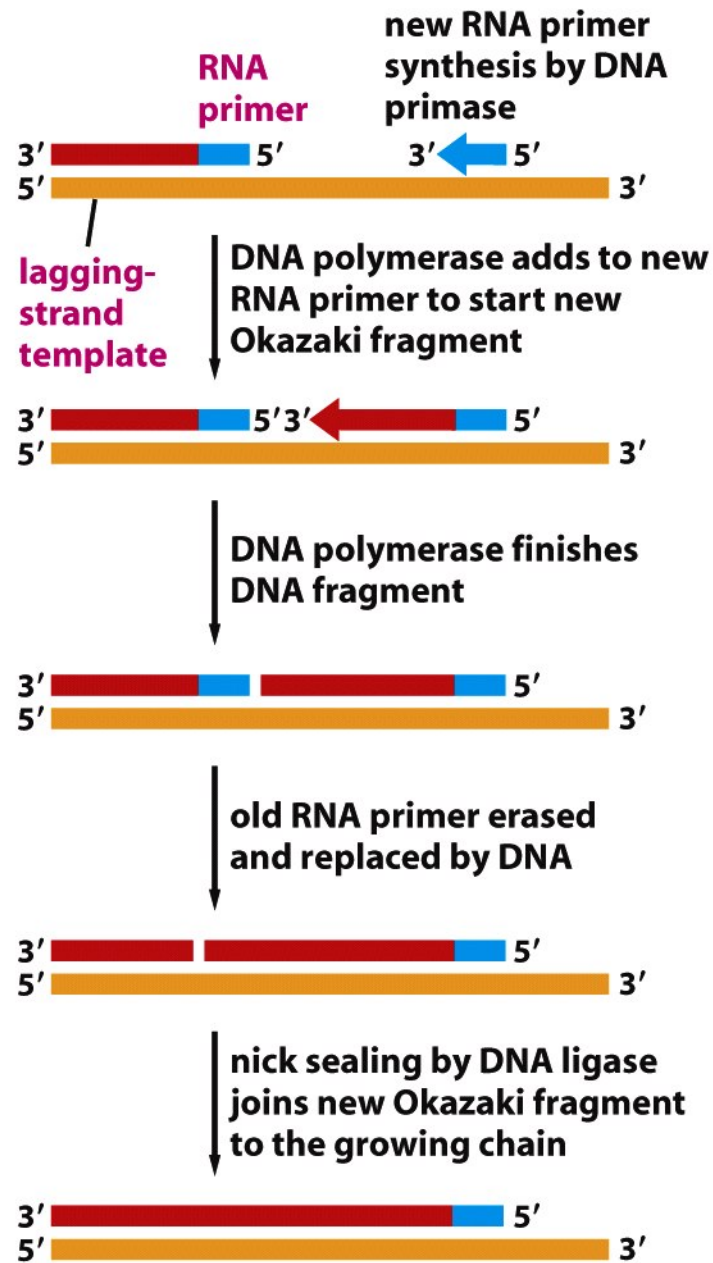
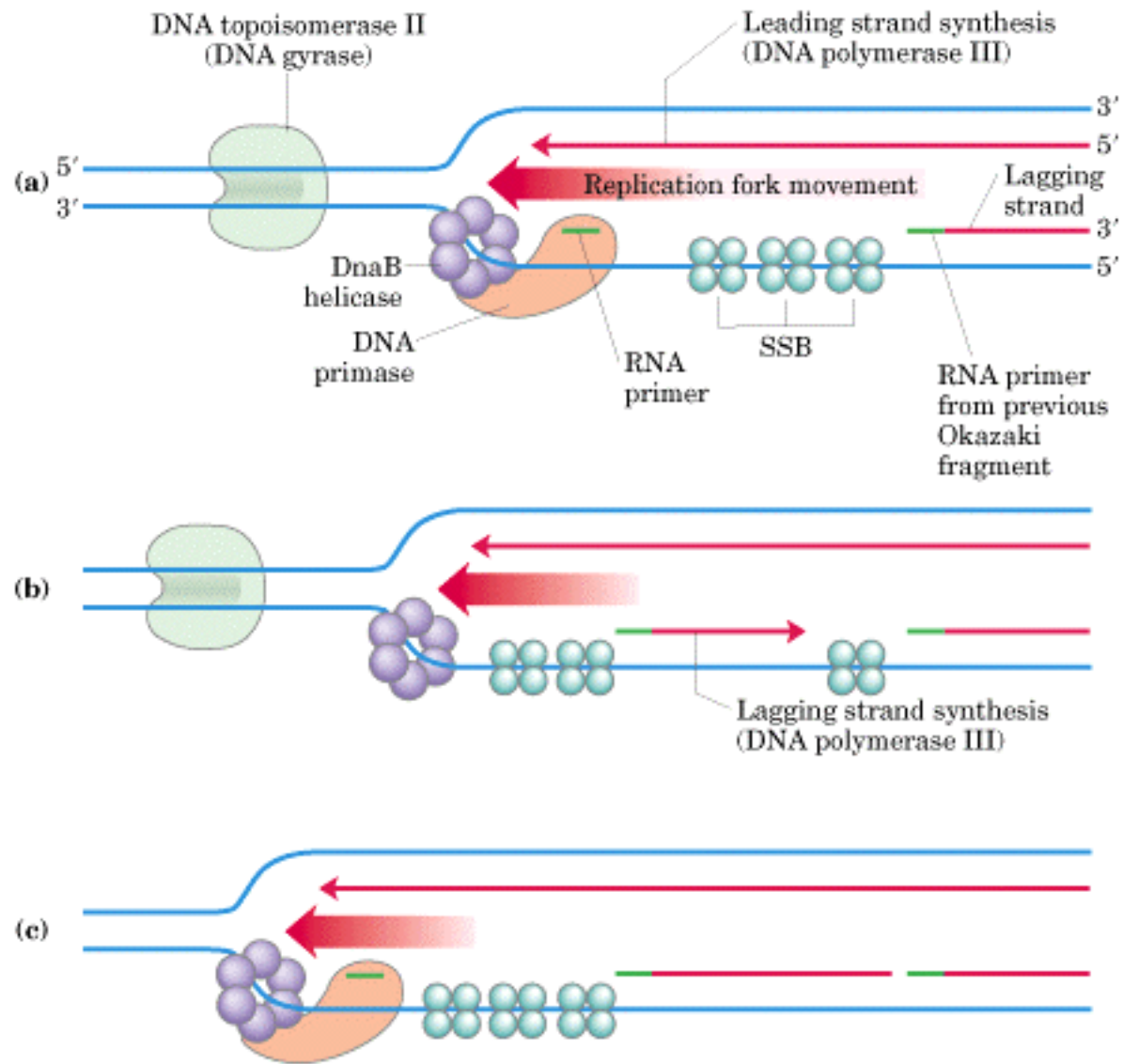
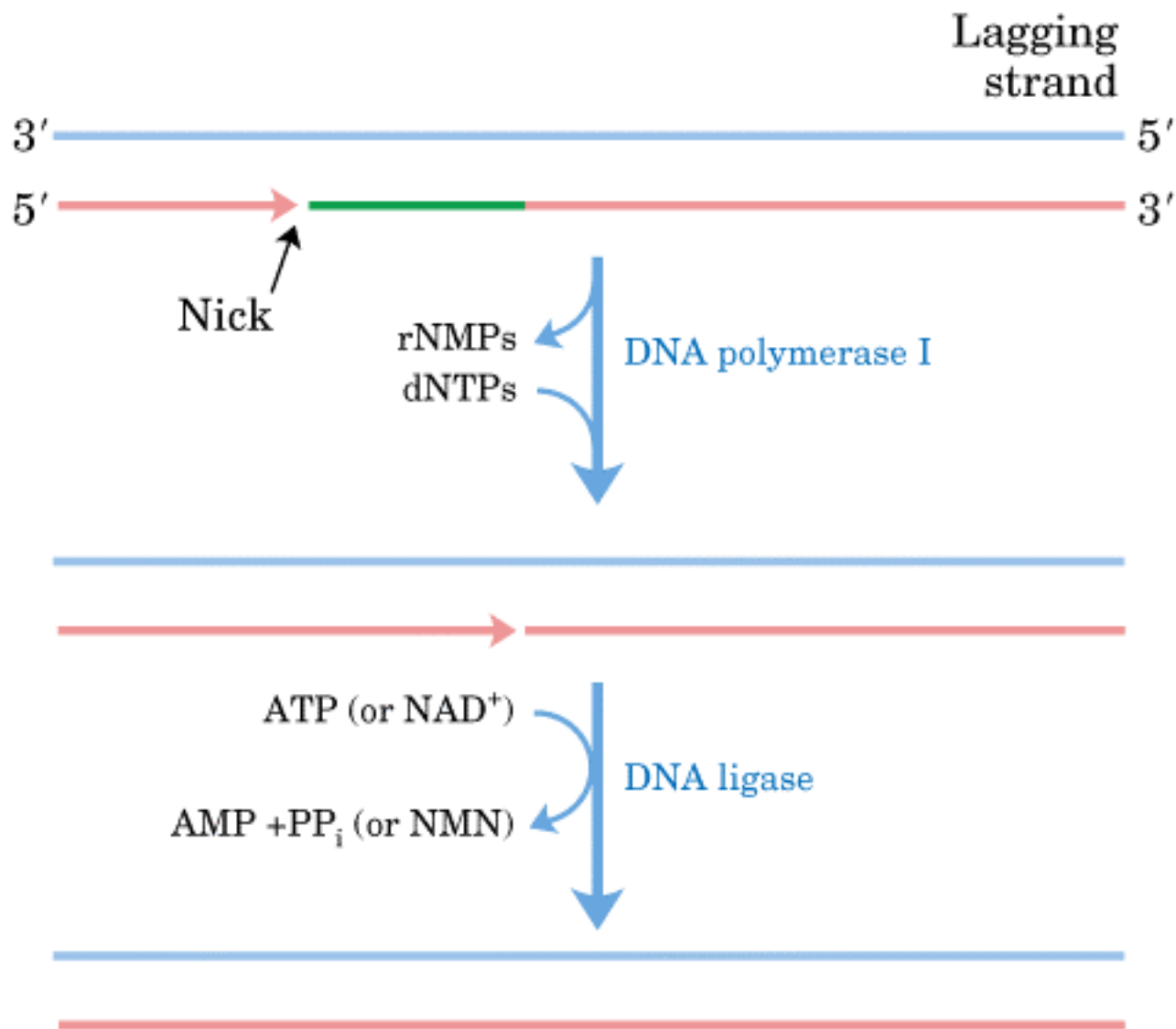
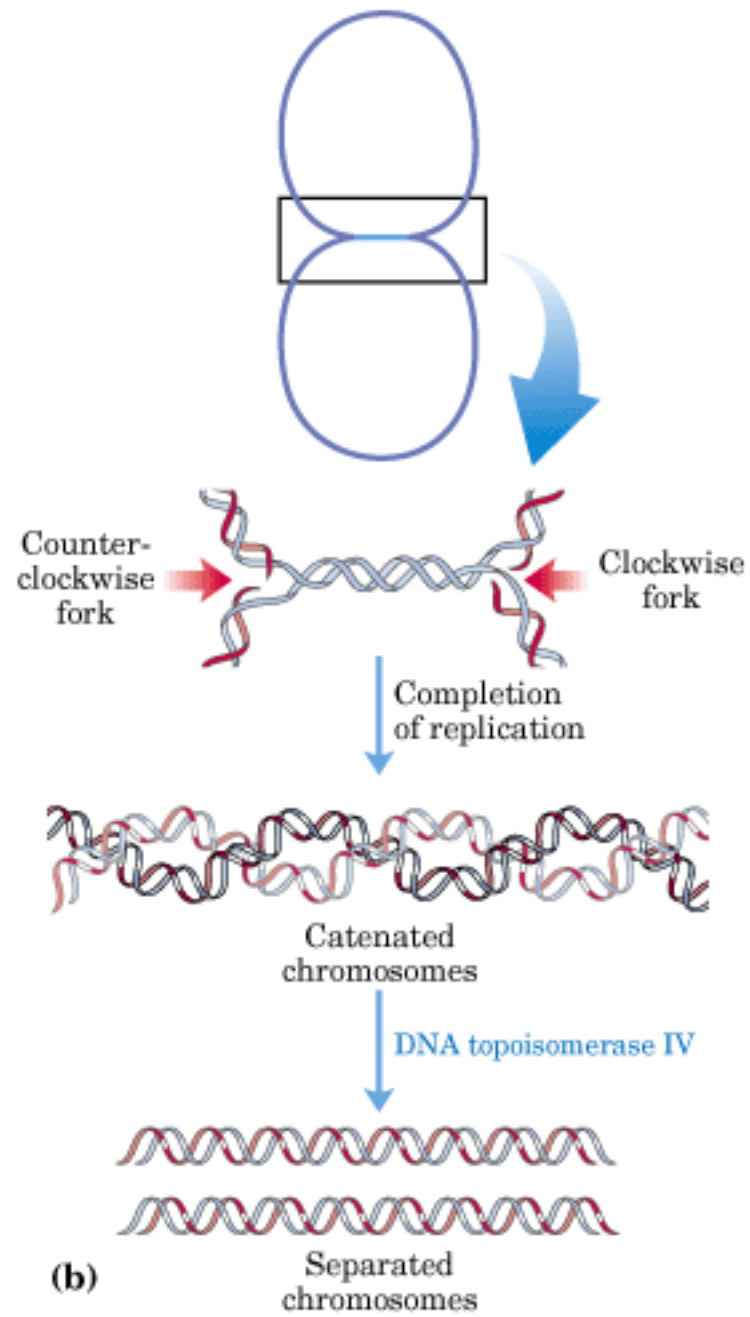


Figure 5-12 *Molecular Biology of the Cell* (© Garland Science 2008)









**table 25–3**

**Proteins Required to Initiate Replication at the *E. coli* Origin**

<b>Protein</b>	<b><i>M<sub>r</sub></i></b>	<b>Number of subunits</b>	<b>Function</b>
DnaA protein	52,000	1	Recognizes origin sequence; opens duplex at specific sites in origin
DnaB protein (helicase)	300,000	6*	Unwinds DNA
DnaC protein	29,000	1	Required for DnaB binding at origin
HU	19,000	2	Histonelike protein; DNA bending protein; stimulates initiation
Primase (DnaG protein)	60,000	1	Synthesizes RNA primers
Single-stranded DNA-binding protein (SSB)	75,600	4*	Binds single-stranded DNA
RNA polymerase	454,000	5	Facilitates DnaA activity
DNA gyrase (DNA topoisomerase II)	400,000	4	Relieves torsional strain generated by DNA unwinding
Dam methylase	32,000	1	Methylates (5')GATC sequences at <i>oriC</i>

\*Subunits in these cases are identical.

**table 25–5**

<b>Types of DNA Repair Systems in <i>E. coli</i></b>	
<b>Enzymes/proteins</b>	<b>Type of damage</b>
<b>Mismatch repair</b>	
Dam methylase	Mismatches
MutH, MutL, MutS proteins	
DNA helicase II	
SSB	
DNA polymerase III	
Exonuclease I	
Exonuclease VII	
RecJ nuclease	
Exonuclease X	
DNA ligase	
<b>Base-excision repair</b>	
DNA glycosylases	Abnormal bases (uracil, hypoxanthine, xanthine); alkylated bases; pyrimidine dimers in some other organisms
AP endonucleases	
DNA polymerase I	
DNA ligase	
<b>Nucleotide-excision repair</b>	
ABC excinuclease	DNA lesions that cause large structural changes (e.g., pyrimidine dimers)
DNA polymerase I	
DNA ligase	
<b>Direct repair</b>	
DNA photolyases	Pyrimidine dimers
<i>O</i> <sup>6</sup> -Methylguanine-DNA methyltransferase	<i>O</i> <sup>6</sup> -Methylguanine

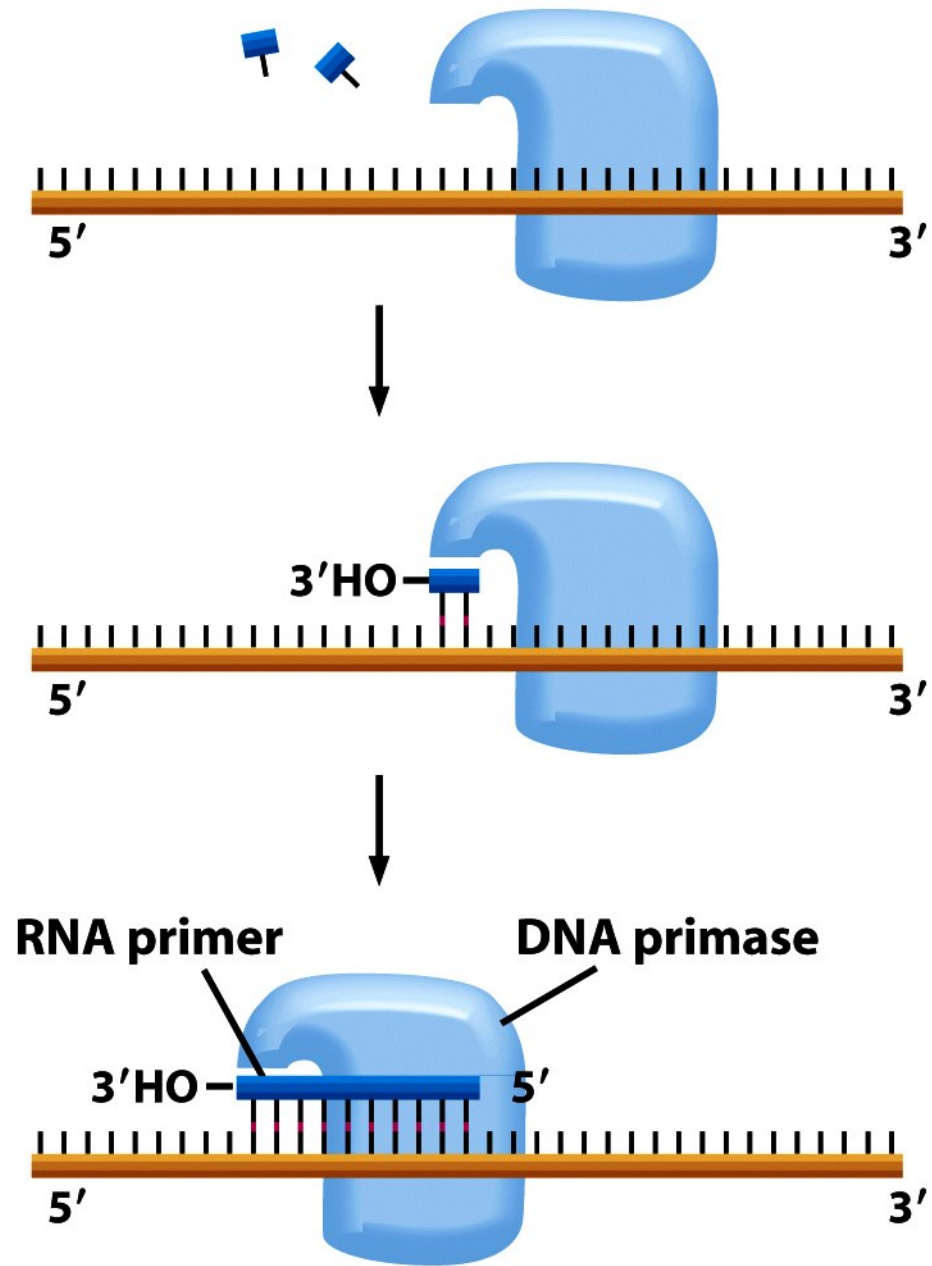


Figure 5-11 *Molecular Biology of the Cell* (© Garland Science 2008)

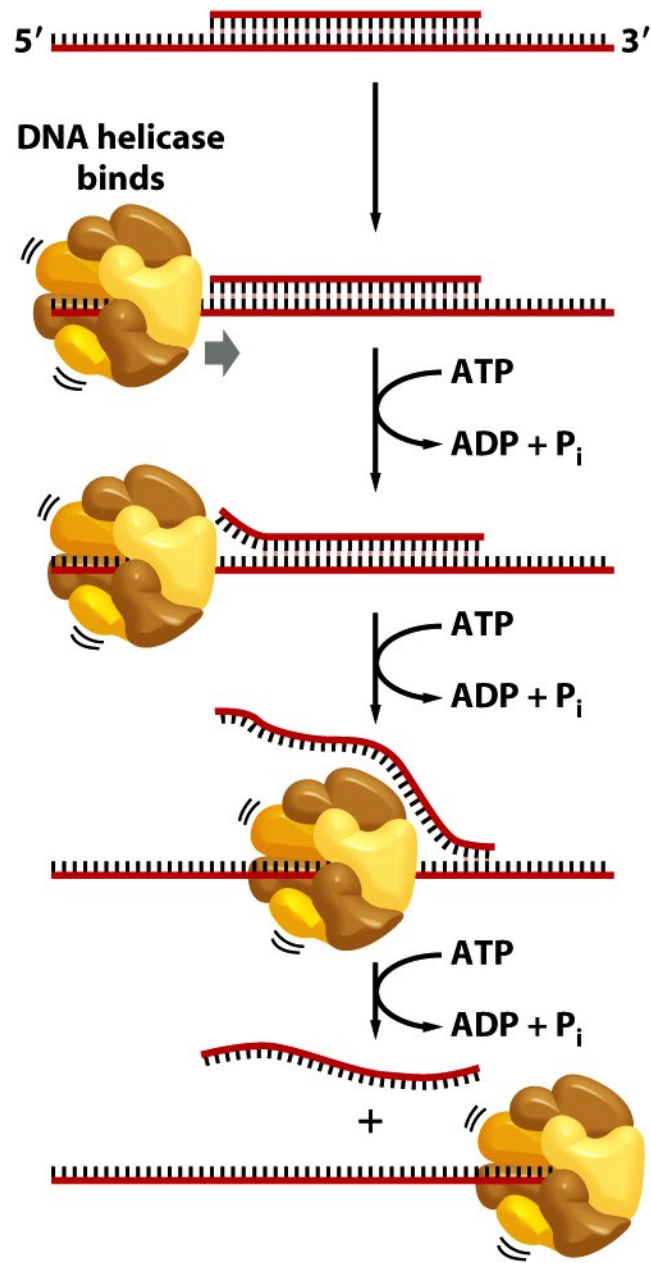


Figure 5-14 *Molecular Biology of the Cell* (© Garland Science 2008)

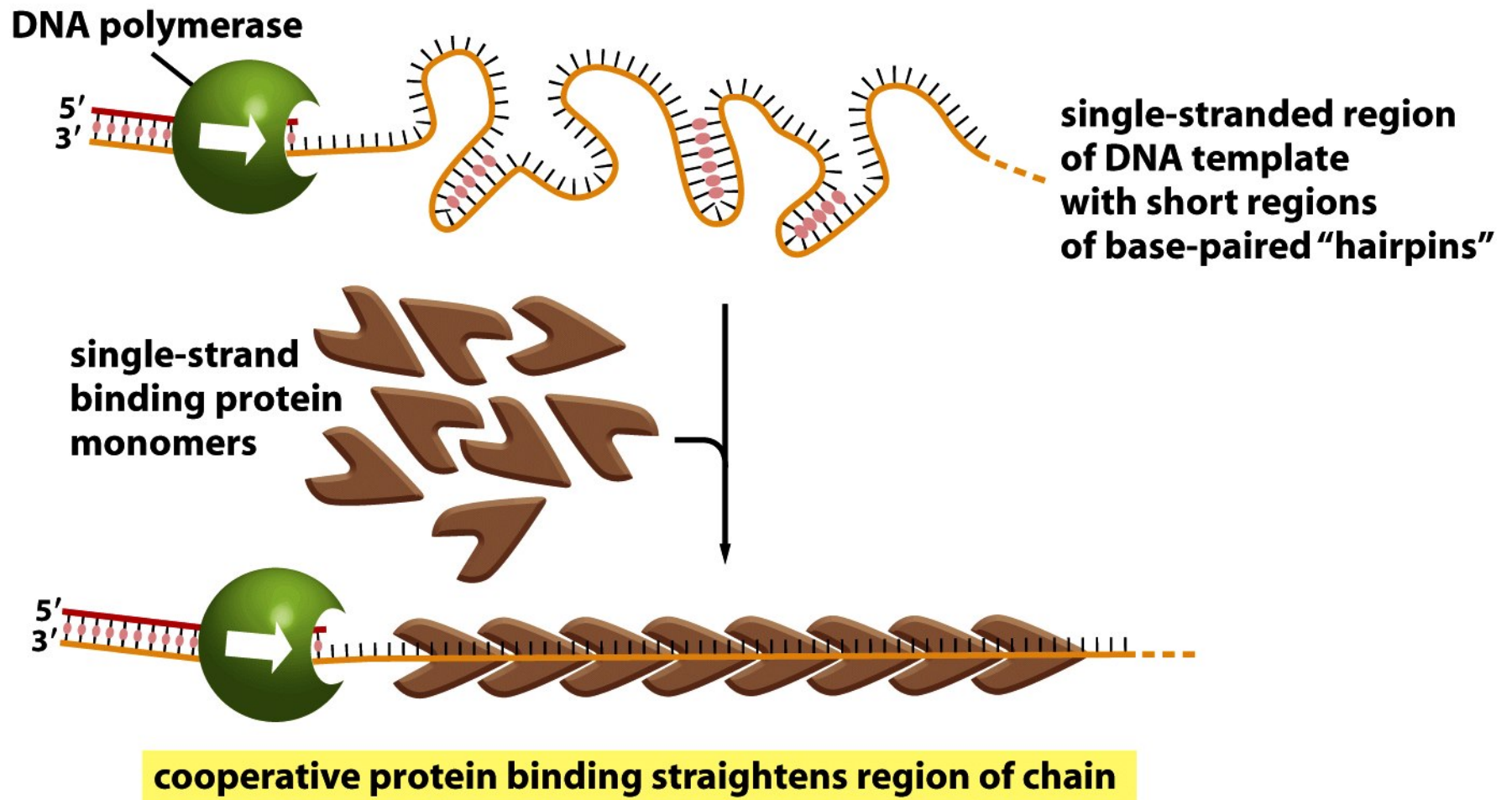


Figure 5-16 *Molecular Biology of the Cell* (© Garland Science 2008)

