GROUP I intron splicing

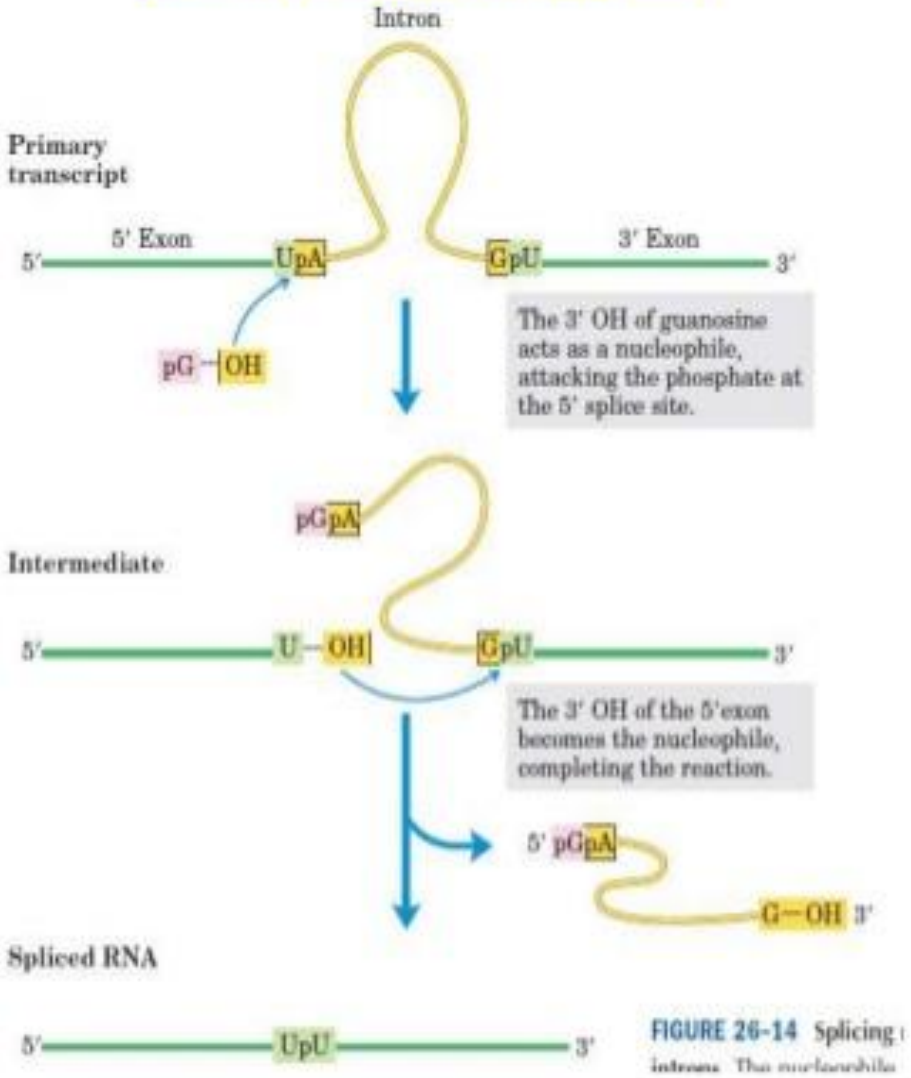


FIGURE 26-14 Splicing

