

Transpositional site-specific recombination

- Modest target site selectivity and insert mobile genetic elements into many sites
- Transposase enzyme cuts out mobile genetic elements and insert them into specific sites.

Three of the many types of mobile genetic elements found in bacteria

Transposase gene: encoding enzymes for DNA breakage and joining

Red segments: DNA sequences as recognition sites for enzymes

Yellow segments: antibiotic genes

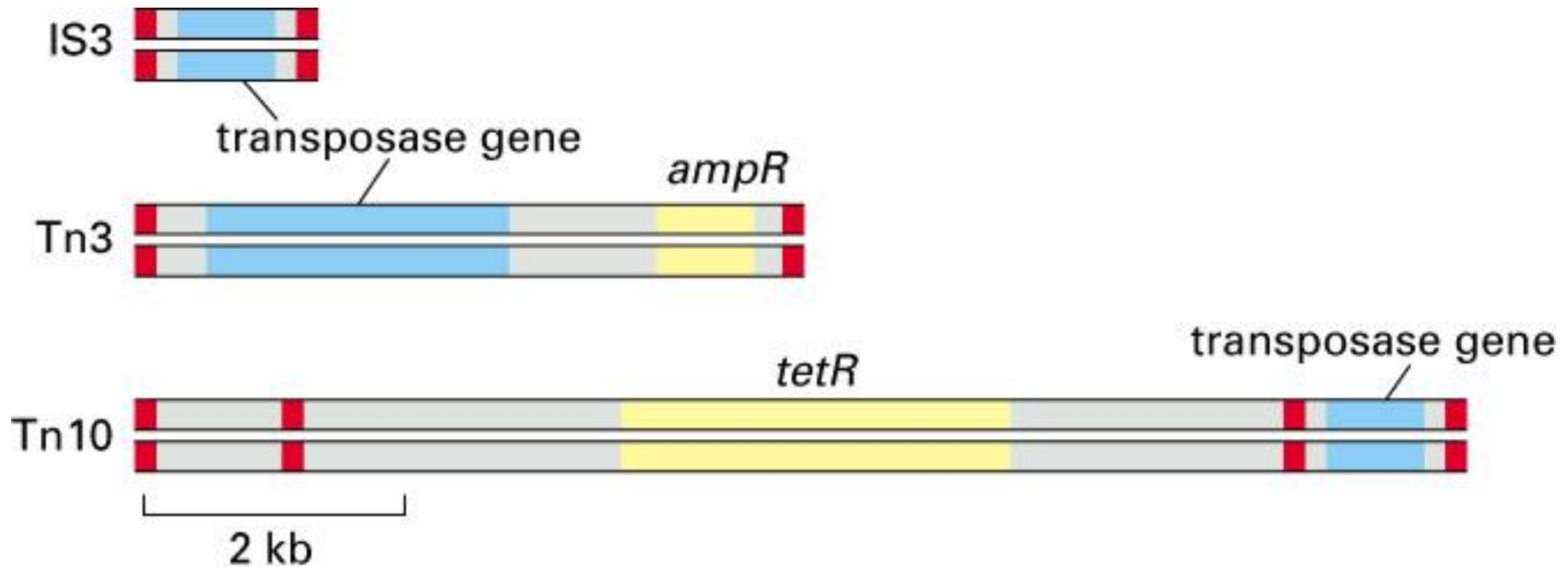

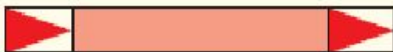
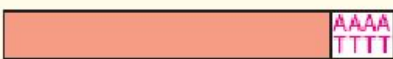


Figure 5-69. Molecular Biology of the Cell, 4th Edition.

TABLE 5-3 Three Major Classes of Transposable Elements

CLASS DESCRIPTION AND STRUCTURE	GENES IN COMPLETE ELEMENT	MODE OF MOVEMENT	EXAMPLES
DNA-only transposons 	encodes transposase	moves as DNA, either excising or following a replicative pathway	P element (<i>Drosophila</i>) Ac-Ds (maize) Tn3 and IS1 (<i>E.coli</i>) Tam3 (snapdragon)
Retroviral-like retrotransposons 	encodes reverse transcriptase and resembles retrovirus	moves via an RNA intermediate produced by promoter in LTR	Copia (<i>Drosophila</i>) Ty1 (yeast) THE-1 (human) Bs1 (maize)
Nonretroviral retrotransposons 	encodes reverse transcriptase	moves via an RNA intermediate that is often produced from a neighboring promoter	F element (<i>Drosophila</i>) L1 (human) Cin4 (maize)

These elements range in length from 1000 to about 12,000 nucleotide pairs; each family contains many members, only a few of which are listed here. In addition to transposable elements, there are selected viruses that can move in and out of host cell chromosomes; these viruses are related to the first two classes of transposons.

Cut and Paste Transposition DNA-only

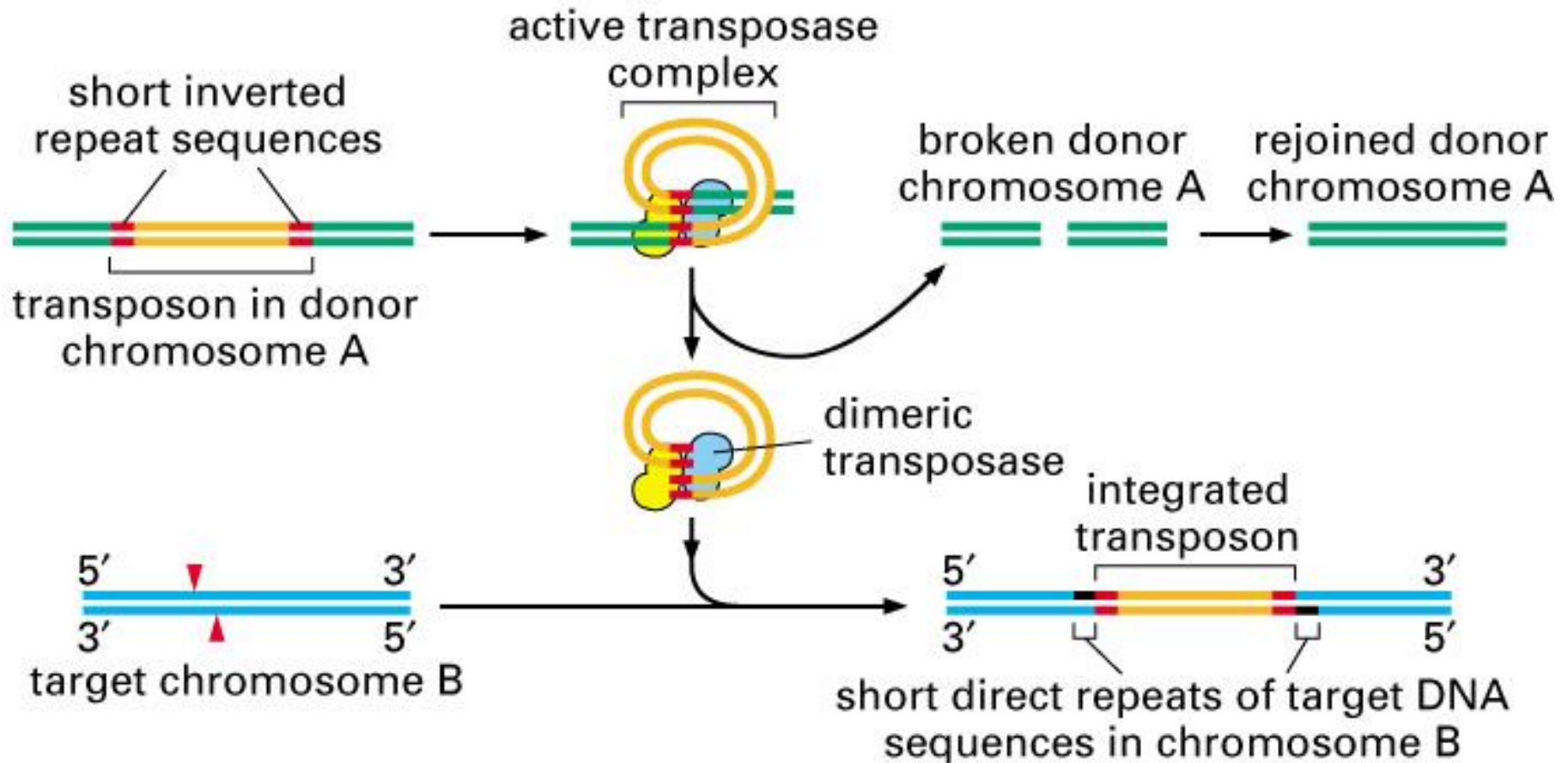


Figure 5-70. Molecular Biology of the Cell, 4th Edition.