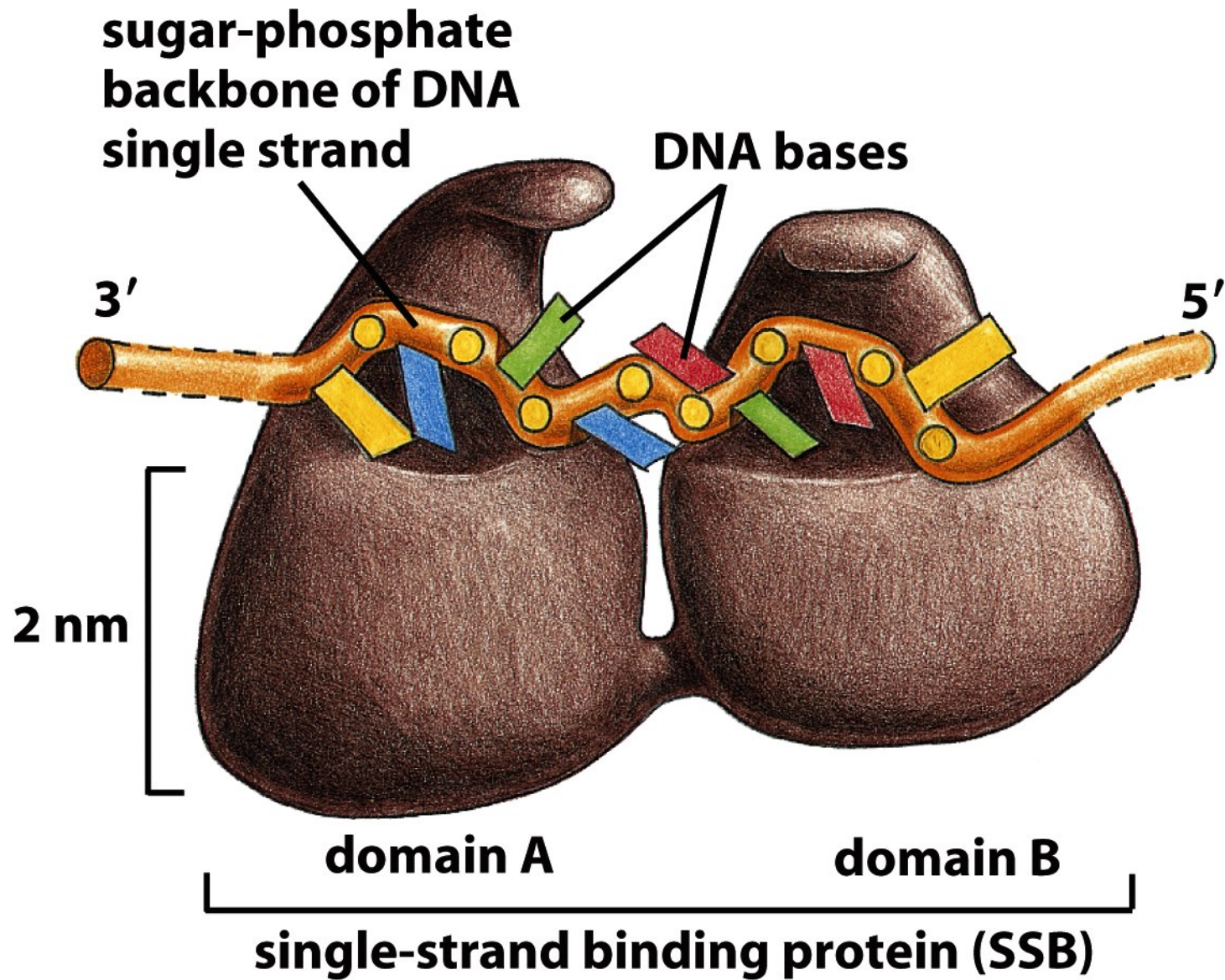


Figure 5-17a *Molecular Biology of the Cell* (© Garland Science 2008)

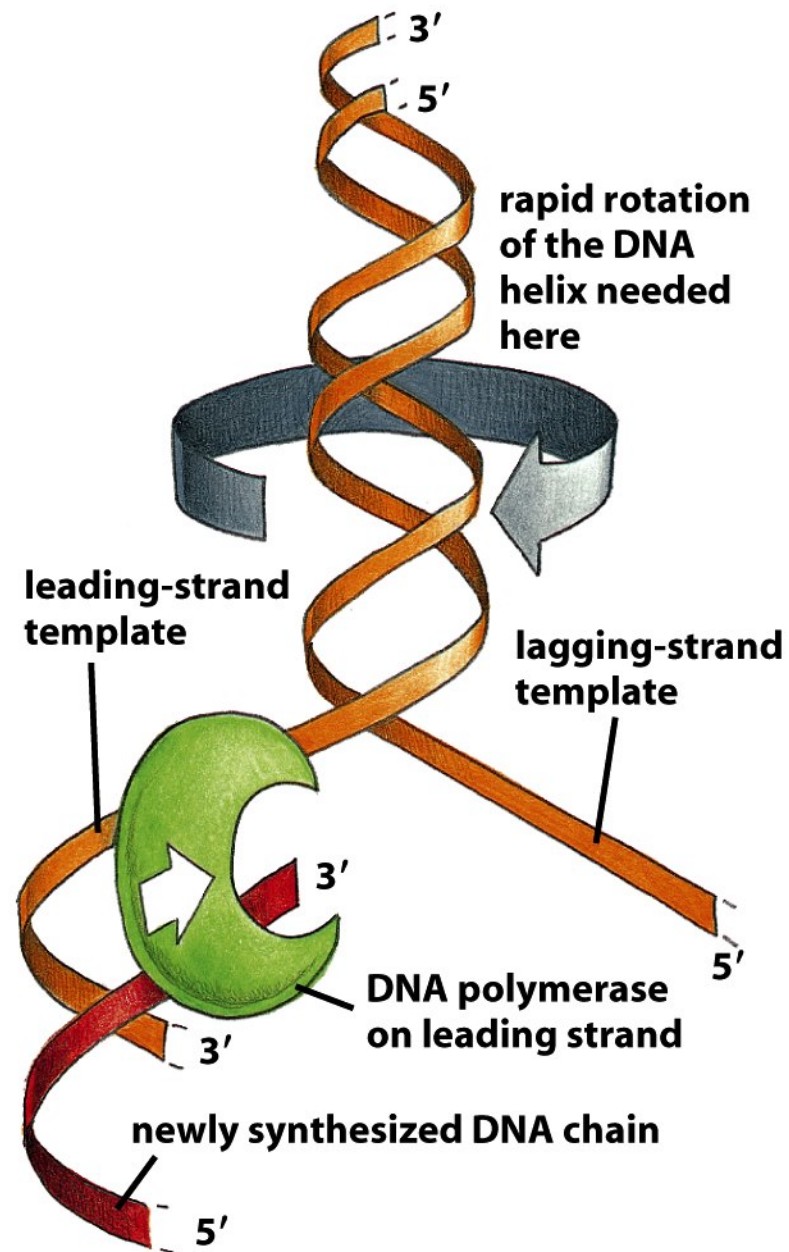
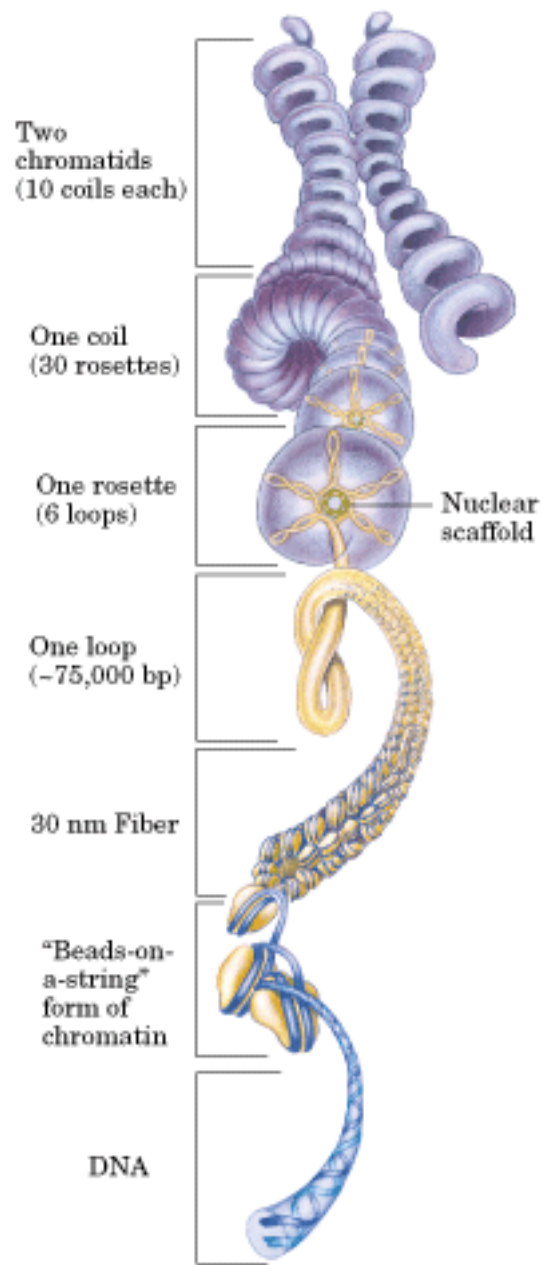


Figure 5-21 *Molecular Biology of the Cell* (© Garland Science 2008)



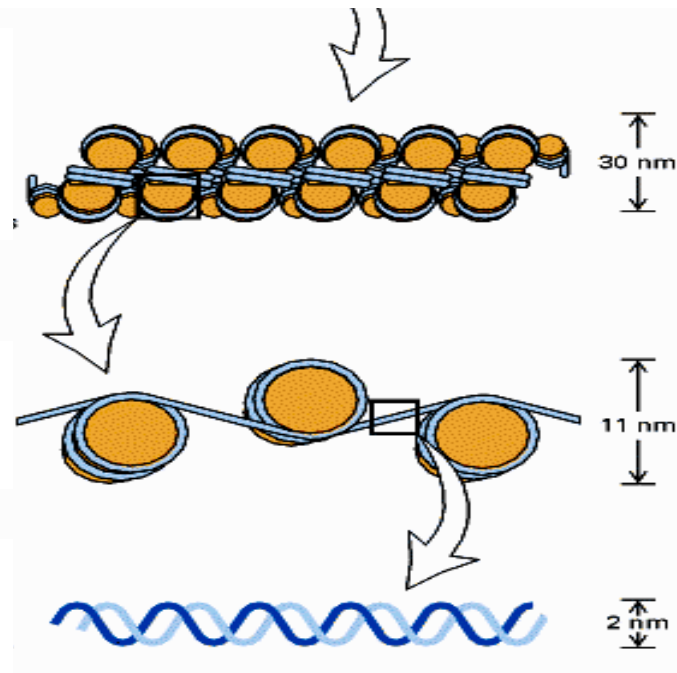


# Organización estructural de cromosomas molécula de DNA, nucleosoma, solenoide (cromatina, eucromatina).

Fibra de 30 nm: cromatina  
en nucleosomas en espiral  
o solenoide

Cromatina en cuentas de  
collar, nucleosomas.

Región corta de doble  
hélice de DNA.



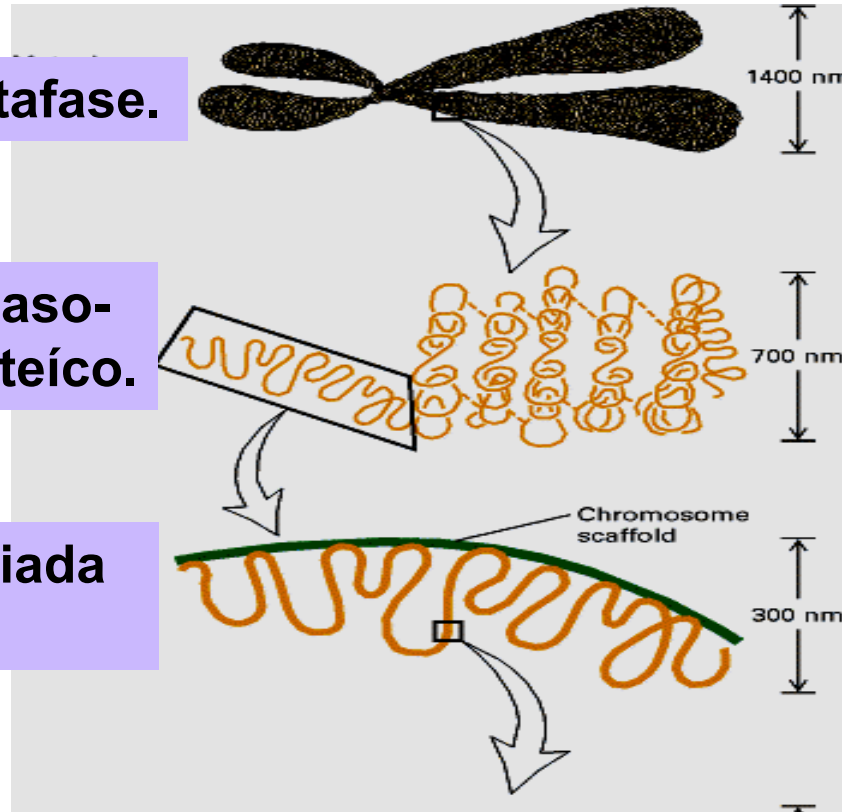
Proteínas:  
Histonas.  
H1, H2A, H2B,  
H3 y H4

Octámero de 2  
copias de.  
H2A, H2B, H3 y  
H4

**Cromosoma en metafase.**

**Forma condensada, asociada a andamio proteico.**

**Forma extendida asociada a andamio proteico.**



**Proteínas no histonas**

**Estructura de cromosoma en metafase.**

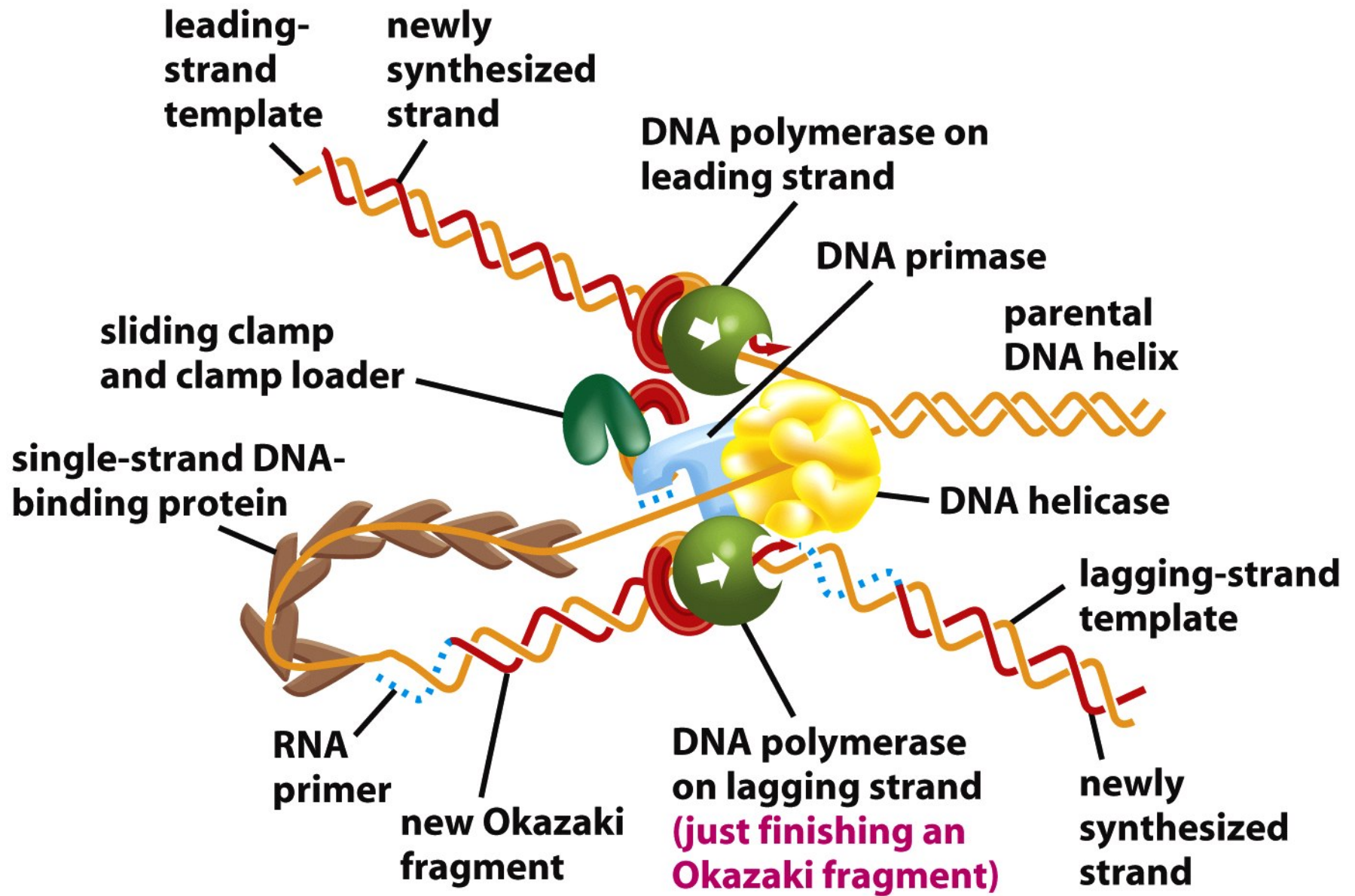


Figure 5-19a *Molecular Biology of the Cell* (© Garland Science 2008)

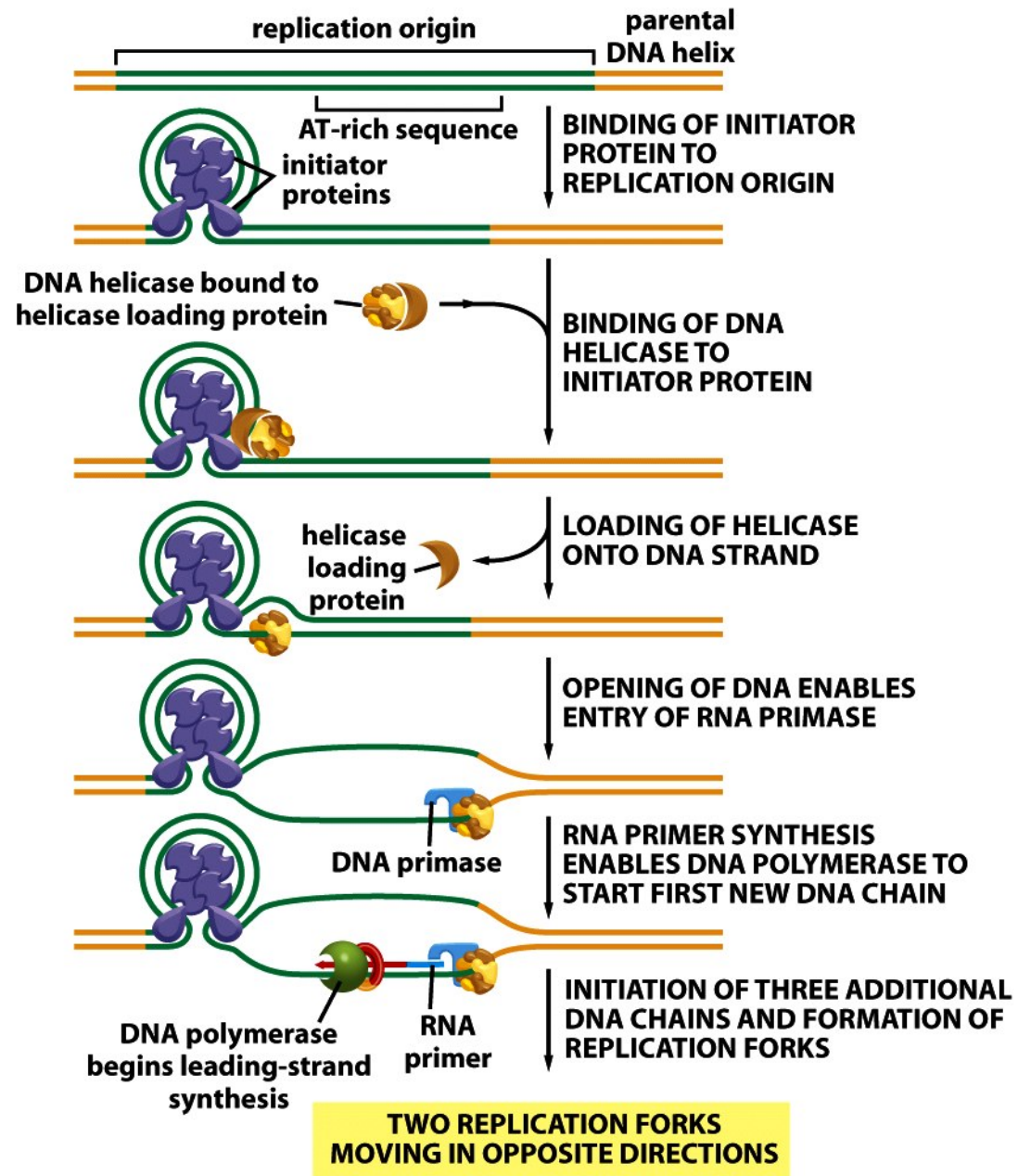


Figure 5-27 *Molecular Biology of the Cell* (© Garland Science 2008)

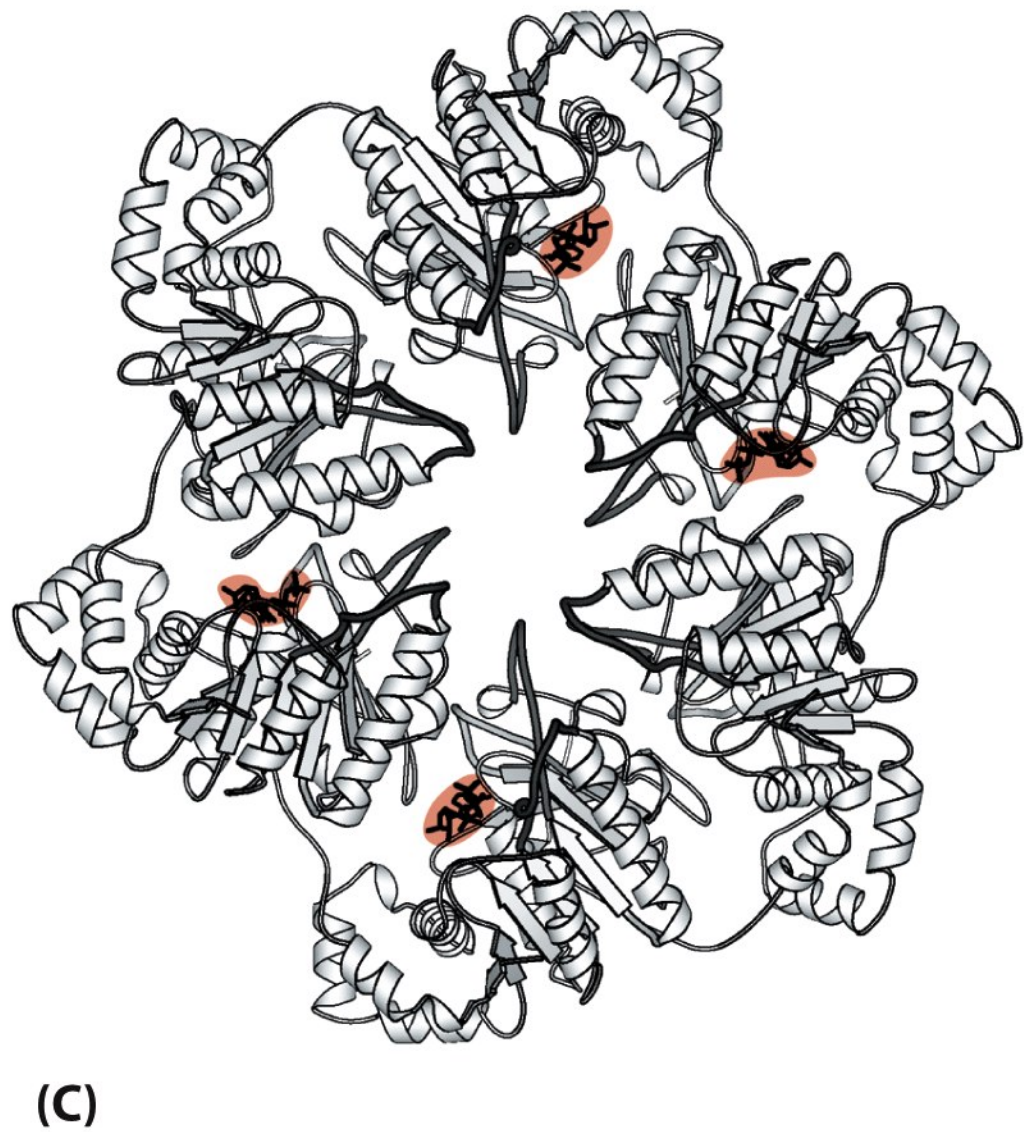
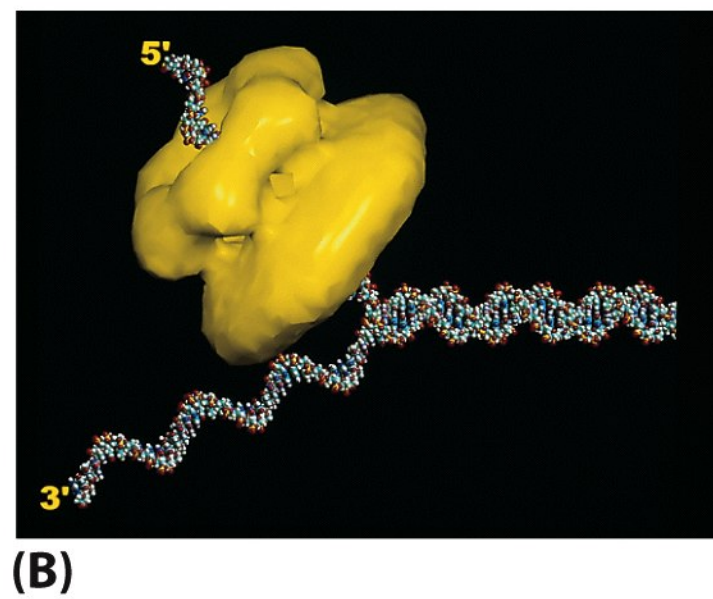
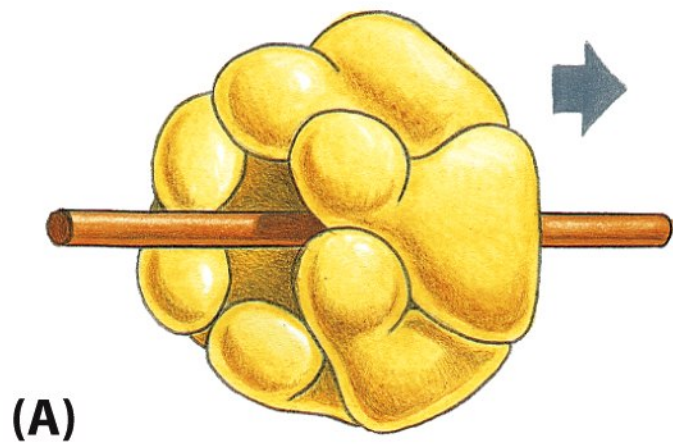


Figure 5-15 *Molecular Biology of the Cell* (© Garland Science 2008)

# Transcripción



La síntesis de RNA se llama transcripción, a partir de un molde o templado de DNA. Las enzimas que catalizan este proceso se llaman RNA polimerasas. En eucariontes el proceso ocurre en el núcleo (RNAm), nucléolo (RNAr), mitocondrias (RNA mitocondrial) y cloroplastos (RNA de cloroplastos).