GROUP II intron splicing

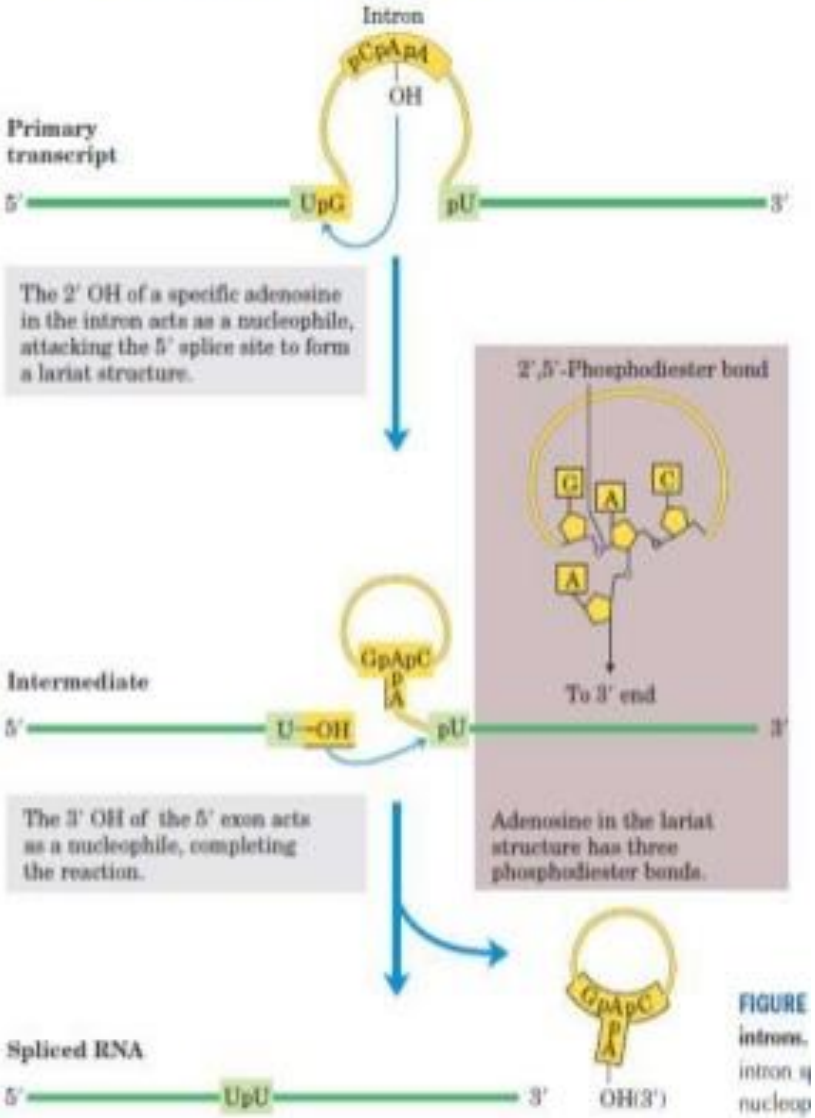
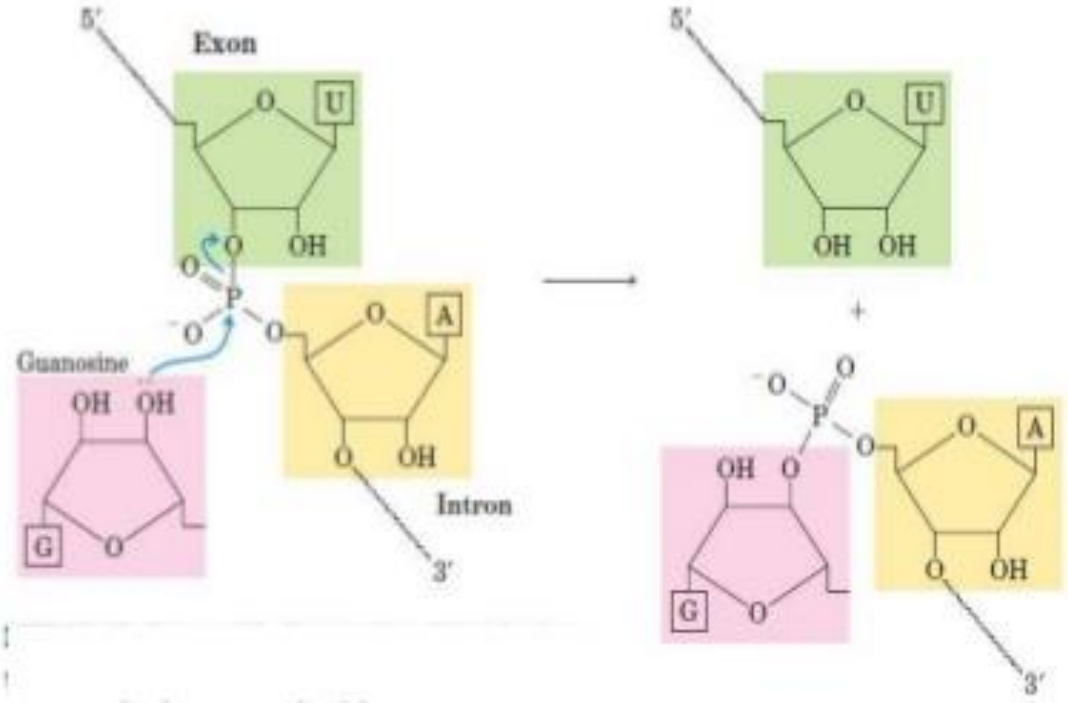


