Watson and crick model of DNA

In 1953, J.D. Watson and F.H.C. Crick proposed a precise three dimensional model of DNA structure based on model building studies, base composition and X-ray diffraction studies carried out by Maurice Wilkins and Rosalind Franklin. This model is popularly known as the DNA double helix.

Different forms of DNA

Particulars	**A DNA**	**B DNA**	**Z DNA**
Helix	Right handed	Right handed	Left handed
Base pairs per turn	~11	~10.5	~12
Helical Diameter (nm)	2.6	**2.0**	**1.8**
Helical length (nm)	**2.6**	**3.4**	**3.7**
Shape	Broadest	Intermediate	Narrowest
Major Grove	Wide, deep	Narrow, deep	Flat
Minor Grove	Narrow, shallow	Broad, shallow	Narrow, deep

Structure

The B form DNA, also known as the Watson- Crick DNA is the most stable and prevalent form of DNA. The important structural features of B- DNA are:

1. There are two polynucleotide chains in the DNA spirally twisted around each other to form a right handed double helix.
2. The sugar-phosphate backbones remain on the outside, while the core of the helix contains the purine and pyrimidine bases.

3. The diameter of DNA is 2 nm or 20 A°. The length of a complete turn of helix is 3.4 nm or 34 A° i.e. there are ~10.5bp per turn.

4. The DNA helix has a shallow groove called minor groove (-1.2nm) and a deep groove called major groove (-2.2nm). Proteins interact with DNA through the minor and major grooves without disrupting the DNA strands.

5. Each polynucleotide chain is made up of four different bases. The purine bases present in DNA are adenine and guanine and the pyrimidine bases present are thymine and cytosine. The sequence of purine and pyrimidine carry the genetic information whereas the sugar and phosphate groups perform the structural role.

6. Each polynucleotide chain has direction or polarity. Further, each polynucleotide chain has 5′phosphorylated and 3′hydroxyl ends.

7. The two strands run in opposite direction (i.e.) they are antiparallel.

8. The two strands are held together by hydrogen bonds (base pairing) between the purine and pyrimidine bases of the opposite strands.

   Watson and Crick deduced the rules of base pairing they are:

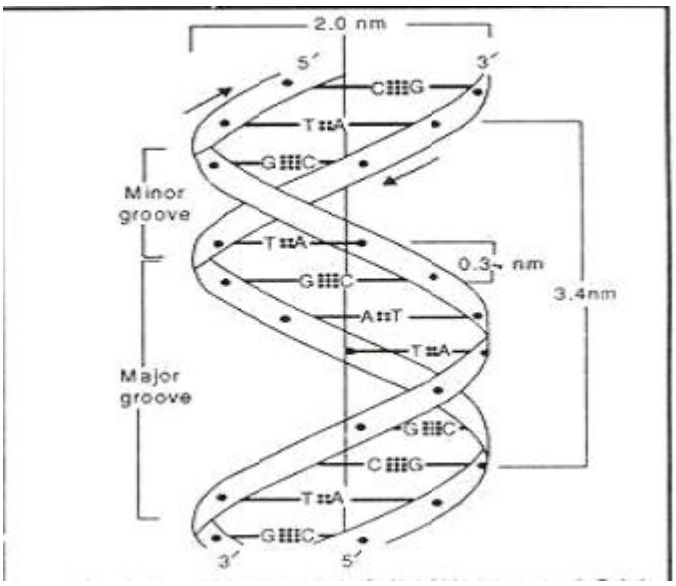
   - The purine adenine (A) always pairs with the pyrimidine thymine (T).
   - The purine guanine (G) always pairs with the pyrimidine cytosine (C).

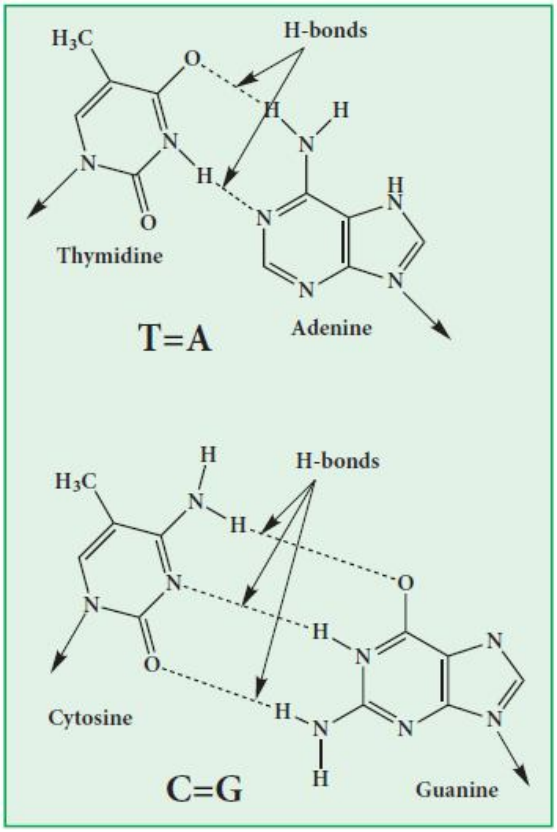
Base pairing is achieved through hydrogen bonding.

Therefore, if adenine appears in one strand, thymine is found in the opposite strand and vice versa. When guanine is found in one strand, cytosine is present in the opposite strand and vice versa. So, Base sequence of one strand is complementary to the opposite strand. For example, If the sequence 5'ATGGACC3′is present in one strand, the complementary strand will be having the sequence, 3'TACCTGG5'.

There are two hydrogen bonds between A and T and three hydrogen bonds between G and C.

9. Base composition of DNA obeys Chargaff's rule.


2.0 nm
5′
3′
C≡G
T=A
G≡C
Minor groove
T=A
G≡C
A=T
T=A
Major groove
G≡C
C≡G
T=A
G≡C
3′
5′
0.3 nm
3.4nm


H-bonds
Thymidine
Adenine
T=A
H-bonds
Cytosine
Guanine
C=G