A medida que ocurre la transcripción la RNA polimerasa separa las dos hebras del DNA e incorpora ribonucleotidos complementarios al molde de DNA.

Las RNA polimerasas, inician cadenas nuevas de RNA desde sitios apropiados en el DNA. Los procariontes tienen una RNA polimerasa, y los eucariontes 3 (I, II y III) que catalizan la síntesis de RNA r (ribosomal), RNAm (mensajero) y RNAt (transferencia), respectivamente. Los RNA transcritos pueden ser modificados luego de la transcripción



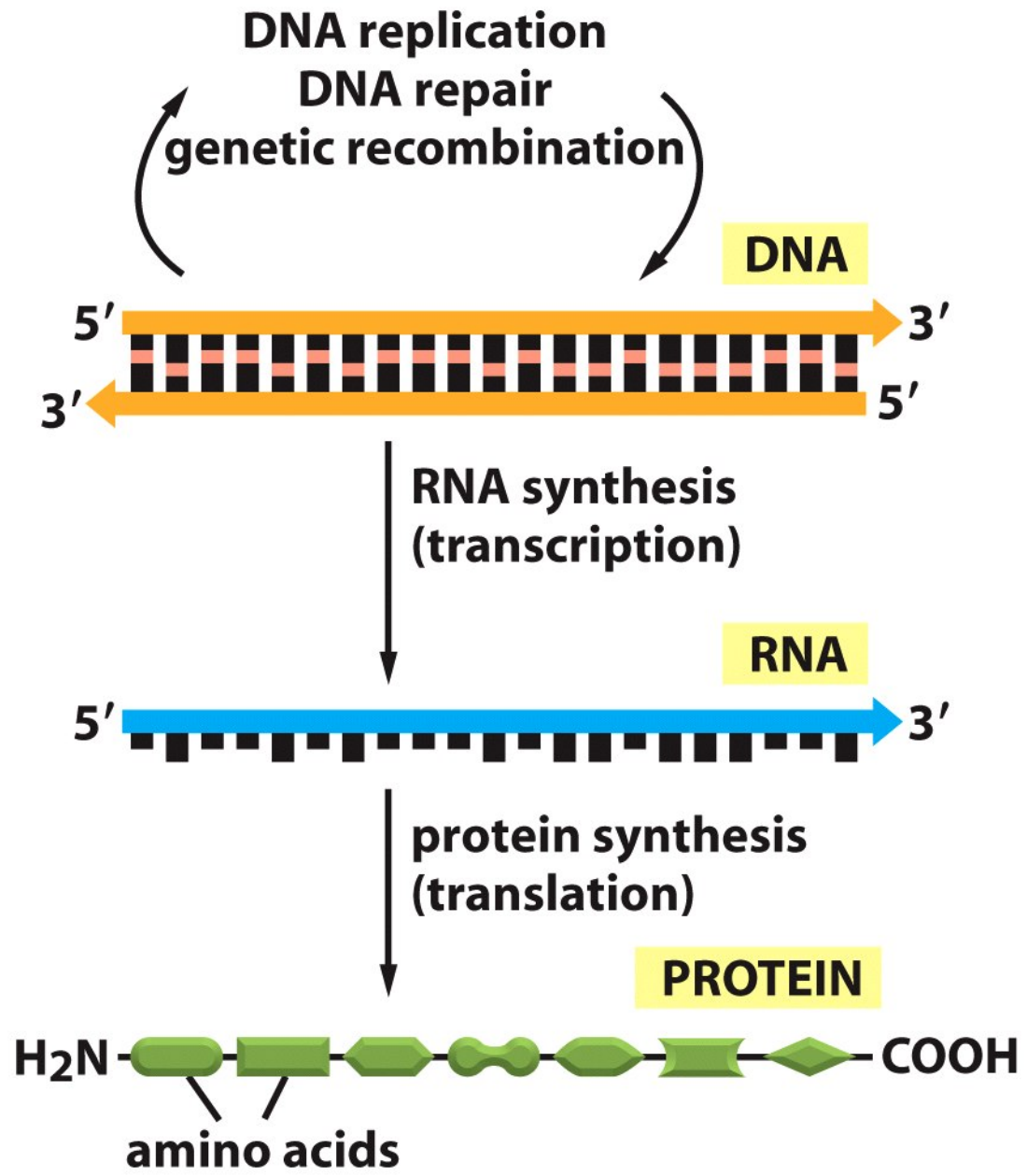
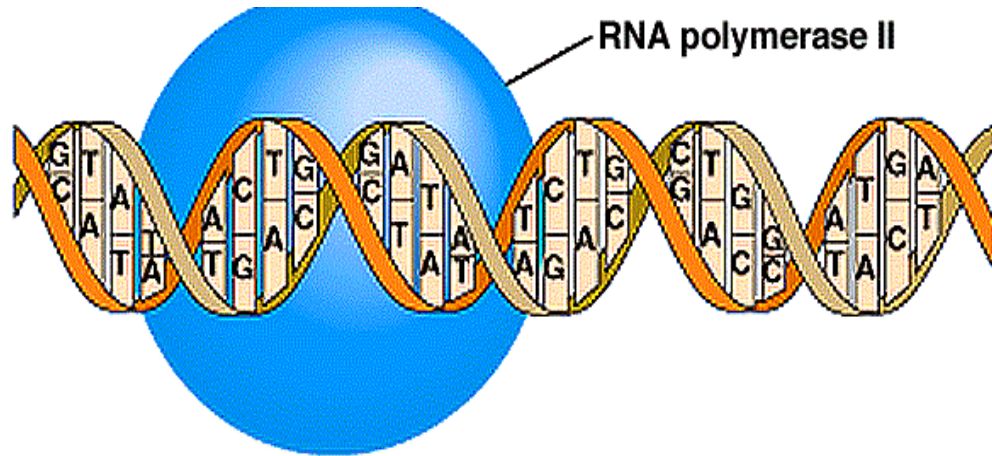
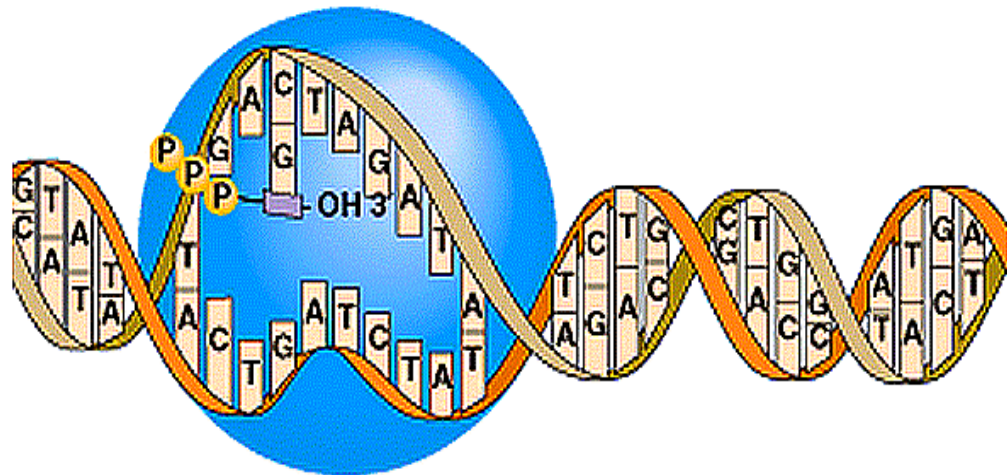


Figure 6-2 *Molecular Biology of the Cell* (© Garland Science 2008)



(a)

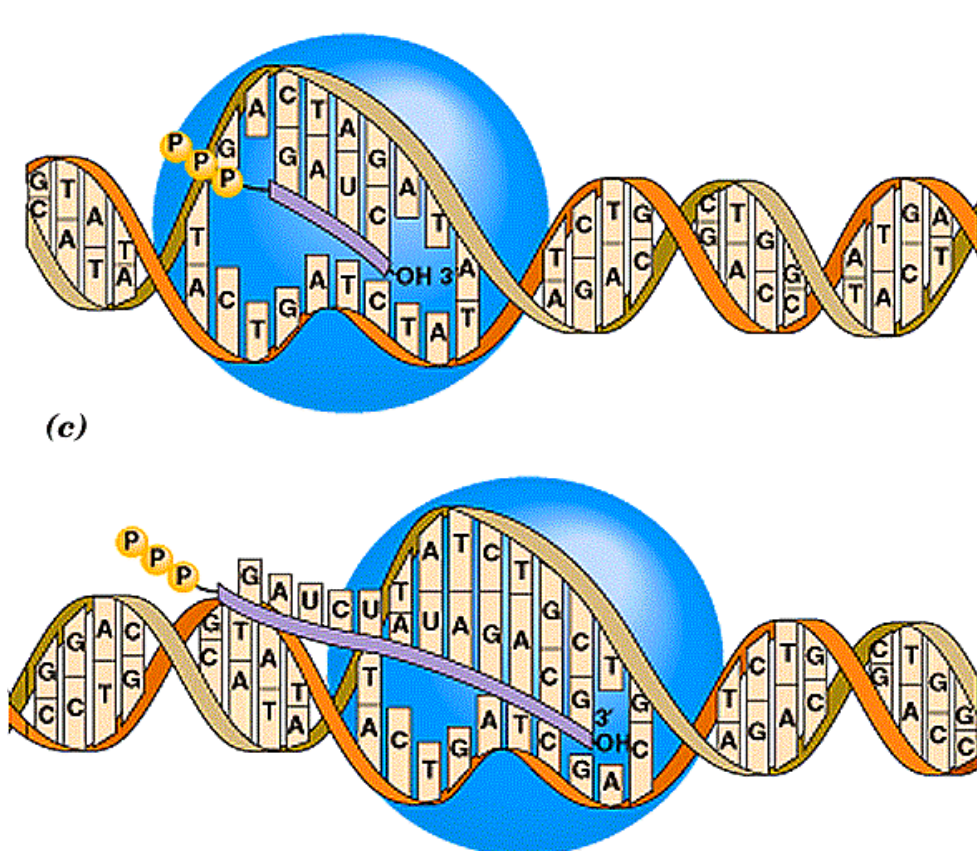
**Reconocimiento del sitio de iniciación de transcripción por la RNA polimerasa, en el promotor del gen que se transcribe**



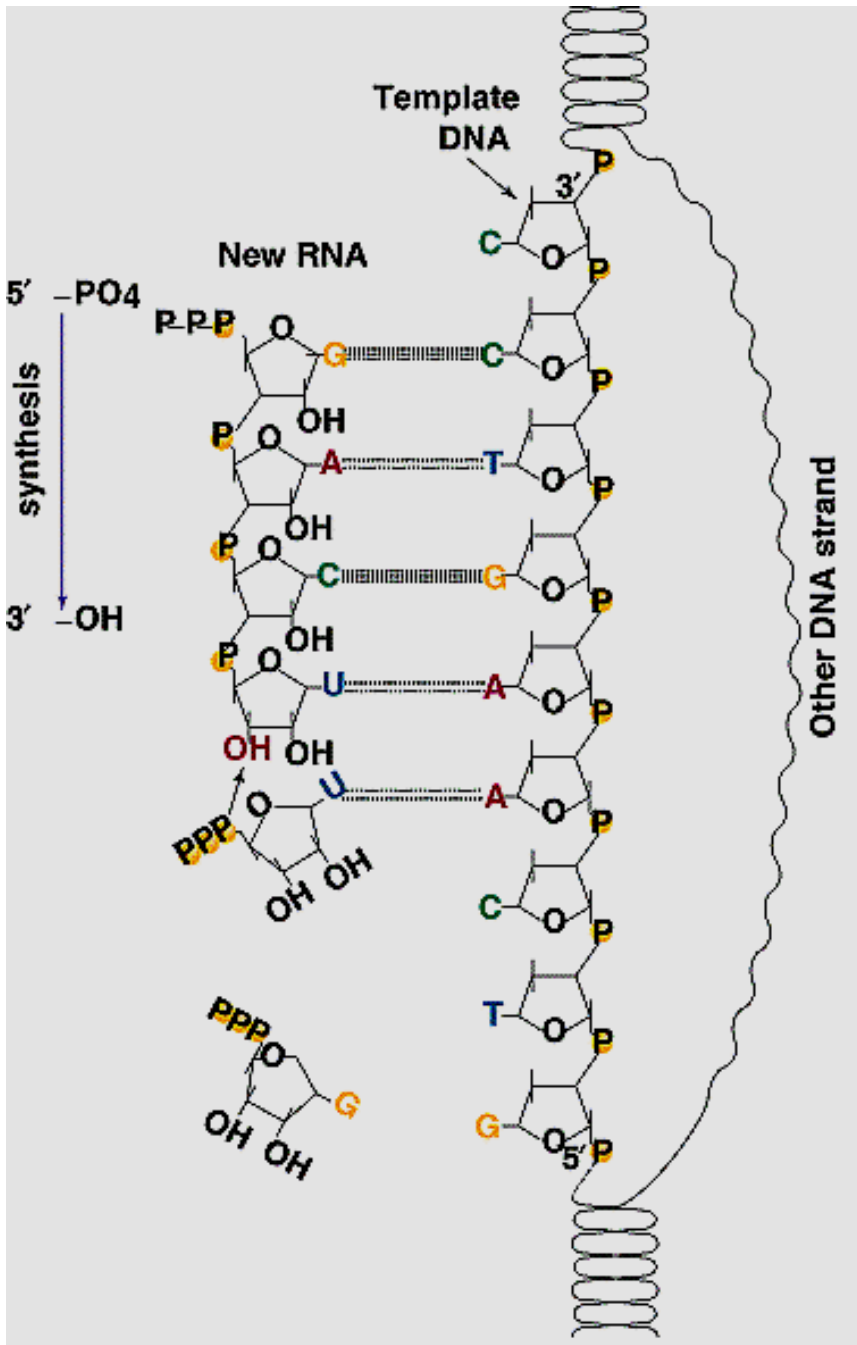
(b)

**Ubicación del primer nucleótido transcrito.**

**c) Formación del primer enlace fosfodiéster.**



**d) Prosigue la síntesis con movimiento de la RNA polimerasa a lo largo del DNA. Se reorganiza la doble hélice.**



**Biosíntesis de RNA mostrando la asimetría en la transcripción. El Nuevo RNA se forma desde su extremo 5' hacia el extremo 3'.**

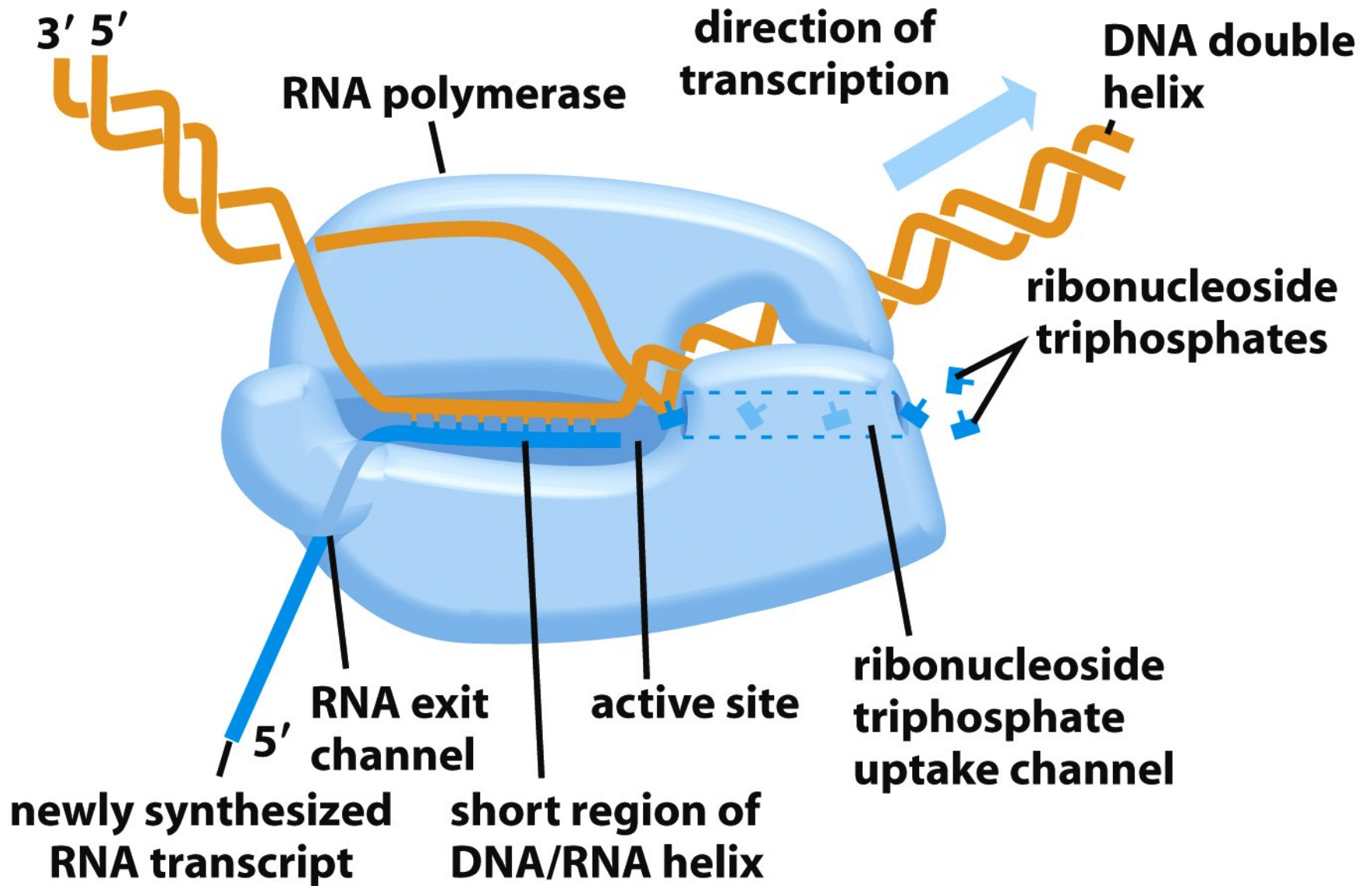


Figure 6-8a *Molecular Biology of the Cell* (© Garland Science 2008)

**Table 6–2 The Three RNA Polymerases in Eucaryotic Cells**

<b>TYPE OF POLYMERASE</b>	<b>GENES TRANSCRIBED</b>
<b>RNA polymerase I</b>	<b>5.8S, 18S, and 28S rRNA genes</b>
<b>RNA polymerase II</b>	<b>all protein-coding genes, plus snoRNA genes, miRNA genes, siRNA genes, and most snRNA genes</b>
<b>RNA polymerase III</b>	<b>tRNA genes, 5S rRNA genes, some snRNA genes and genes for other small RNAs</b>

**The rRNAs are named according to their “S” values, which refer to their rate of sedimentation in an ultracentrifuge. The larger the S value, the larger the rRNA.**

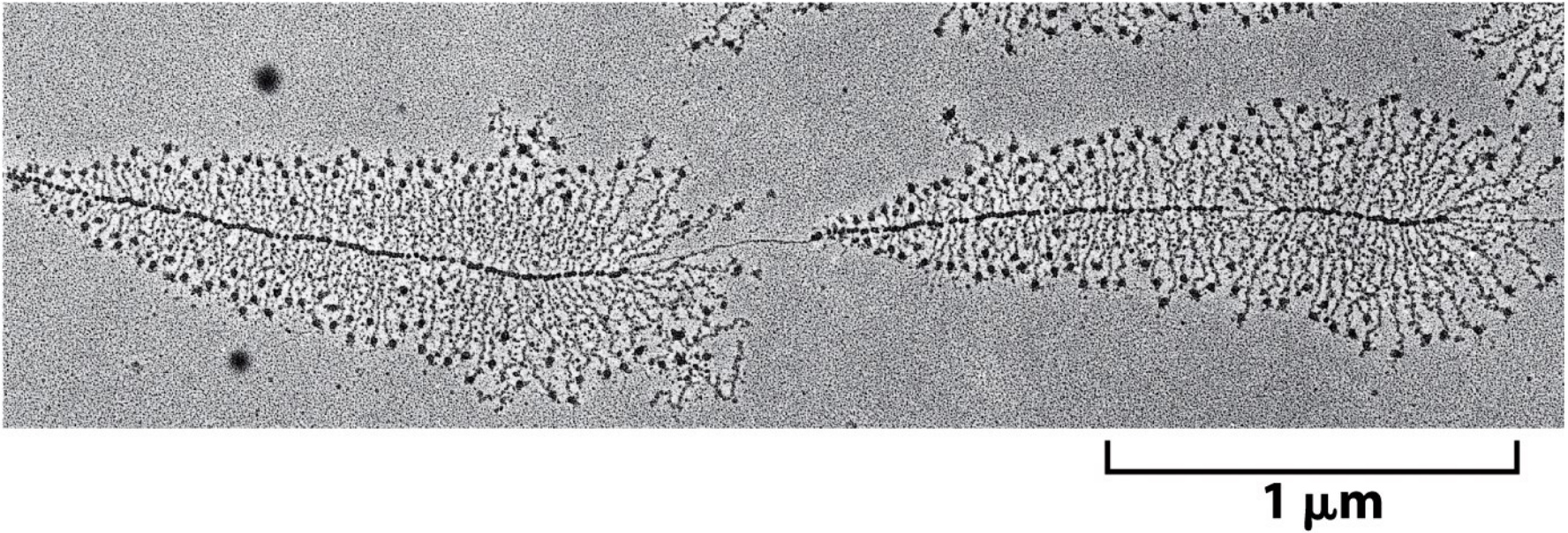


Figure 6-9 *Molecular Biology of the Cell* (© Garland Science 2008)

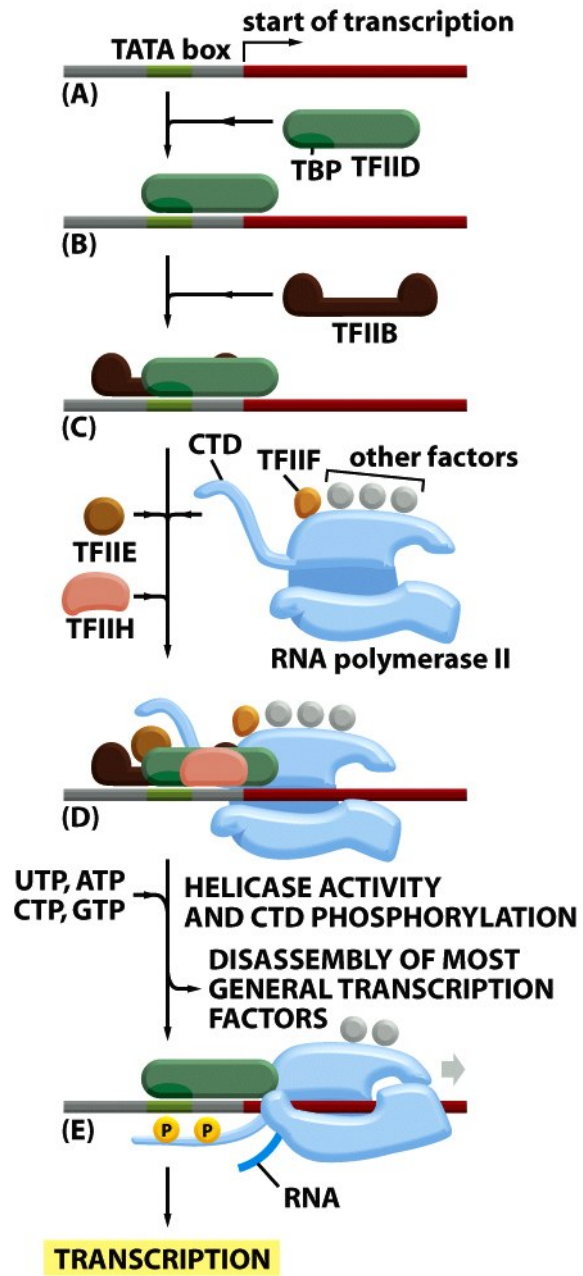


Figure 6-16 *Molecular Biology of the Cell* (© Garland Science 2008)



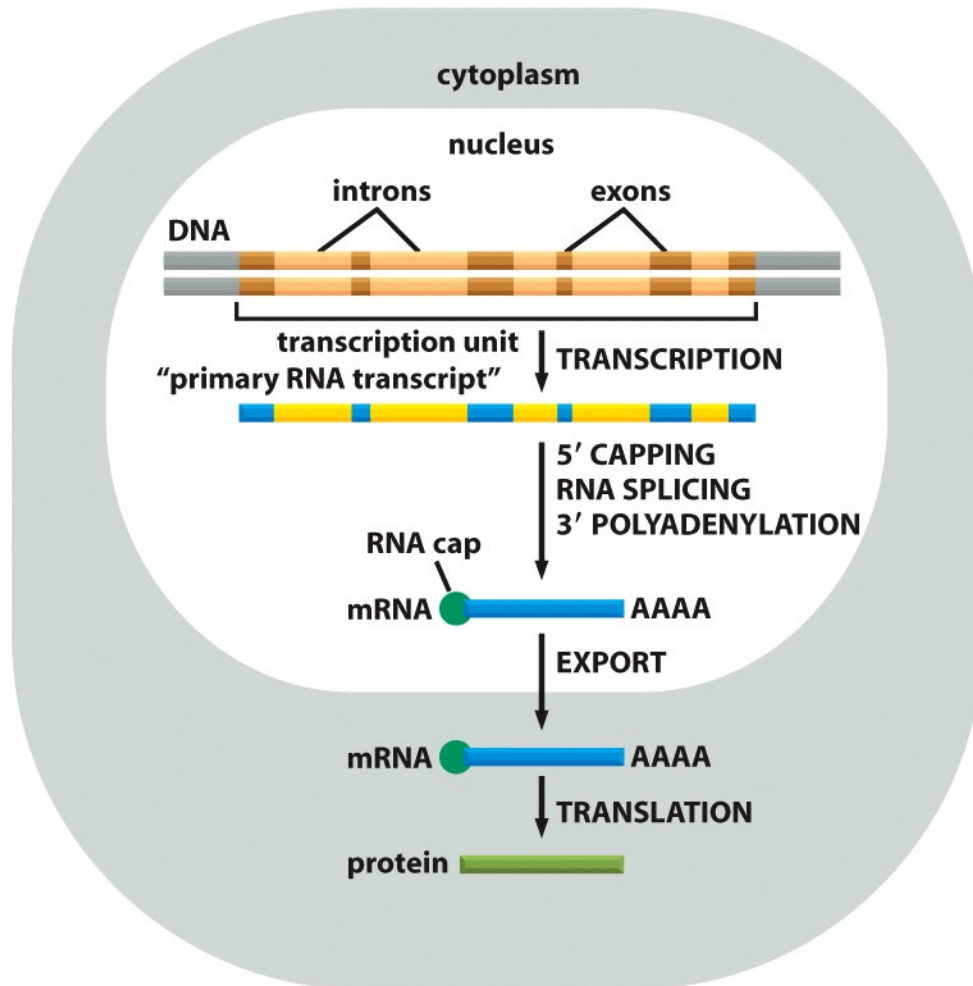
**Table 6–3 The General Transcription Factors Needed for Transcription Initiation by Eucaryotic RNA Polymerase II**

<b>NAME</b>	<b>NUMBER OF SUBUNITS</b>	<b>ROLES IN TRANSITION INITIATION</b>
<b>TFIID</b>		
<b>TBP subunit</b>	1	recognizes TATA box
<b>TAF subunits</b>	~11	recognizes other DNA sequences near the transcription start point; regulates DNA-binding by TBP
<b>TFIIB</b>	1	recognizes BRE element in promoters; accurately positions RNA polymerase at the start site of transcription
<b>TFIIF</b>	3	stabilizes RNA polymerase interaction with TBP and TFIIB; helps attract TFIIE and TFIIH
<b>TFIIE</b>	2	attracts and regulates TFIIH
<b>TFIIH</b>	9	unwinds DNA at the transcription start point, phosphorylates Ser5 of the RNA polymerase CTD; releases RNA polymerase from the promoter

TFIID is composed of TBP and ~11 additional subunits called TAFs (TBP-associated factors); CTD, C-terminal domain.