The structure of the central intermediate formed by transposase (integrase)

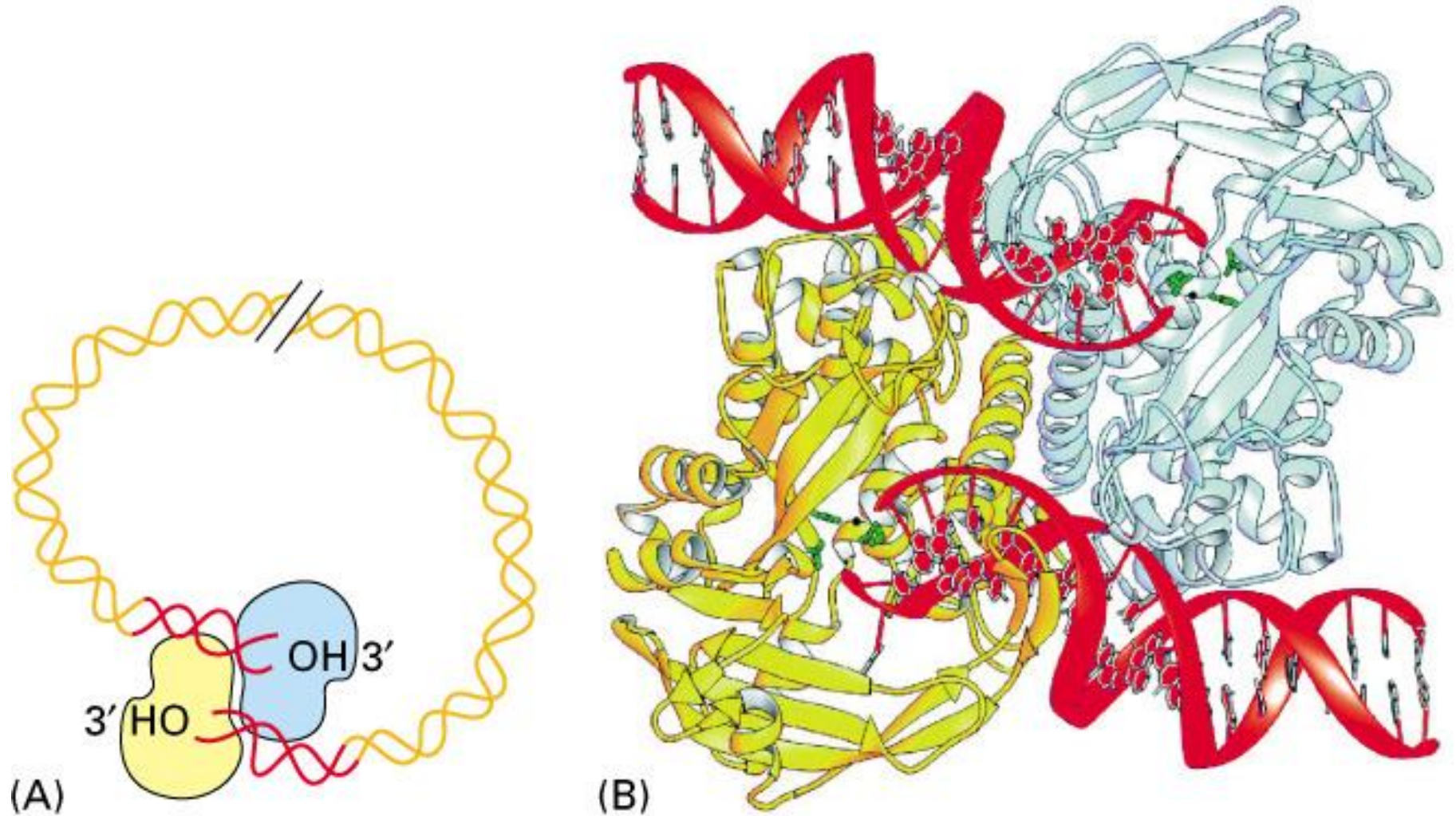


Figure 5-71. Molecular Biology of the Cell, 4th Edition.

Replicative Transposition

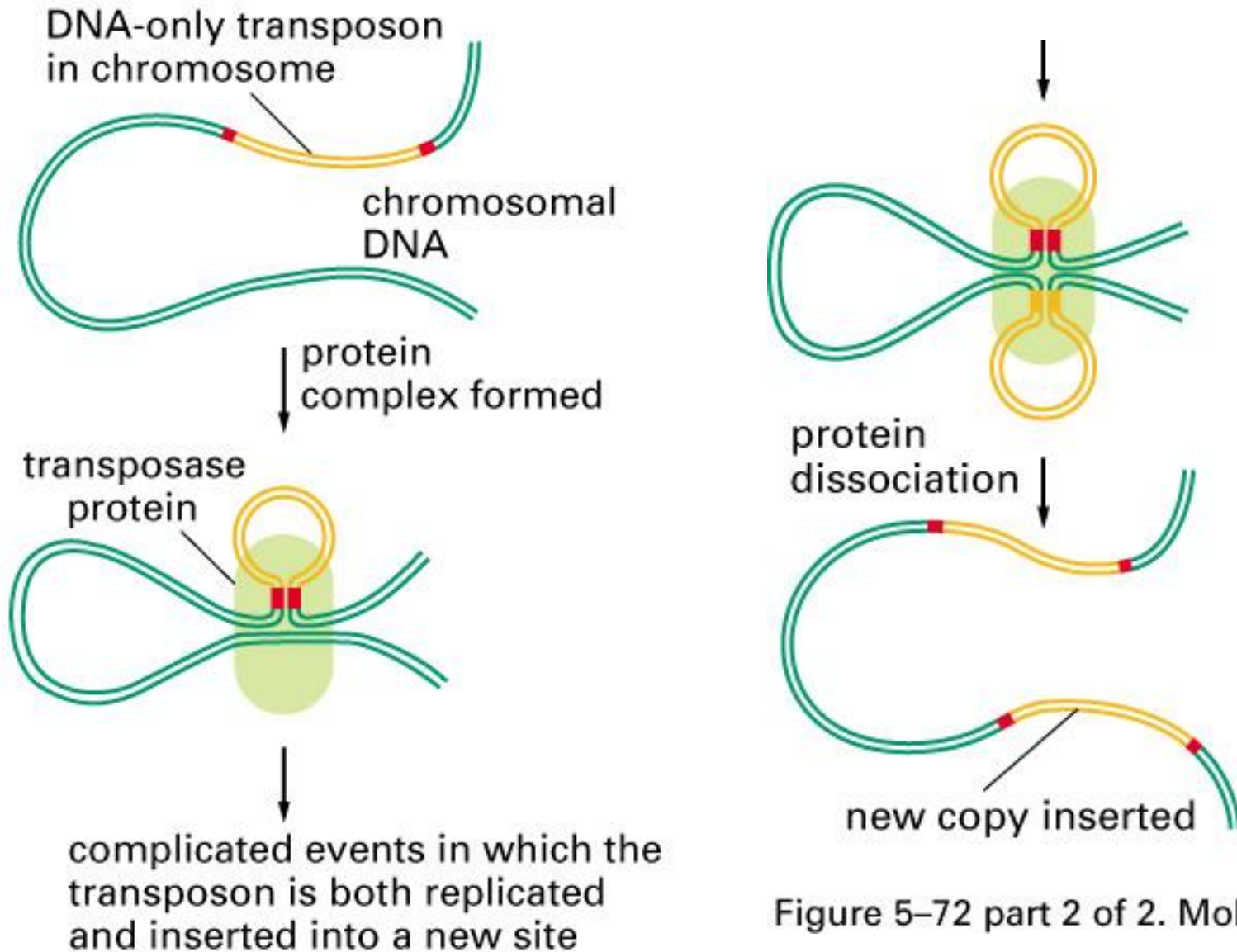


Figure 5-72 part 2 of 2. Mole

Retrovirus-based Transposition

Retroviral-like retrotransposition

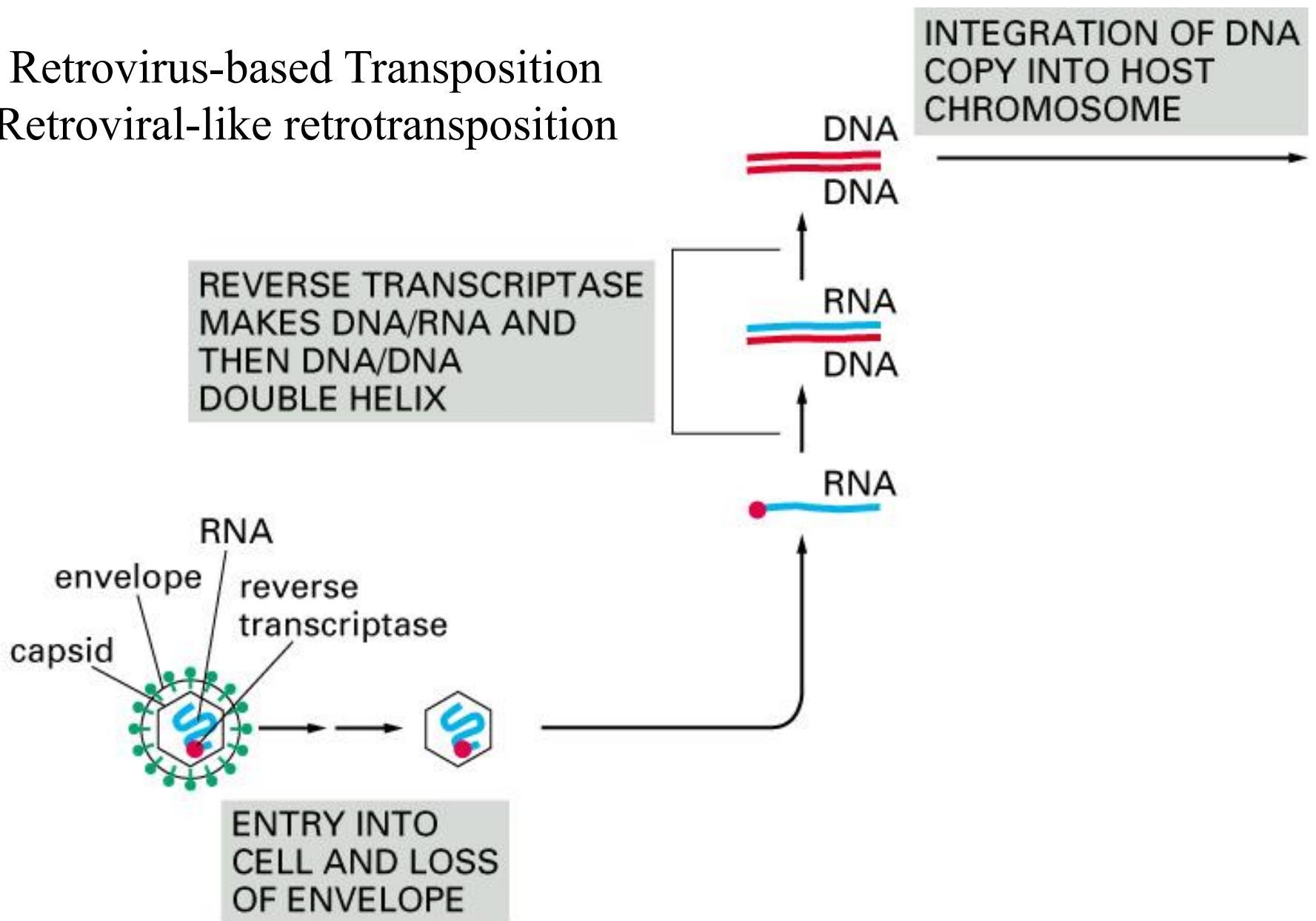
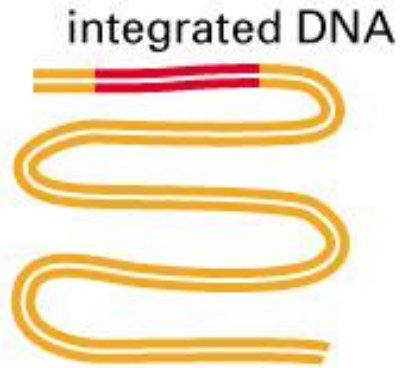


