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

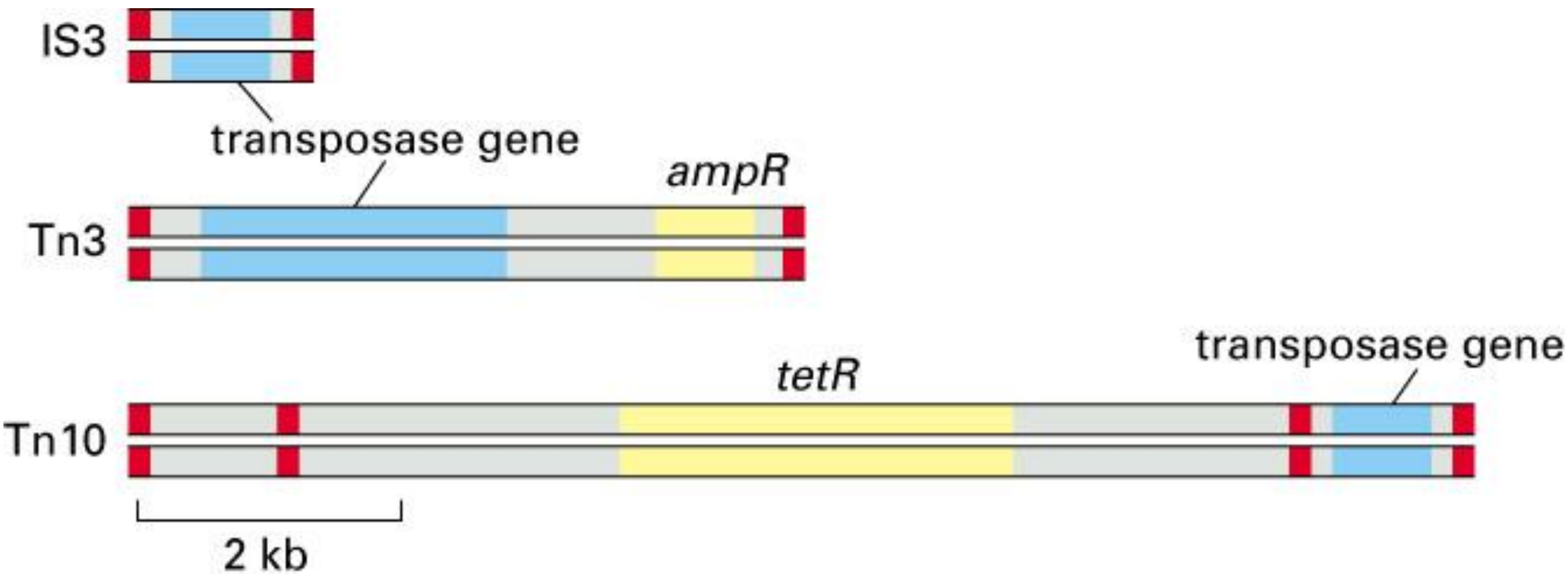
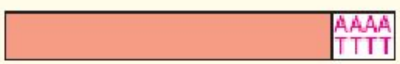


Figure 5–69. Molecular Biology of the Cell, 4th Edition.

TABLE 5–3 **Three Major Classes of Transposable Elements**

CLASS DESCRIPTION AND STRUCTURE	GENES IN COMPLETE ELEMENT	MODE OF MOVEMENT	EXAMPLES
DNA-only transposons  short inverted repeats at each end	encodes transposase	moves as DNA, either excising or following a replicative pathway	P element (*Drosophila*) Ac-Ds (maize) Tn3 and IS1 (*E.coli*) Tam3 (snapdragon)
Retroviral-like retrotransposons  directly repeated long terminal repeats (LTRs) at ends	encodes reverse transcriptase and resembles retrovirus	moves via an RNA intermediate produced by promoter in LTR	Copia (*Drosophila*) Ty1 (yeast) THE-1 (human) Bs1 (maize)
Nonretroviral retrotransposons  Poly A at 3′ end of RNA transcript; 5′ end is often truncated	encodes reverse transcriptase	moves via an RNA intermediate that is often produced from a neighboring promotor	F element (*Drosophila*) 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

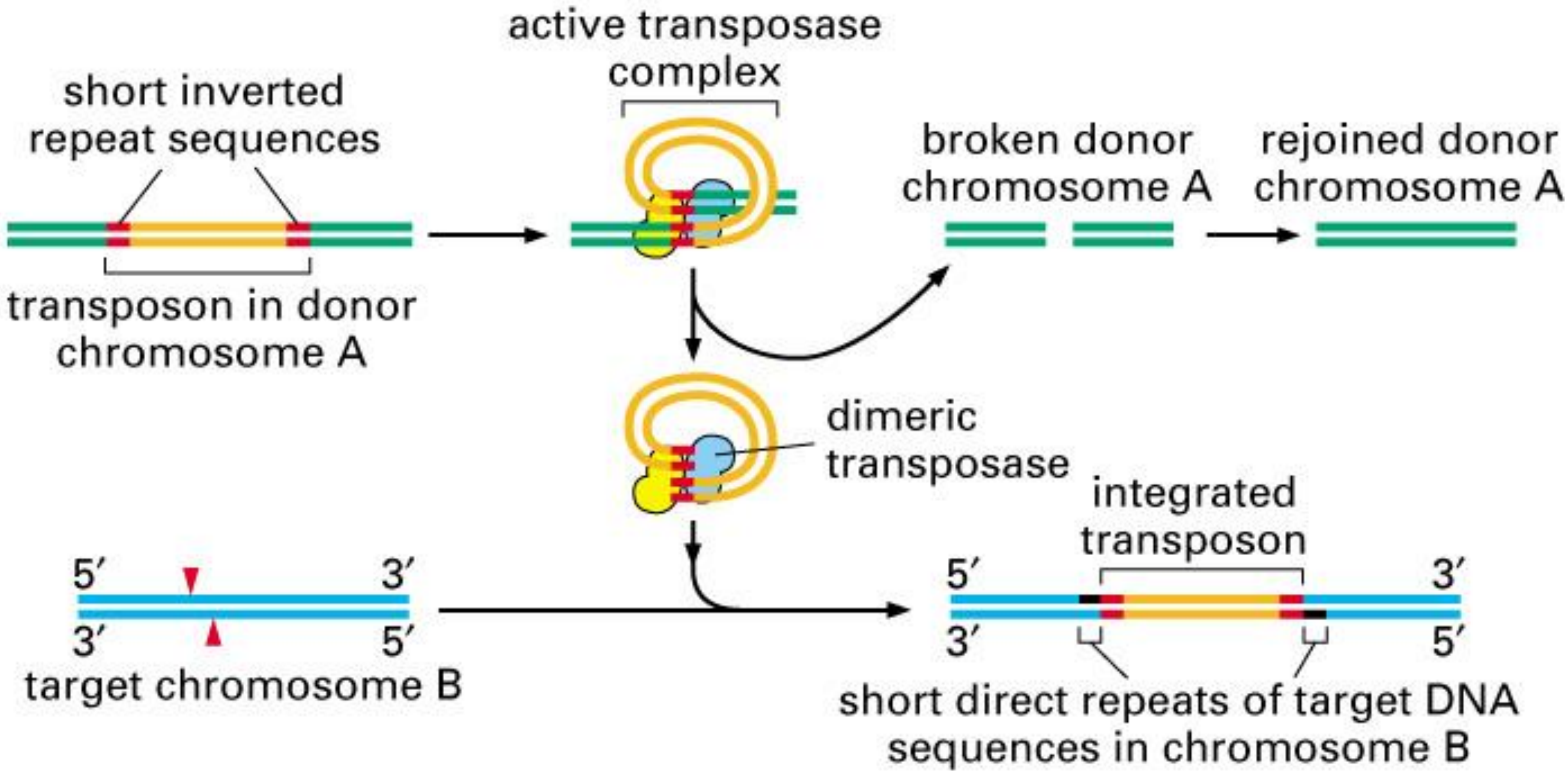


Figure 5–70. Molecular Biology of the Cell, 4th Edition.