(A)

**EUCARYOTES**



(B)

**PROCARYOTES**

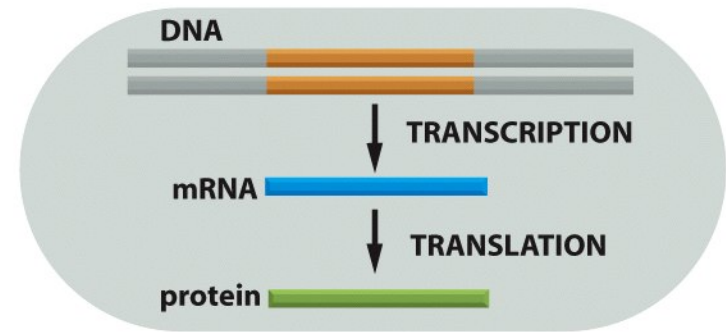


Figure 6-21 *Molecular Biology of the Cell* (© Garland Science 2008)

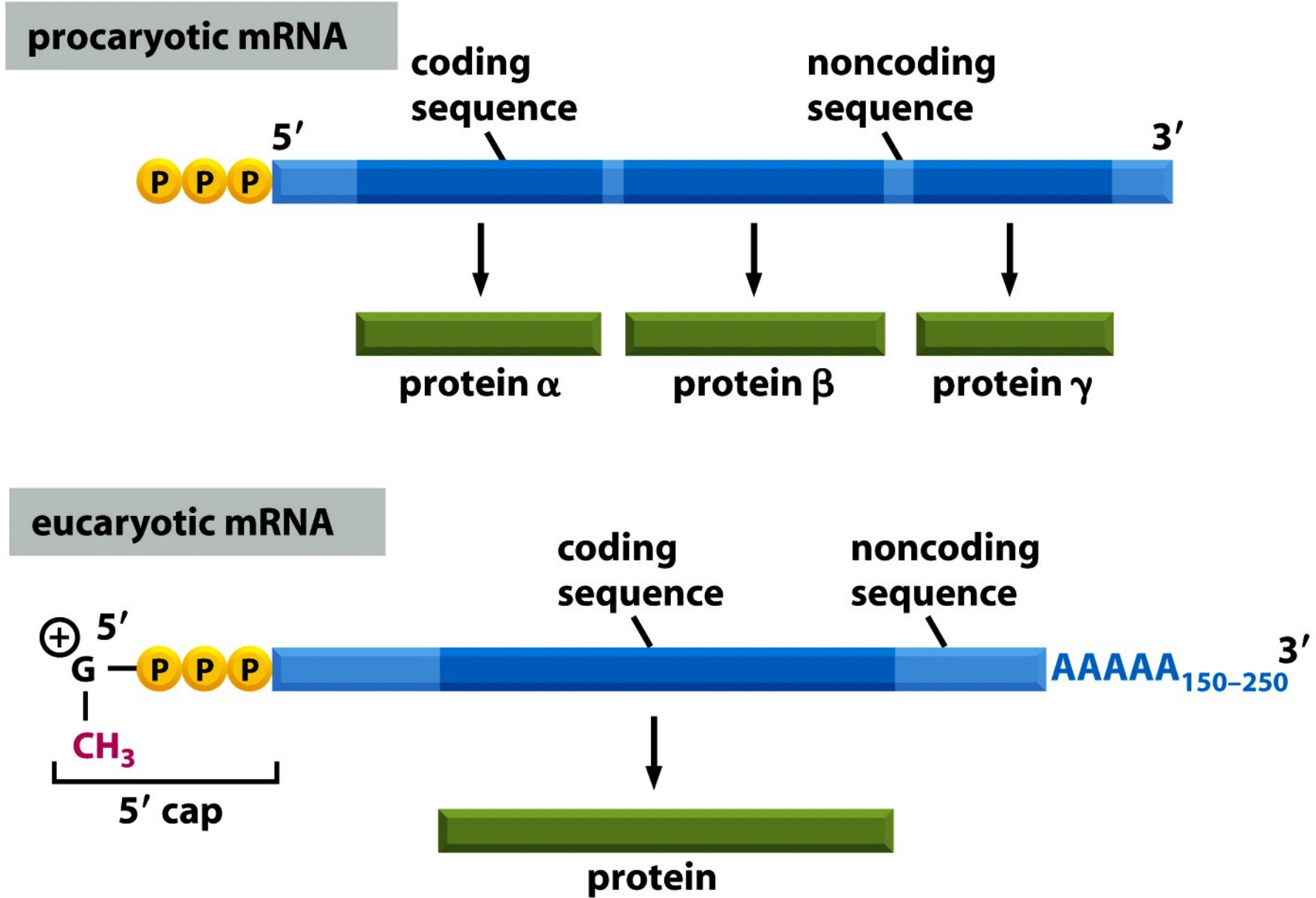
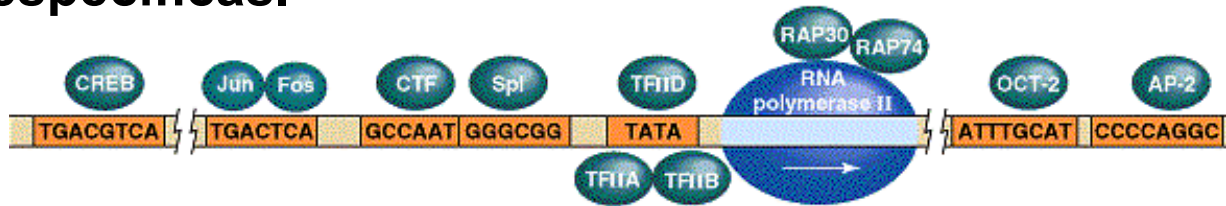


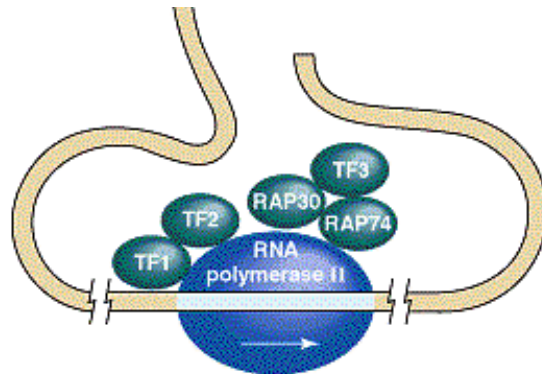
Figure 6-22a *Molecular Biology of the Cell* (© Garland Science 2008)

**El DNA tiene dos tipos de secuencia: sitios de control y la región codificante. Los sitios de control son reconocidos por proteínas específicas.**



**Un gen típico (transcrito por la RNA polimerasa II ) tiene un promotor que se extiende río arriba del sitio en que se inicia la transcripción. El promotor tiene varios elementos de secuencia cortos (< 10 pb) que unen factores de transcripción, estos pueden extenderse por mas de 200 pb.**

**El DNA puede estar doblado o reordenado de modo que el sitio de iniciación no es accesible, los factores de transcripción en el promotor y en sitios enhancer (potenciadores) interactúan para formar un gran complejo de proteínas que facilitan el reconocimiento del inicio.**



### human $\beta$ -globin gene



2000

(A) nucleotide pairs

### human Factor VIII gene

1

5

10

14

22

25

26



exons



(B)

200,000 nucleotide pairs

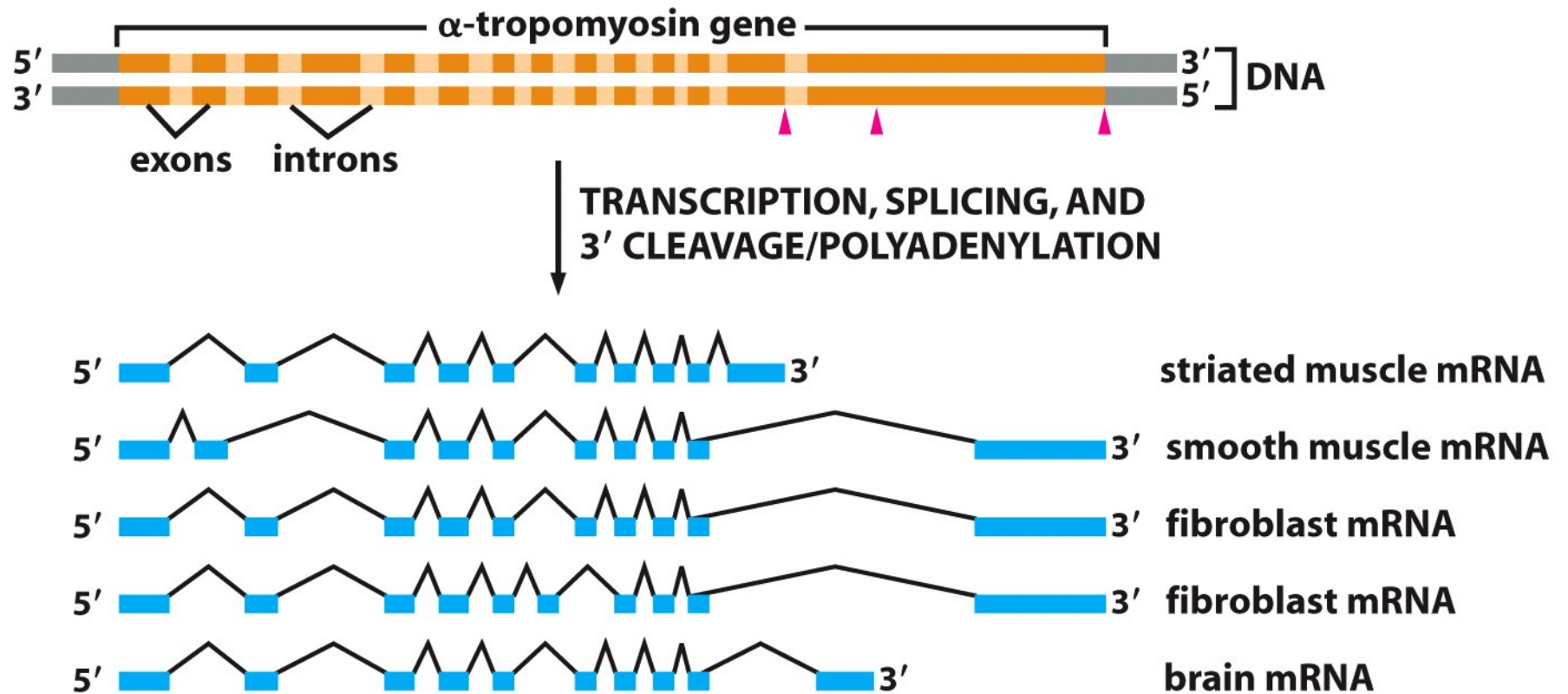


Figure 6-27 *Molecular Biology of the Cell* (© Garland Science 2008)

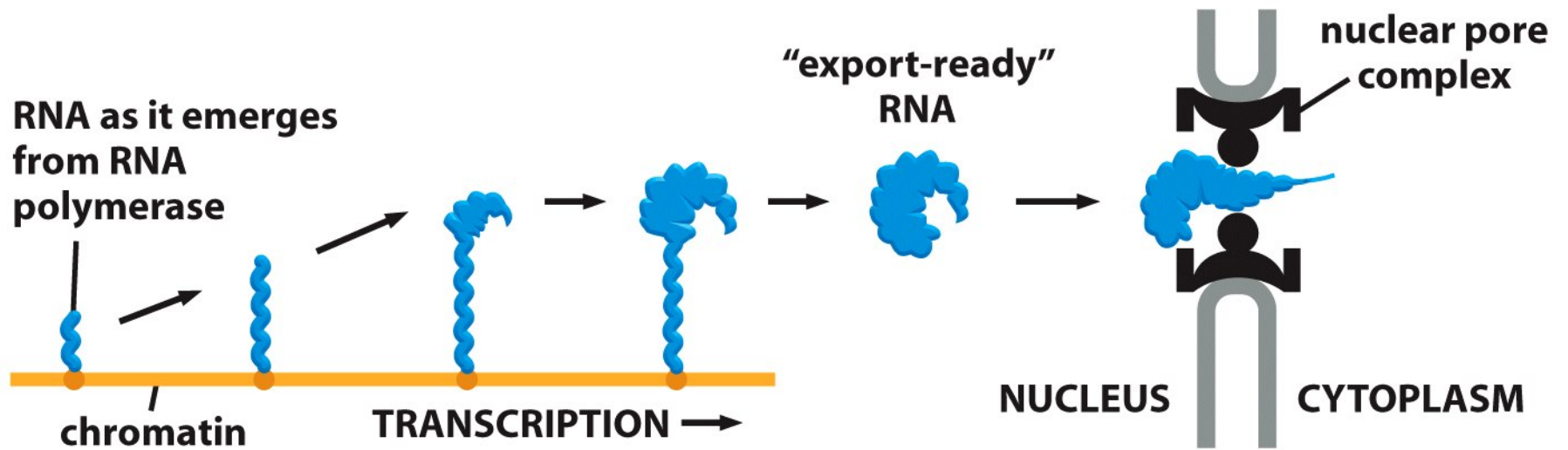


Figure 6-39a *Molecular Biology of the Cell* (© Garland Science 2008)



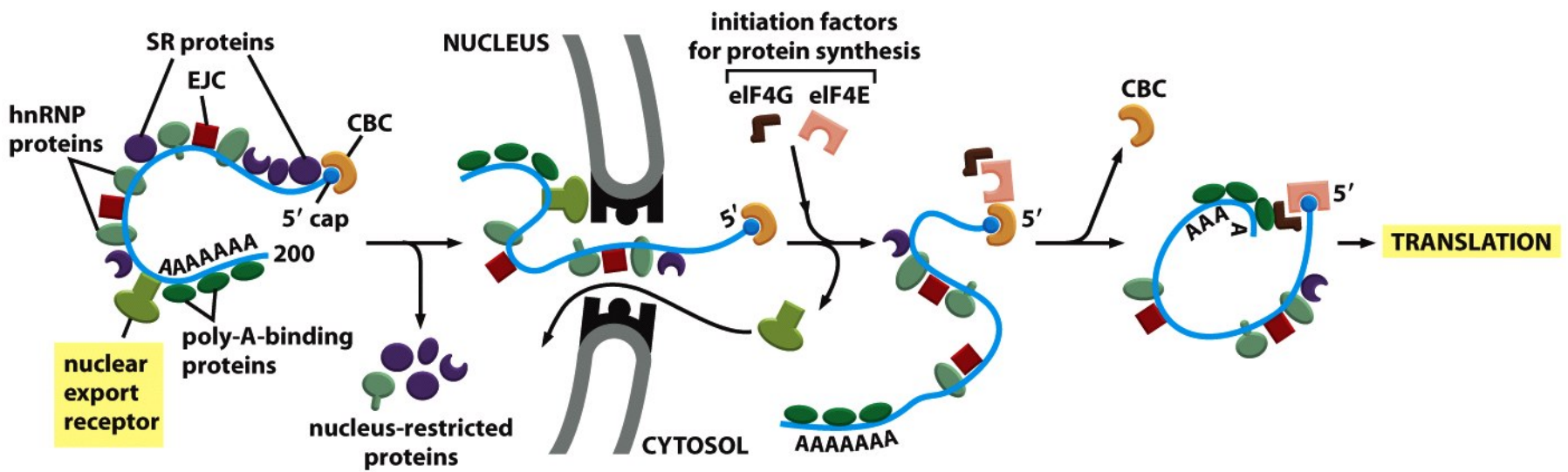


Figure 6-40 *Molecular Biology of the Cell* (© Garland Science 2008)

# Traducción

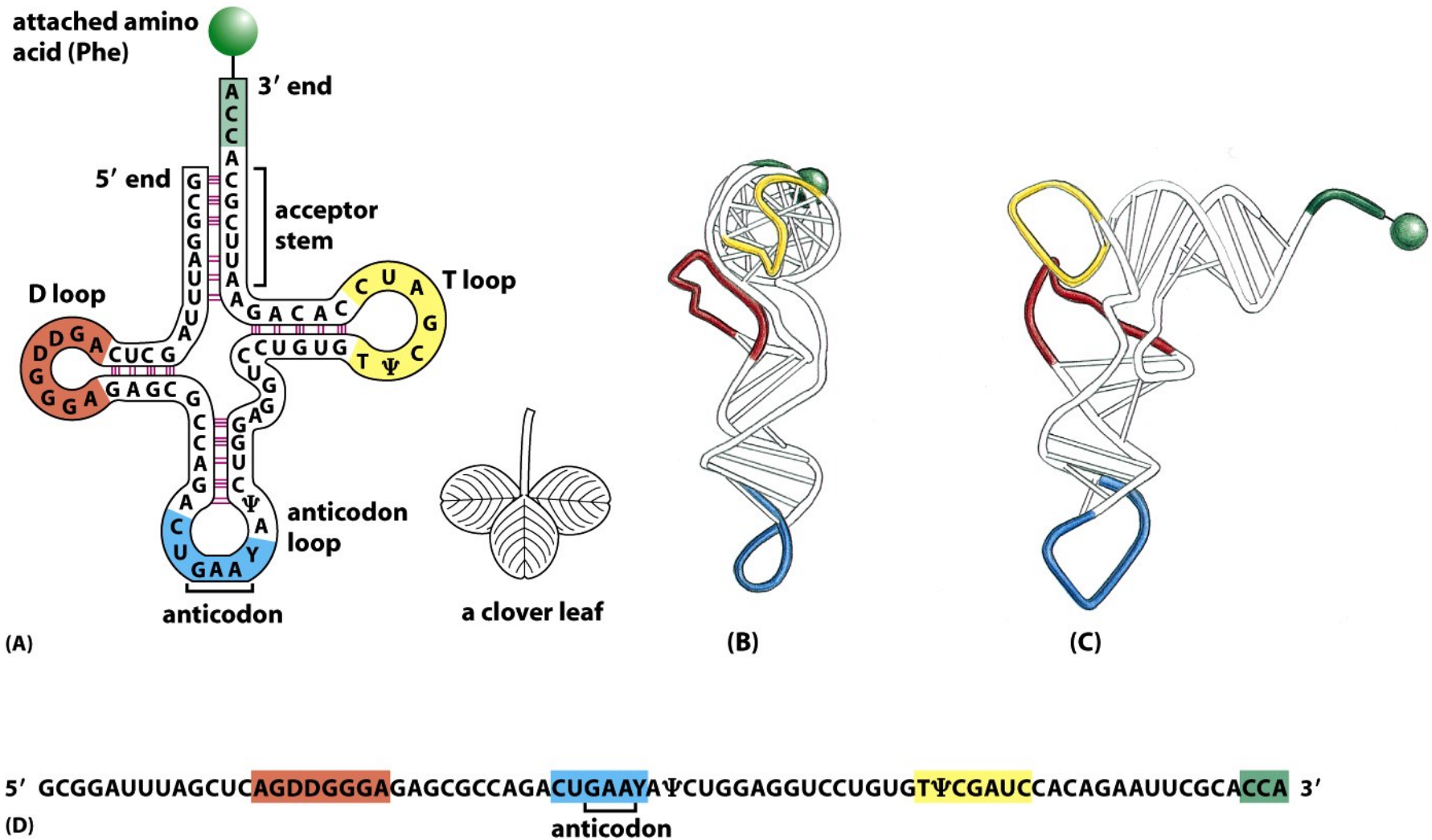
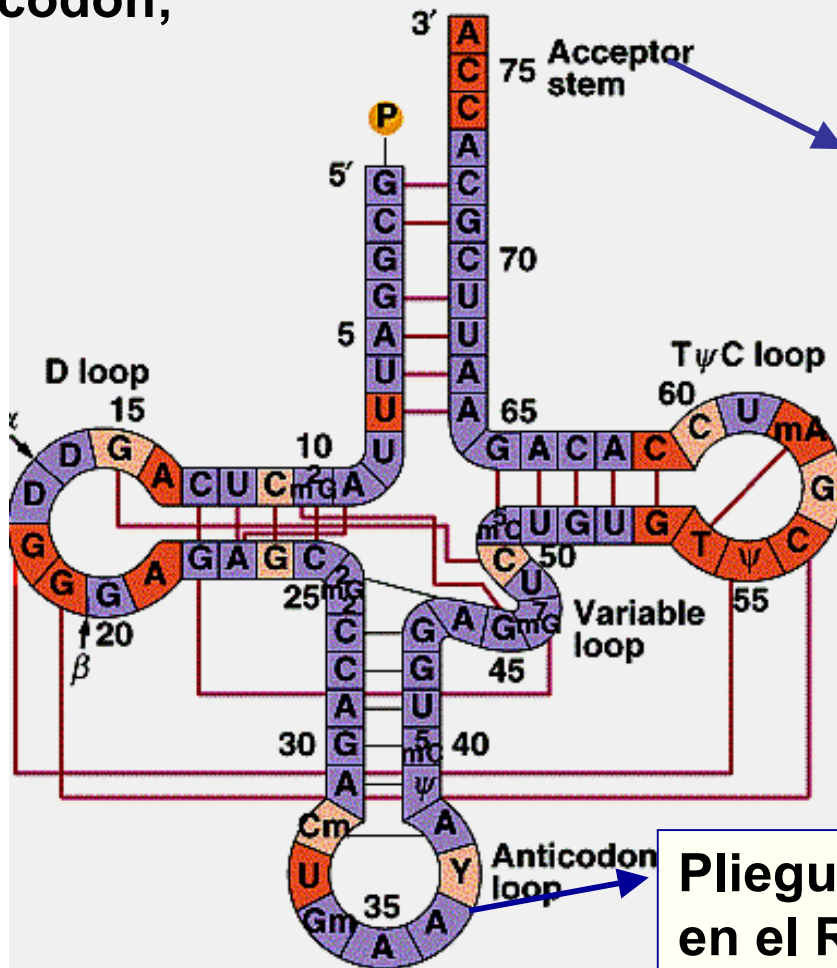


Figure 6-52 *Molecular Biology of the Cell* (© Garland Science 2008)

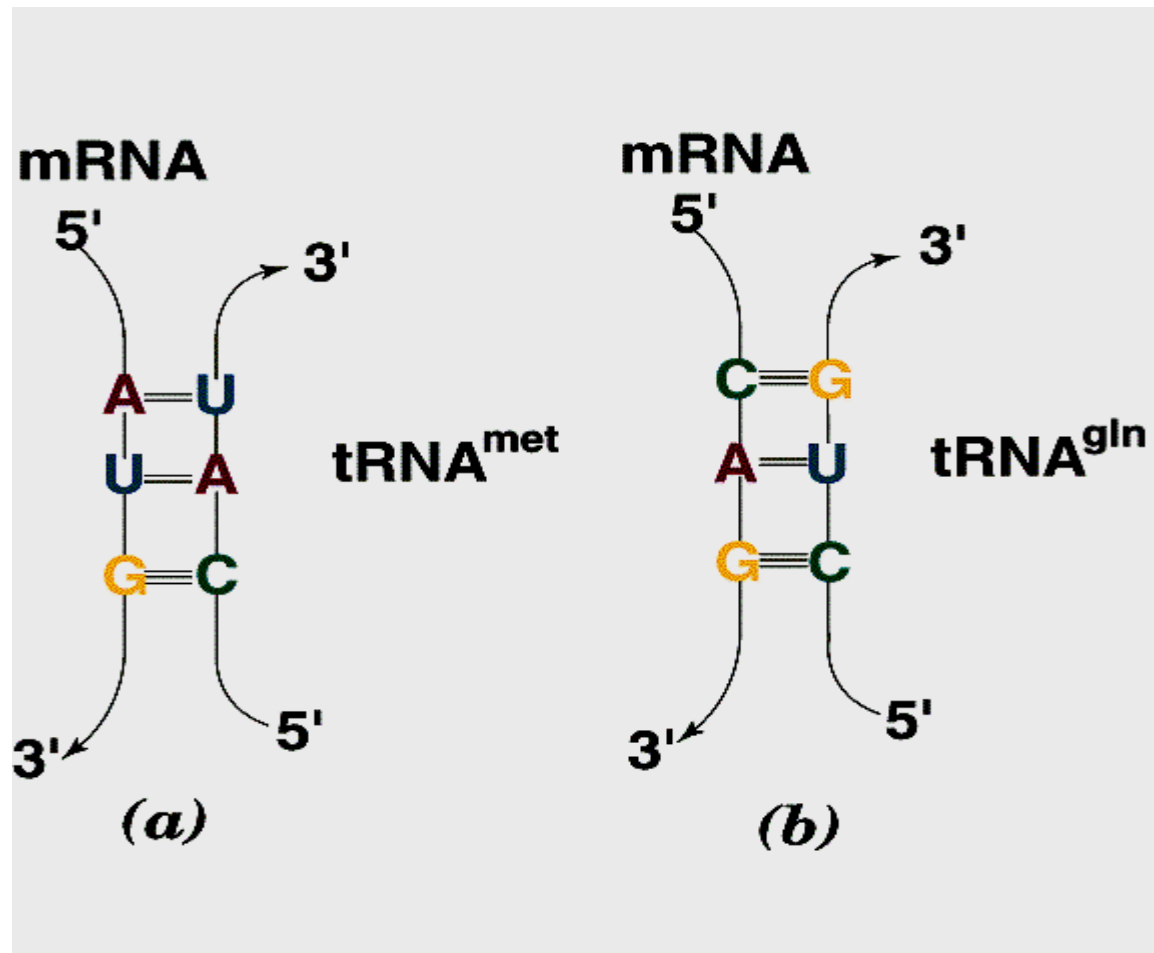
Los RNAt son moléculas pequeñas (70-80 nucleótidos), y hay varias para los distintos aminoácidos. Son moléculas adaptadoras, reconocen: un codón en el RNAm y al aminoácido que corresponde al codón;



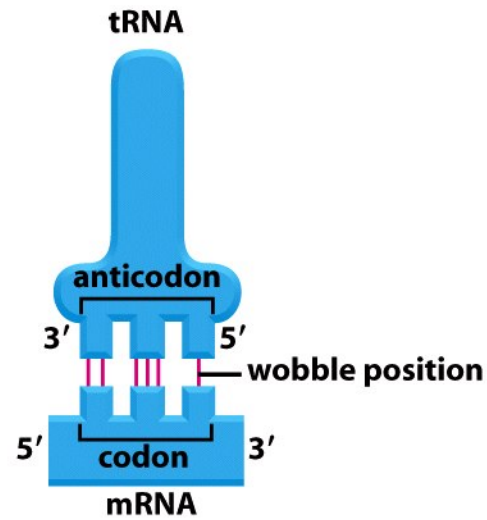
El extremo 3', aceptor, reconoce y une al aminoácido correspondiente

La enzima que cataliza la unión de los RNAt con el aminoácido correspondiente es la aminoacil-tRNA- sintetasa.