Figure 5-73 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

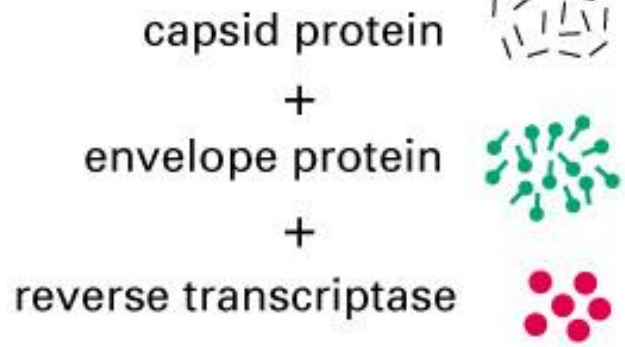
INTEGRATION OF DNA COPY INTO HOST CHROMOSOME



TRANSCRIPTION



TRANSLATION



ASSEMBLY OF MANY NEW VIRUS PARTICLES, EACH CONTAINING REVERSE TRANSCRIPTASE, INTO PROTEIN COATS

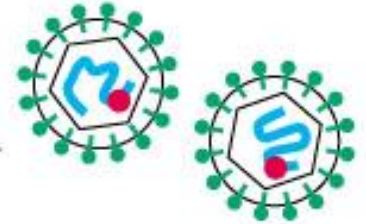
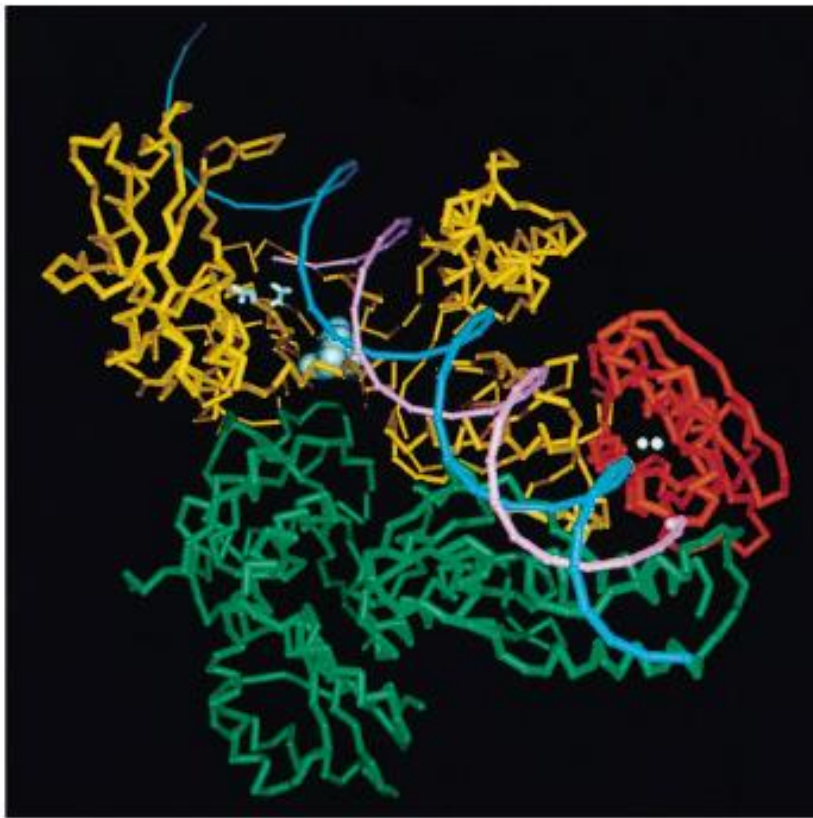
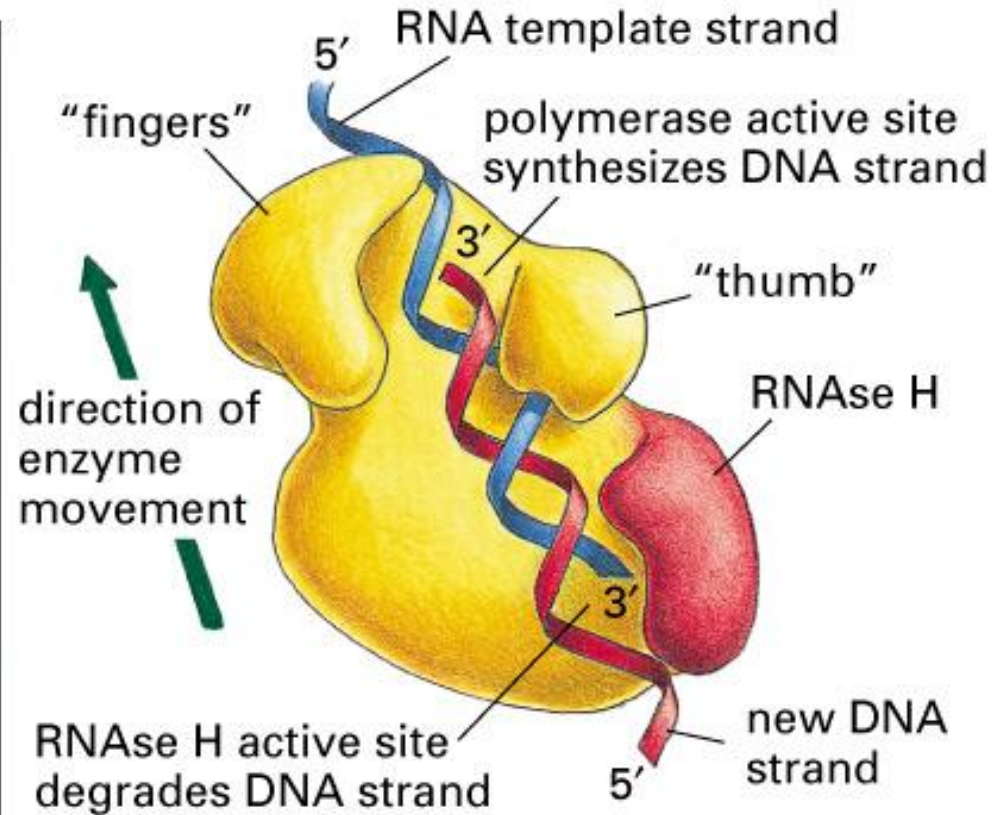


Figure 5-73 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

Reverse Transcriptase From RNA to DNA



(A)



(B)