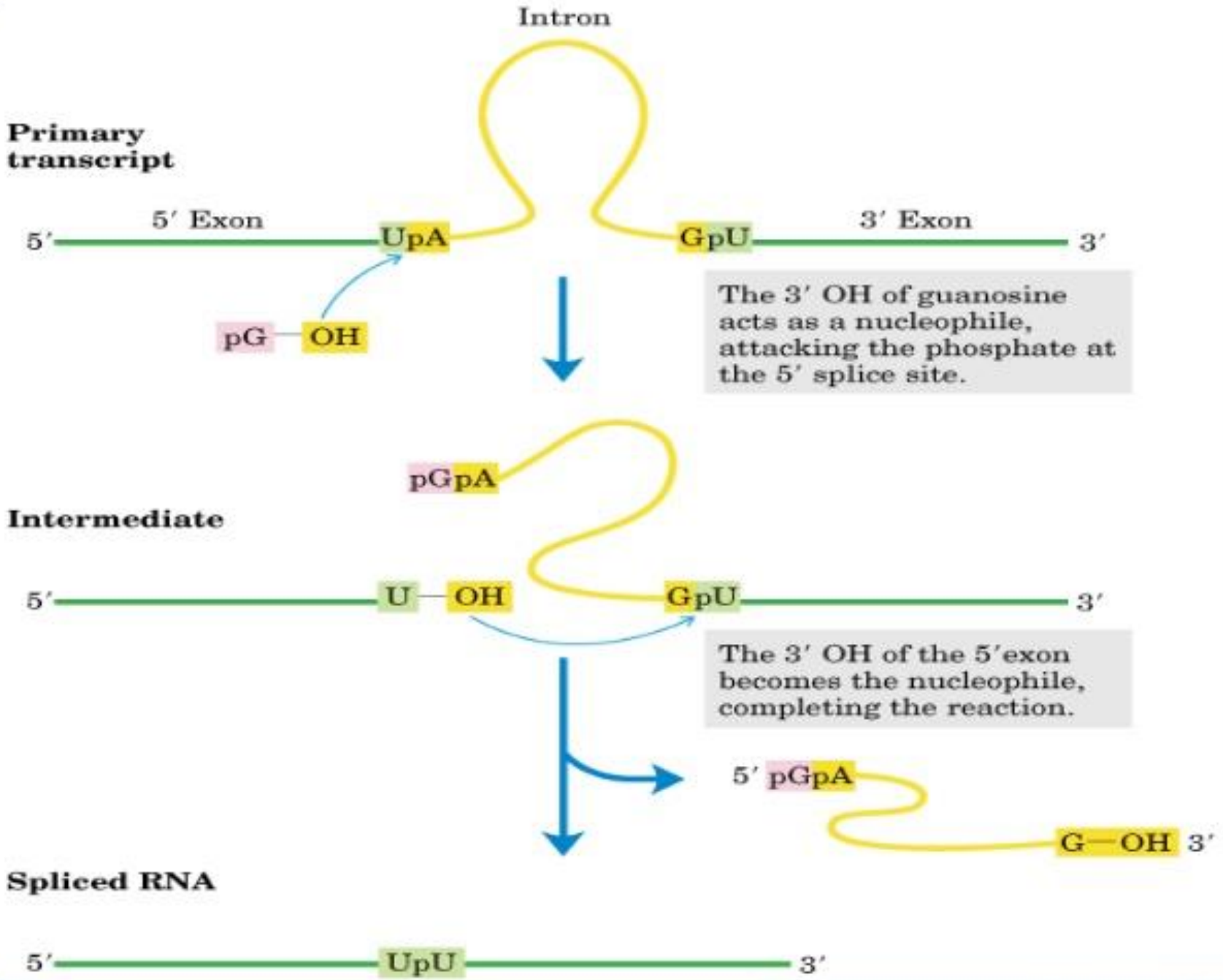
FIGURE
introns.