Pliegue anticodón, reconoce y une al codón en el RNAm, con bases complementarias.



**Interacciones codón anticodón. a) Interacción entre el codón AUG y su anti codón CAU. b) El codón CAG (glutamina) y su anticodón (CUG). Hay interacciones complementarias de apareamiento anti paralelo entre mRNA y tRNA. Este reconocimiento ocurre en los ribosomas.**



**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* (© Garland Science 2008)

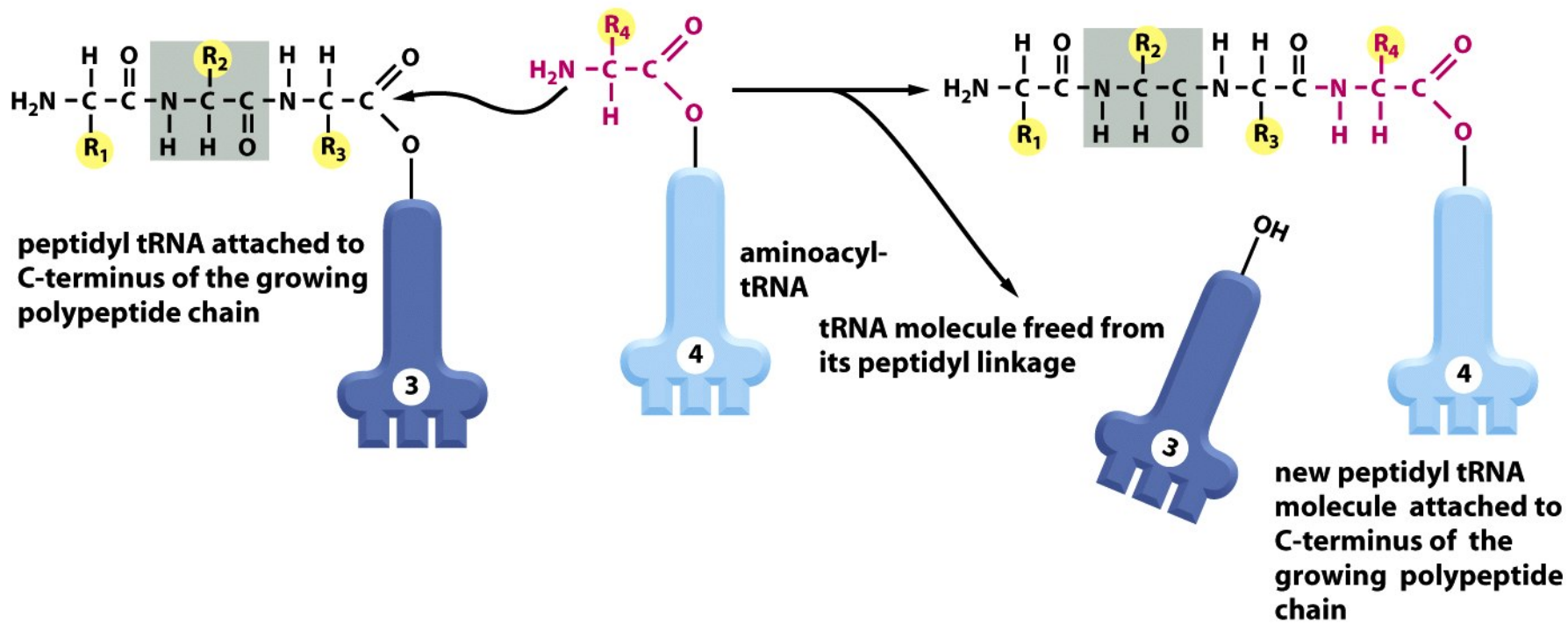
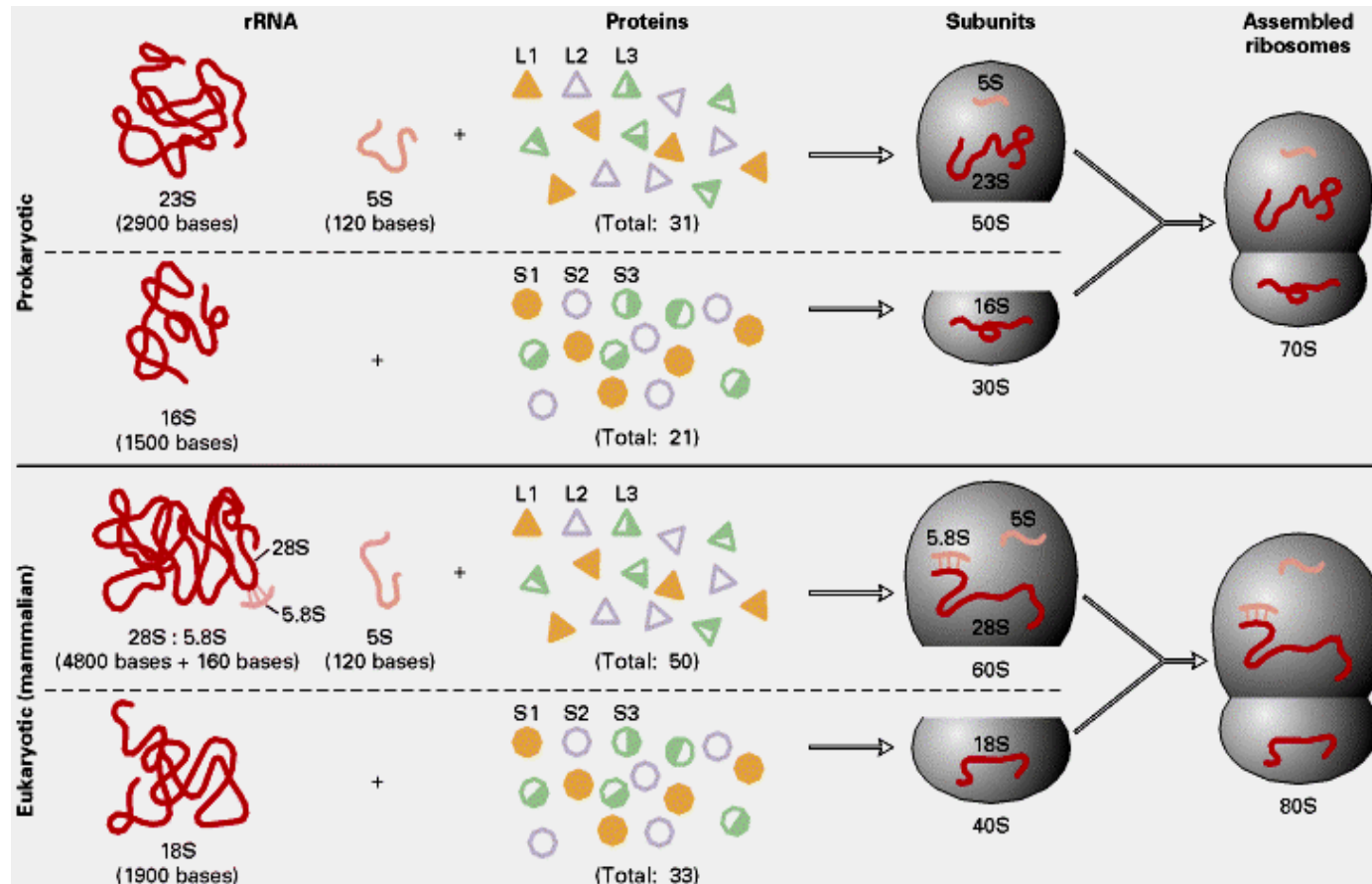


Figure 6-61 *Molecular Biology of the Cell* (© Garland Science 2008)

## Composición de ribosomas de procariontes y eucariontes, cada uno con una sub-unidad pequeña y otra grande



Los ribosomas son organizaciones macromoleculares que sintetizan proteínas. Un ribosoma es una partícula compuesta de moléculas de RNA individuales (contienen un tercio del RNA celular) y mas de 50 proteínas, organizadas en una sub unidad pequeña y otra grande.



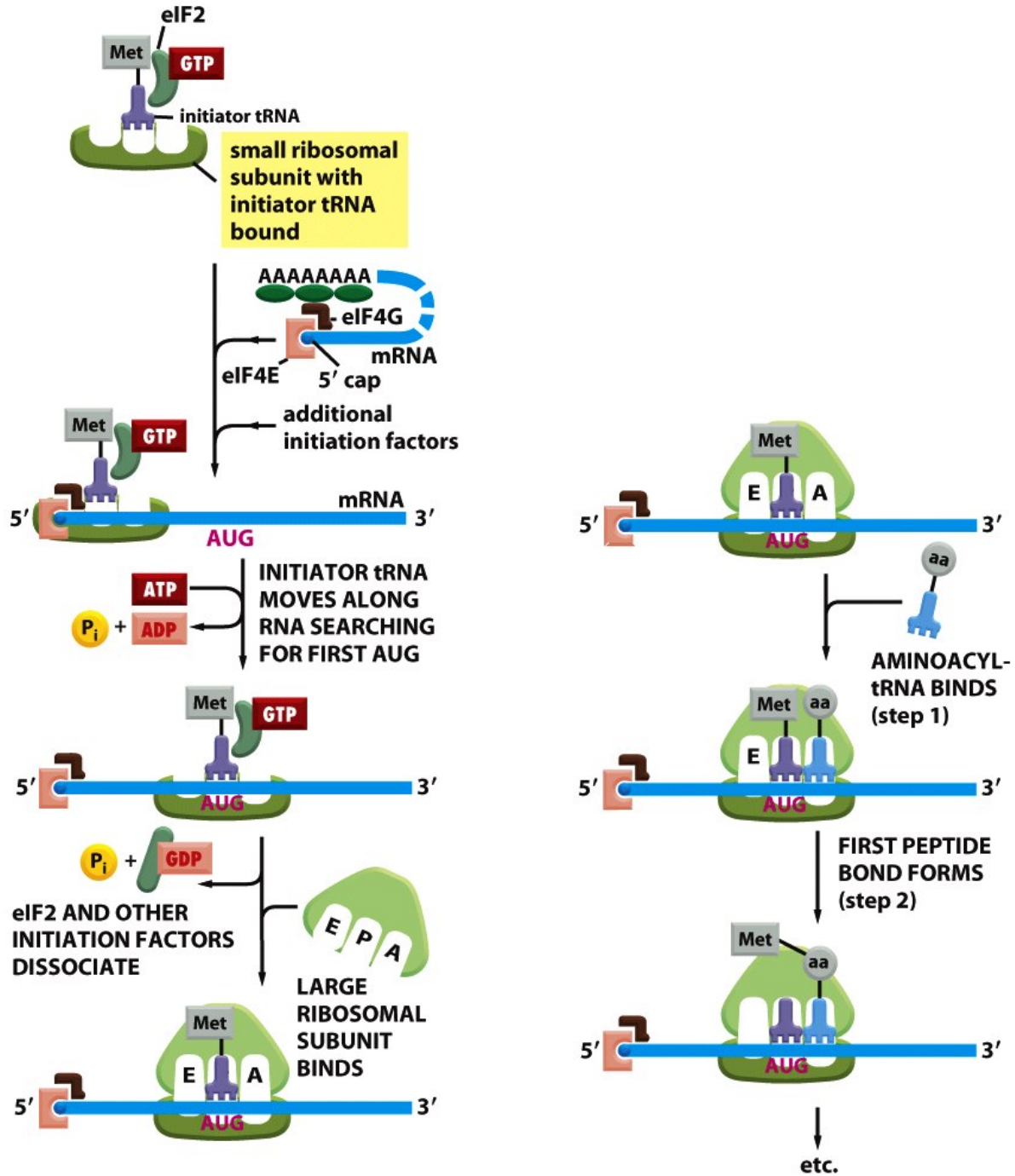


Figure 6-72 *Molecular Biology of the Cell* (© Garland Science 2008)

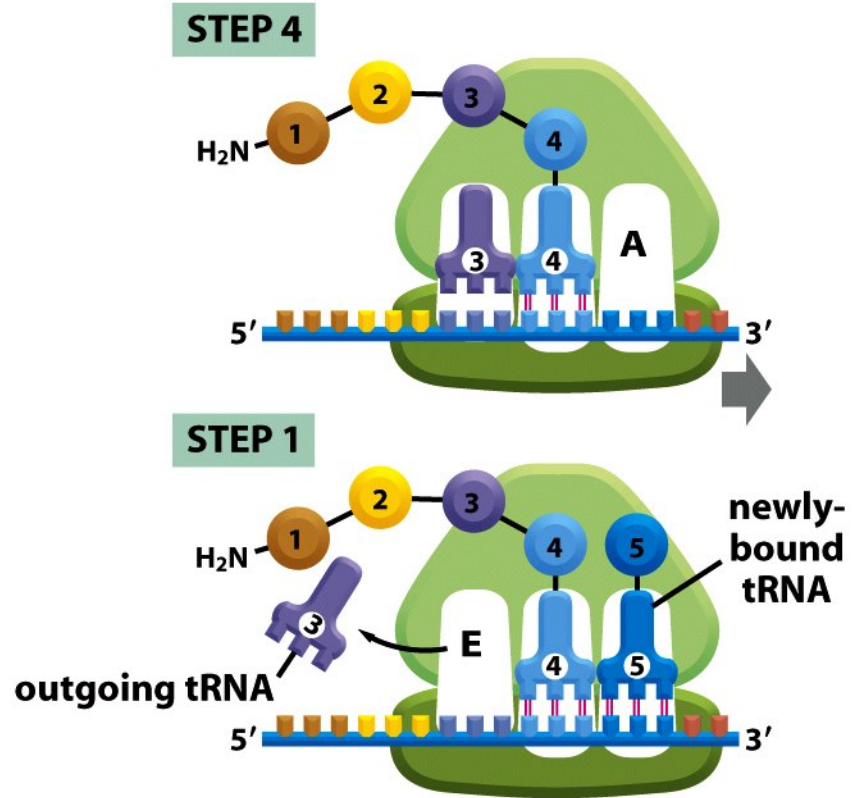
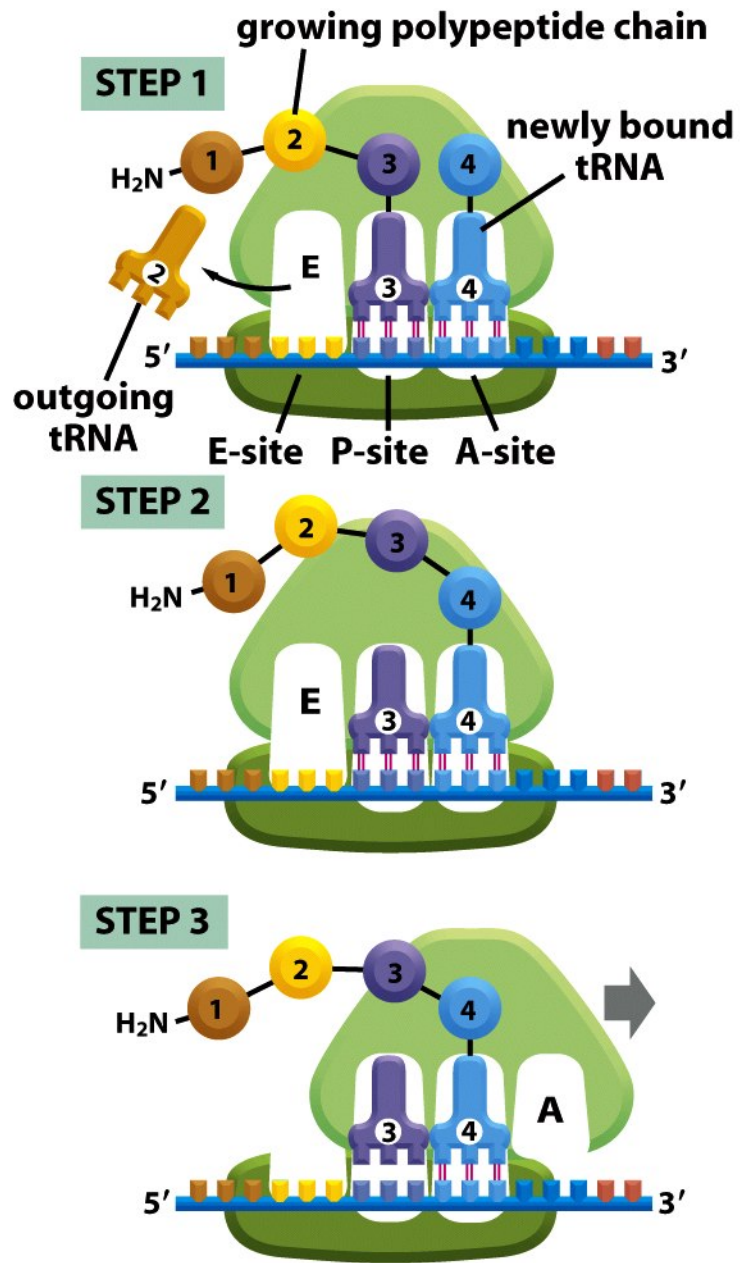
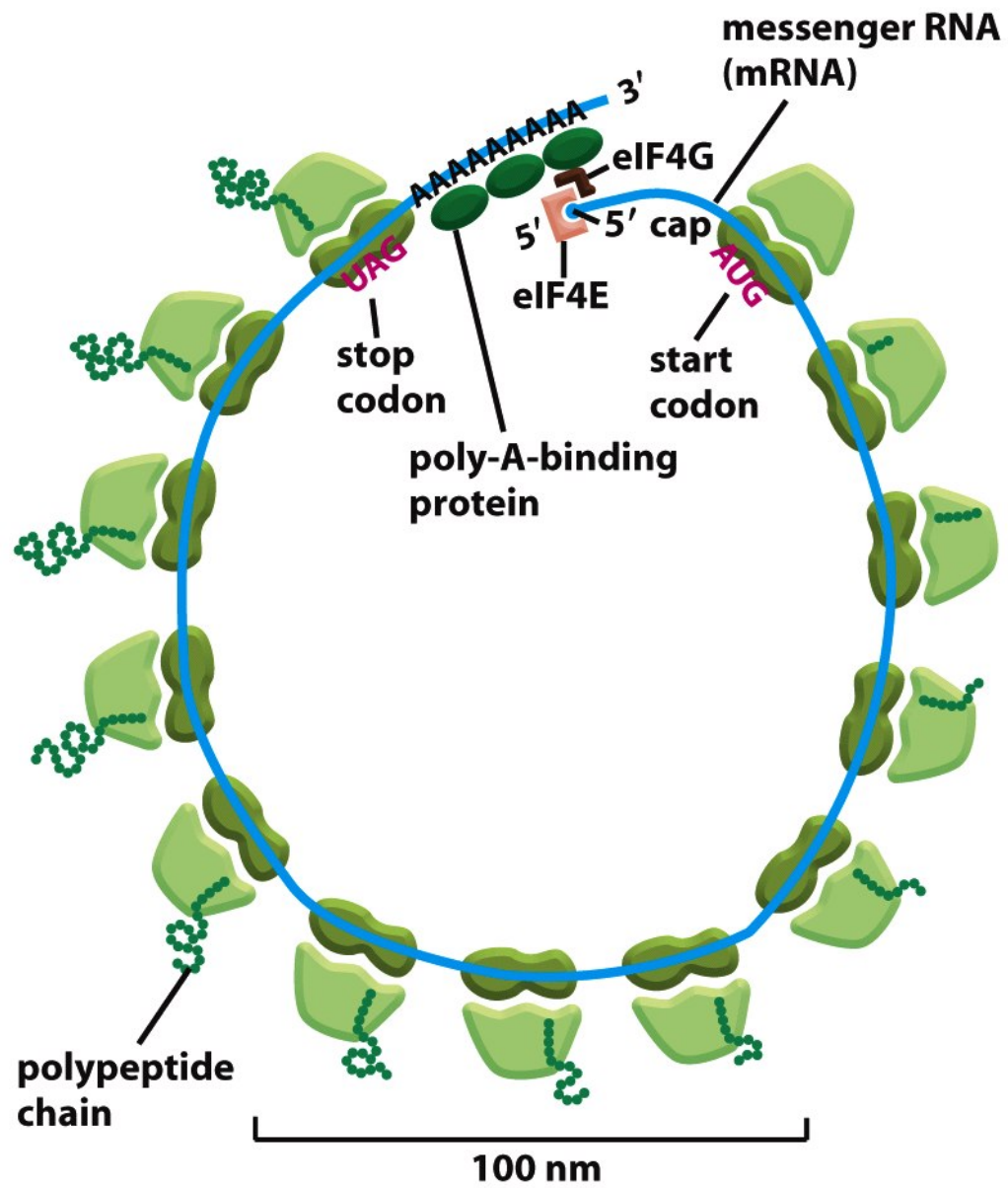
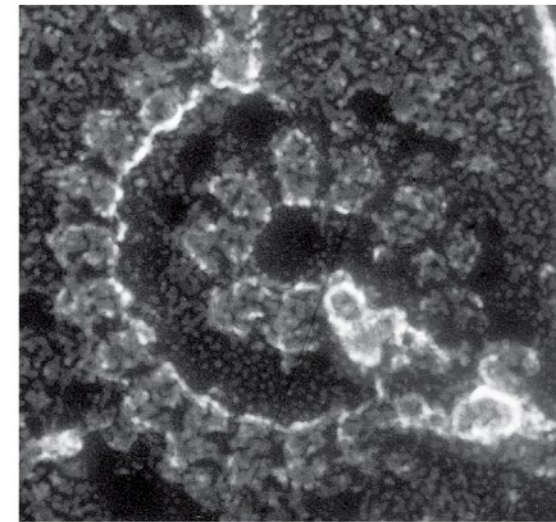


Figure 6-66 *Molecular Biology of the Cell* (© Garland Science 2008)



(A)



(B)

Figure 6-76 *Molecular Biology of the Cell* (© Garland Science 2008)

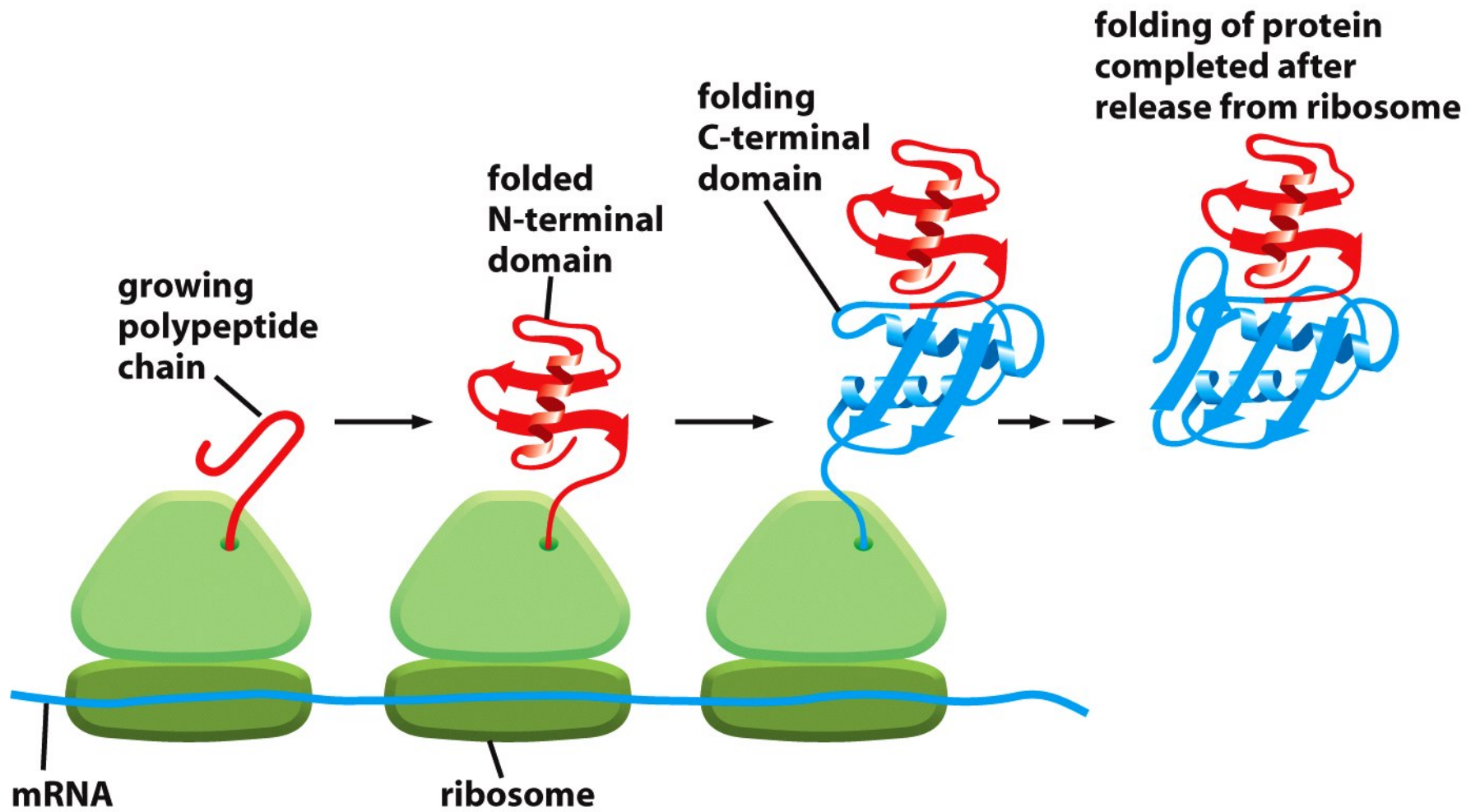


Figure 6-84 *Molecular Biology of the Cell* (© Garland Science 2008)