Non-retroviral retrotransposition L1 Element

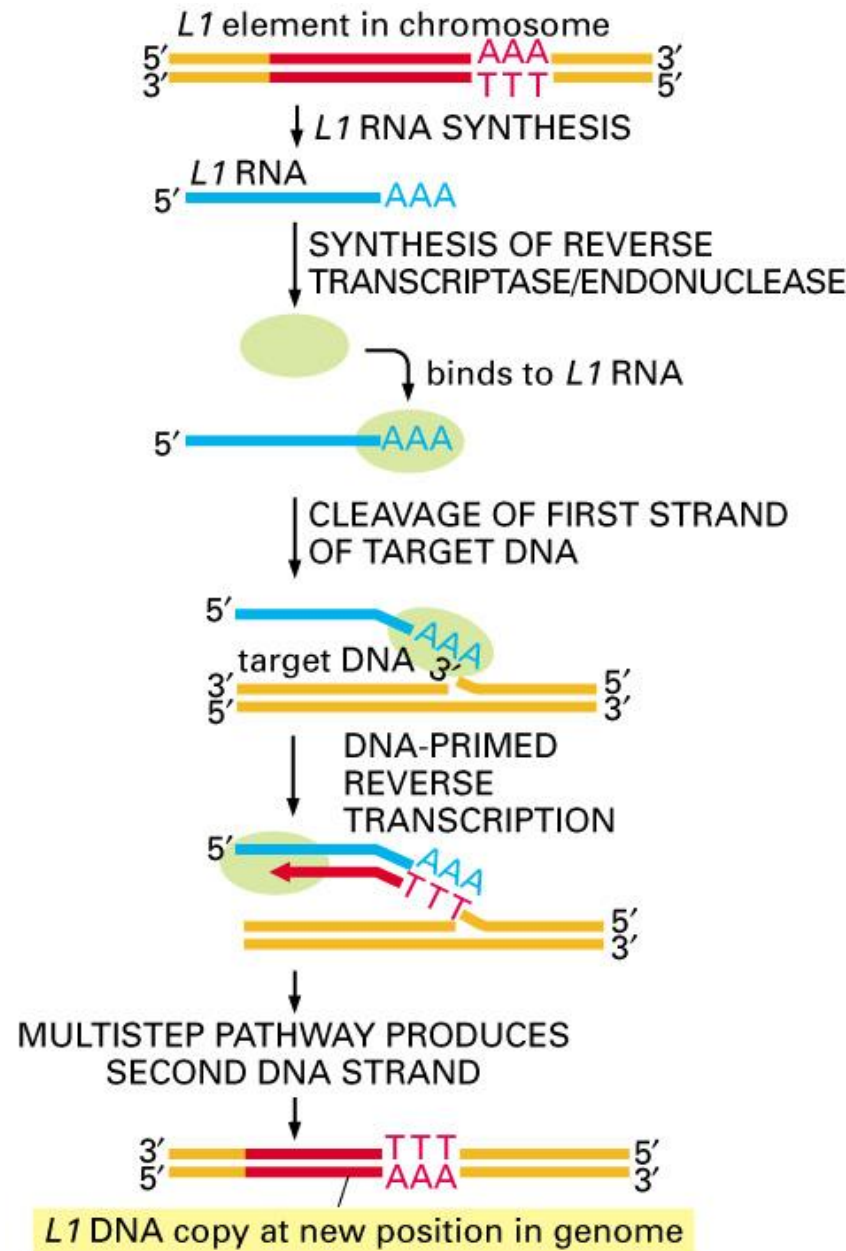


Figure 5-76. Molecular Biology of the Cell, 4th Edition.

Conservative Site Specific Recombination

Integration vs. inversion

Notice the arrows of directions

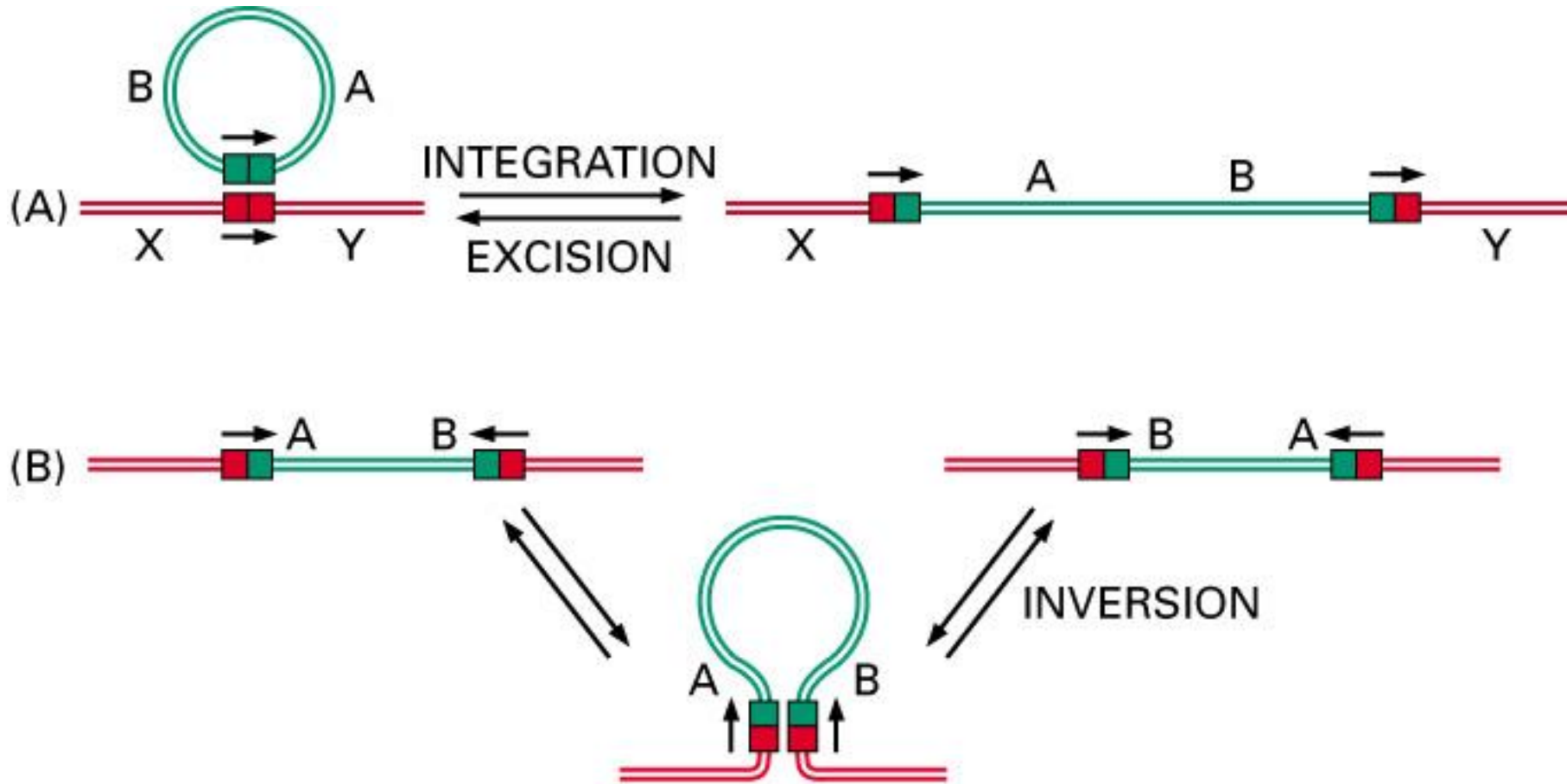


Figure 5-79. Molecular Biology of the Cell, 4th Edition.