1. Self-splicing introns

This is a transesterification reaction in which the guanosine hydroxyl group attacks the phosphodiester bond between the 3′ end of the first exon and the first nucleotide of the intron.



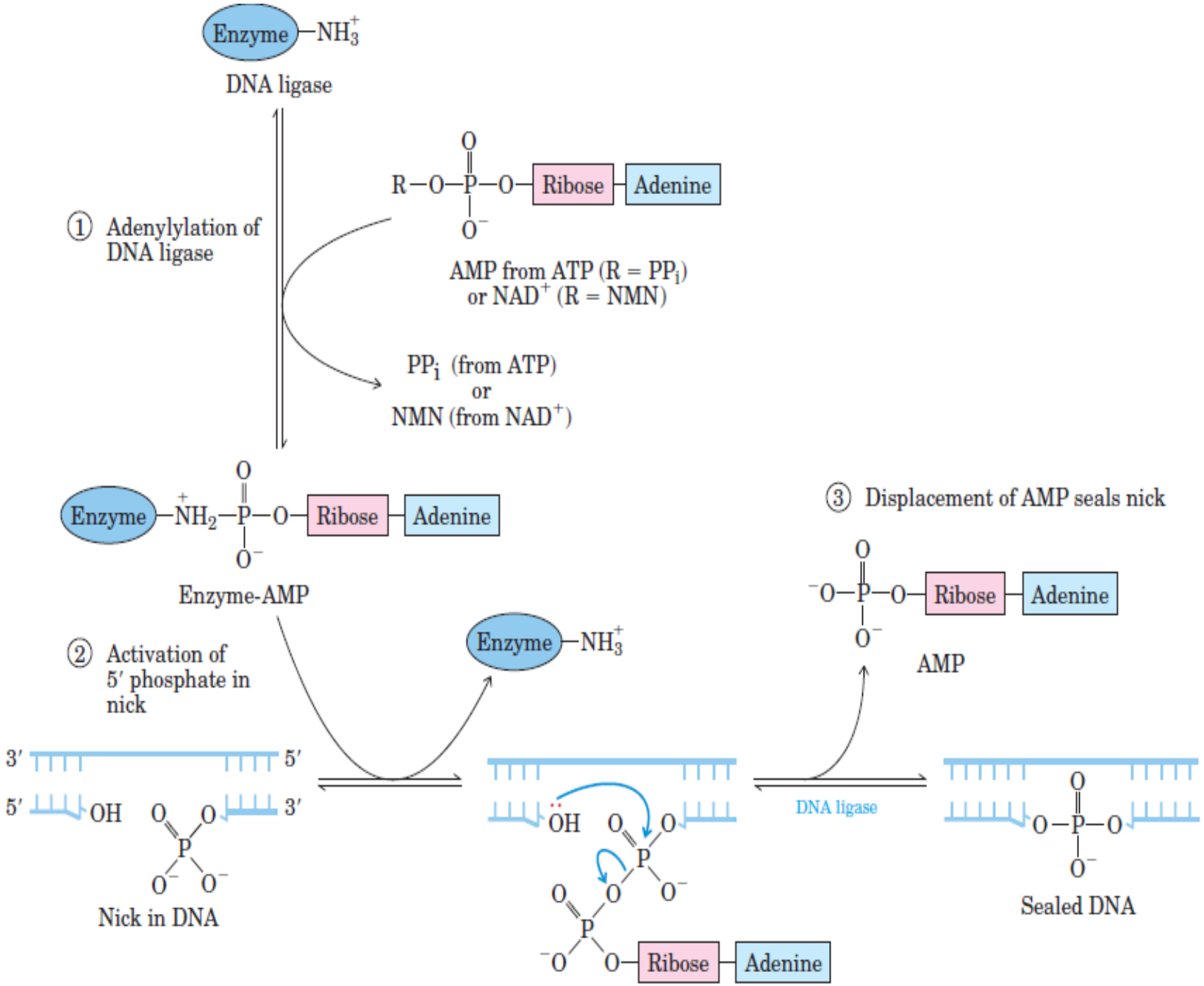
The guanosine remains attached to the 5′ end of the intron. Then, the 3′ end of the liberated exon attacks the extremity of base 413 from the intron to bring together the exon's two ends