**Table 6–4 Inhibitors of Protein or RNA Synthesis**

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

**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.**

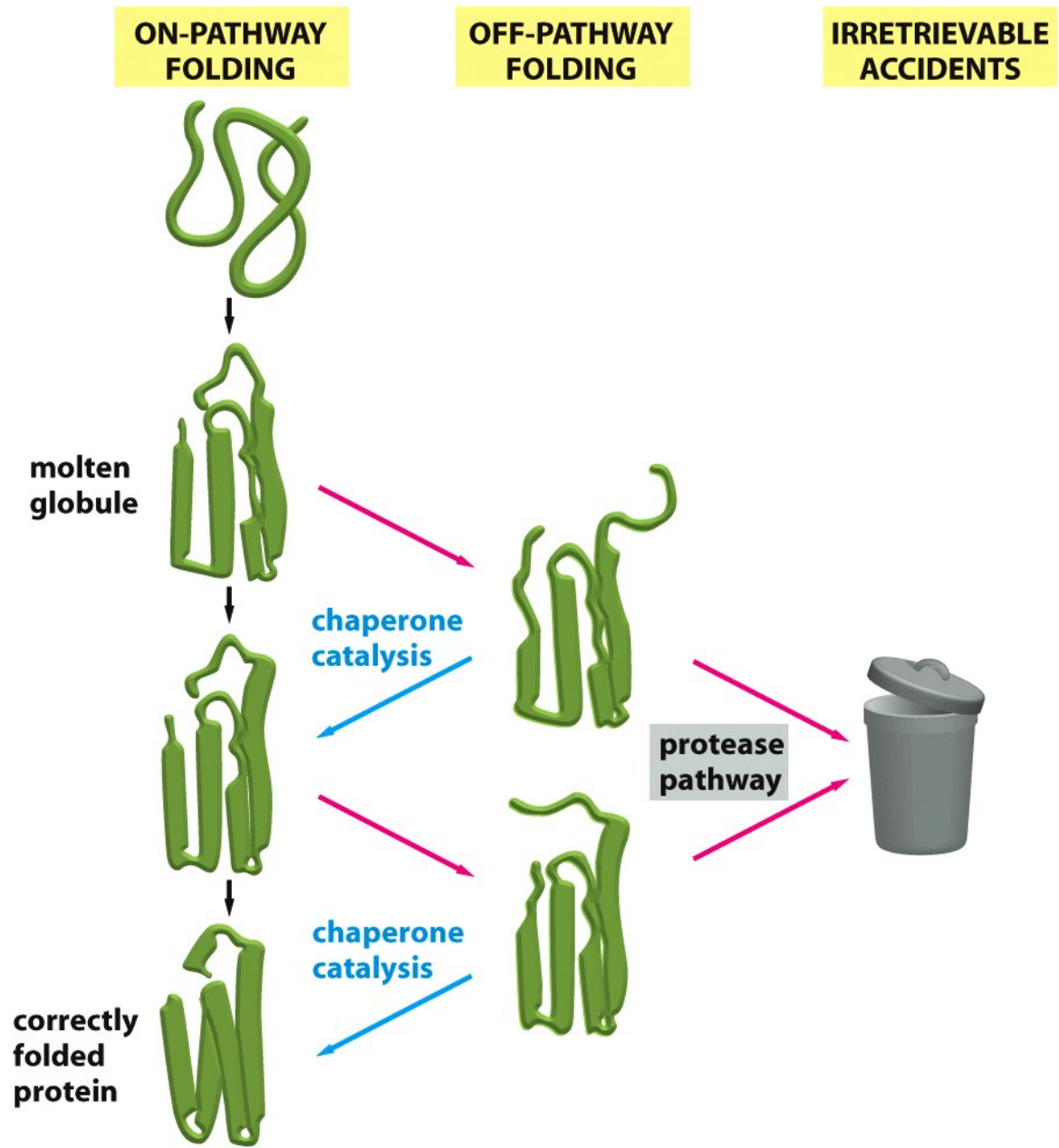


Figure 6-85 *Molecular Biology of the Cell* (© Garland Science 2008)

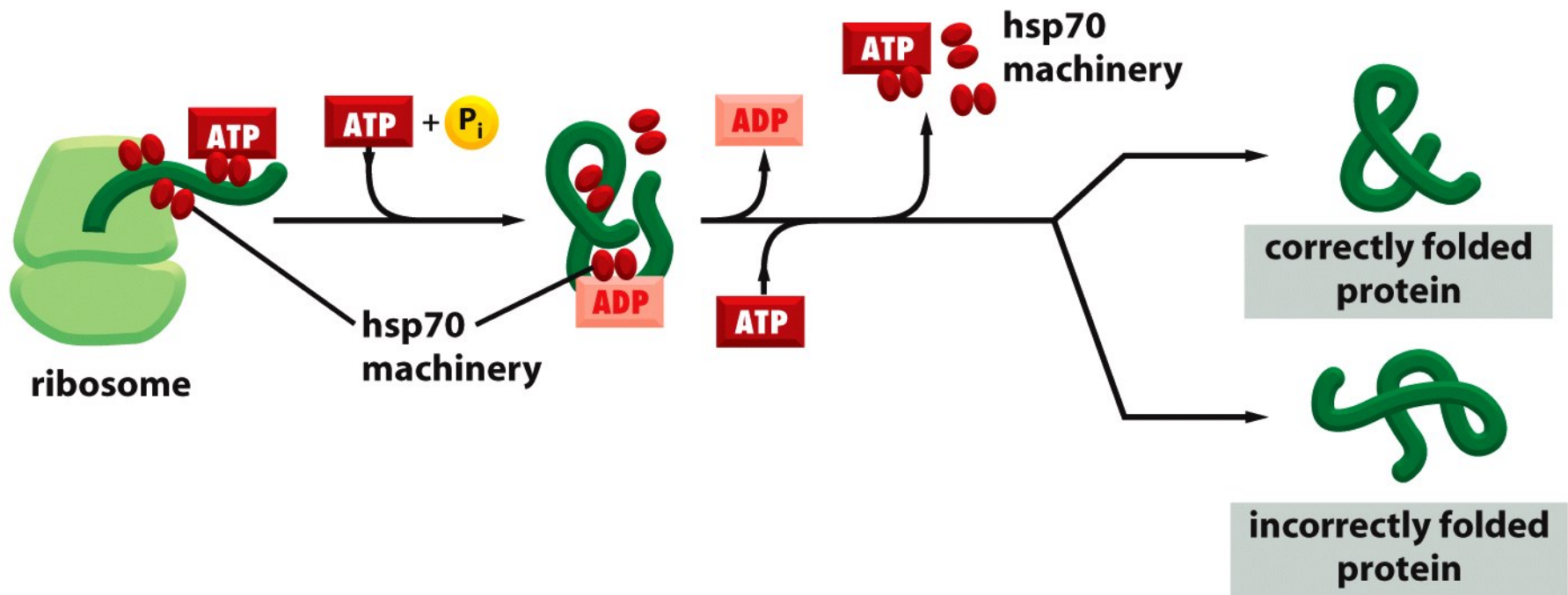


Figure 6-86 *Molecular Biology of the Cell* (© Garland Science 2008)

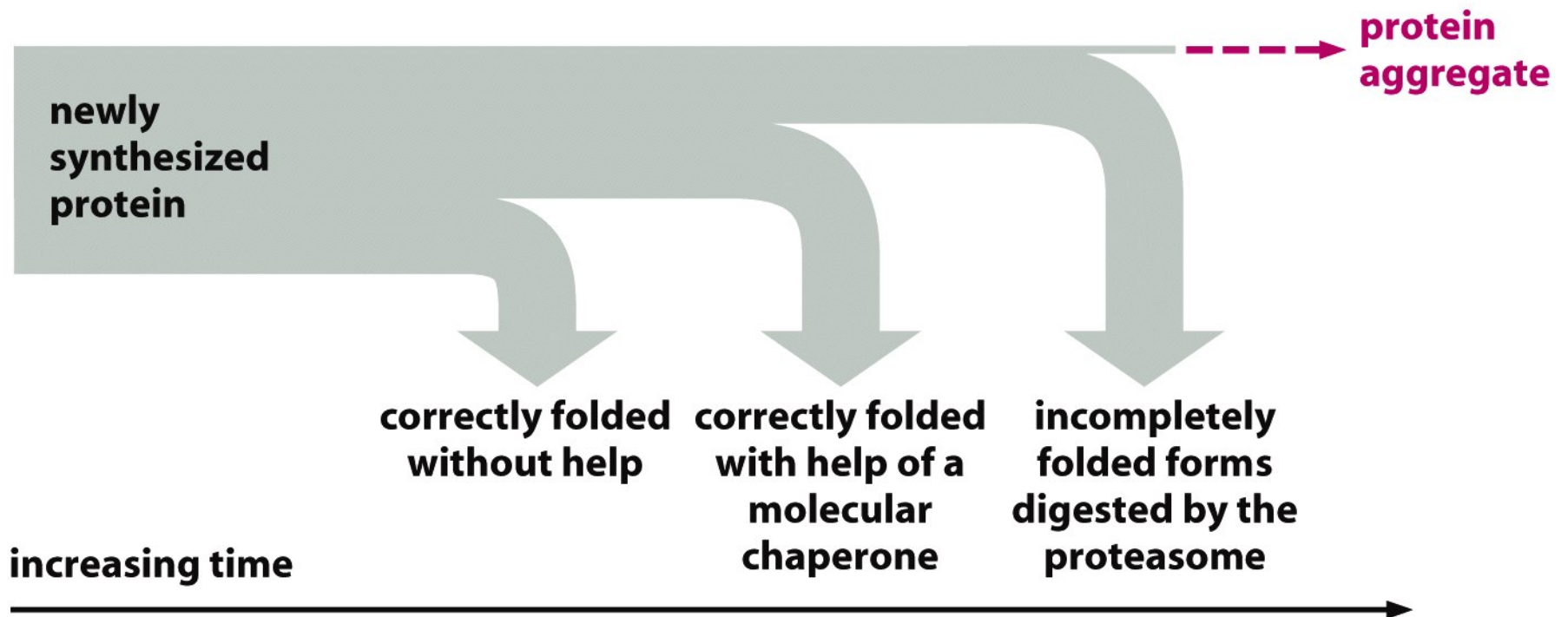


Figure 6-88 *Molecular Biology of the Cell* (© Garland Science 2008)



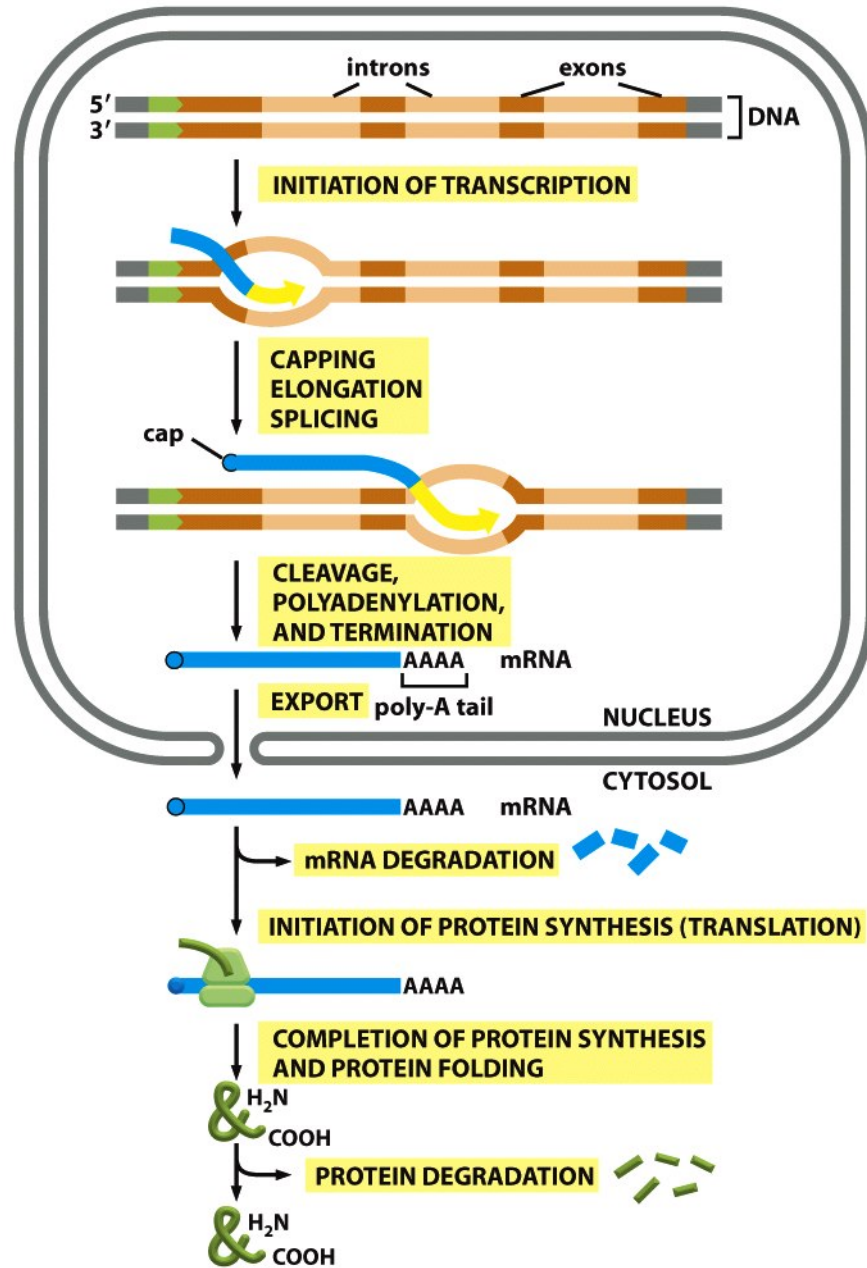


Figure 6-97 *Molecular Biology of the Cell* (© Garland Science 2008)

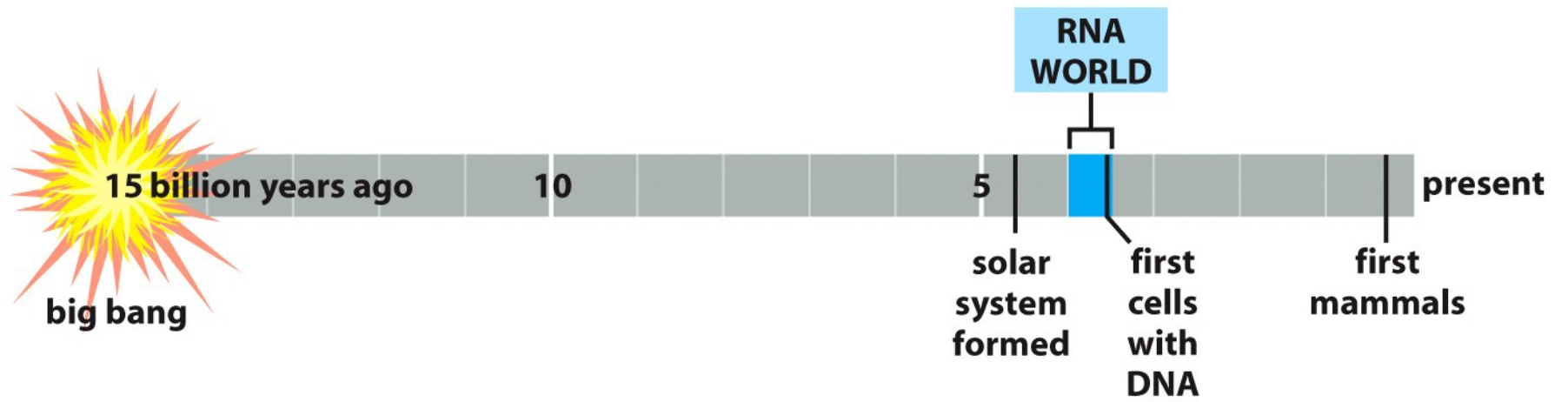


Figure 6-98 *Molecular Biology of the Cell* (© Garland Science 2008)

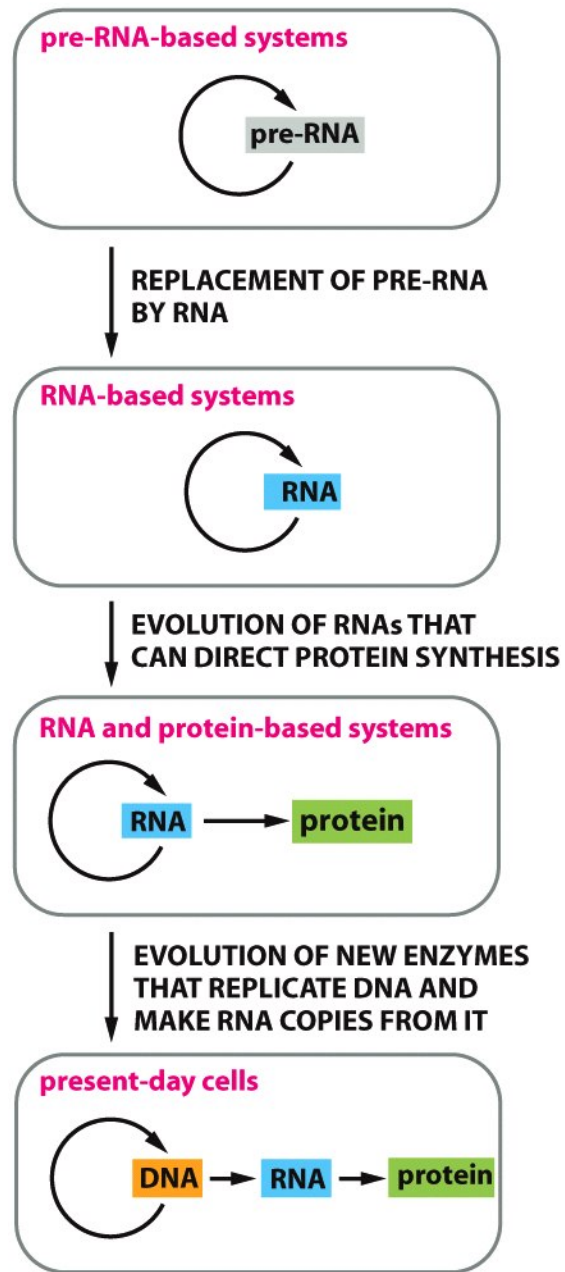


Figure 6-110 *Molecular Biology of the Cell* (© Garland Science 2008)

# Regulación de la Expresión Génica

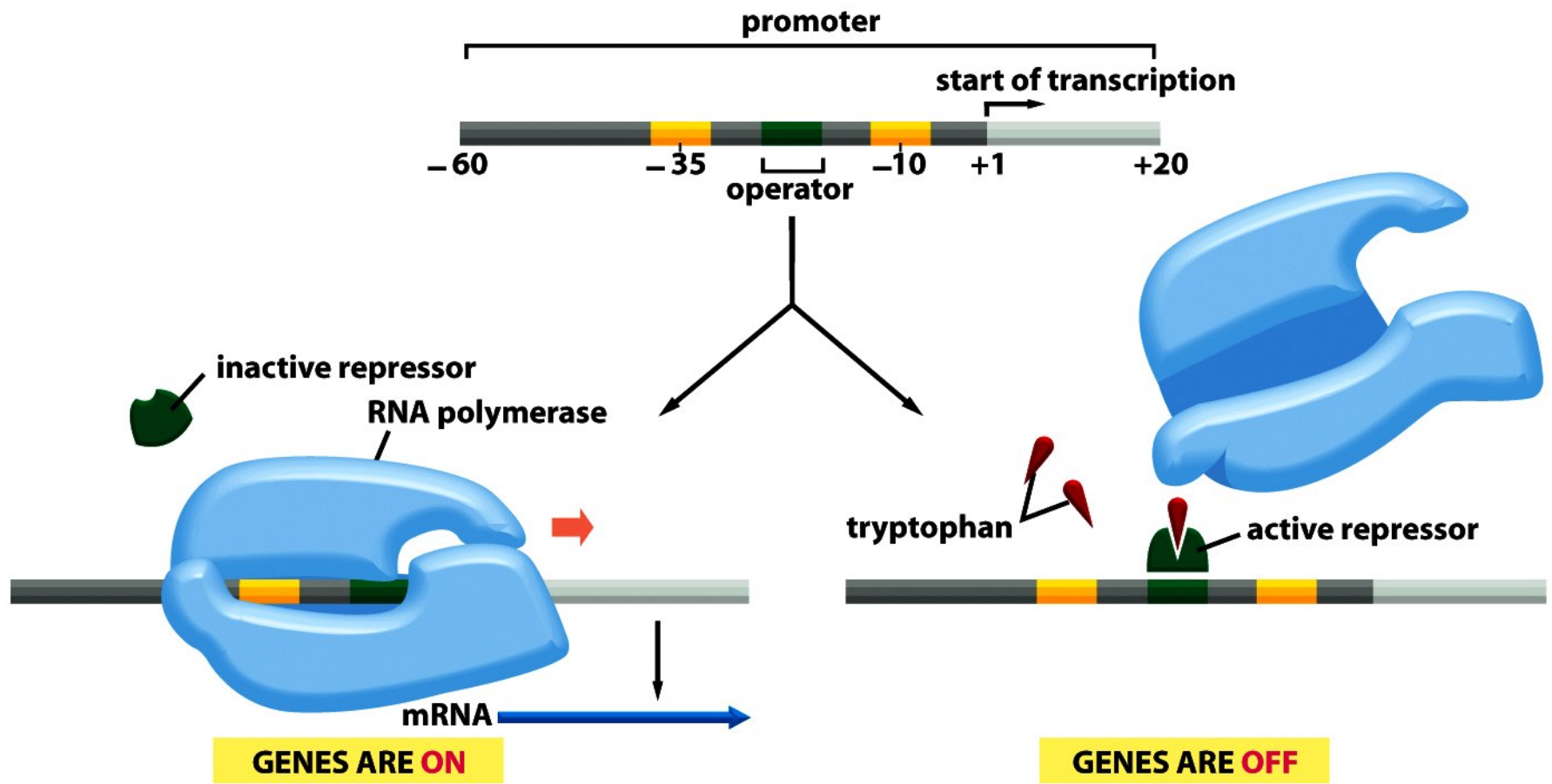


Figure 7-35 *Molecular Biology of the Cell* (© Garland Science 2008)

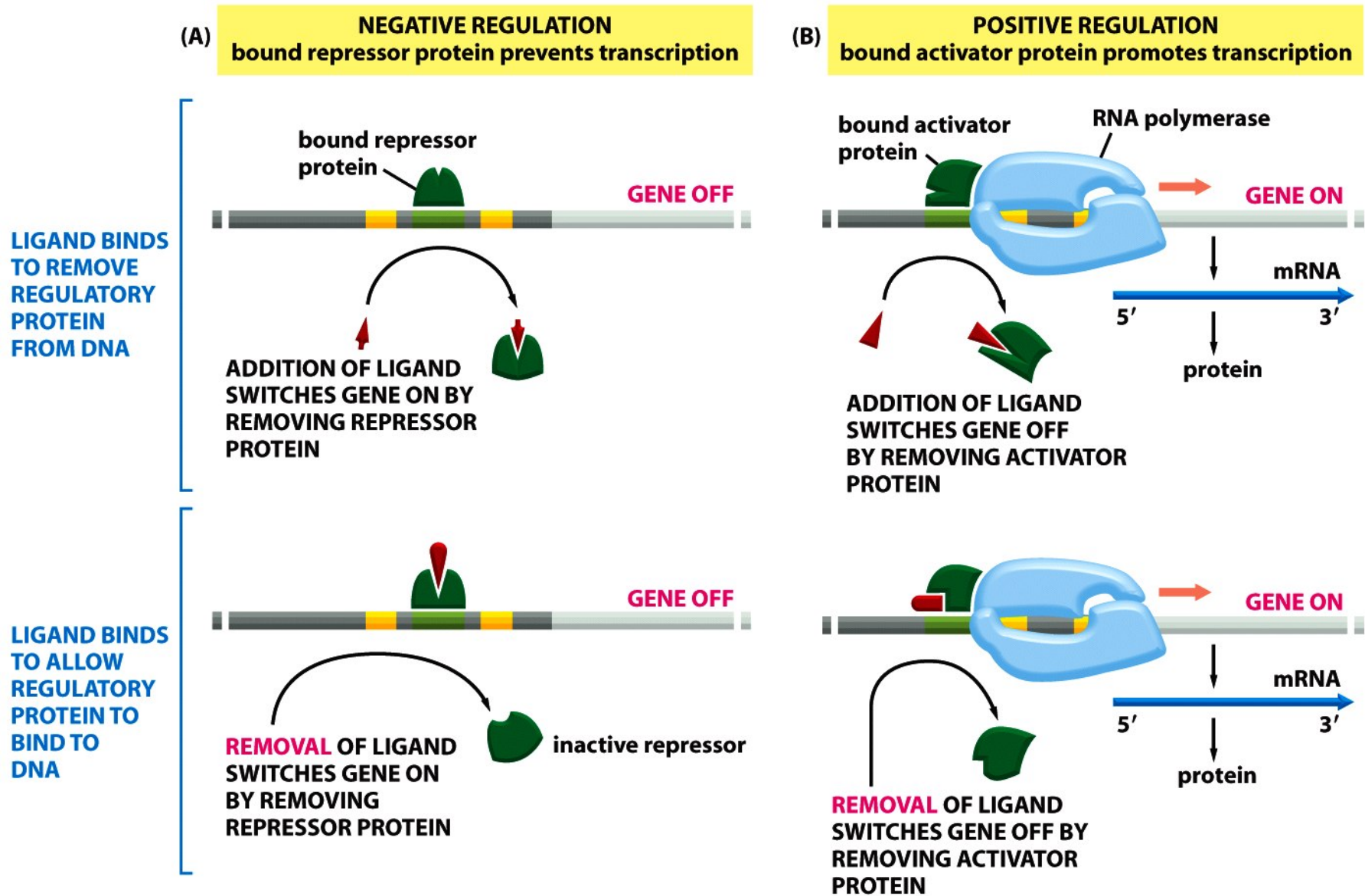


Figure 7-37 *Molecular Biology of the Cell* (© Garland Science 2008)