Bacteriophage Lambda

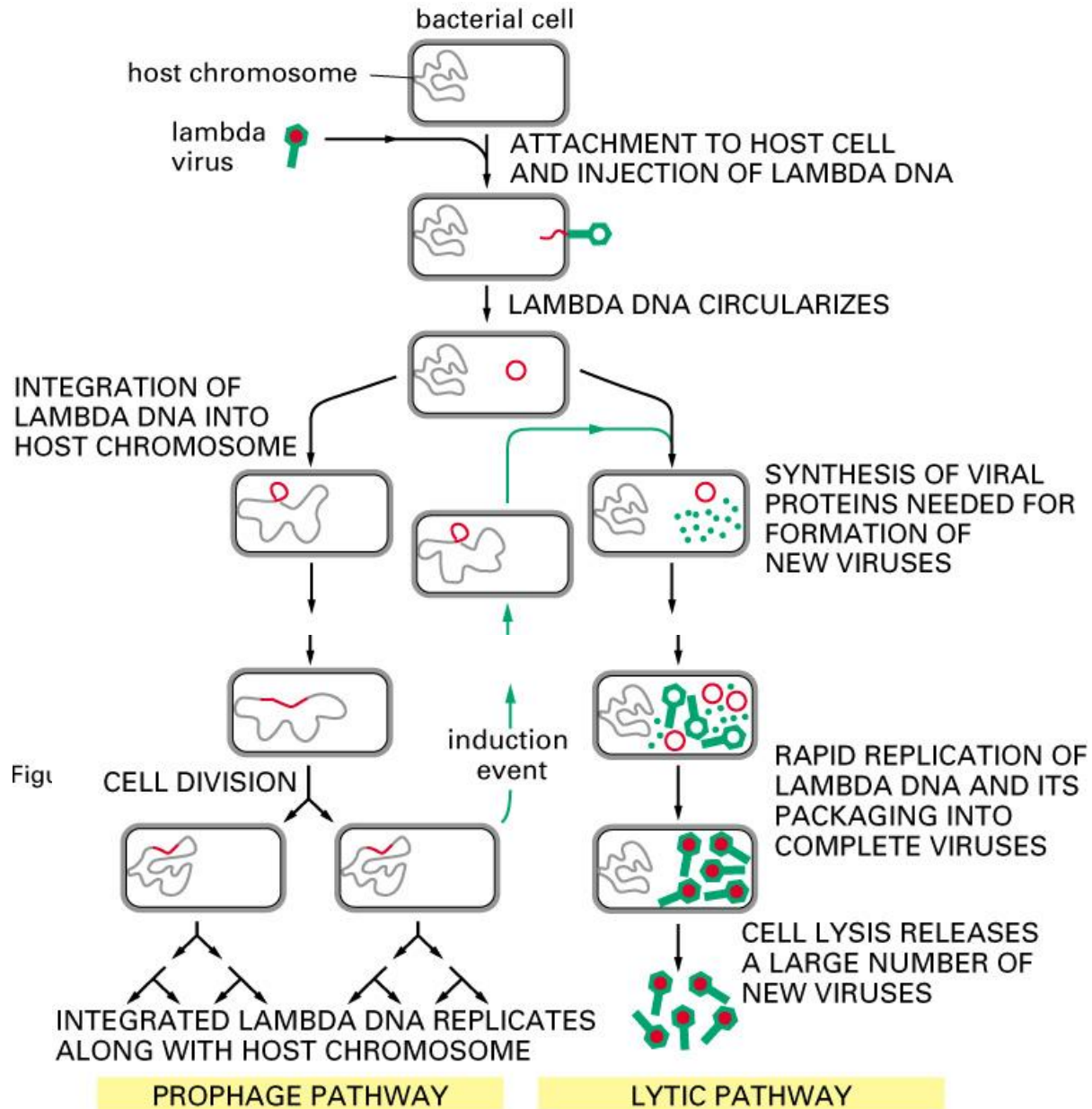
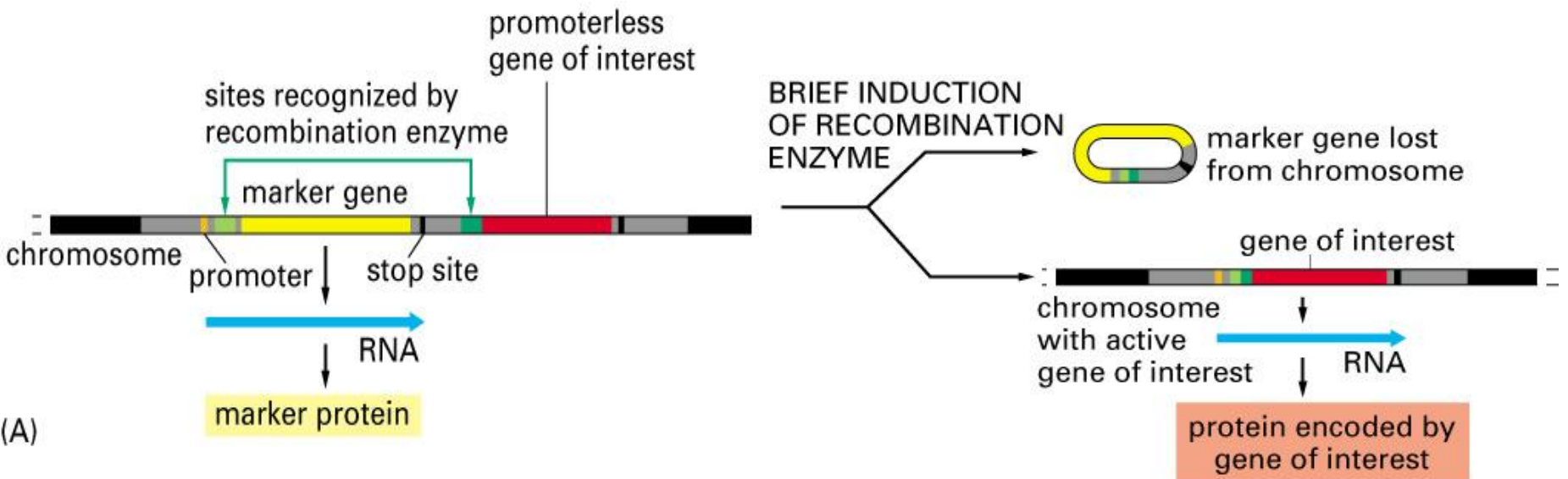


Figure 5-81 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

Genetic Engineering to control Gene expression



(A)

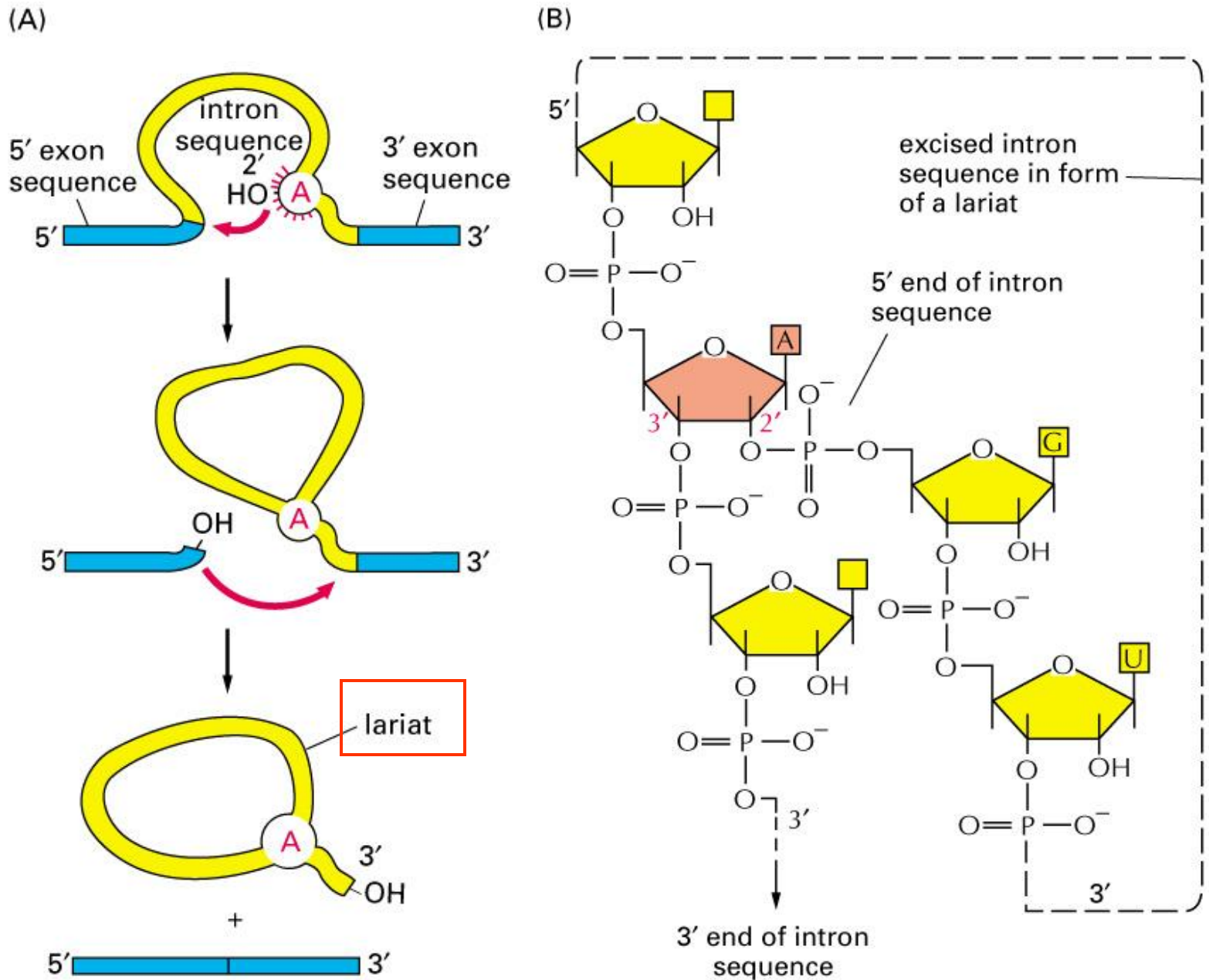
Figure 5-82 part 1 of 3. Molecular Biology of the Cell, 4th Edition

Figure 5-82 part 2 of 3. Molecular Biology of the Cell, 4th Edition.

Summary

- DNA site-specific recombination
- transpositional; conservative
- Transposons: mobile genetic elements
- Transpositional: DNA only transposons, retroviral-like retrotransposons, nonretroviral retrotransposons

