1.2 GENERAL STRUCTURE OF NUCLEIC ACIDS

Nucleic acids are linear polymers of nucleotides strung together in a genetically determined order that is critical to their role as informational macromolecules. The two major types of nucleic acids are **DNA (deoxyribonucleic acid)** and **RNA (ribonucleic acid).** DNA and RNA differ in their chemistry and their role in the cell. Nucleic acids are informational macromolecules and contain nonidentical monomeric units in a specified sequence. The monomeric units of nucleic acids are called **nucleotides.** Each nucleotide consists of a five-carbon sugar to which is attached a phosphate group and a nitrogen-containing aromatic base. The phosphate is joined by a phosphoester bond to the 5' carbon of the sugar, and the base is attached to the 1' carbon of the sugar. Without the phosphate, the remaining base-sugar unit is called a **nucleoside.** Each pyrimidine and purine may therefore occur as the free base, the nucleoside, or the nucleotide. Both DNA and RNA contain two major **purine** bases, **adenine (A)** and **guanine (G)**, and two major **pyrimidines**. In both DNA and RNA one of the pyrimidines is cytosine (C), but the second major pyrimidine is **thymine (T)** in DNA and **uracil (U)** in RNA. Only rarely does thymine occur in RNA or uracil in DNA.

Nucleic acids have two kinds of pentoses. The recurring deoxyribonucleotide units of DNA contain **2'-deoxy-D-ribose**, and the ribonucleotide units of RNA contain **D-ribose**. In nucleotides, both types of pentoses are in their β-furanose (closed five-membered ring) the pentose ring is not planar but occurs in one of a variety of conformations generally described as "puckered." The base of a nucleotide is joined covalently (at N-1 of pyrimidines and N-9 of purines) in an N-β-glycosyl bond to the 1' carbon of the pentose, and the phosphate is esterified to the 5' carbon. The N-β-glycosyl bond is formed by removal of the elements of water (a hydroxyl group from the pentose and hydrogen from the base), as in O-glycosidic bond formation. Although nucleotides bearing the major purines and pyrimidines are most common, both DNA and RNA also contain some minor bases. In DNA the most common of these are methylated forms of the major bases; in some viral DNAs, certain bases may be hydroxymethylated or glycosylated. Altered or unusual bases in DNA molecules often have roles in regulating or protecting the genetic information. Minor bases of many types are also found in RNAs, especially in tRNAs. Following figure describes the structure of various components of nucleic acids.

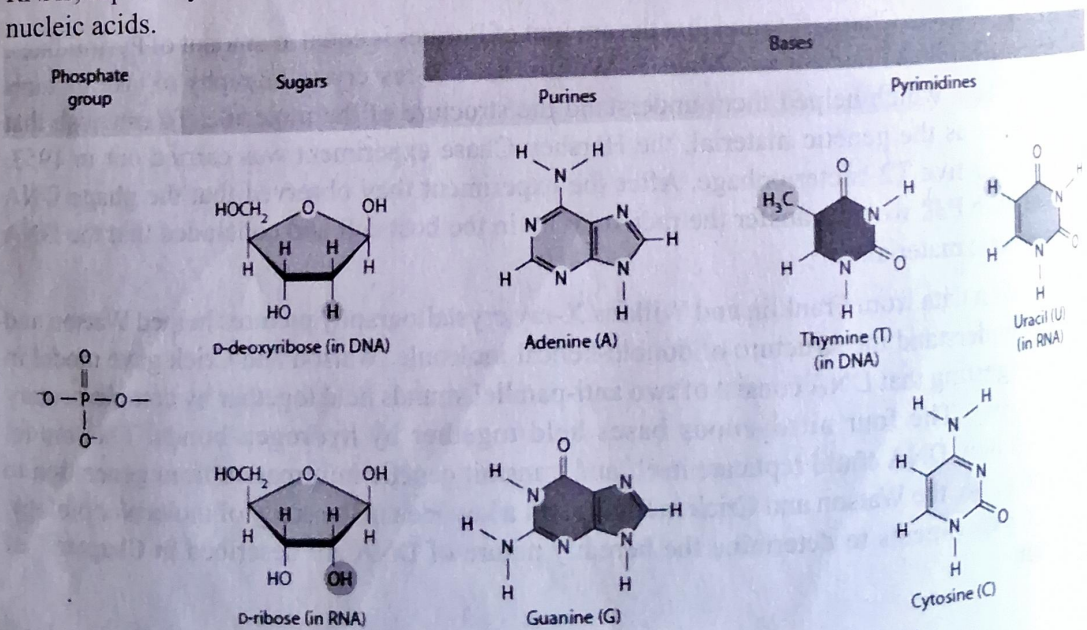

Fig. 1.1. *Chemical structure of various components of nucleic acids.*

TABLE 1.1 *Nitrogen bases, nucleosides, nucleotides and their nomenclature.*

	RNA		DNA	
Bases	**Nucleoside**	**Nucleotide**	**Deoxynucleoside**	**Deoxynucleotide**
Purines				
Adenine (A)	Adenosine	Adenosine monophosphate (AMP)	Deoxyadenosine	Deoxynucleotide monophosphate (dAMP)
Guanine (G)	Guanosine	Guanosine monophosphate (GMP)	Deoxyadenosine	Deoxynucleotide monophosphate (dGMP)
Pyrimidines				
Cytosine (C)	Cytidine	Cytidine monophosphate (CMP)	Deoxyadenosine	Deoxyadenosine monophosphate (dCMP)
Uracil (U)	Uridine	Uridine monophosphate (UMP)	–	–
Thymine (T)	–	–	Deoxyadenosine	Deoxyadenosine monophosphate (dCMP)