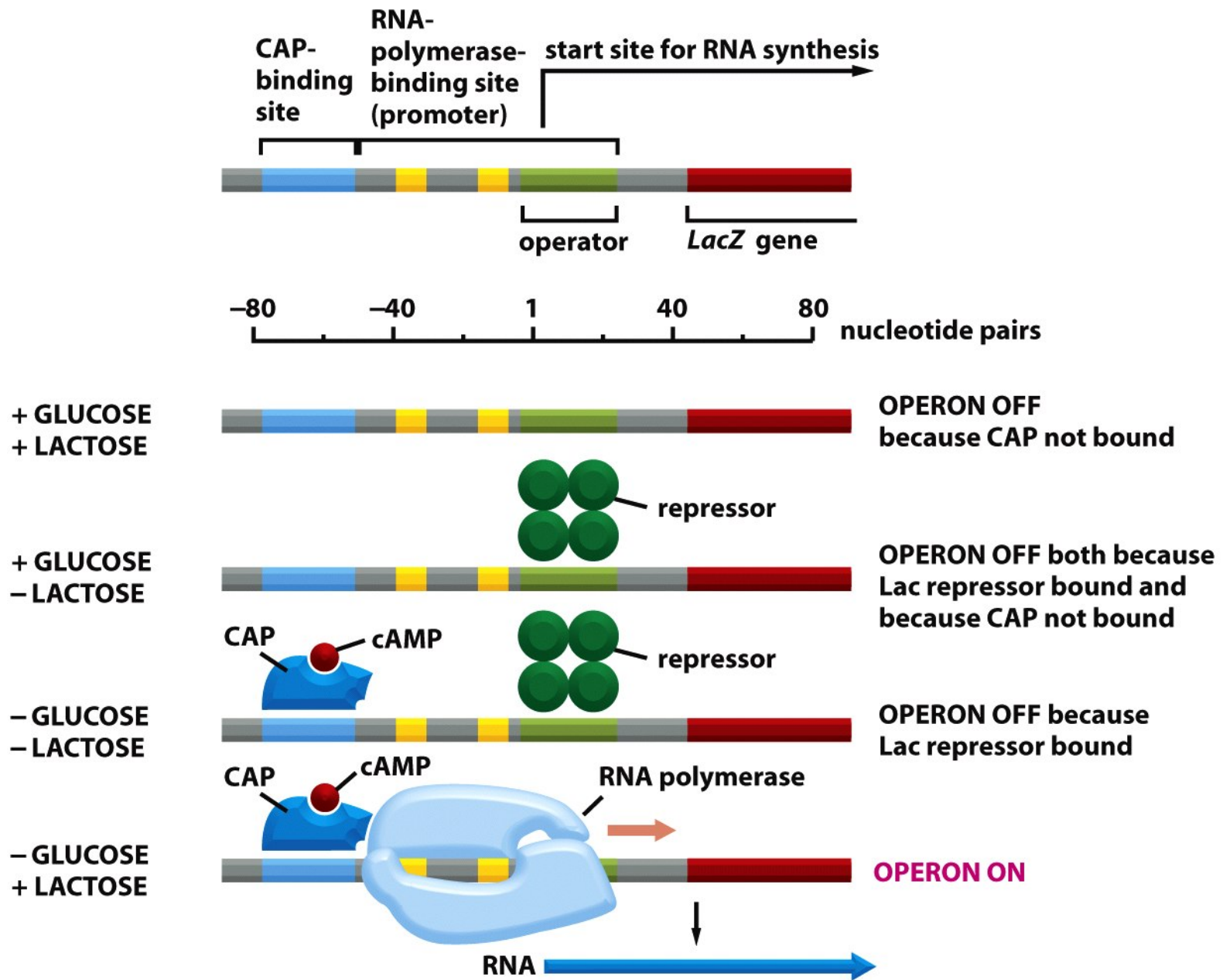


Figure 7-39 *Molecular Biology of the Cell* (© Garland Science 2008)

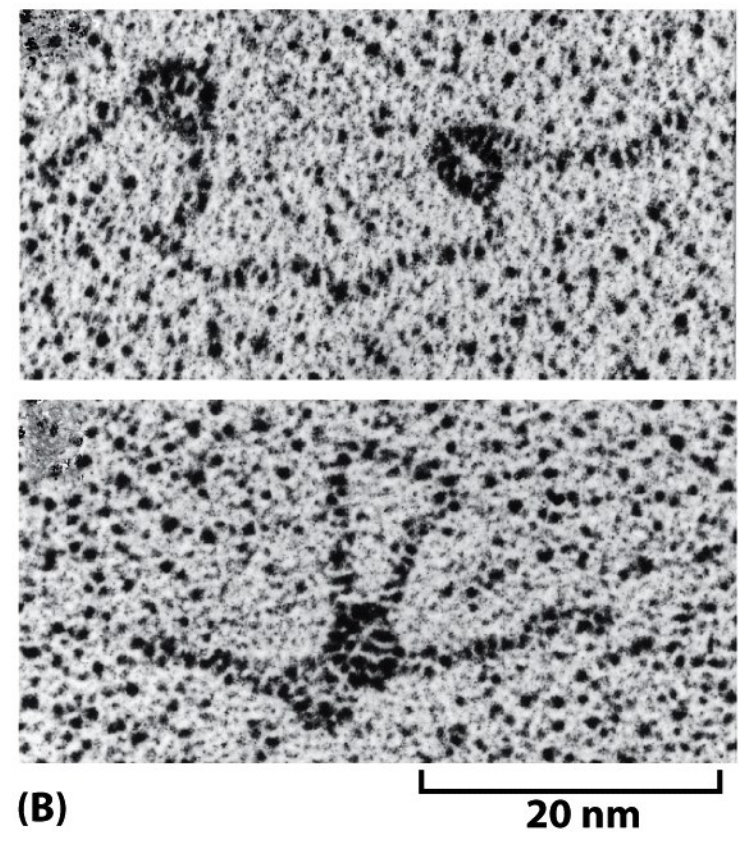
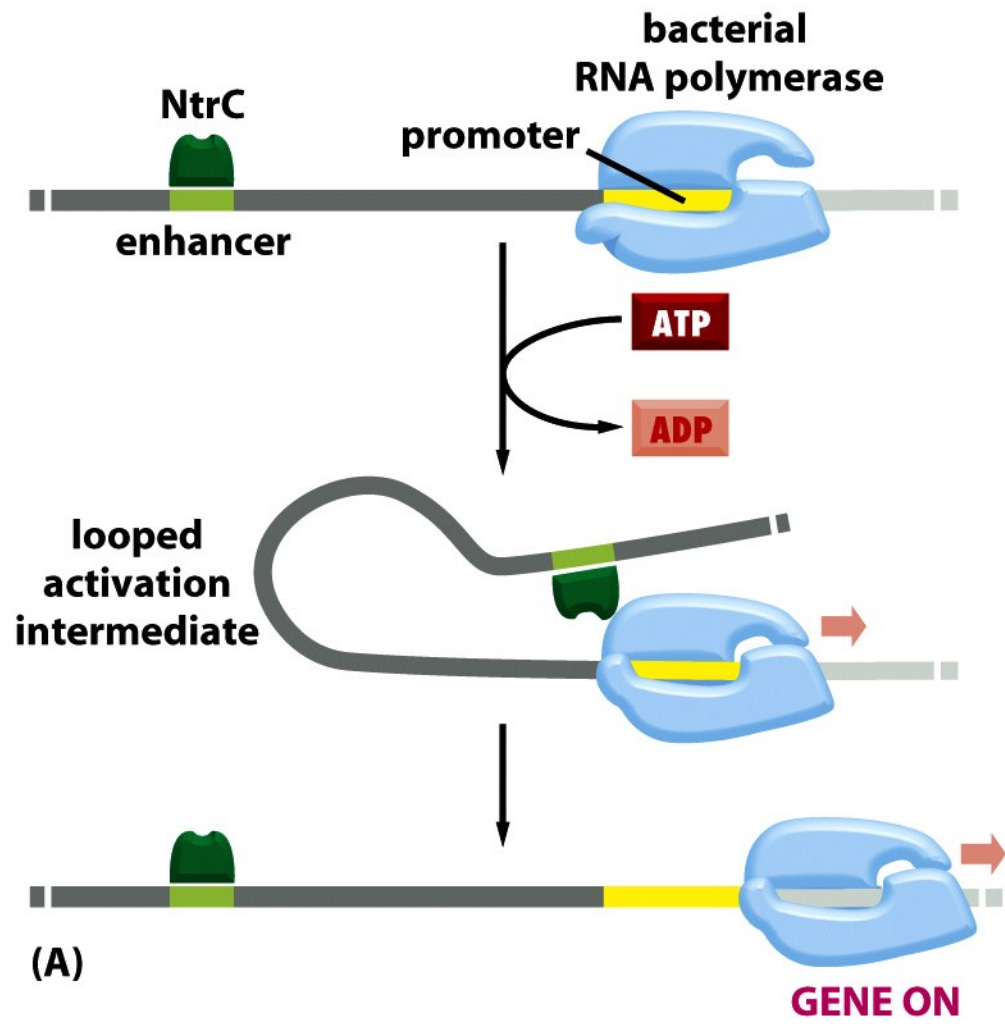


Figure 7-42 *Molecular Biology of the Cell* (© Garland Science 2008)



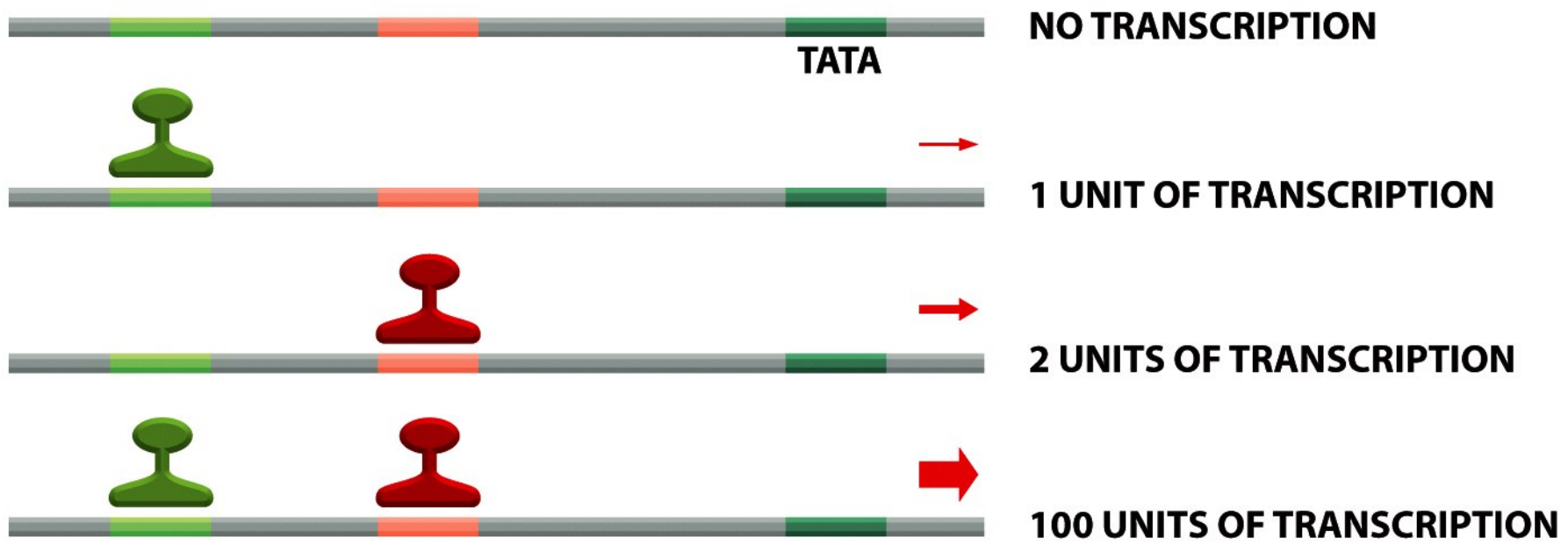


Figure 7-48 *Molecular Biology of the Cell* (© Garland Science 2008)

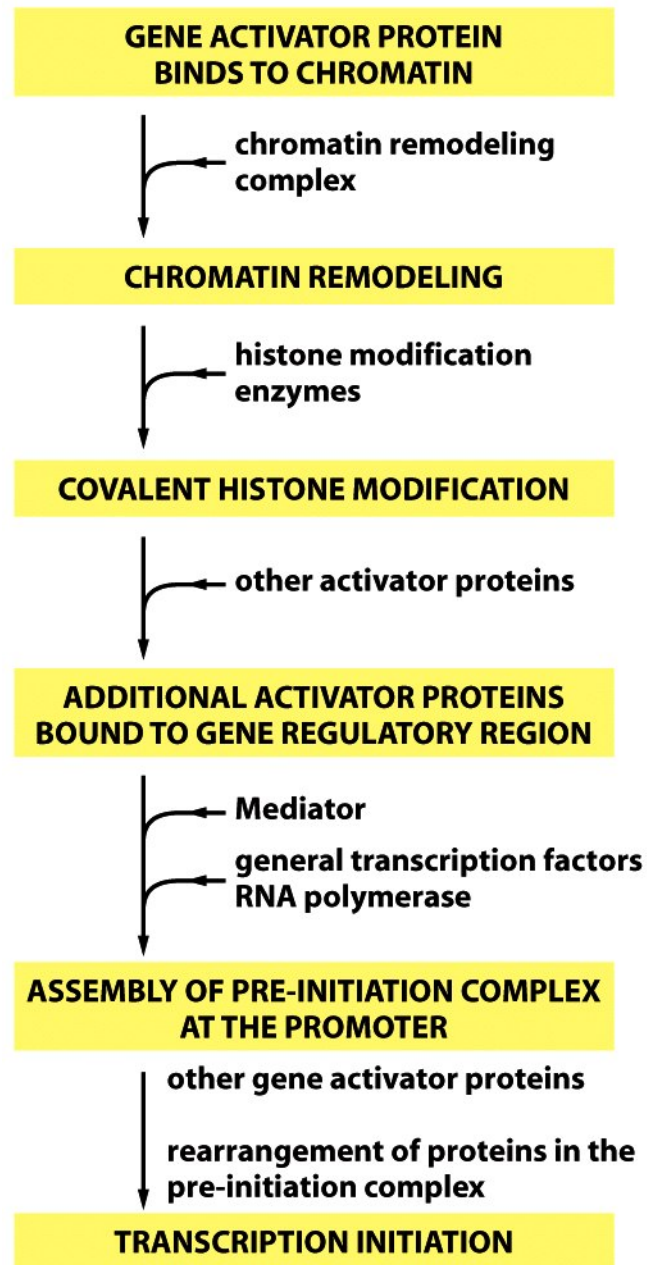


Figure 7-49 *Molecular Biology of the Cell* (© Garland Science 2008)

**competitive  
DNA  
binding**

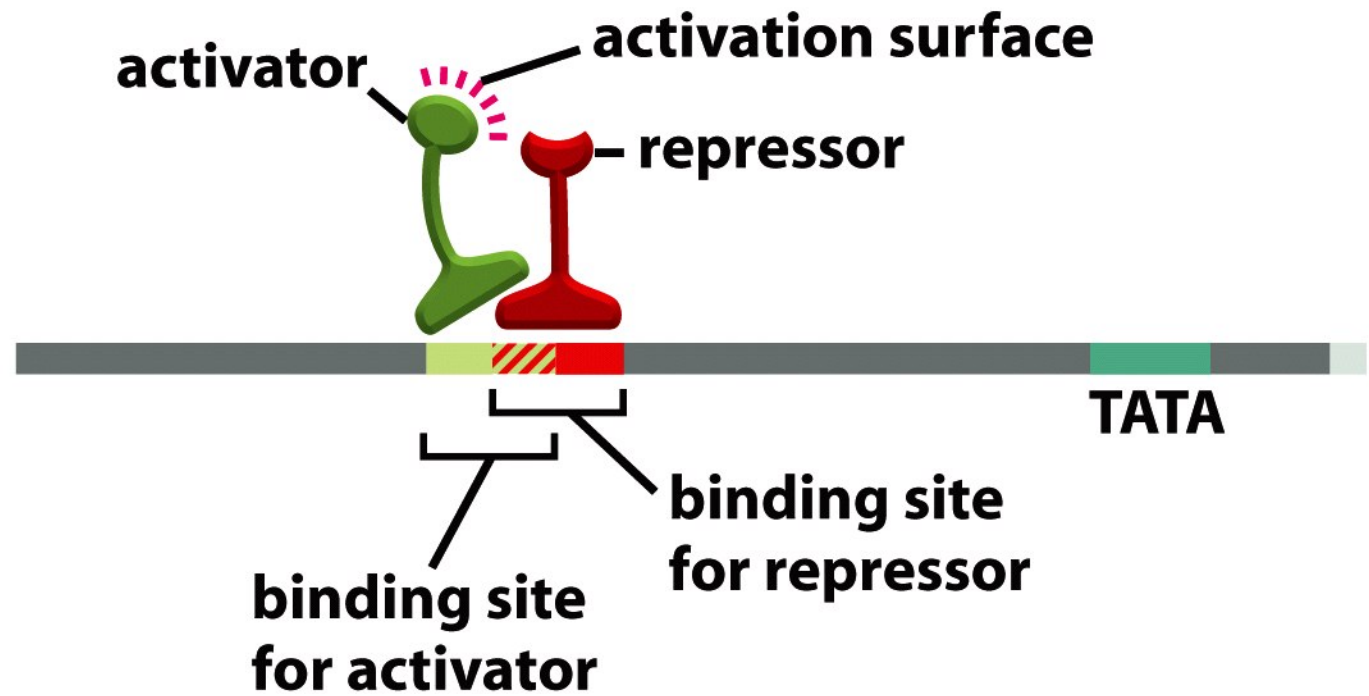


Figure 7-50a *Molecular Biology of the Cell* (© Garland Science 2008)

**(A) IN SOLUTION**



**(B) ON DNA**

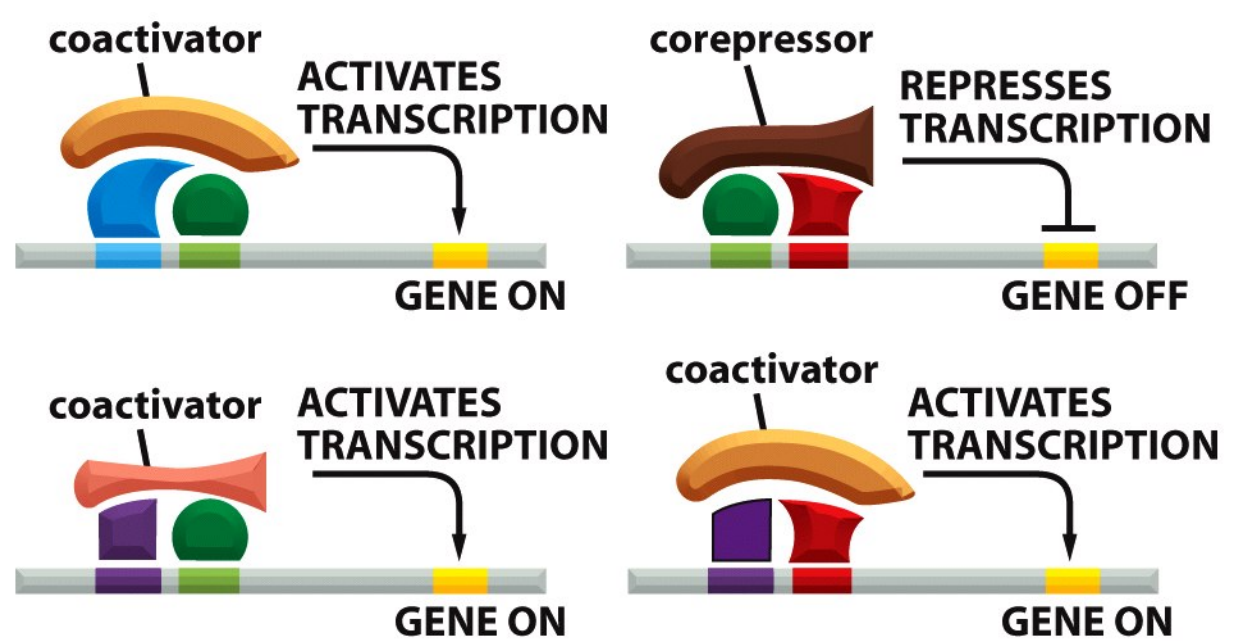


Figure 7-51 *Molecular Biology of the Cell* (© Garland Science 2008)

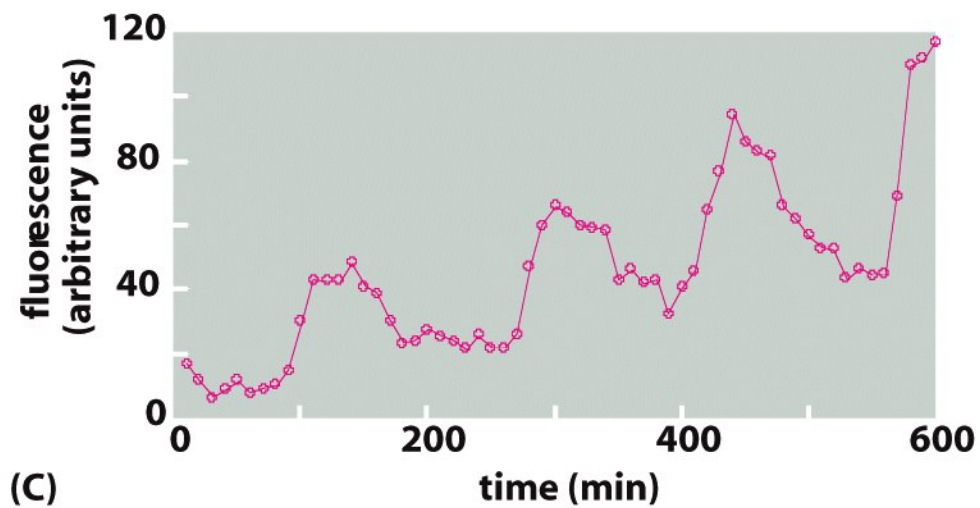
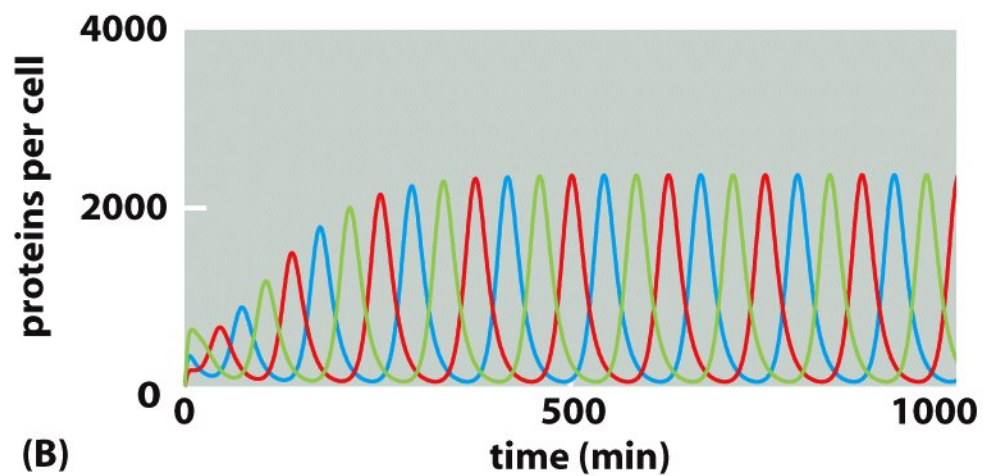
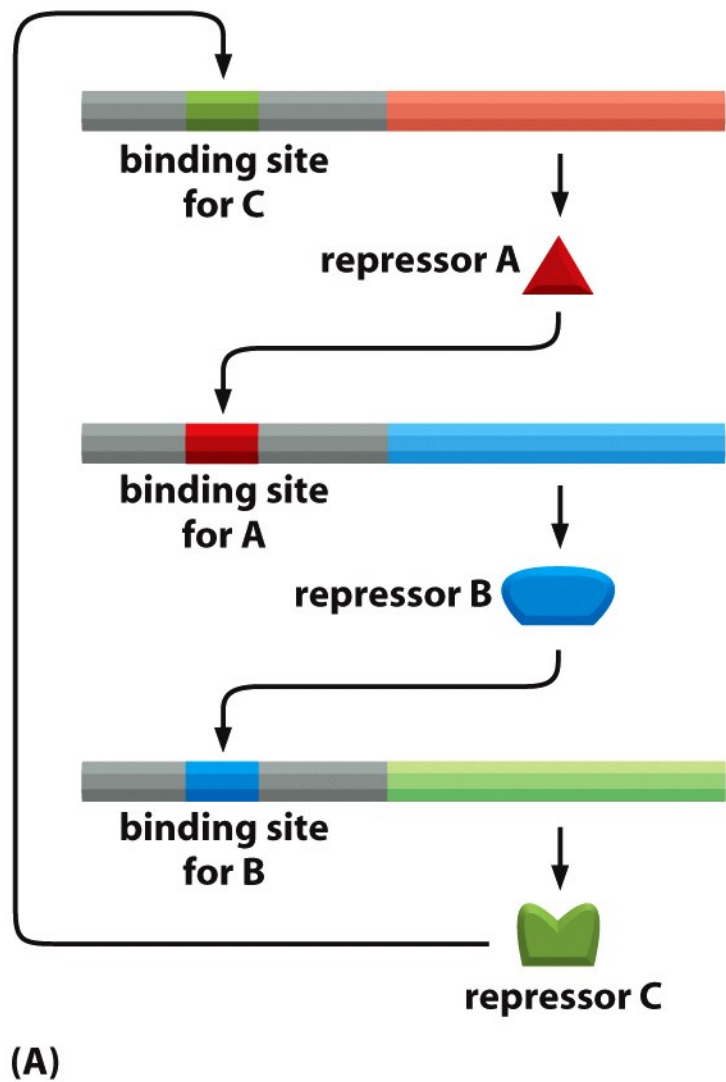


Figure 7-72 *Molecular Biology of the Cell* (© Garland Science 2008)

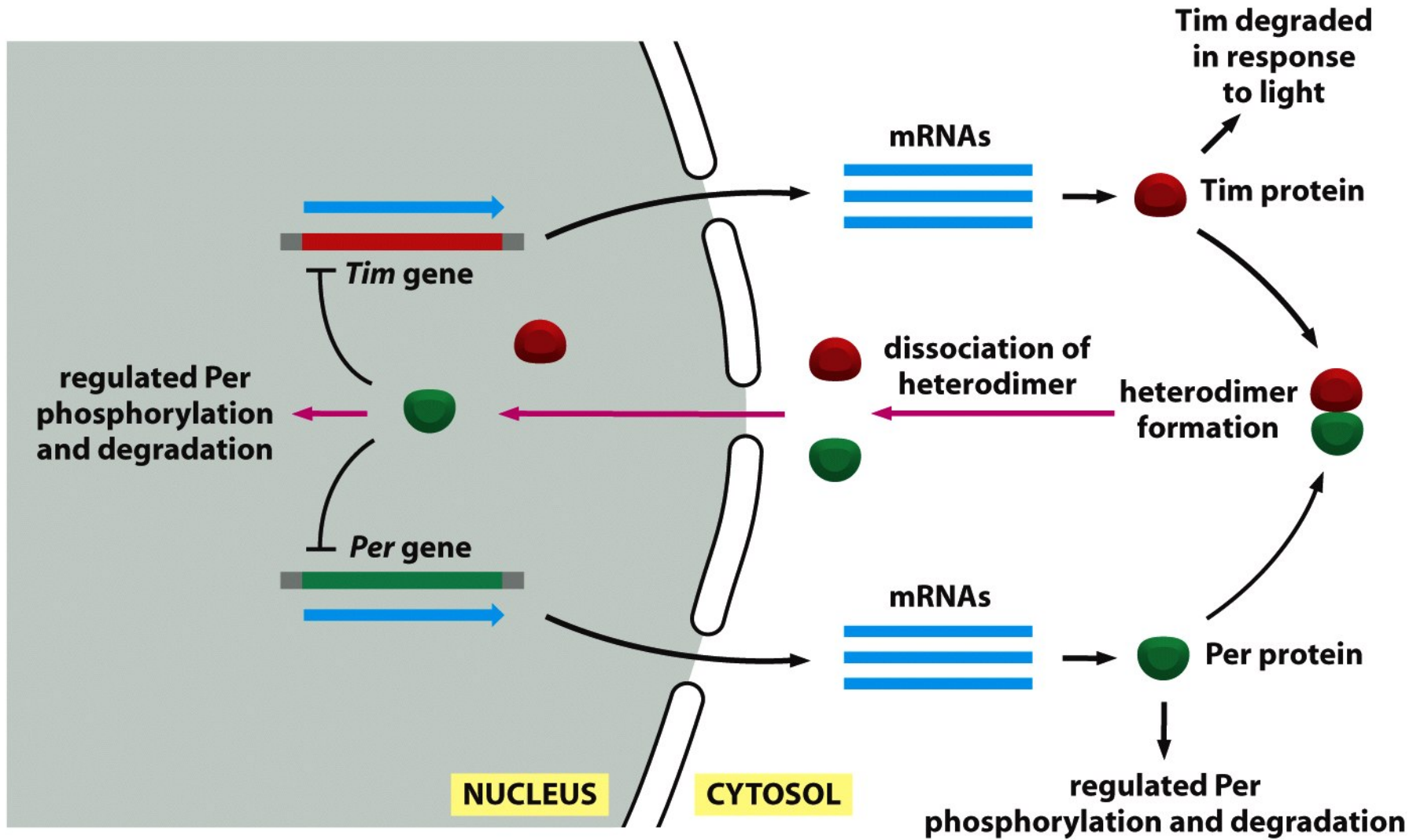


Figure 7-73 *Molecular Biology of the Cell* (© Garland Science 2008)