RNA splicing reactions



3 Important sequences for Splicing to occur

R: A or G; Y: C or U

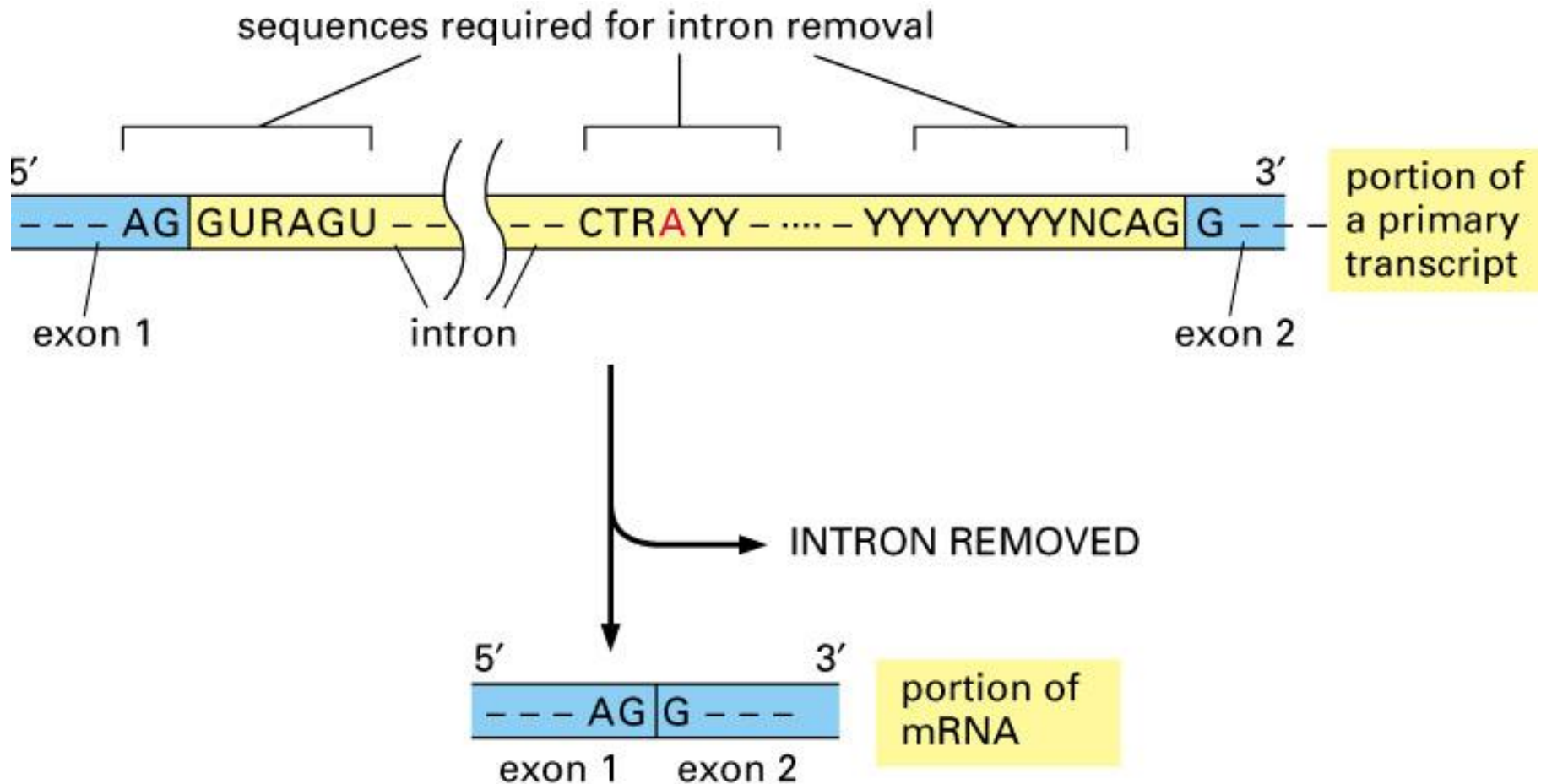


Figure 6-28. Molecular Biology of the Cell, 4th Edition.

RNA Splicing mechanism
 BBP: branch-point binding protein
 U2AF: a helper protein

snRNA: small nuclear RNA
 snRNP: small nuclear ribonucleoprotein
 Components for spliceosome

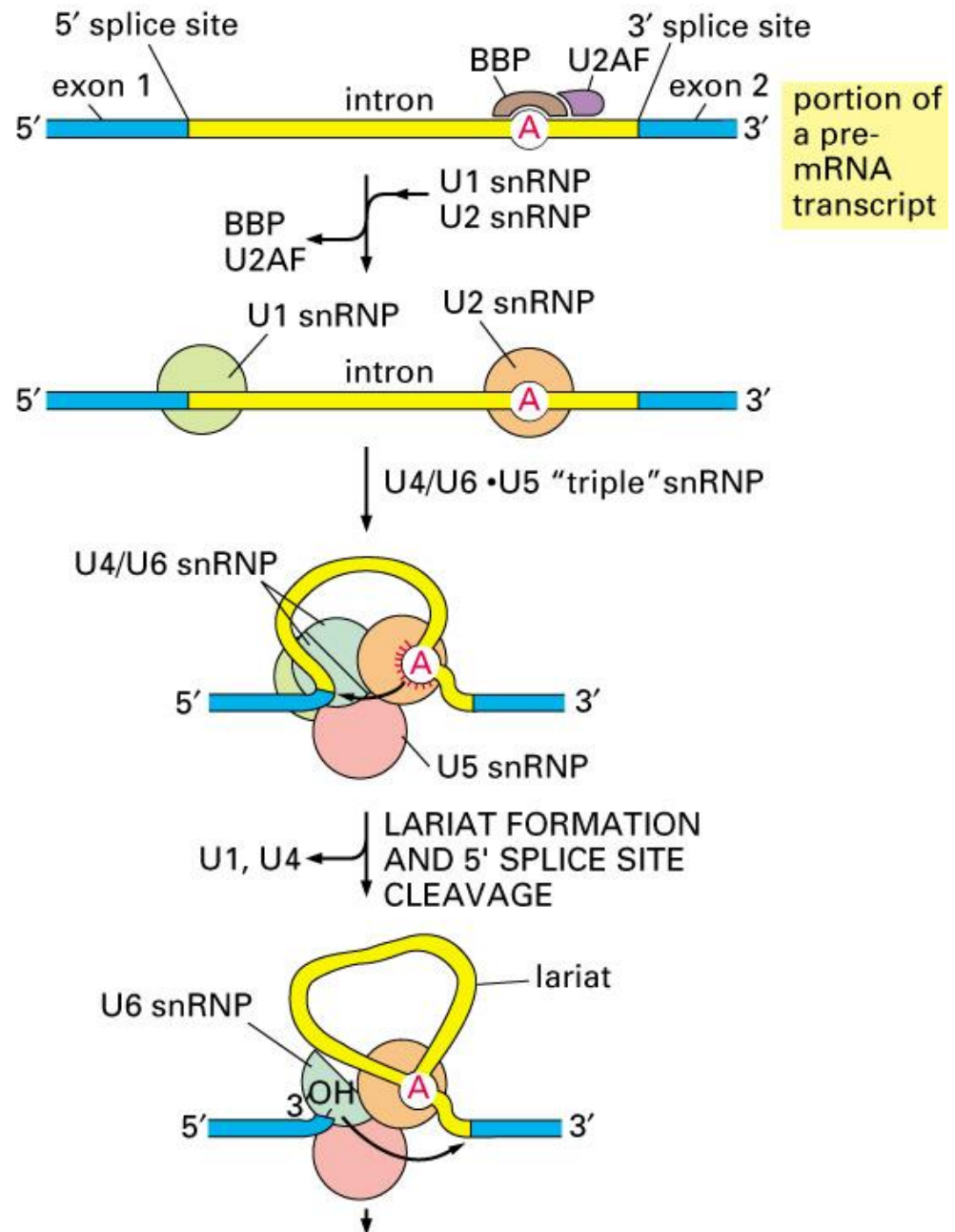


Figure 6-29 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

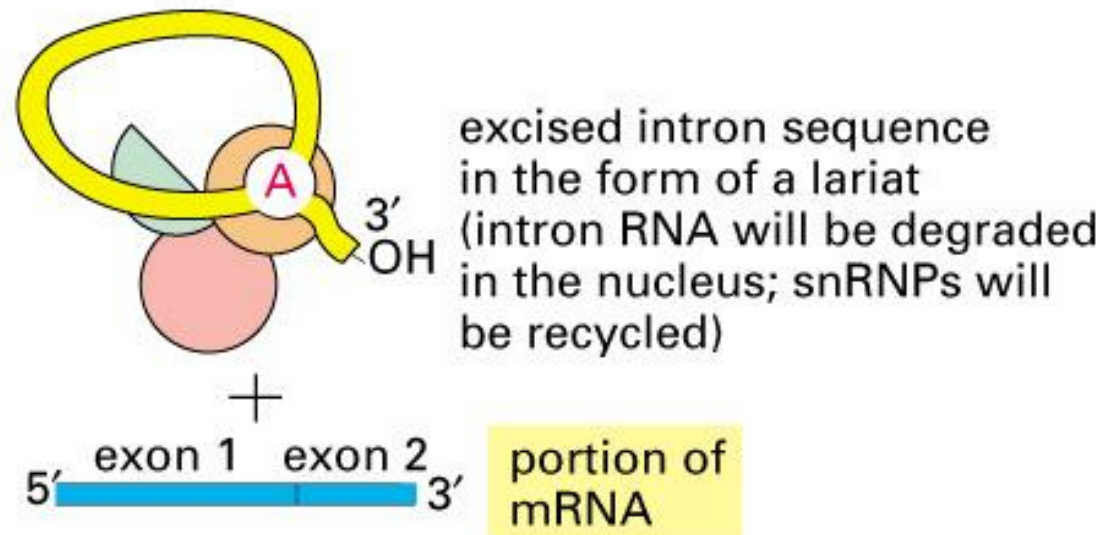
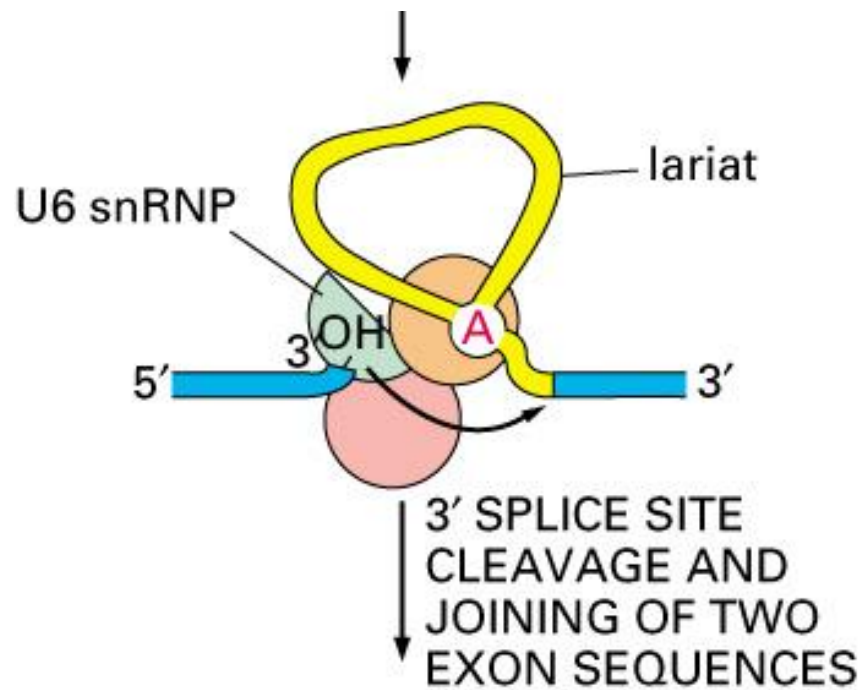