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

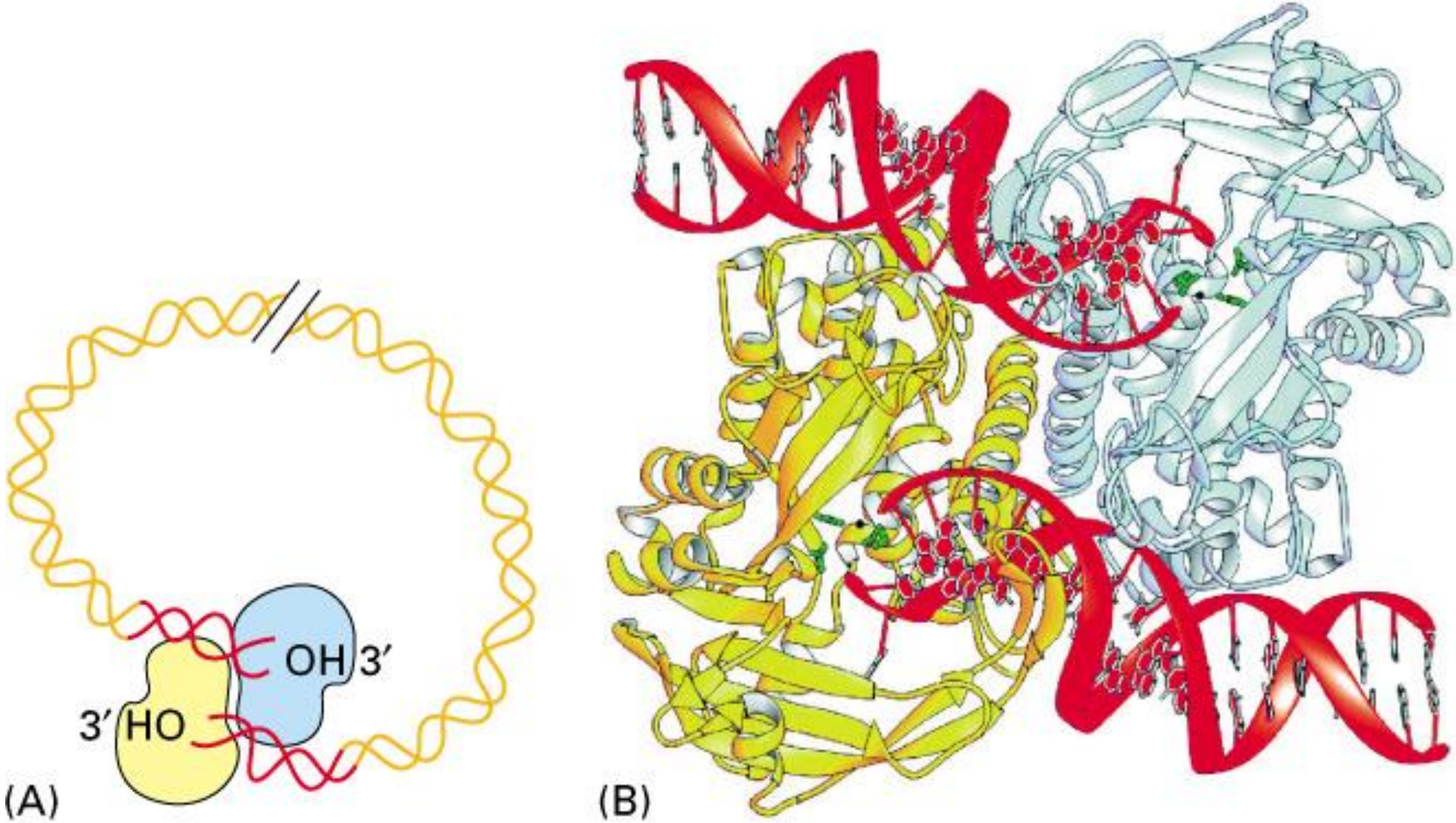


Figure 5–71. Molecular Biology of the Cell, 4th Edition.