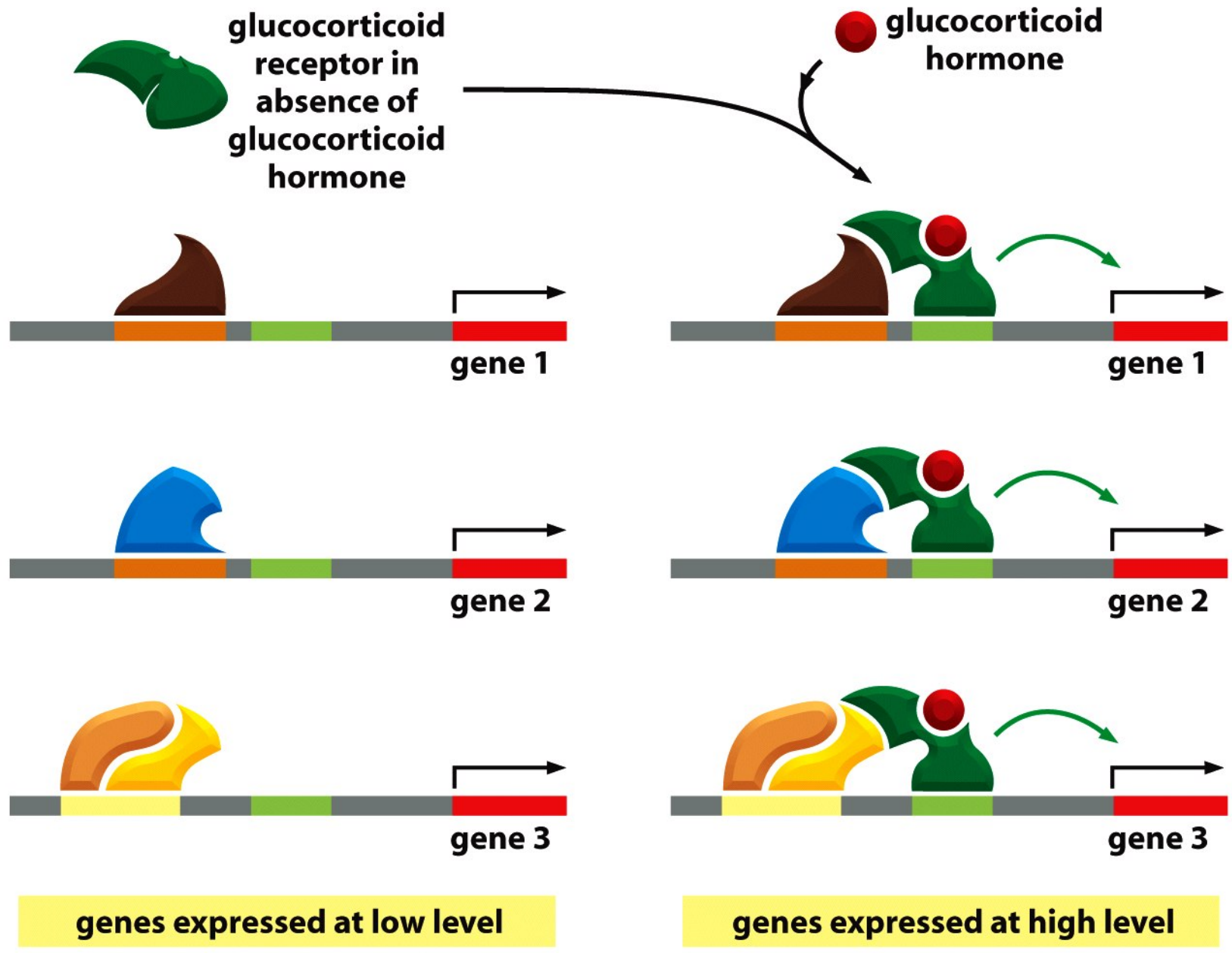


Figure 7-74 *Molecular Biology of the Cell* (© Garland Science 2008)

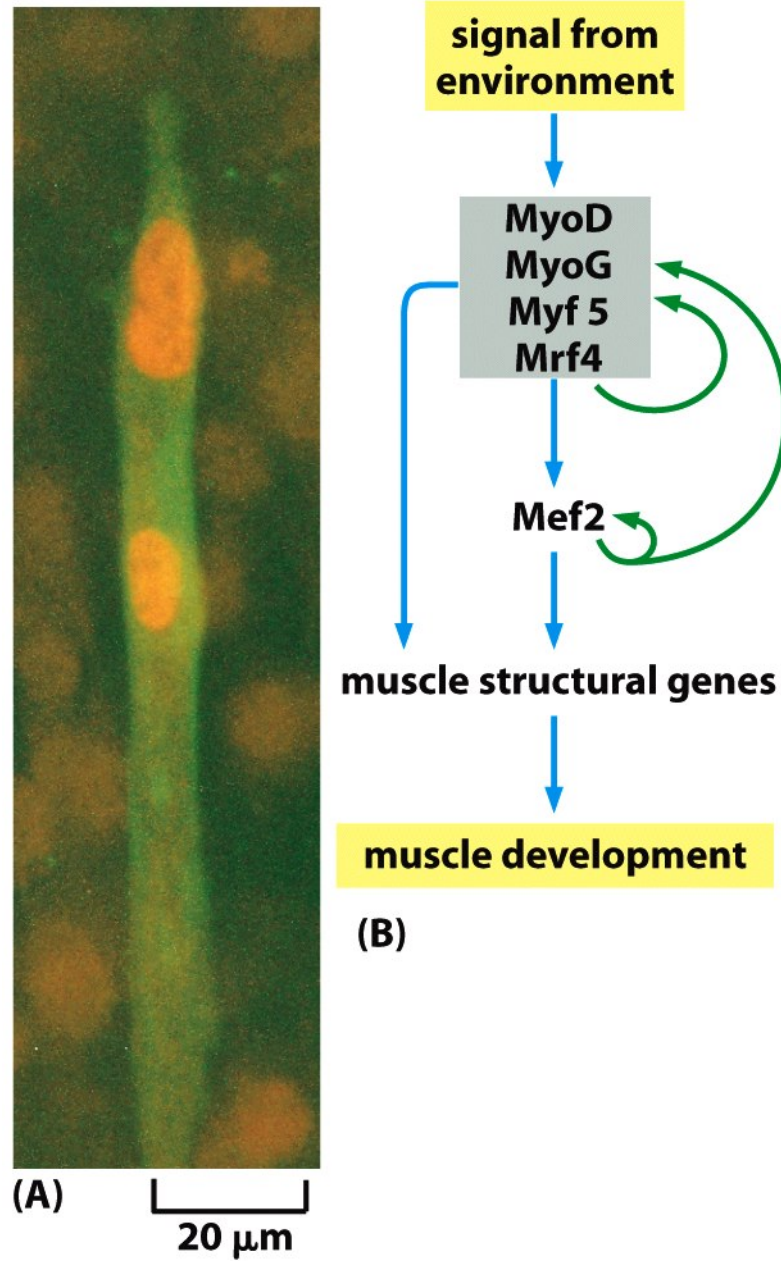


Figure 7-75 *Molecular Biology of the Cell* (© Garland Science 2008)



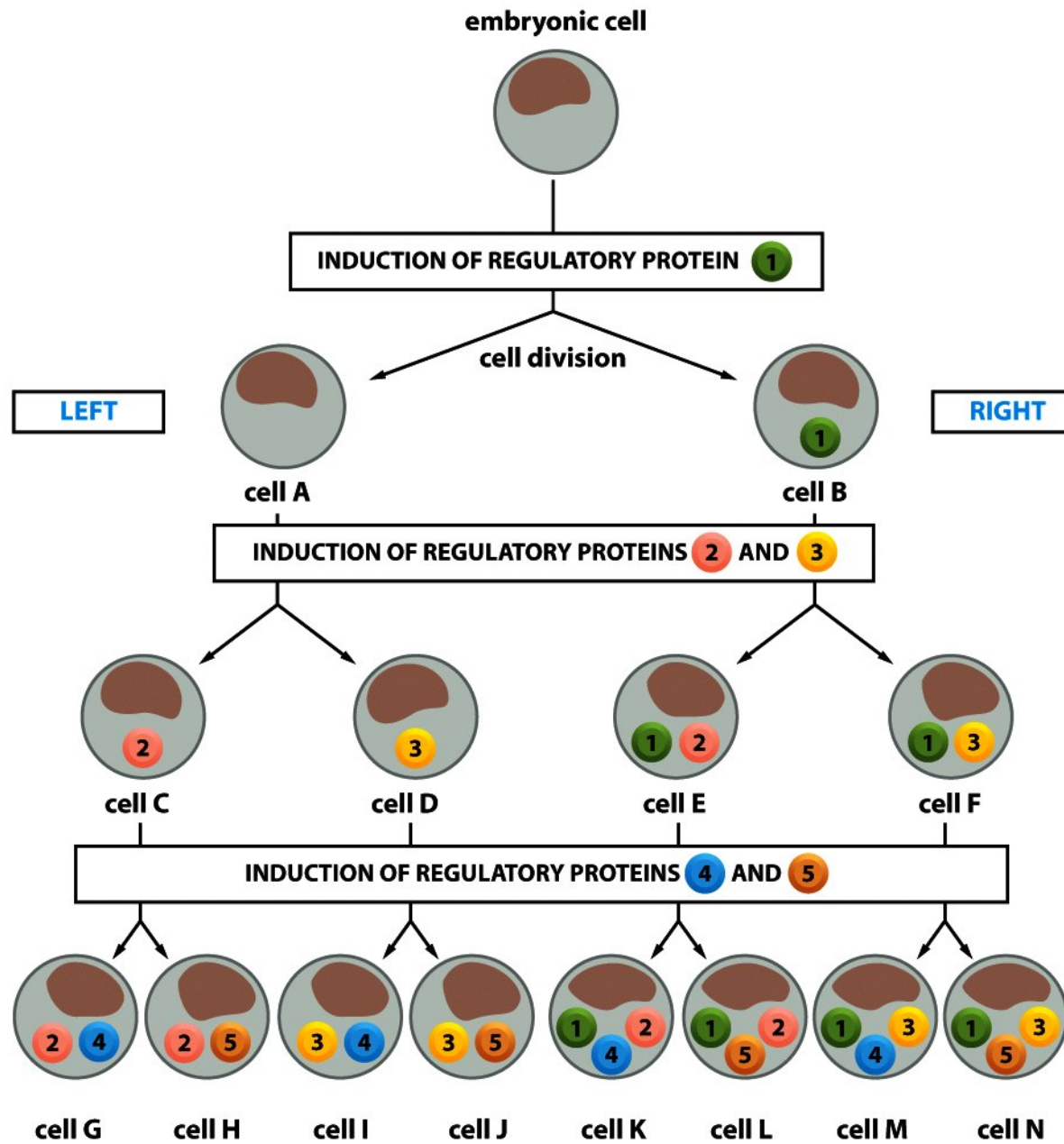
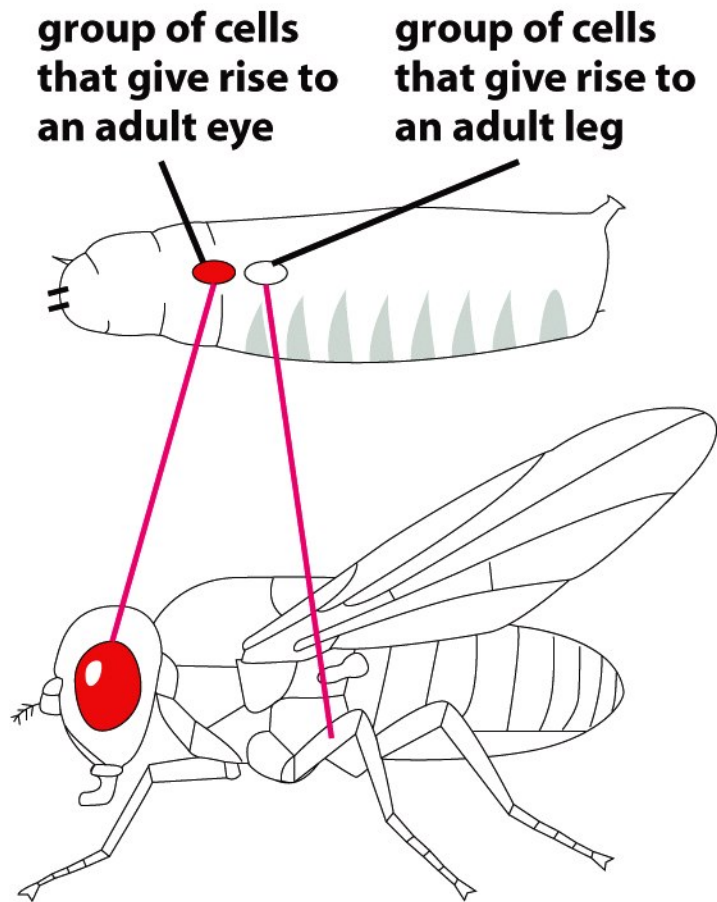
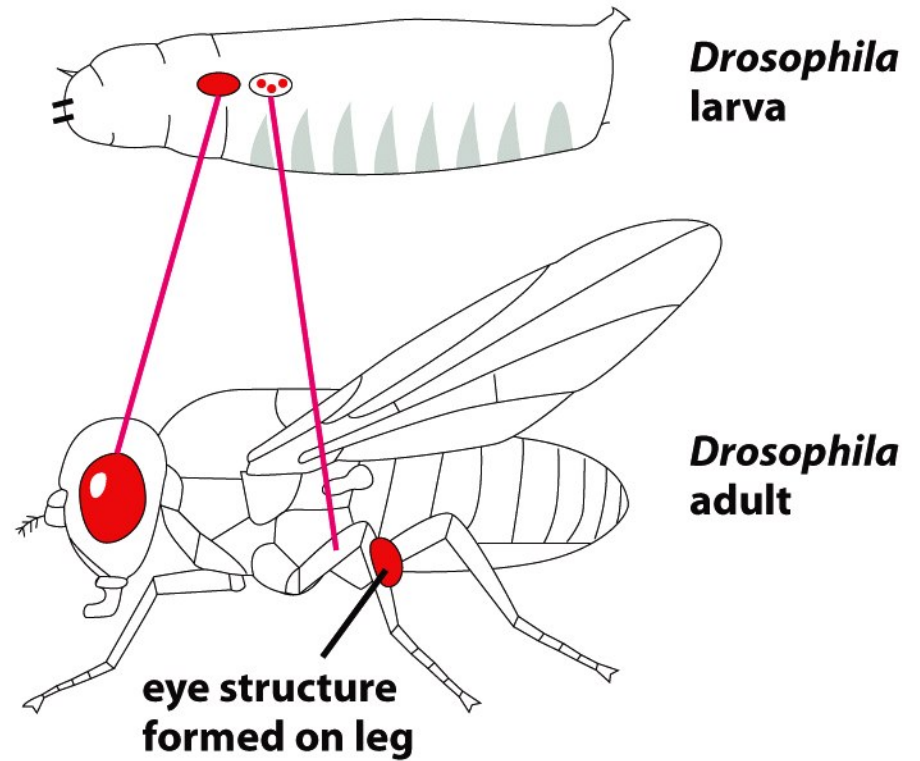


Figure 7-76 *Molecular Biology of the Cell* (© Garland Science 2008)



**normal fly**

(red shows cells expressing *Ey* gene)



**fly with *Ey* gene artificially expressed in leg precursor cells**

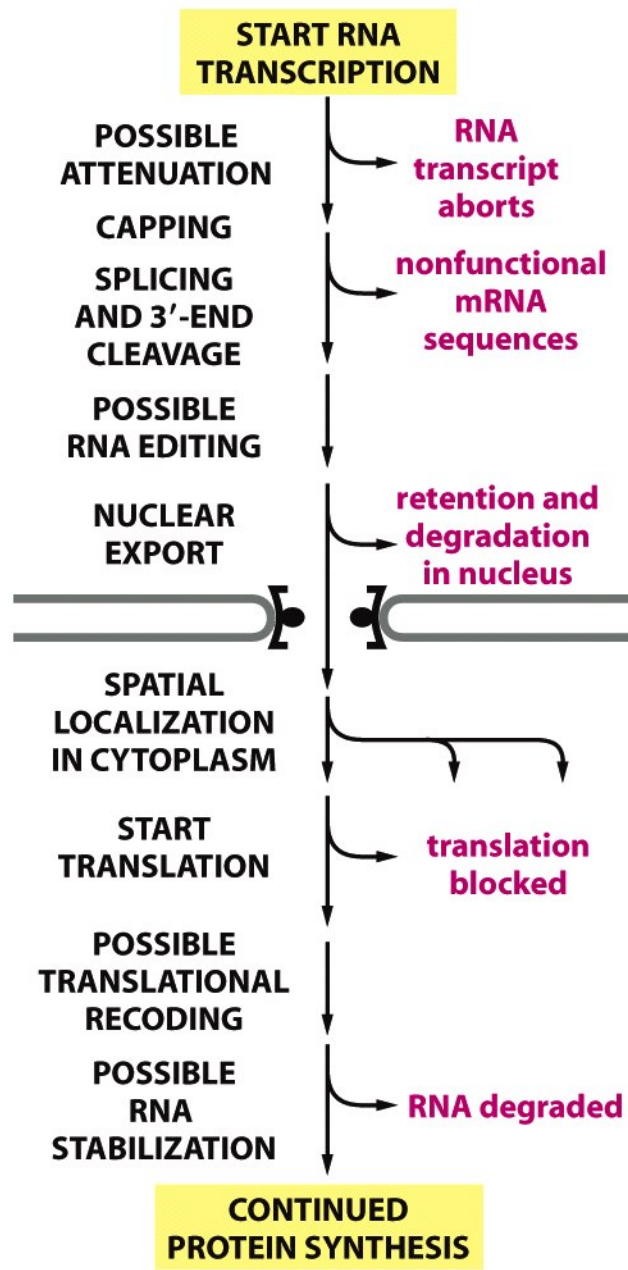


Figure 7-92 *Molecular Biology of the Cell* (© Garland Science 2008)

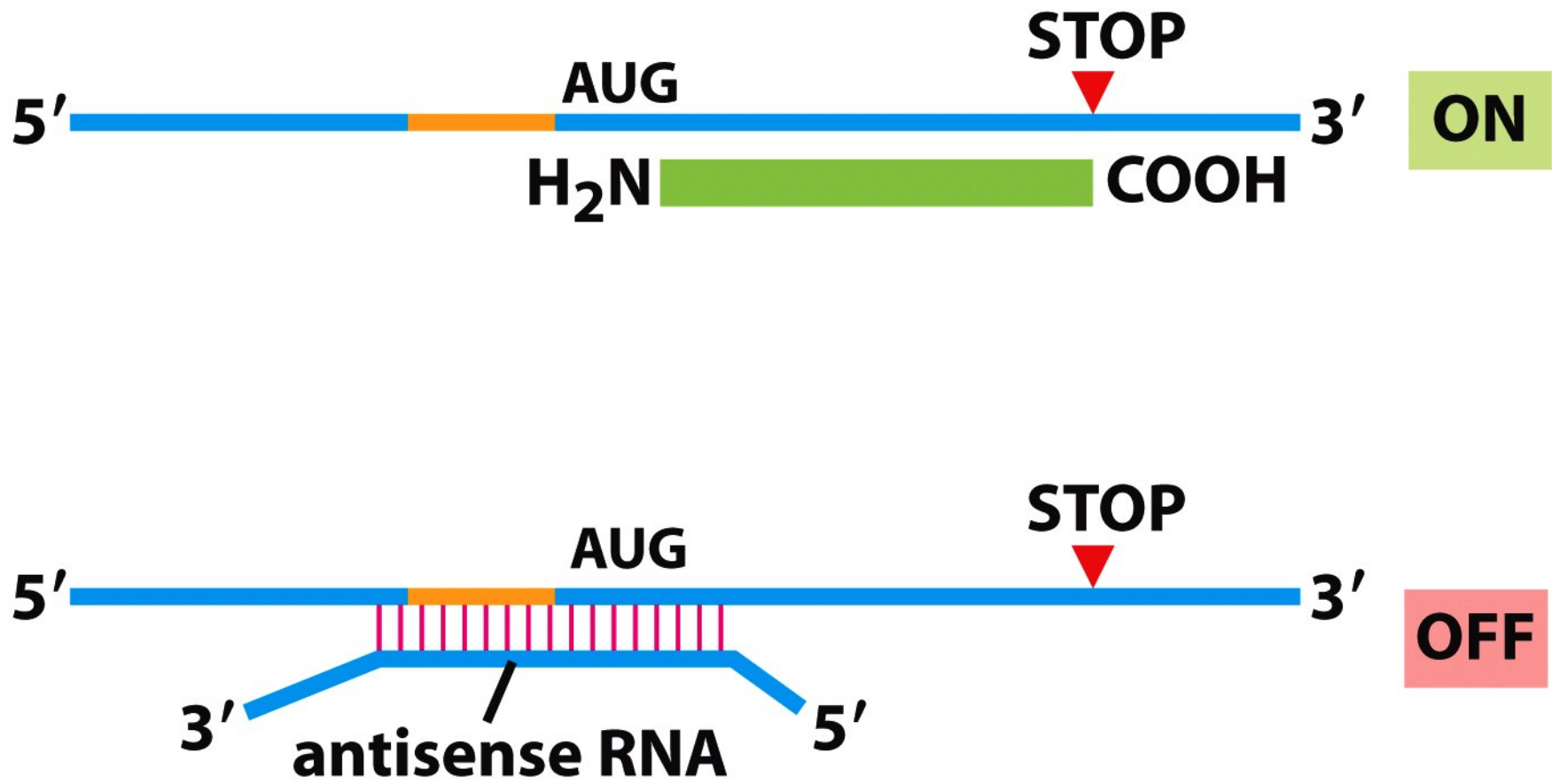


Figure 7-106d *Molecular Biology of the Cell* (© Garland Science 2008)

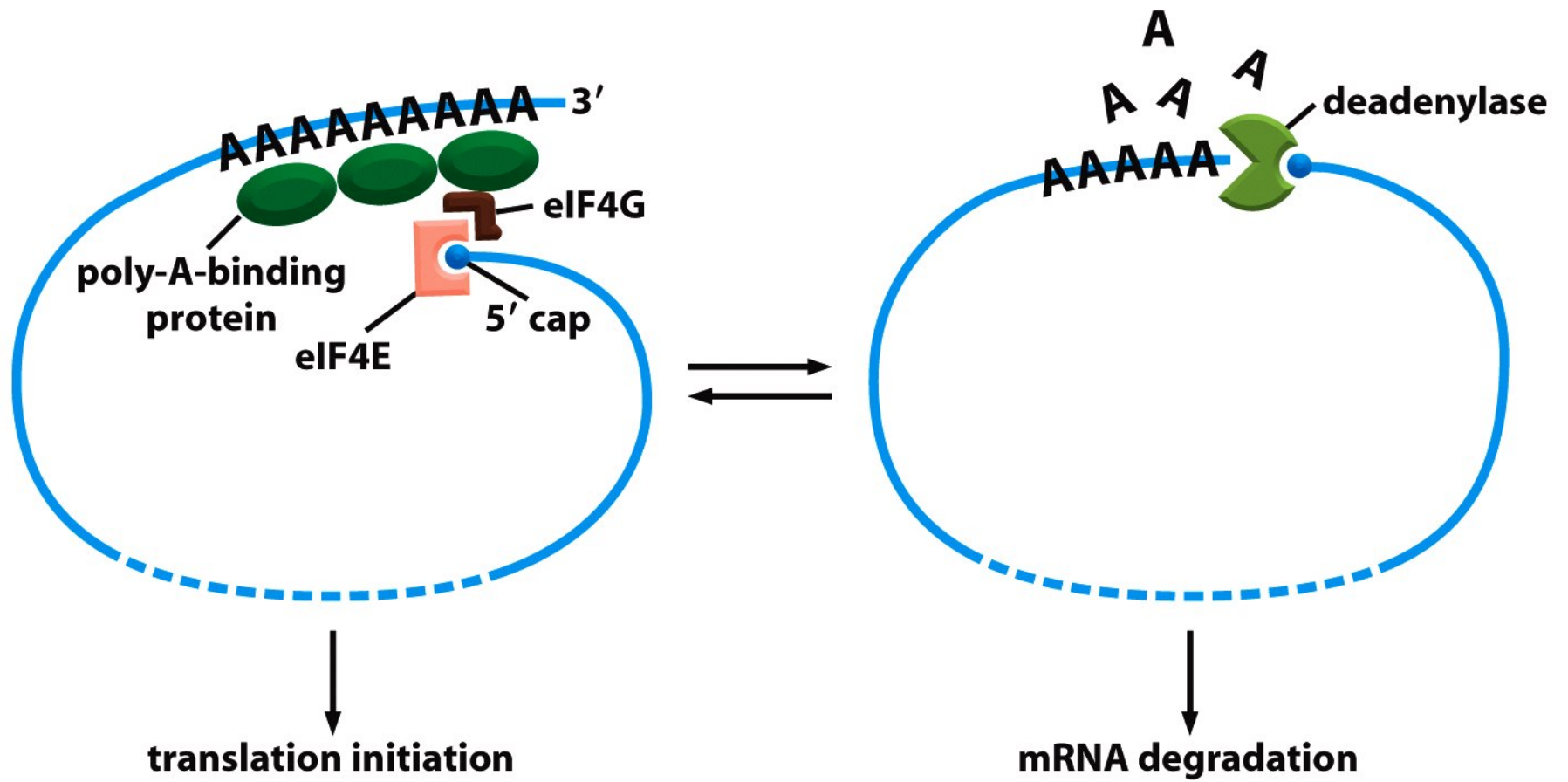


Figure 7-110 *Molecular Biology of the Cell* (© Garland Science 2008)