Figure 6-29 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

Further mechanism to mark Exon and Intron difference

CBC: capping binding complex

hnRNP: heterogeneous nuclear ribonucleoprotein, binding to introns

SR: rich in serine and arginines, binding to exons

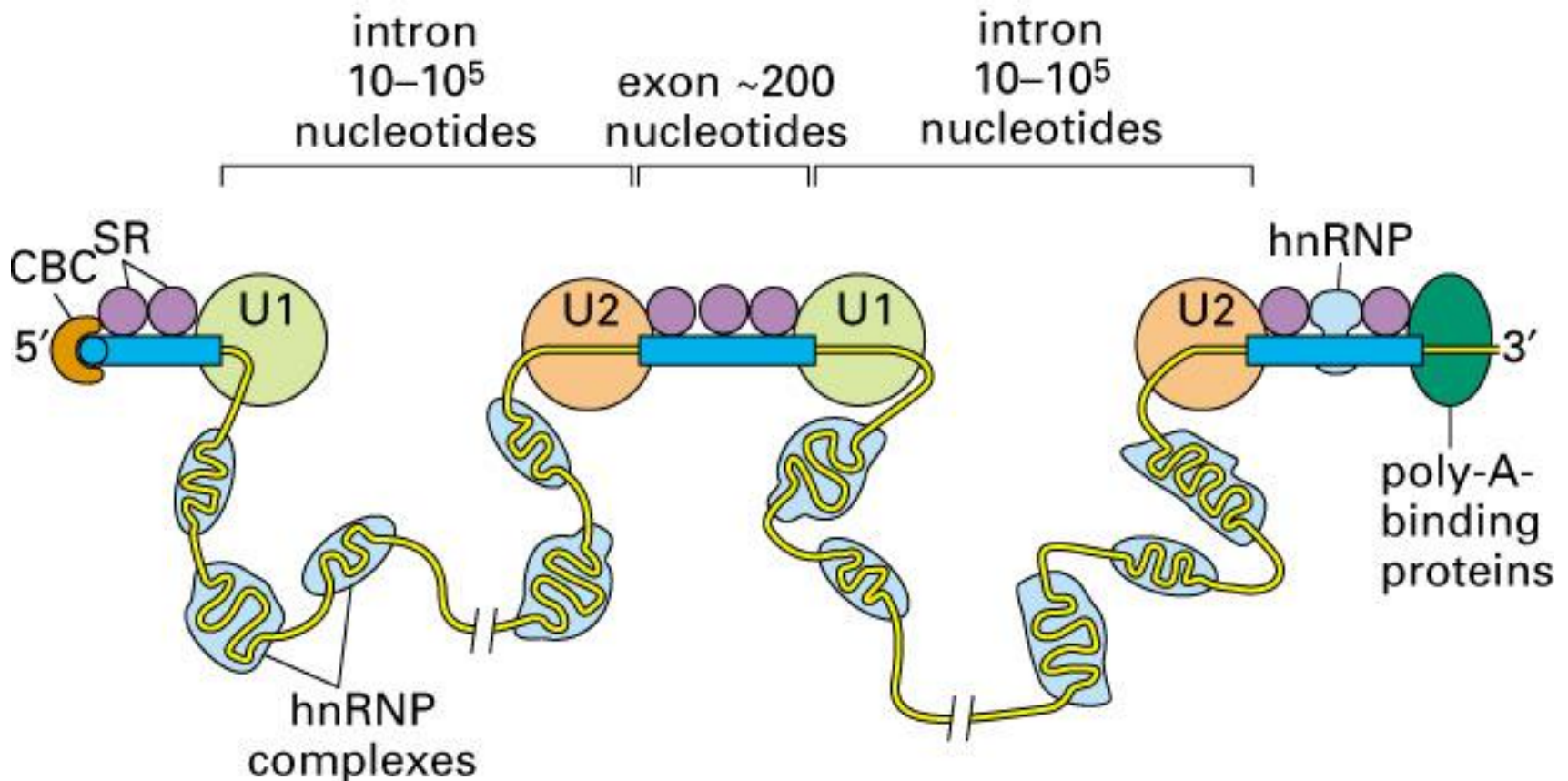


Figure 6-33. Molecular Biology of the Cell, 4th Edition.

Consensus sequence for 3' process

AAUAAA: CstF (cleavage stimulation factor F)

GU-rich sequence: CPSF (cleavage and polyadenylation specificity factor)

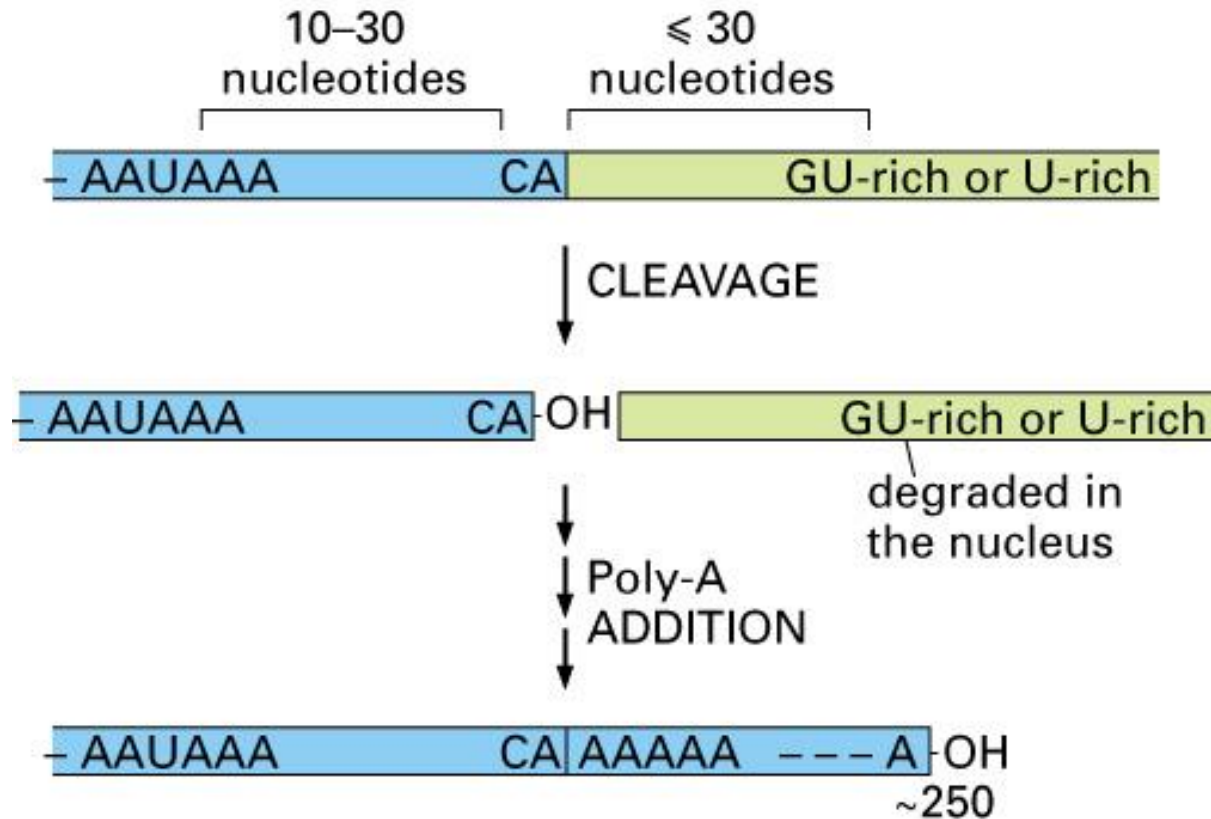


Figure 6-37. Molecular Biology of the Cell, 4th Edition.

The Genetic Code

GCA	AGA							GGA		
GCC	AGG							GGC		AUA
GCG	CGA	GAC	AAC	UGC	GAA	CAA	GGG	CAC		AUC
GCU	CGC	GAU	AAU	UGU	GAG	CAG	GGU	CAU		AUU
	CGG									
	CGU									
Ala	Arg	Asp	Asn	Cys	Glu	Gln	Gly	His	Ile	
A	R	D	N	C	E	Q	G	H	I	
UUA						AGC				
UUG						AGU				
CUA				CCA	UCA	ACA			GUA	
CUC				CCC	UCC	ACC			GUC	UAA
CUG	AAA		UUC	CCG	UCG	ACG		UAC	GUG	UAG
CUU	AAG	AUG	UUU	CCU	UCU	ACU	UGG	UAU	GUU	UGA
Leu	Lys	Met	Phe	Pro	Ser	Thr	Trp	Tyr	Val	stop
L	K	M	F	P	S	T	W	Y	V	

Figure 6–50. Molecular Biology of the Cell, 4th Edition.