Replicative Transposition

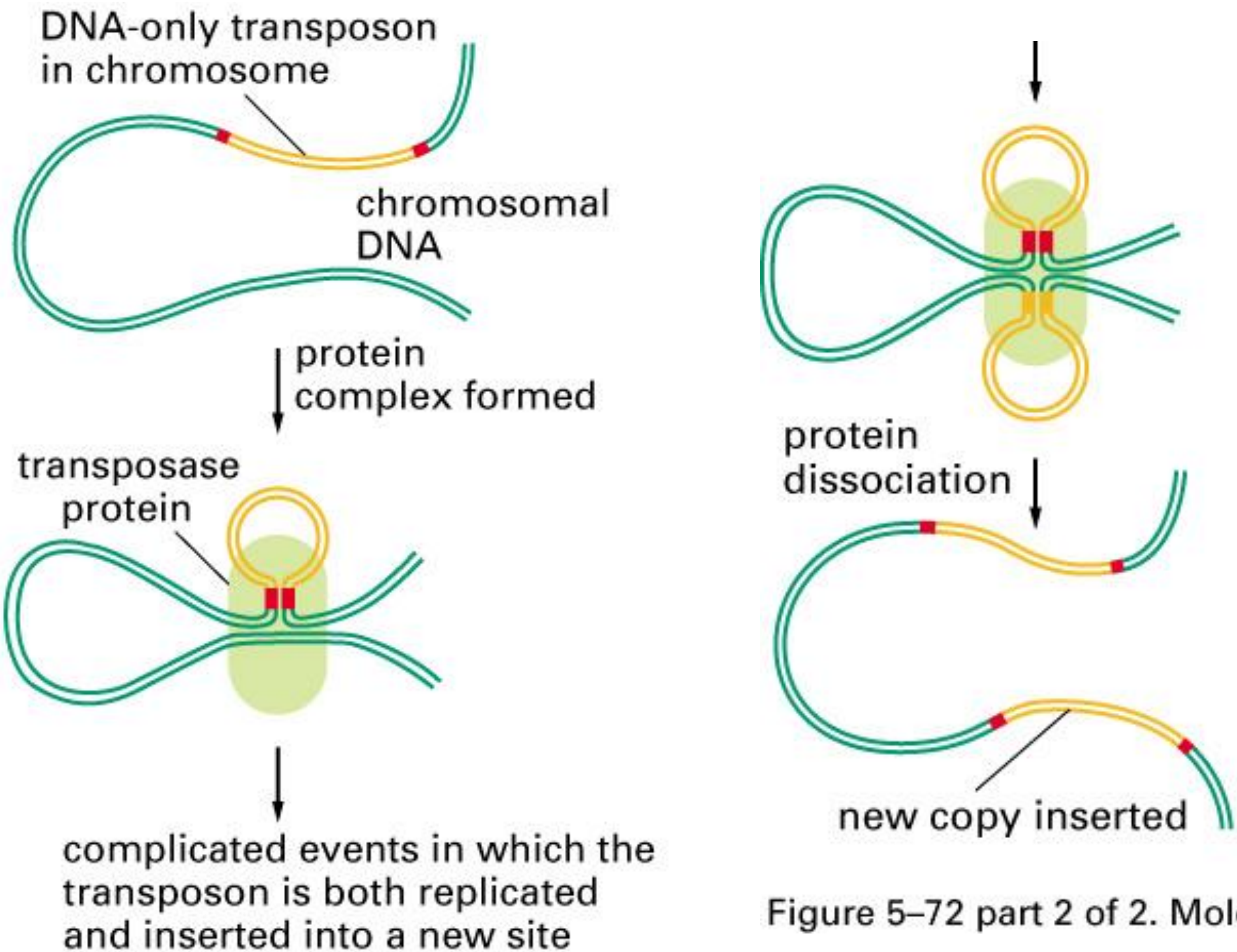


Figure 5–72 part 2 of 2. Mole

Retrovirus-based Transposition
Retroviral-like retrotransposition

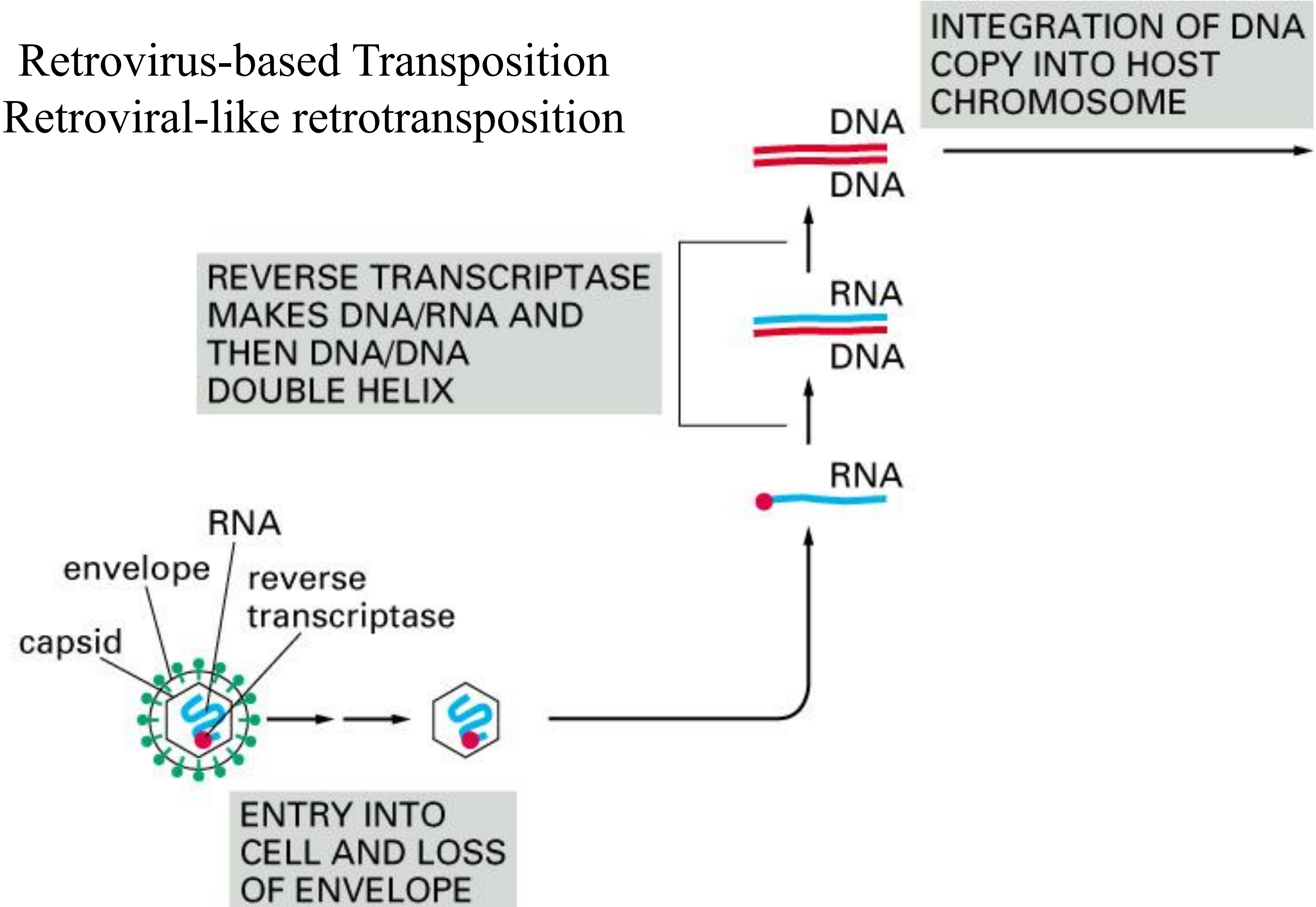


Figure 5–73 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

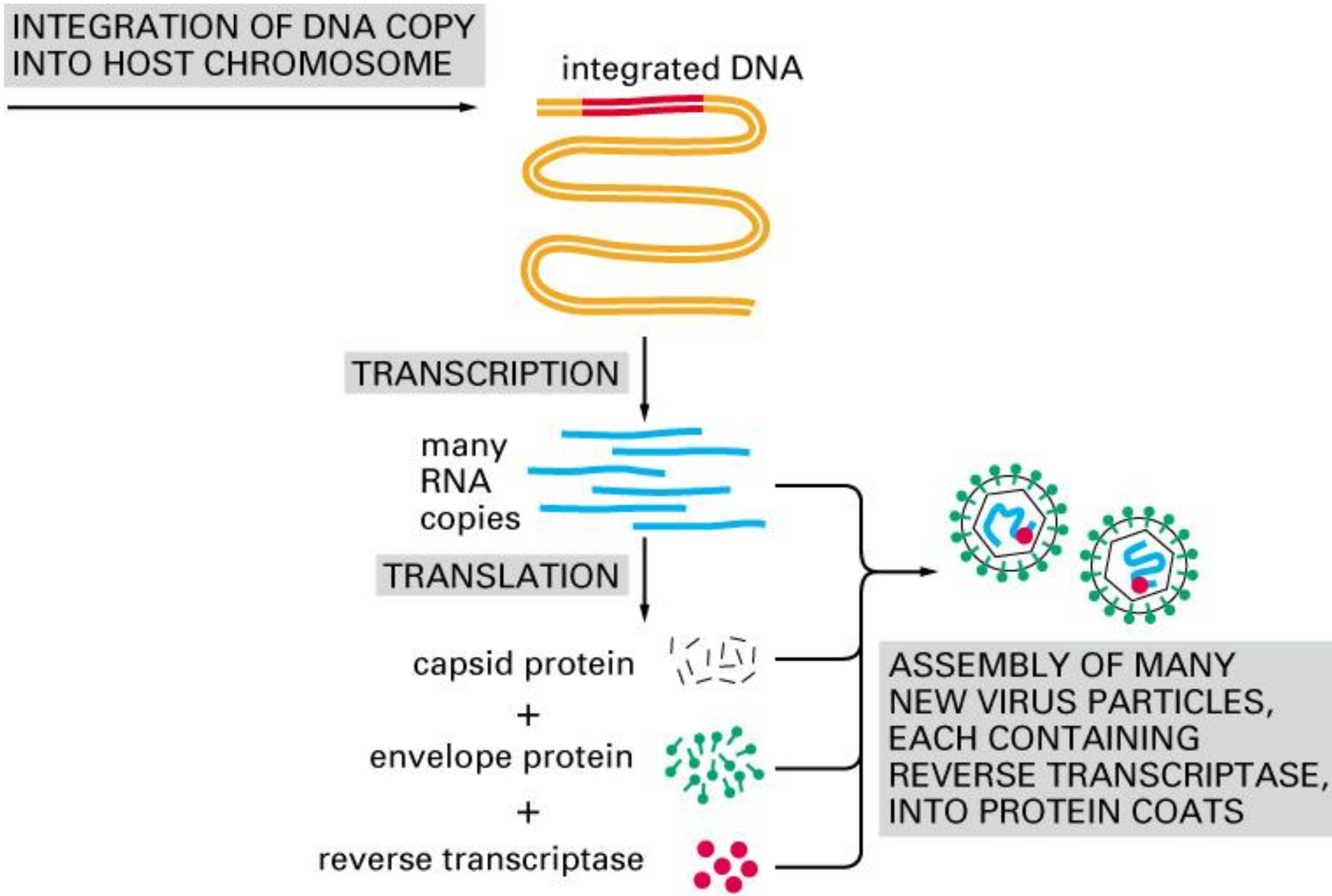


Figure 5–73 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

Reverse Transcriptase
From RNA to DNA

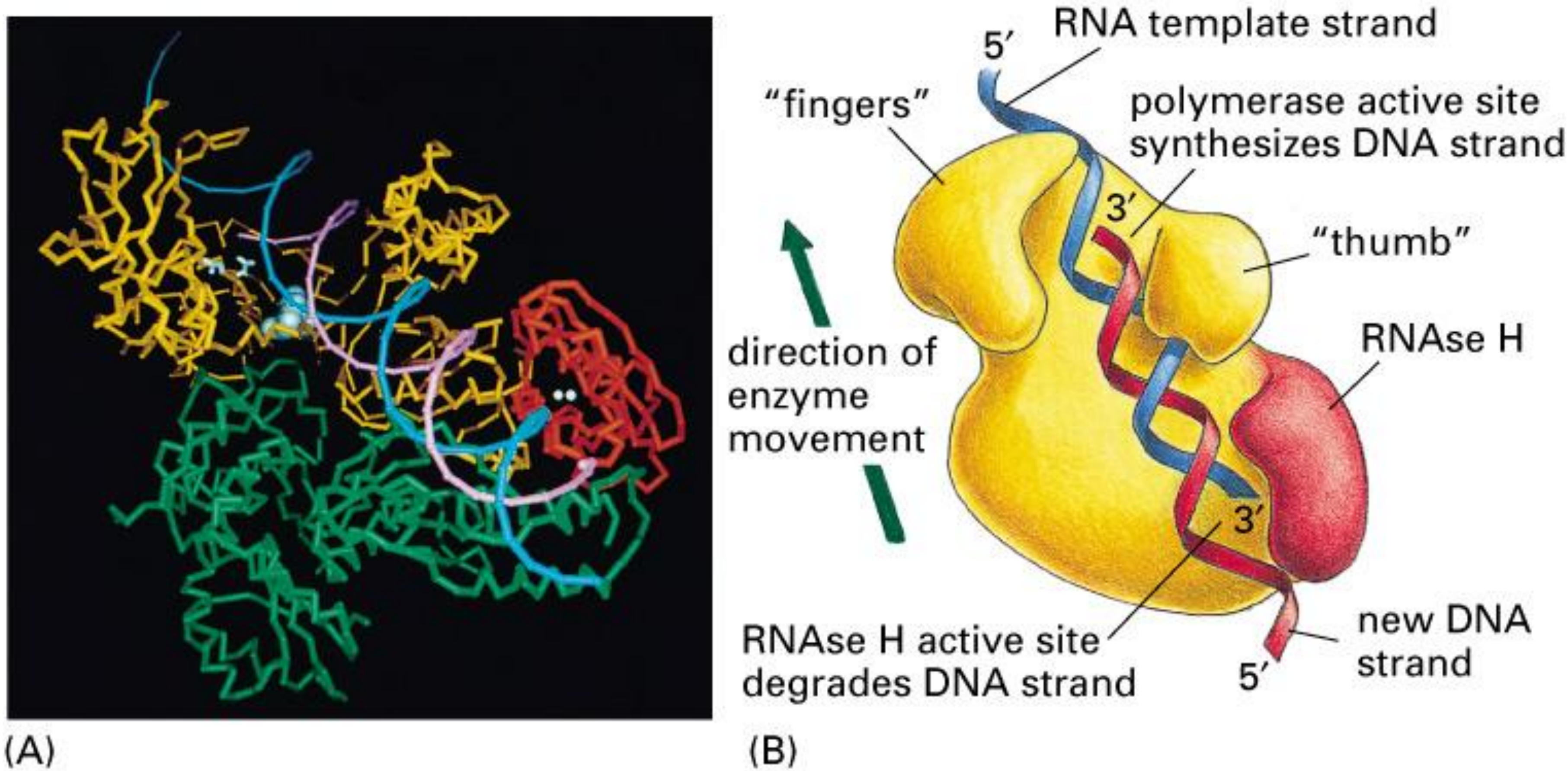


Figure 5–74. Molecular Biology of the Cell, 4th Edition.