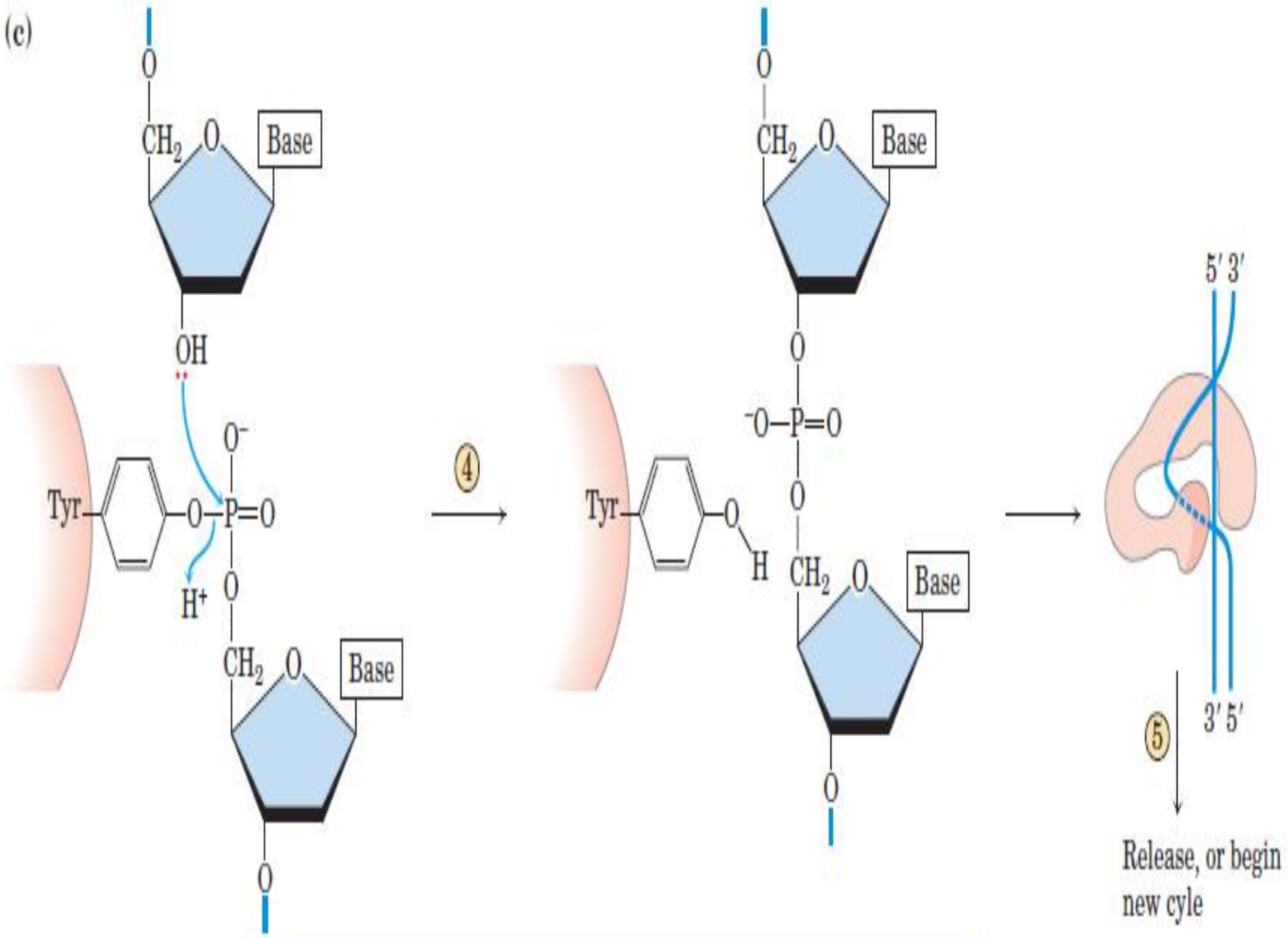

Intron
Primary transcript
5′ Exon
UpA
GpU
3′ Exon
5′
3′
pG
OH
The 3′ OH of guanosine acts as a nucleophile, attacking the phosphate at the 5′ splice site.
pGpA
Intermediate
5′
U
OH
GpU
3′
The 3′ OH of the 5′exon becomes the nucleophile, completing the reaction.
5′ pGpA
G
OH
3′
Spliced RNA
5′
UpU
3′

The group I splicing reaction requires a guanine nucleoside or nucleotide cofactor, but the cofactor is not used as a source of energy; instead, the 3′-hydroxyl group of guanosine is used as a nucleophile in the first step of the splicing pathway. The guanosine 3′-hydroxyl group forms a normal 3′,5′-phosphodiester bond with the 5′ end of the intron (Fig. 26–14). The 3′ hydroxyl of the exon that is displaced in this step then acts as a nucleophile in a similar reaction at the 3′ end of the intron. The result is precise excision of the intron and ligation of the exons.

