Deoxyribonucleic acid (DNA)

It a molecule composed of two polynucleotide chains that coil around each other to form a double helix carrying genetic instructions for the development, functioning, growth and reproduction of all known organisms and many viruses. DNA and ribonucleic acid (RNA) are nucleic acids. Alongside proteins, lipids and complex carbohydrates (polysaccharides), nucleic acids are one of the four major types of macromolecules that are essential for all known forms of life.

The two DNA strands are known as polynucleotides as they are composed of simpler monomeric units called nucleotides. Each nucleotide is composed of one of four nitrogen-containing nucleobases (cytosine [C], guanine [G], adenine [A] or thymine [T]), a sugar called deoxyribose, and a phosphate group. The nucleotides are joined to one another in a chain by covalent bonds (known as the phospho-diester linkage) between the sugar of one nucleotide and the phosphate of the next, resulting in an alternating sugar-phosphate backbone. The nitrogenous bases of the two separate polynucleotide strands are bound together, according to base pairing rules (A with T and C with G), with hydrogen bonds to make double-stranded DNA. The complementary nitrogenous bases are divided into two groups, pyrimidines and purines. In DNA, the pyrimidines are thymine and cytosine; the purines are adenine and guanine.

TYPES OF DNA

At least three DNA conformations are believed to be found in nature-

A-DNA, B-DNA, and Z-DNA. The *B* form described by James Watson and Francis Crick is believed to predominate in cells. It is 23.7 Å wide and extends 34 Å per 10 bp of sequence. The double helix makes one complete turn about its axis every 10.4–10.5 base pairs in solution. This frequency of twist (termed the helical *pitch*) depends largely on stacking forces that each base exerts on its neighbours in the chain. The absolute configuration of the bases determines the direction of the helical curve for a given conformation.

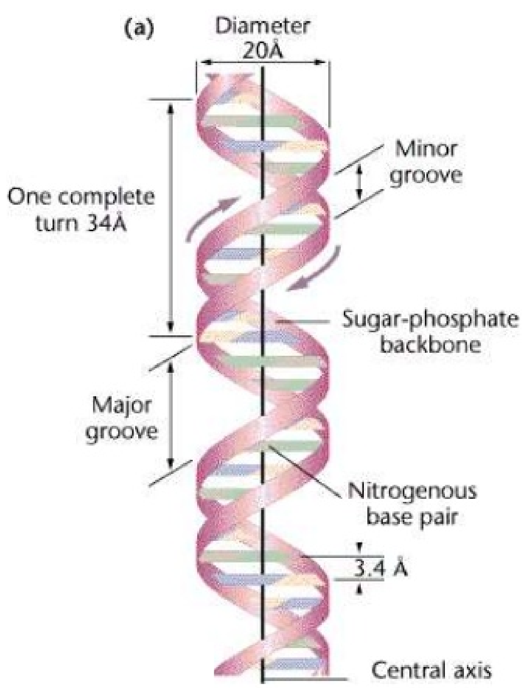


FIG: Structural features of a nucleic acid

A-DNA and Z-DNA differ significantly in their geometry and dimensions to B-DNA, although still form helical structures. It was long thought that the A form only occurs in dehydrated samples of DNA in the laboratory, such as those used in crystallographic experiments, and in hybrid pairings of DNA and RNA strands, but DNA dehydration does occur in vivo, and A-DNA is now known to have biological functions. Segments of DNA that cells have methylated for regulatory purposes may adopt the Z geometry, in which the strands turn about the helical axis the opposite way to A-DNA and B-DNA. There is also evidence of protein-DNA complexes forming Z-DNA structures.

Other conformations are possible; A-DNA, B-DNA, C-DNA, E-DNA, L-DNA (the enantiomeric form of D-DNA), P-DNA, S-DNA, Z-DNA, etc. have been described so far. In fact, only the letters F, Q, U, V, and Y are now available to describe any new DNA structure that may appear in the future. However, most of these forms have been created synthetically and have not been observed in naturally occurring biological systems.

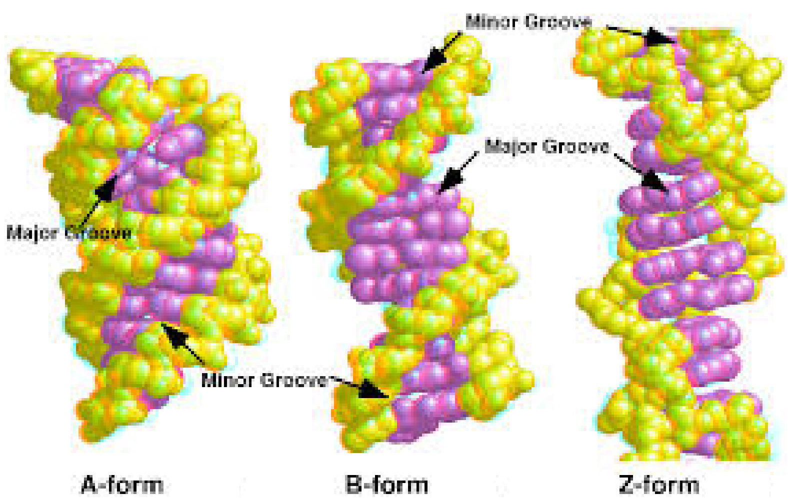
Comparison of A-, B-, and Z-DNA

	Helix type		
	A	B	Z
Shape	Broadest	Intermediate	Narrowest
Rise per base pair	2.3 Å	3.4 Å	3.8 Å
Helix diameter	25.5 Å	23.7 Å	18.4 Å
Screw sense	Right-handed	Right-handed	Left-handed
Glycosidic bond	*anti*	*anti*	alternating *anti and syn*
Base pairs per turn of helix	11	10.4	12
Pitch per turn of helix	25.3 Å	35.4 Å	45.6 Å
Tilt of base pairs from normal to helix axis	19°	1°	9°
Major groove	Narrow and very deep	Wide and quite deep	Flat
Minor groove	Very broad and shallow	Narrow and quite deep	Very narrow and deep

LEFT HANDED Z DNA

Z-DNA is one of the many possible double helical structures of DNA. It is a left-handed double helical structure in which the helix winds to the left in a zigzag pattern, instead of to the right, like the more common B-DNA form. Z-DNA is thought to be one of three biologically active double-helical structures along with A-DNA and B-DNA.

Left-handed DNA was first discovered by Robert Wells and colleagues, during their studies of a repeating polymer of inosine–cytosine. The relationship between Z-DNA and the more familiar B-DNA was indicated by the work of Pohl and Jovin, who showed that the ultraviolet circular dichroism of poly(dG-dC) was nearly inverted in 4 M sodium chloride solution. The suspicion that this was the result of a conversion from B-DNA to Z-DNA was confirmed by examining the Raman spectra of these solutions and the Z-DNA crystals. The crystallisation of a B- to Z-DNA junction in 2005 provided a better understanding of the potential role Z-DNA plays in cells. Whenever a segment of Z-DNA forms, there must be B–Z junctions at its two ends, interfacing it to the B-form of DNA found in the rest of the genome.



References:

1.en.wikipedia.org/wiki/Z-Dna

2.en.wikipedia.org/wiki/DNA