Nucleic Acid Structure & Function

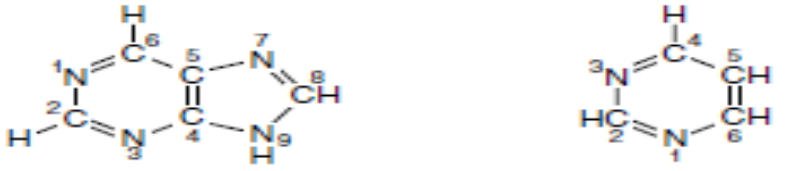


Figure 33–1. Purine and pyrimidine. The atoms are numbered according to the international system.

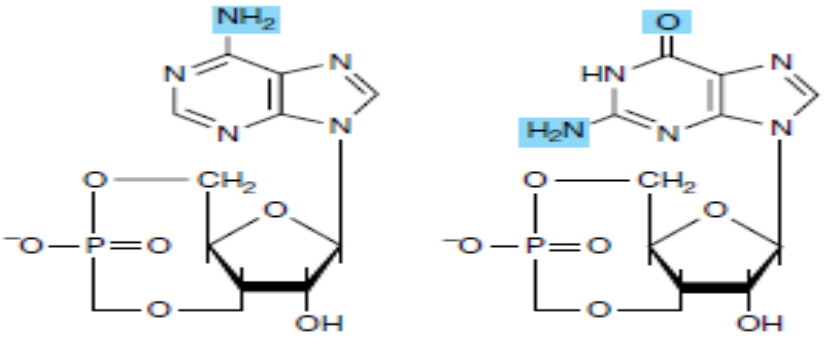
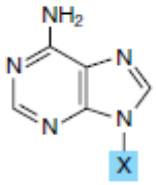
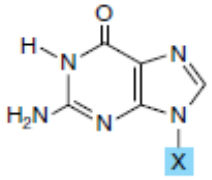
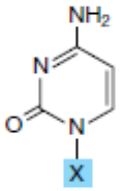
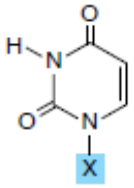
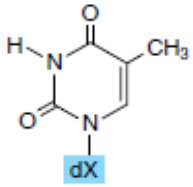


Figure 33–9. cAMP, 3′,5′-cyclic AMP, and cGMP.

Table 33–1. Bases, nucleosides, and nucleotides.

Base Formula	Base X = H	Nucleoside X = Ribose or Deoxyribose	Nucleotide, Where X = Ribose Phosphate
	Adenine A	Adenosine A	Adenosine monophosphate AMP
	Guanine G	Guanosine G	Guanosine monophosphate GMP
	Cytosine C	Cytidine C	Cytidine monophosphate CMP
	Uracil U	Uridine U	Uridine monophosphate UMP
	Thymine T	Thymidine T	Thymidine monophosphate TMP

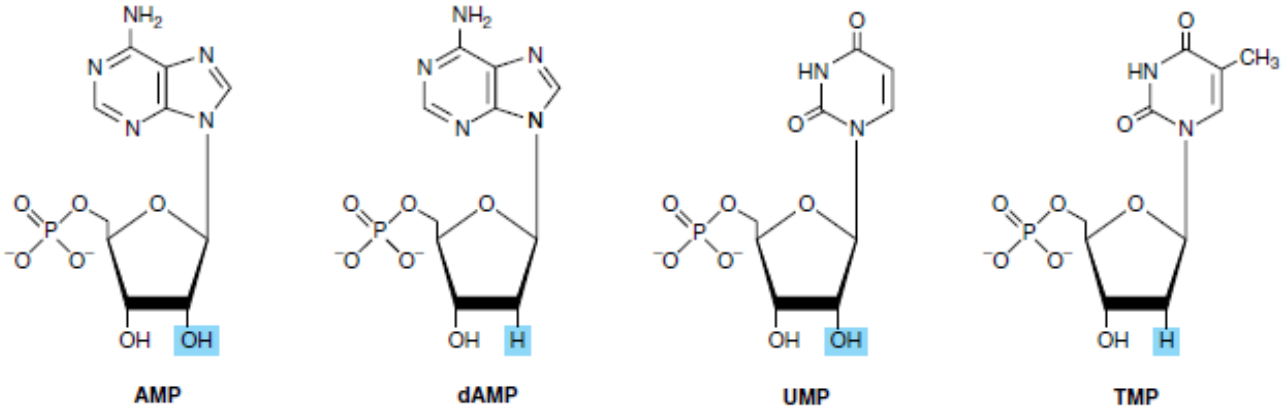


Figure 33–6. AMP, dAMP, UMP, and TMP.

Nucleosides & Nucleotides

Nucleo**sides** are derivatives of purines and pyrimidines that have a sugar linked to a ring nitrogen. Numerals with a prime (eg, 2′ or 3′) distinguish atoms of the sugar from those of the heterocyclic base. The sugar in **ribonucleosides** is D-ribose, and in **deoxyribonucleosides** it is 2-deoxy-D-ribose. The sugar is linked to the heterocyclic base via a β-**N-glycosidic bond,** almost always to N-1 of a pyrimidine or to N-9 of a purine (Figure 33–3).

Figure 33–2. Tautomerism of the oxo and amino functional groups of purines and pyrimidines.

