Let's begin our discussion of the structure and properties of biochemical molecules with a description of nucleic acids.

There are two general kinds of nucleic acids-ribonucleic acid (RNA) and deoxyribonucleic acid (DNA).

DNA is the repository of genetic information; it contains the information required for the synthesis of all the protein molecules in a cell and the information to regulate the synthesis of these molecules.

Ribonucleic acids have a number of functions. mRNA (messenger RNA) is the transmitter of genetic information from the site of DNA in a cell (primarily the nucleus and to a smaller extent the mitochondrian and chloroplast) to the site of protein biosynthesis in the cell (ribosome).

As suggested last hour (Fig1-14), nucleic acids are linear polymers composed of monomer units called nucleotides linked to each other in a chain.

Let's first consider the structure and properties of the nucleotides of DNA.

The general structure of these nucleotides as shown in (Fig 22-1) is -

The nucleotide is itself composed of three components: a phosphate group, β-2'-deoxy-D-ribose (a sugar) and a heterocyclic nitrogenous base.

The sugar is drawn as a Haworth perspective, a planar projection. In this representation, the five-member ring appears to be planar and is shown perpendicular to the page with two carbon atoms in the foreground and the ring oxygen atom in the background.

All of the hydrogen atoms bonded to carbon are shown. Alternatively, the structure can be drawn without the H atoms bonded to carbon. This is a common convention in organic chemistry. All of the H atoms bonded to O and N must be shown.

The numbered carbon atoms of deoxy-D-ribose in the nucleotide are primed to distinguish them from the numbered carbon and nitrogen atoms in the nitrogenous base.

Note that in the nucleotides of DNA (deoxyribonucleic acid), the 2' carbon of β-deoxy-D-ribose does not have a hydroxyl oxygen atom bound to it in contrast to C-2 in β-D-ribose (Fig 21-1).

β refers to the stereochemical configuration of C-1 in the cyclic form of 2-deoxy-D-ribose.

The β configuration of the anomeric carbon (C-1) is that for which the OH group is on the same side of the ring as C-5.

Recall that the D and L designations refer to stereoisomers that have configurations corresponding to the D and L stereoisomers of glyceraldehyde.

The Fisher projection of D-glyceraldehyde is -

The penultimate carbon (C-4) of 2-deoxy-D-ribose, shown below in the open chain form, has the same stereochemical configuration as that of D-glyceraldehyde.

Note that the open chain form of 2-deoxy-D-ribose has an aldehyde group.

β-2-deoxy-D-ribose is the cyclic hemiacetal form of 2-deoxy-D-ribose that results from intramolecular reaction of the C-4 oxygen of the OH group with the C-1 aldehyde group.

Four principal heterocyclic nitrogenous bases are found in DNA: adenine (A), guanine (G), cytosine (C), and thymine (T).

Adenine and guanine are bicyclic nitrogen heterocycles referred to as purines -

Cytosine and thymine are monocyclic nitrogen heterocycles referred to as pyrimidines -

Purines and pyrimidines are referred to as bases because the $NH_2$ group and ring nitrogen atoms are weakly basic, i.e., they will accept a proton in an acid-base equilibrium –

Another characteristic of nucleotide bases is that they can exist in other tautomeric forms (Fig 22-7) -