Non-retroviral retrotransposition
L1 Element

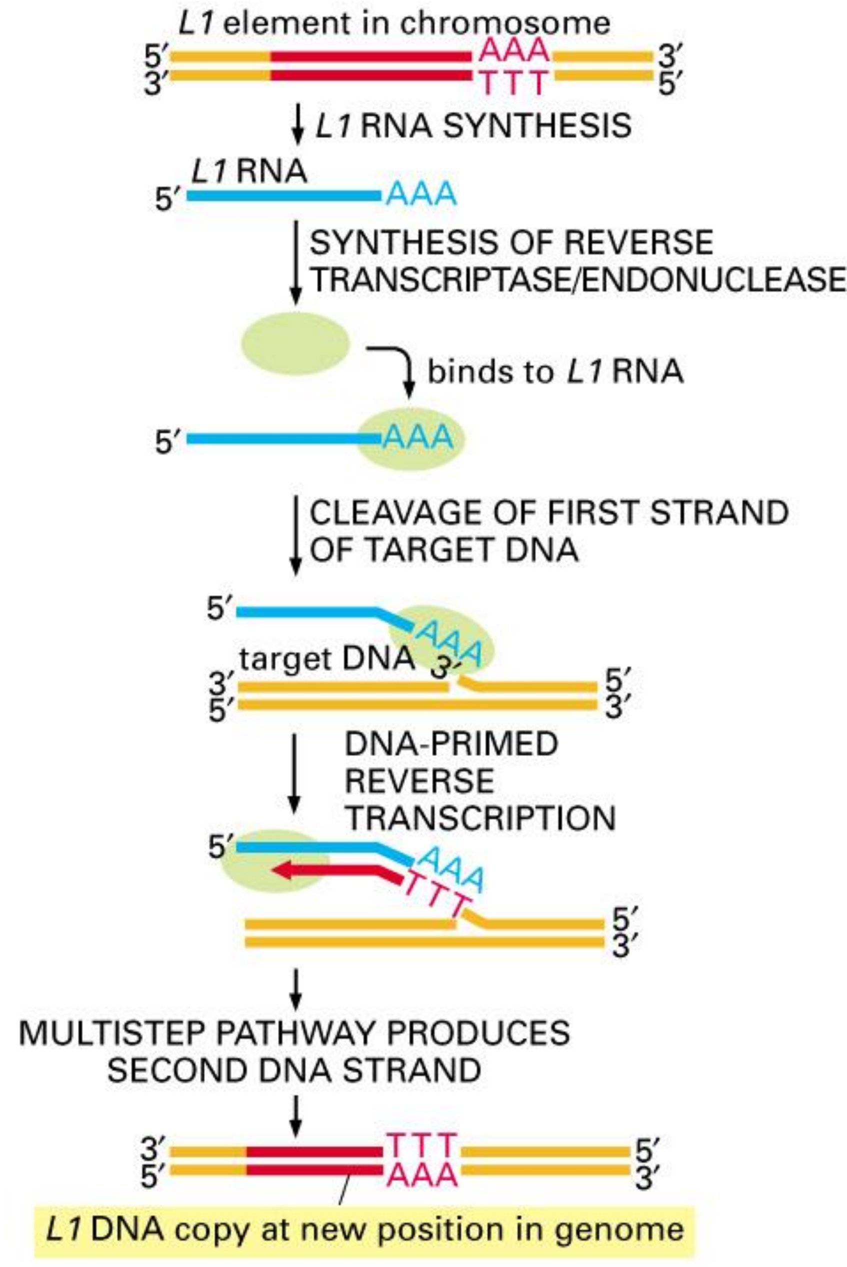


Figure 5–76. Molecular Biology of the Cell, 4th Edition.

Conservative Site Specific Recombination
Integration vs. inversion
Notice the arrows of directions

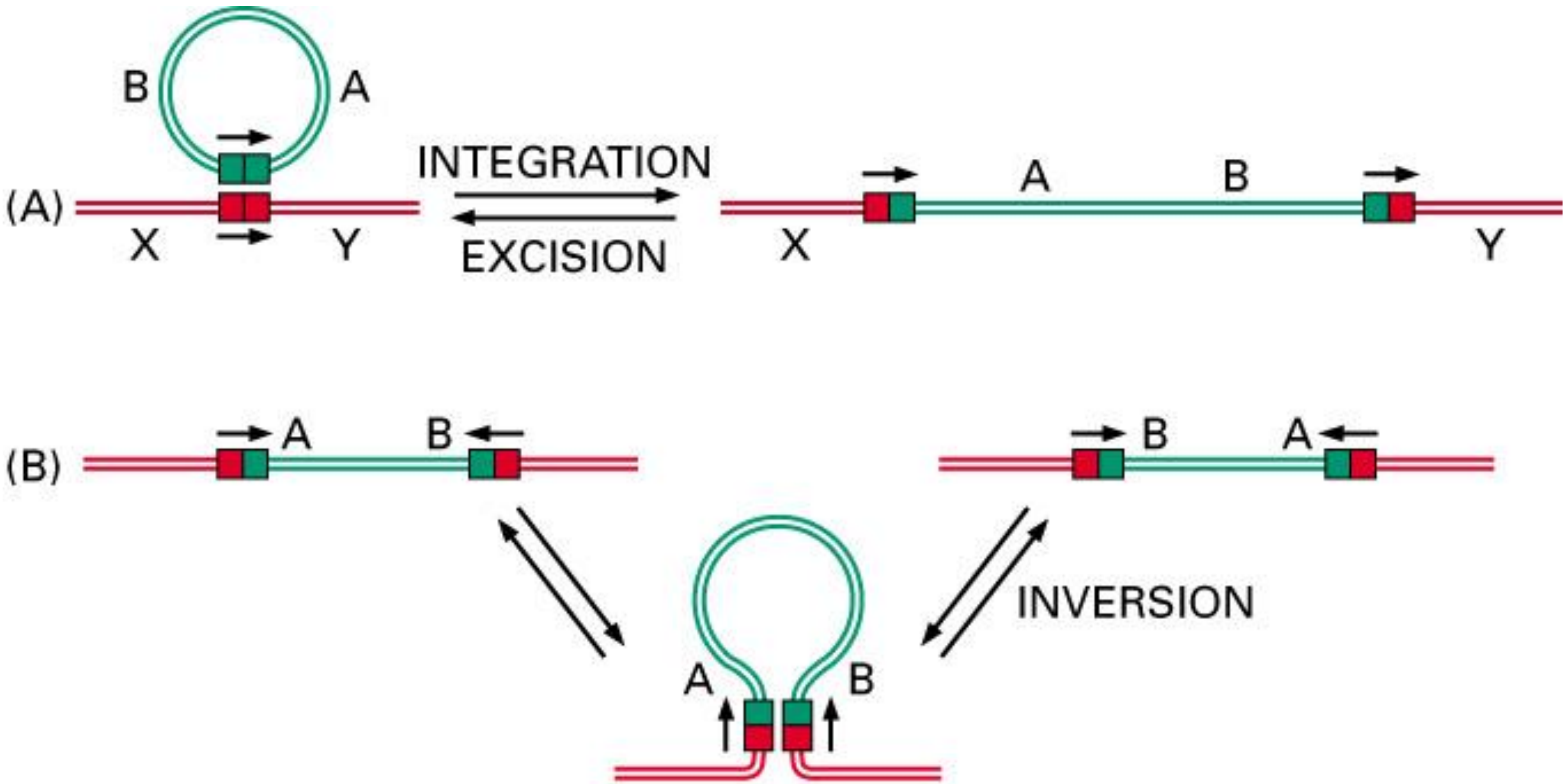


Figure 5–79. Molecular Biology of the Cell, 4th Edition.