Mononucleo**tides** are nucleo**sides** with a phosphoryl group esterified to a hydroxyl group of the sugar. The 3′- and 5′-nucleo**tides** are nucleo**sides** with a phosphoryl

group on the 3′- or 5′-hydroxyl group of the sugar, respectively. Since most nucleotides are 5′-, the prefix "5′-" is usually omitted when naming them. UMP and dAMP thus represent nucleotides with a phosphoryl group on C-5 of the pentose. Additional phosphoryl groups linked by **acid anhydride bonds** to the phosphoryl group of a mononucleotide form nucleoside **diphosphates** and **triphosphates** .Steric hindrance by the base restricts rotation about the β-N-glycosidic bond of nucleosides and nucleotides. Both therefore exist as syn or anti conformers. While both conformers occur in nature, anti conformers predominate. Table 33–1 lists the major purines and pyrimidines and their nucleoside and nucleotide derivatives. Single-letter abbreviations are used to identify adenine (A), guanine (G), cytosine (C), thymine (T), and uracil (U), whether free or present in nucleosides or nucleotides. The prefix "d" (deoxy) indicates that the sugar is 2′-deoxy-D-ribose (eg, dGTP)

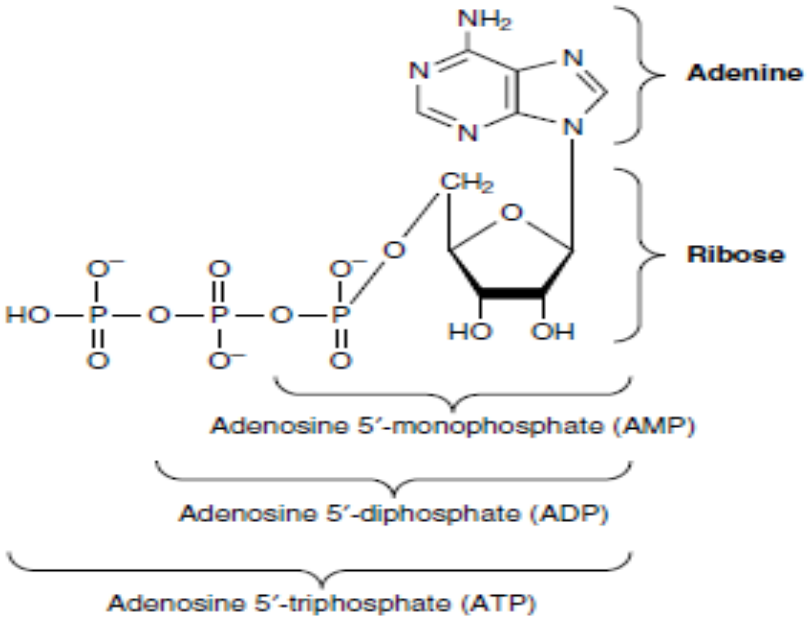


Figure 33–4. ATP, its diphosphate, and its monophosphate.

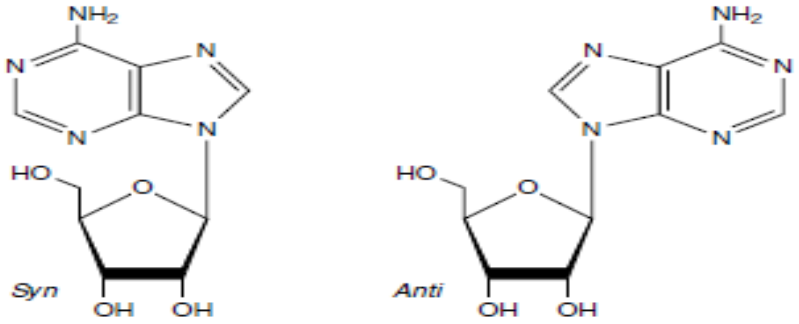


Figure 33–5. The syn and anti conformers of adenosine differ with respect to orientation about the N-glycosidic bond.

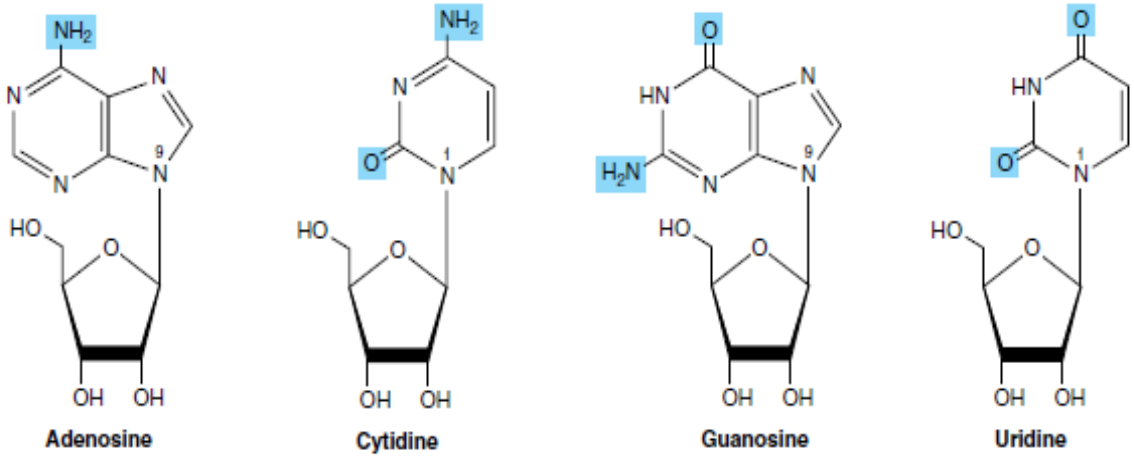


Figure 33–3. Ribonucleosides, drawn as the syn conformers.