In group II introns the reaction pattern is similar except for the nucleophile in the first step, which in this case is the 2′-hydroxyl group of an A residue *within* the intron (Fig. 26–15). A branched lariat structure is formed as an intermediate.

tion reaction steps (Fig. 26–13). A ribose 2′- or 3′-hydroxyl group makes a nucleophilic attack on a phosphorus and, in each step, a new phosphodiester bond is formed at the expense of the old, maintaining the balance of energy. These reactions are very similar to the DNA breaking and rejoining reactions promoted by topoisomerases (see Fig. 24–21) and site-specific recombinases (see Fig. 25–38).


Enzyme—NH3+
DNA ligase
① Adenylylation of DNA ligase
R—O—P—O—Ribose—Adenine
AMP from ATP (R = PPi) or NAD+ (R = NMN)
PPi (from ATP) or NMN (from NAD+)
Enzyme—NH2—P—O—Ribose—Adenine
Enzyme-AMP
② Activation of 5′ phosphate in nick
3′
5′
5′
OH
3′
Nick in DNA
Enzyme—NH3+
OH
Ribose—Adenine
③ Displacement of AMP seals nick
AMP
DNA ligase
Sealed DNA


(c)
Tyr
Base
OH
H+
4
5
5′ 3′
3′ 5′
Release, or begin new cyle