Bacteriophage Lambda

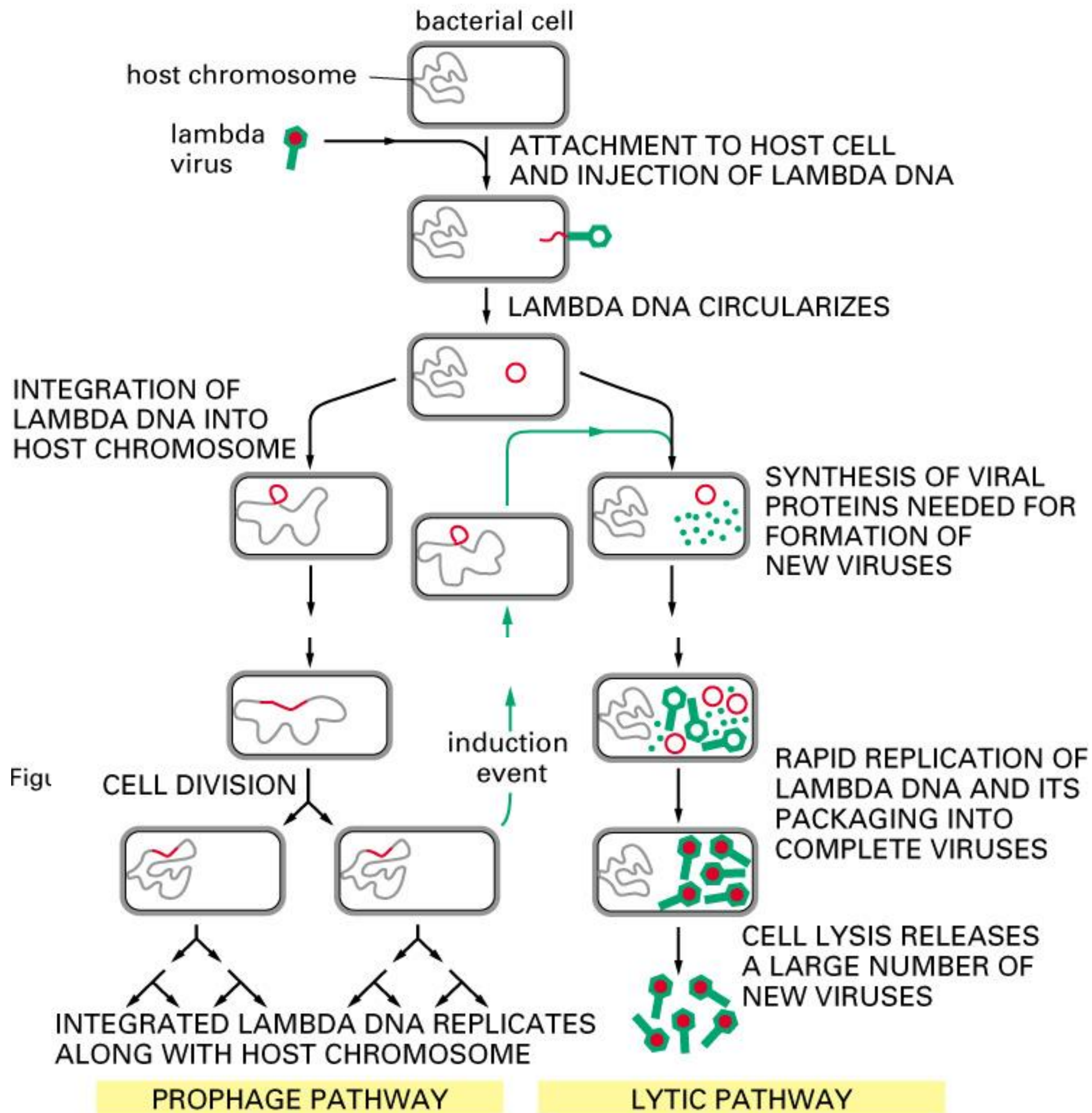


Figure 5–81 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

Genetic Engineering to control Gene expression

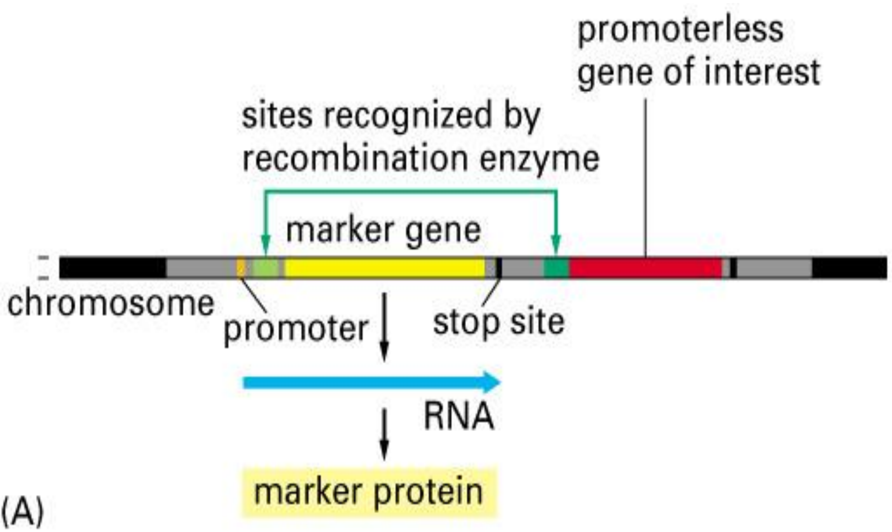


Figure 5–82 part 1 of 3. Molecular Biology of the Cell, 4th Edition

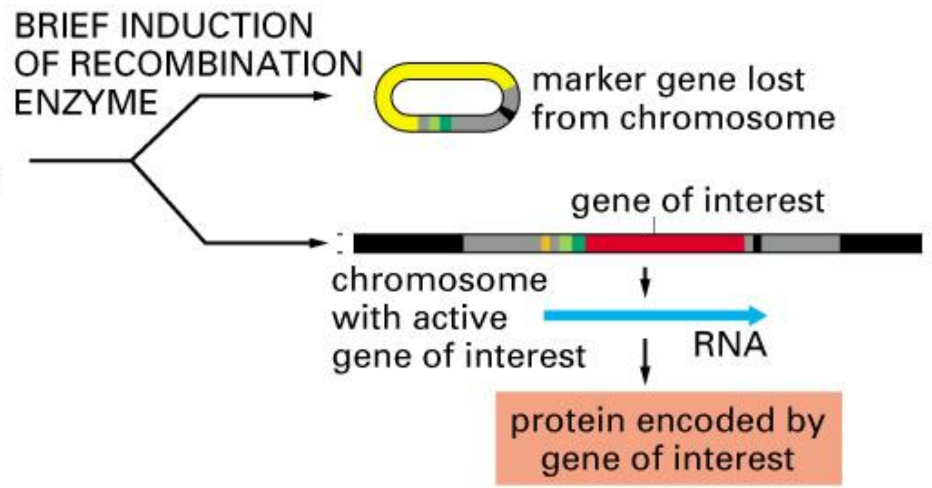


Figure 5–82 part 2 of 3. Molecular Biology of the Cell, 4th Edition.

Summary

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

RNA splicing reactions

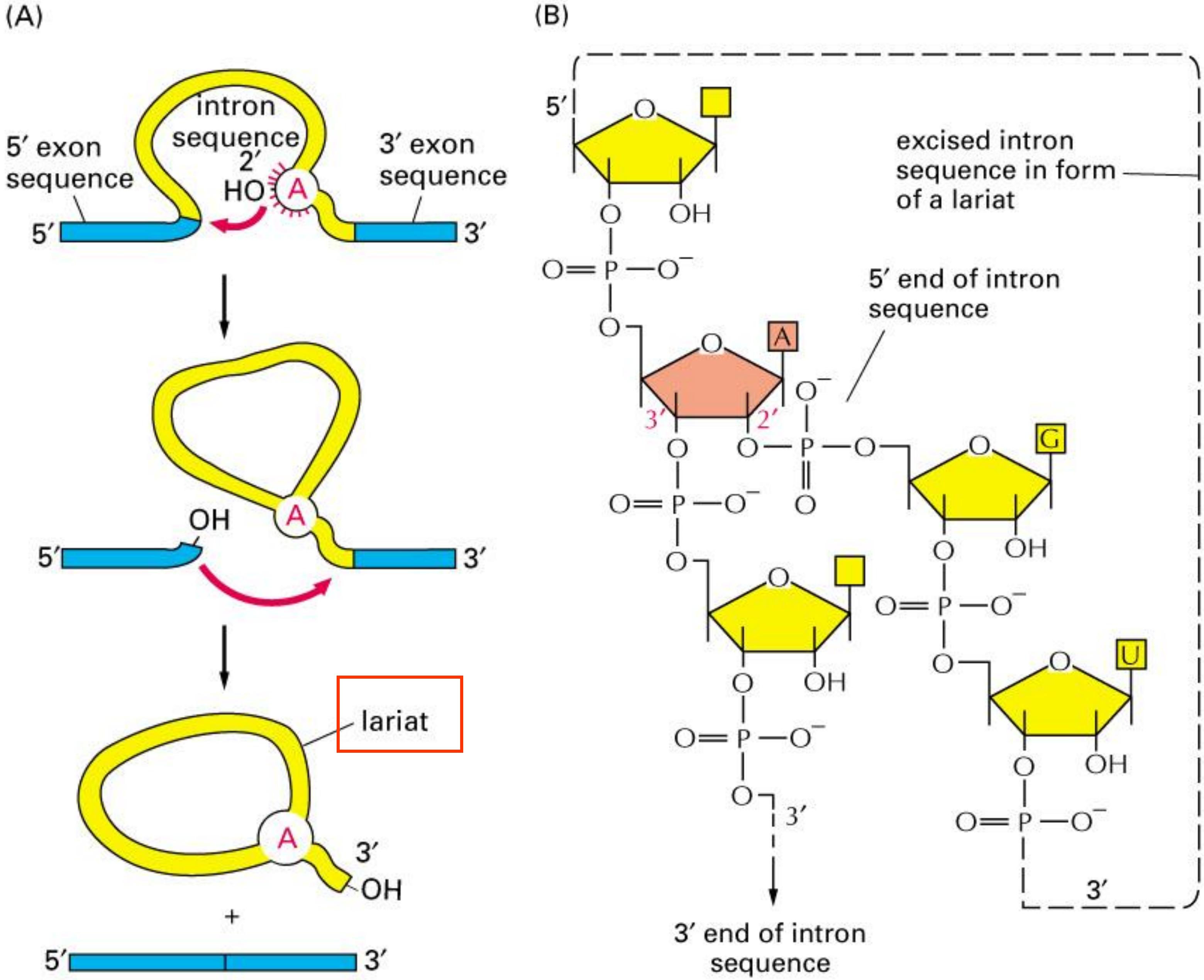


Figure 6–26 part 1 of 2. Molecular Biology c Figure 6–26 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