The Reading Frames

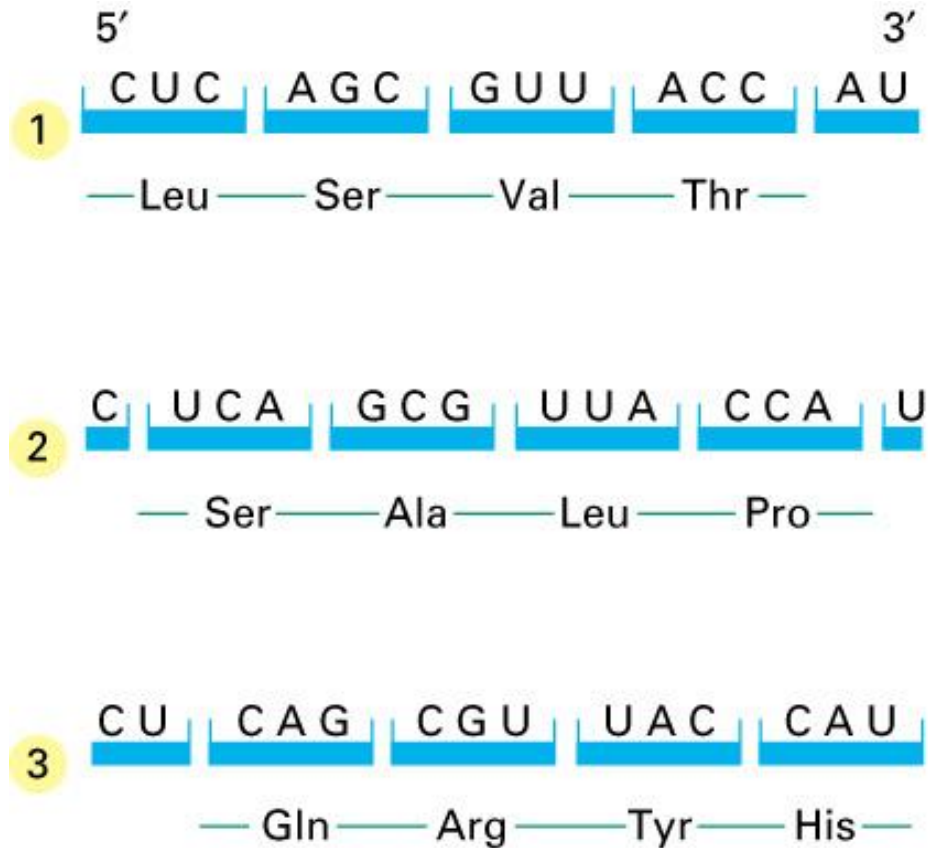


Figure 6-51. Molecular Biology of the Cell, 4th Edition.

tRNA (clover leaf shape with four strands folded, finally L-shape)

attached amino acid (Phe)

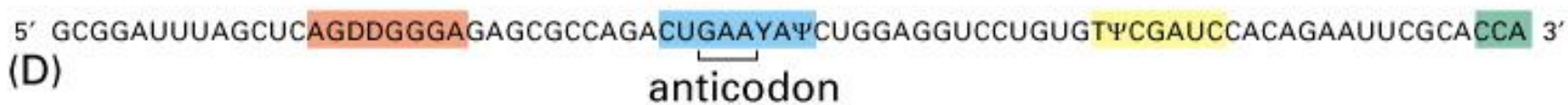
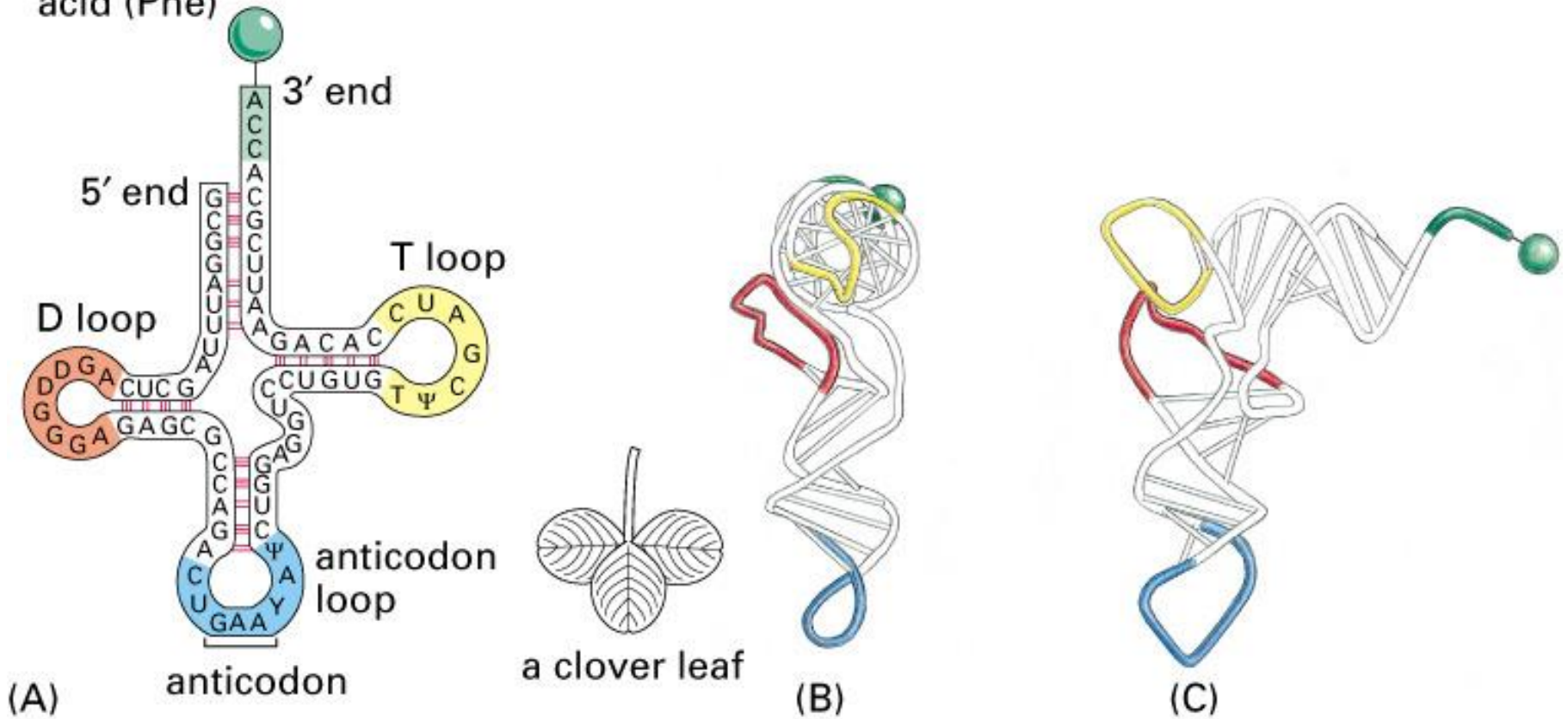
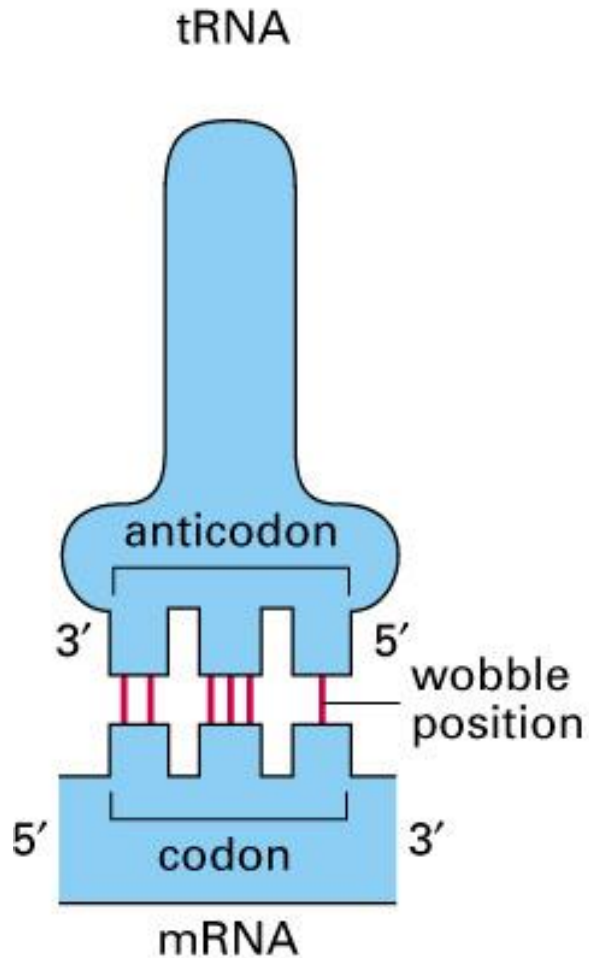


Figure 6-52. Molecular Biology of the Cell, 4th Edition.

tRNA and mRNA pairing



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	G or I
C	G or I
A	U
G	C

Figure 6-53. Molecular Biology of the Cell, 4th Edition.