3 Important sequences for Splicing to occur

R: A or G; Y: C or U

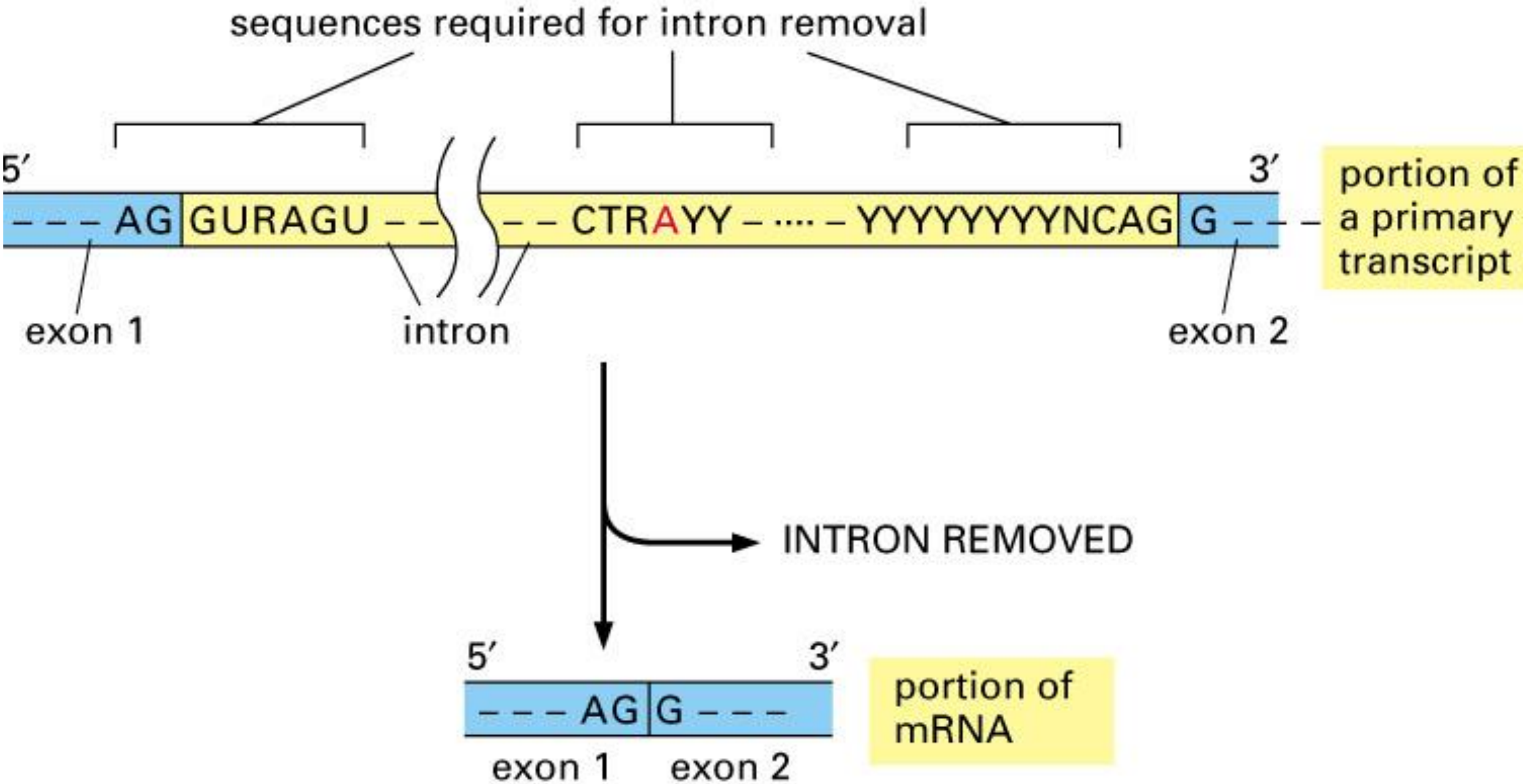


Figure 6–28. Molecular Biology of the Cell, 4th Edition.

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

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

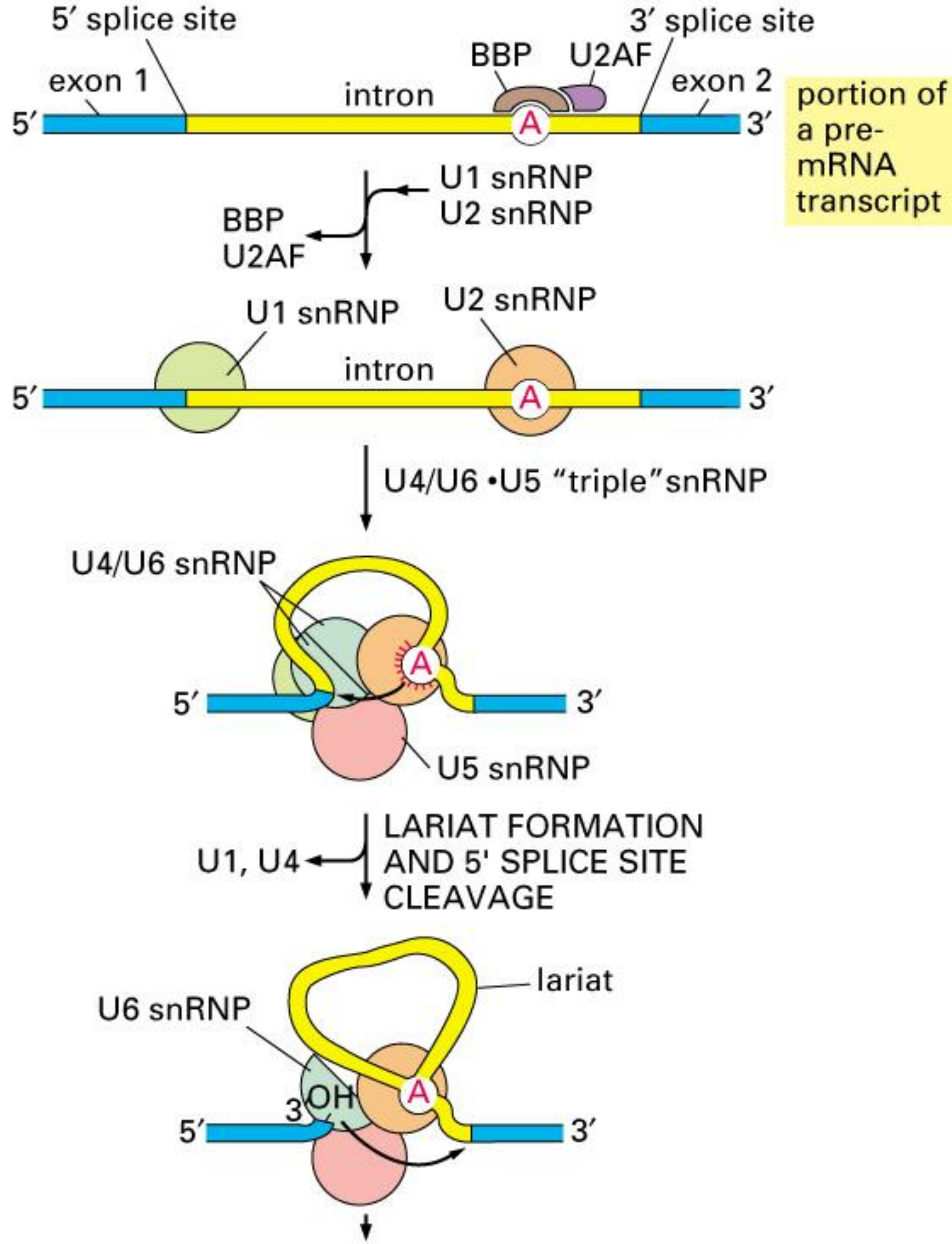


Figure 6–29 part 1 of 2. Molecular Biology of the Cell, 4th Edition.

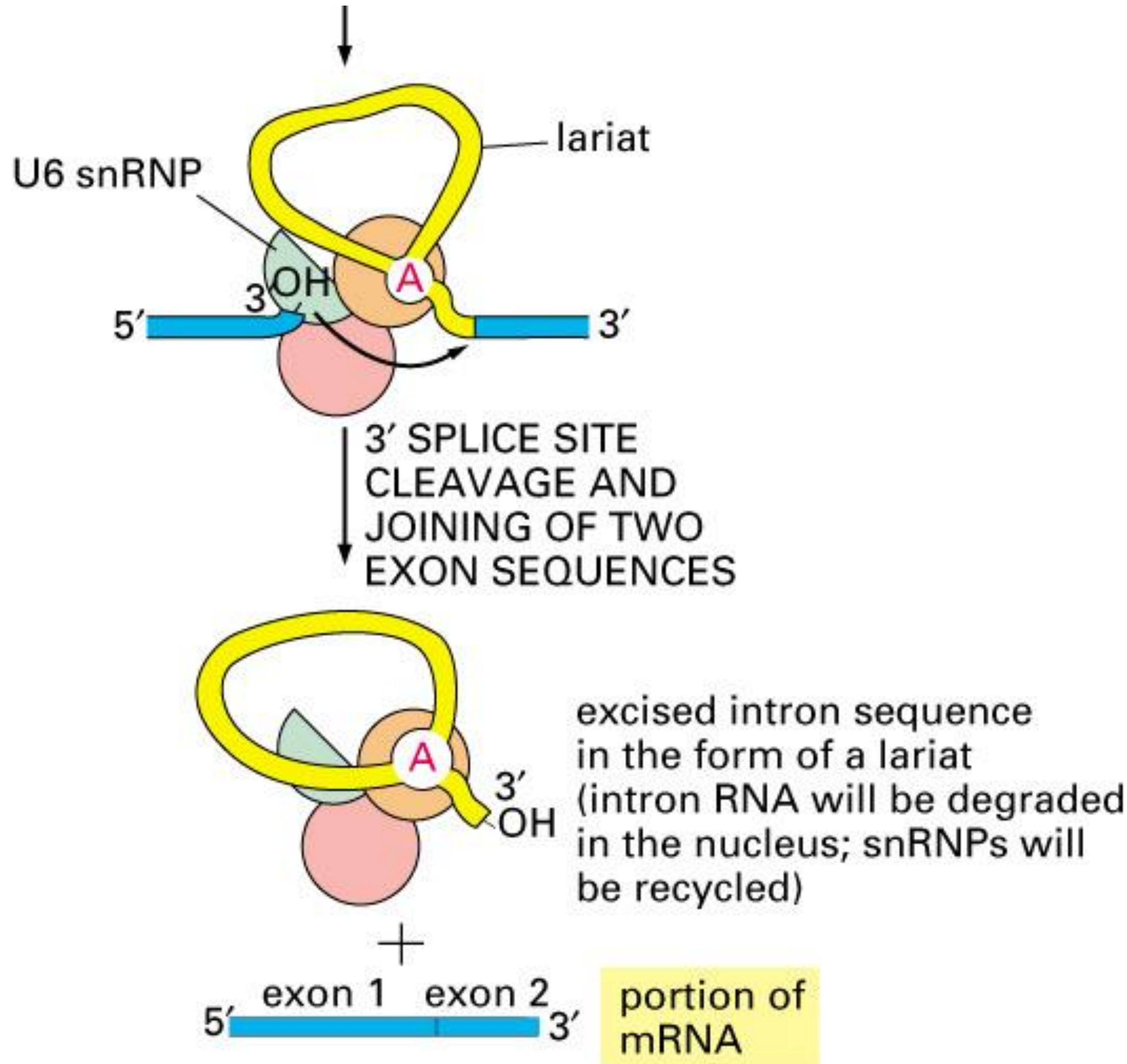


Figure 6–29 part 2 of 2. Molecular Biology of the Cell, 4th Edition.

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

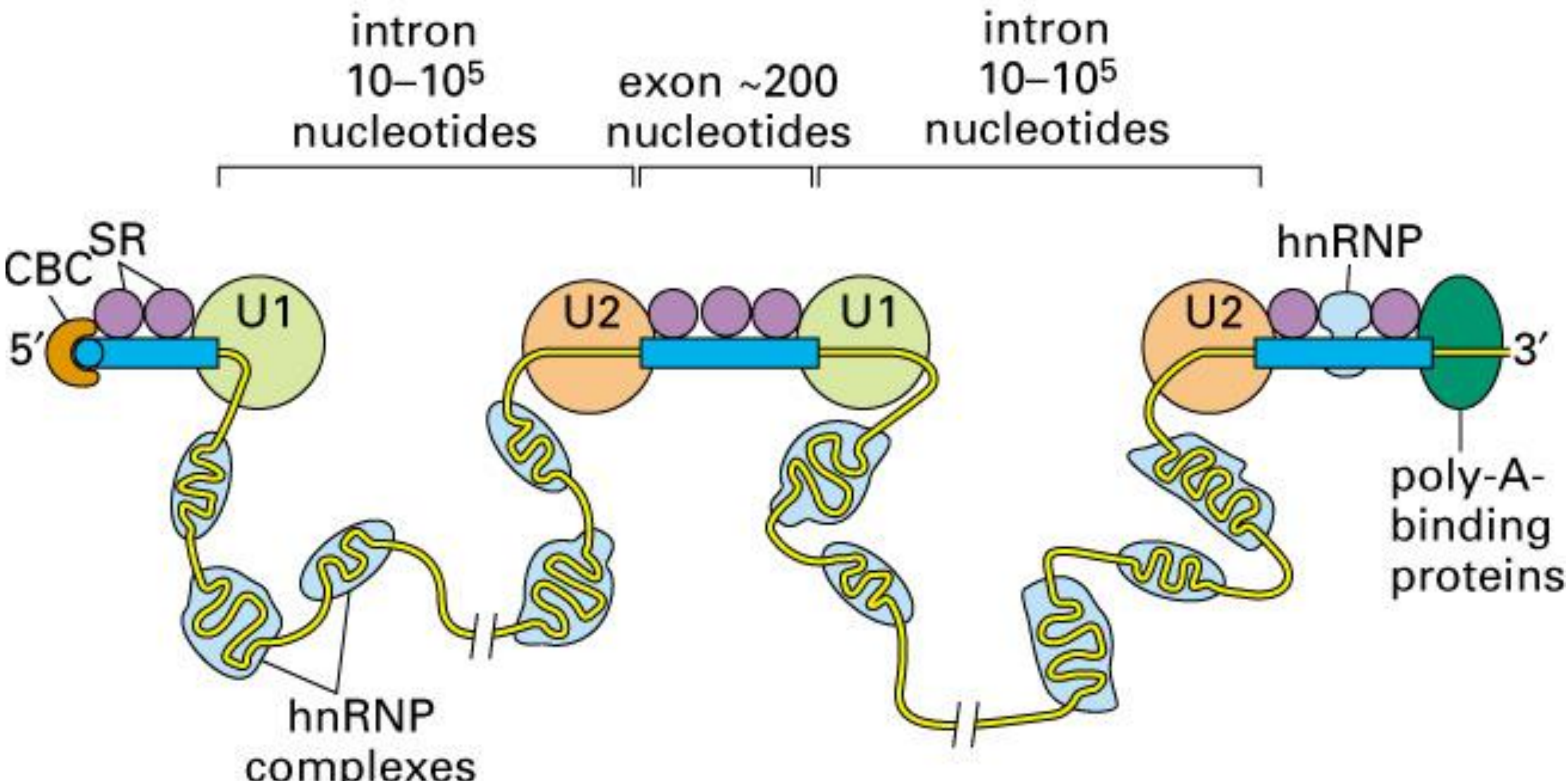


Figure 6–33. Molecular Biology of the Cell, 4th Edition.

Consensus sequence for 3' process

AAUAAA: CstF (cleavage stimulation factor F)

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

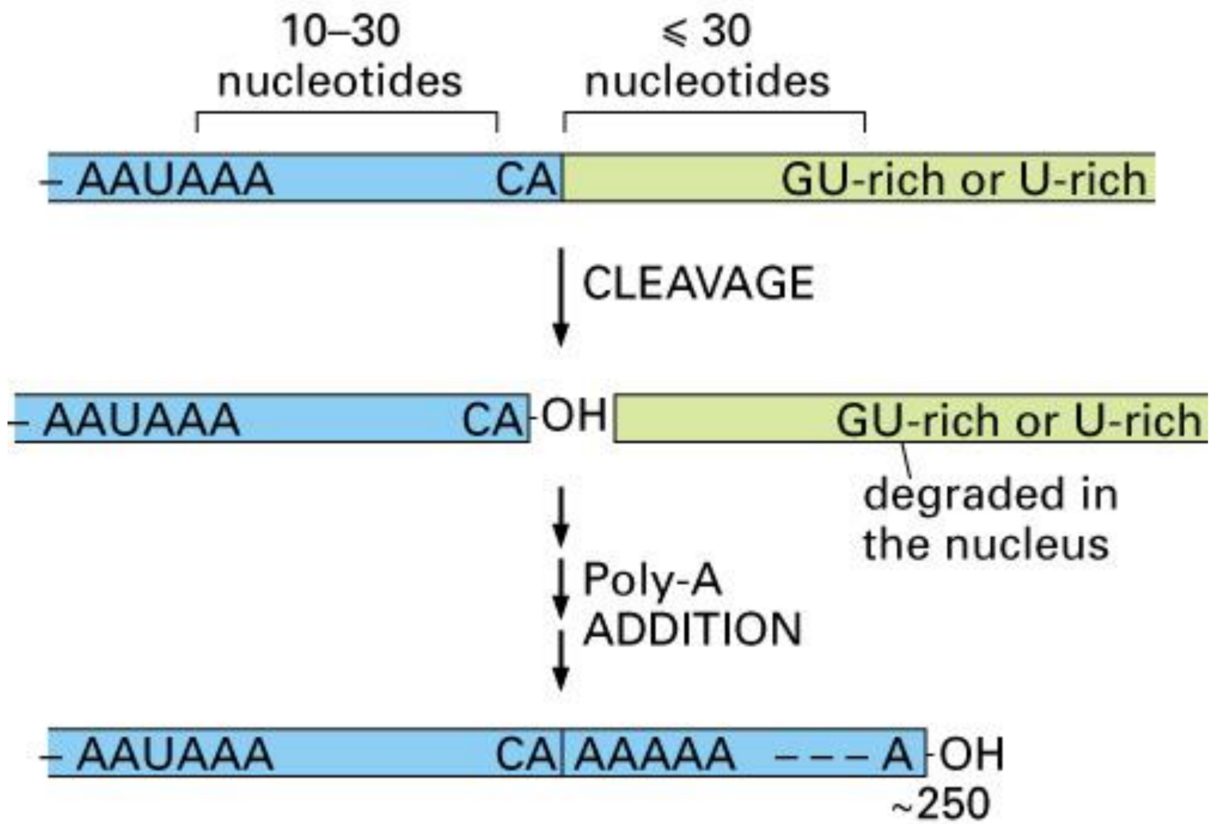


Figure 6–37. Molecular Biology of the Cell, 4th Edition.

The Genetic Code

	AGA								
	AGG								
GCA	CGA						GGA		
GCC	CGC						GGC		AUA
GCG	CGG	GAC	AAC	UGC	GAA	CAA	GGG	CAC	AUC
GCU	CGU	GAU	AAU	UGU	GAG	CAG	GGU	CAU	AUU
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

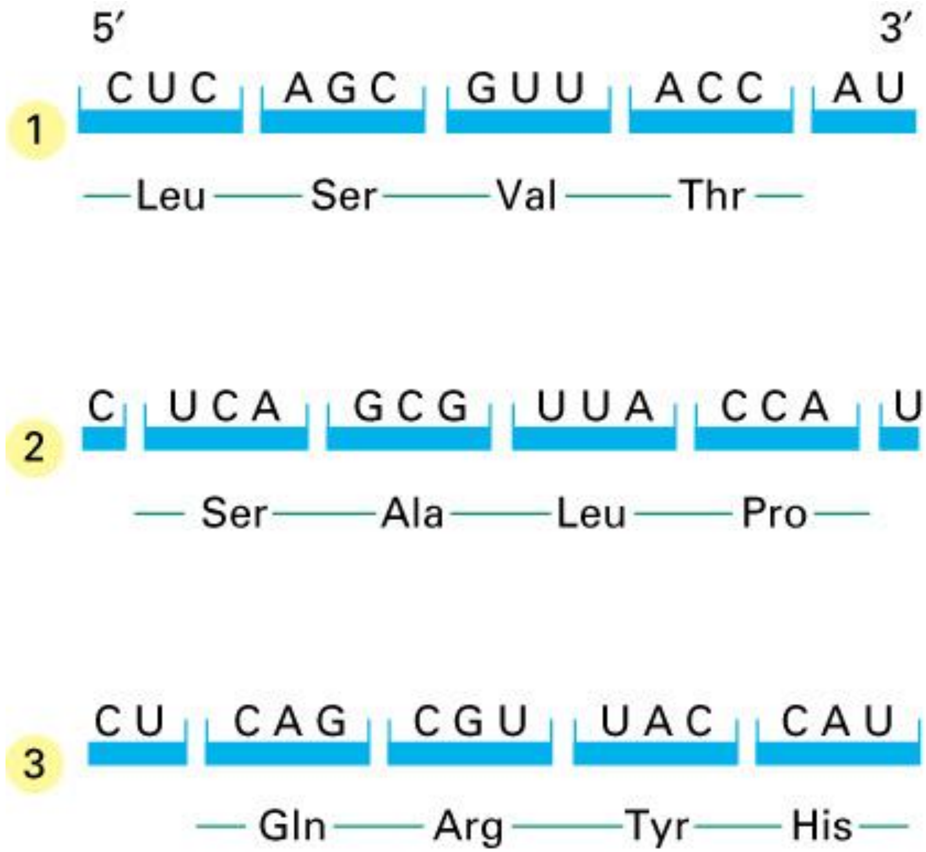


Figure 6–51. Molecular Biology of the Cell, 4th Edition.

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

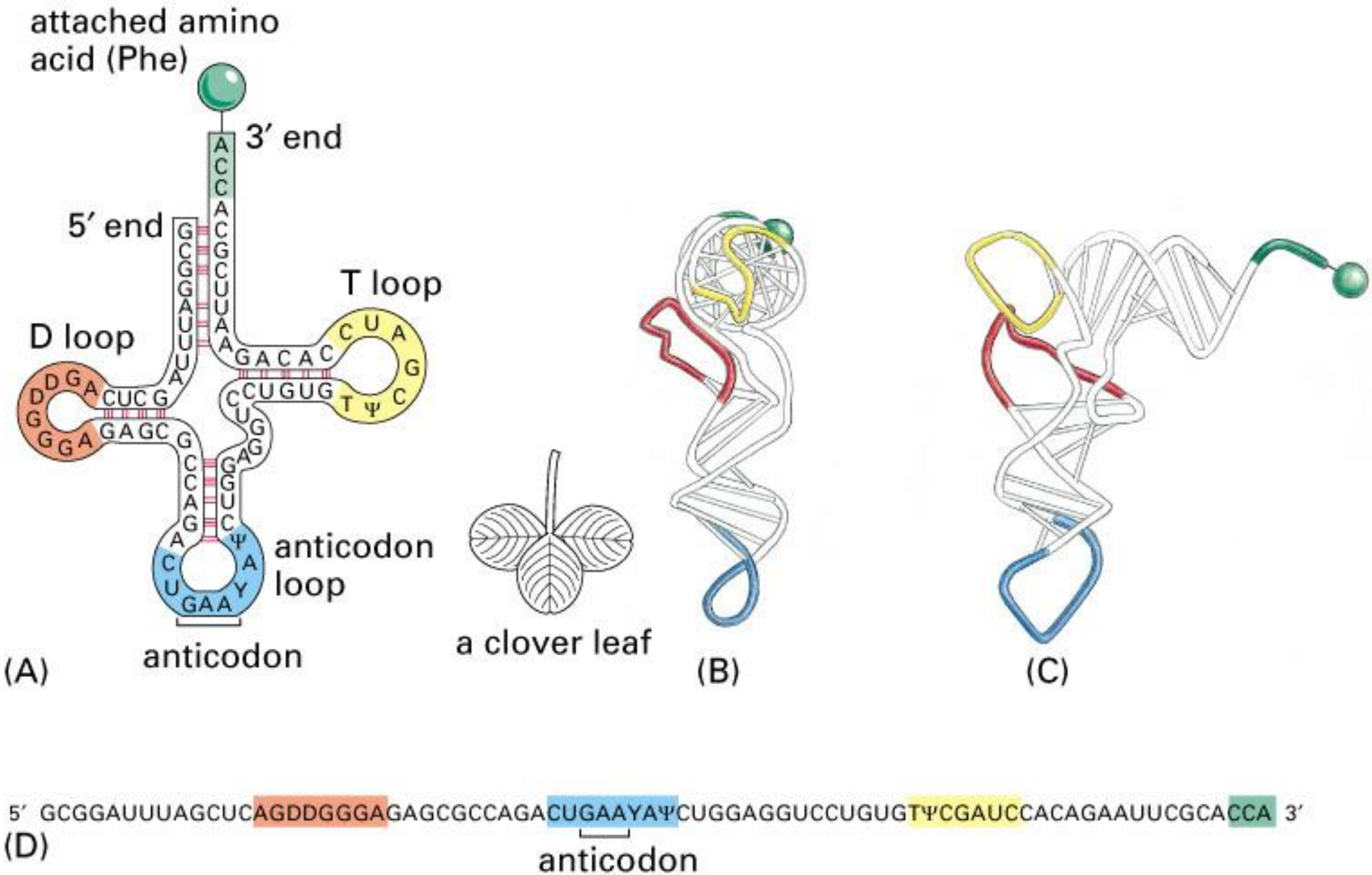
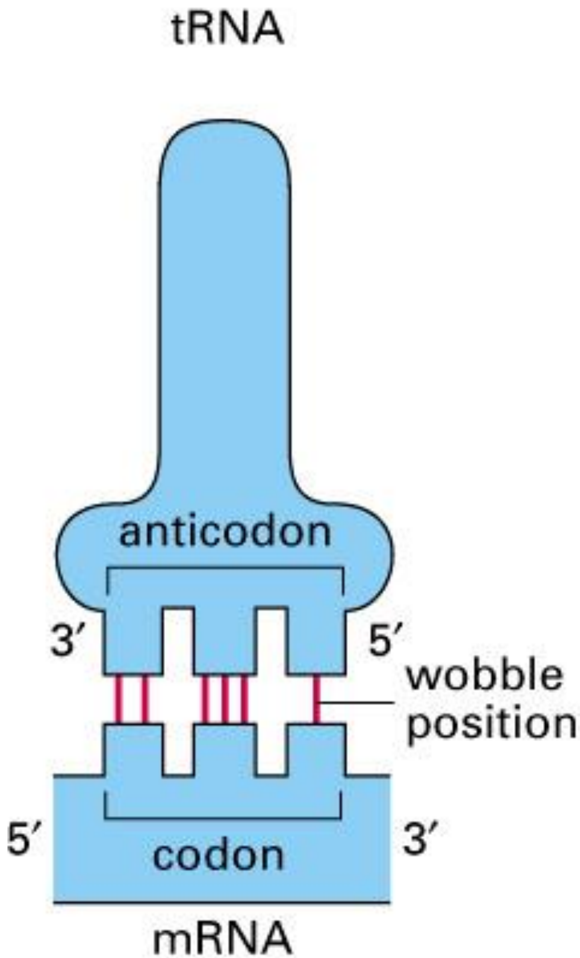


Figure 6–52. Molecular Biology of the Cell, 4th Edition.

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.