

Nucleic acid metabolism and Genetic information transfer

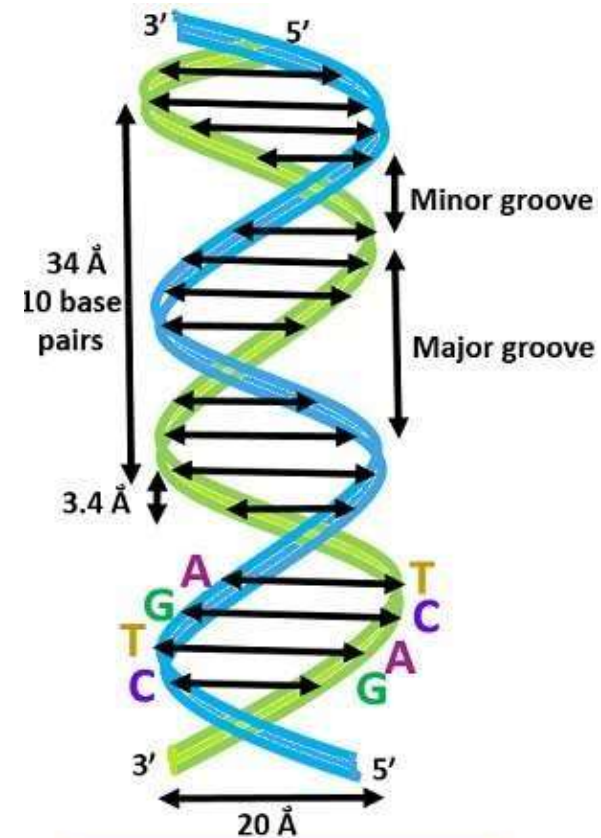
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Organization of mammalian genome

- The total DNA (genetic information) contained in an organism or a cell is regarded as the genome.
- The genome is **the storehouse of biological information.**
- It includes the chromosomes in the nucleus and the DNA in mitochondria, and chloroplasts.

Structure of DNA

- DNA is a **polymer of deoxyribonucleotides**.
- It is composed of monomeric units namely **deoxyadenylate (dAMP)**, **deoxyguanylate (dGMP)**, **deoxycytidylate (dCMP)** and **deoxythymidylate (dTMP)**.
- The monomeric deoxynucleotides in DNA are held together by **3',5'-phosphodiester bridges**.
- Chargaff's rule of DNA composition:
- DNA had equal numbers of adenine and thymine residues ($A = T$) and equal numbers of guanine and cytosine residues ($G = C$).
- The **double helical structure** of DNA was proposed by **James Watson and Francis Crick**.



STRUCTURE OF DNA BY
WATSON AND CRICK

1. The DNA is a **right handed double helix**. It consists of two polydeoxyribo nucleotide chains twisted around each other on a common axis.
2. The two strands are **antiparallel**, i.e., one strand runs in the 5' to 3' direction while the other in 3' to 5' direction.
3. The **width** (or diameter) of a double helix is **20 Å** (2 nm).
4. Each turn of the helix is 34 Å (3.4 nm) with 10 pairs of nucleotides, each pair placed at a **distance of about 3.4 Å**.
5. Each strand of DNA has a **hydrophilic 3'-5' phosphodiester bonds on the outside** of the molecule while the **hydrophobic bases are stacked inside**.
6. The two polynucleotide chains are not identical but **complementary** to each other due to base pairing.
7. The two strands are held together by **H-bonds** formed by complementary base pairs. (A-T pair has 2 and G-C pair has 3 hydrogen bonds).
8. The hydrogen bonds are formed **between a purine and a pyrimidine** only.
9. The complementary base pairing in DNA helix proves **Chargaff's rule**.
10. The genetic information resides on one of the two strands known as **template strand or sense strand**. The opposite strand is **antisense**

Structure of RNA

- RNA is a **polymer** of **ribonucleotides** held together by 3',5'- phosphodiester bridges.
- Pentose: The sugar in RNA is ribose (deoxyribose in DNA).
- Pyrimidine : RNA contains the pyrimidine uracil (thymine in DNA).
- Single strand: RNA is usually a single stranded polynucleotide.
- Chargaff's rule-not obeyed.
- Susceptibility to alkali hydrolysis : Alkali

- The **mRNA** is synthesized in the nucleus as heterogeneous nuclear RNA (hnRNA).
- mRNA is capped at the 5'-terminal end by 7-methylguanosine triphosphate.
- The 3'-terminal end of mRNA contains a polymer of adenylate residues (20-250 nucleotides) which is known as poly (A) tail.
- The structure of **tRNA** resembles a clove leaf and contain acceptor arm, the anticodon arm, The D arm, the TYC arm, the variable arm.

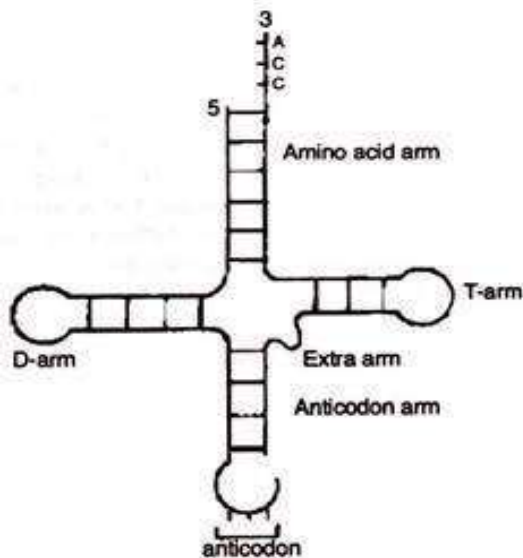
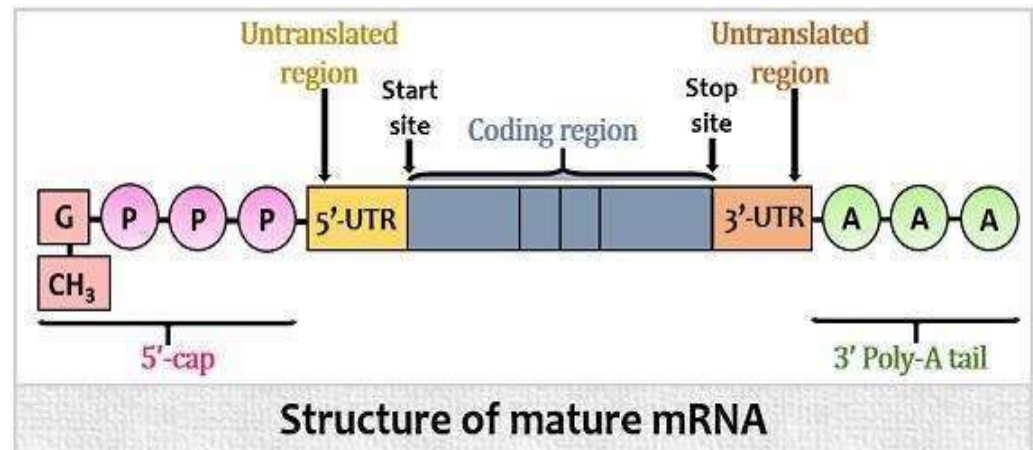


Fig. 7.3. Clover leaf model of tRNA.



Structure of mature mRNA

FUNCTIONS OF DNA

- DNA is the chemical basis of heredity and regarded as the reserve bank of genetic information
- DNA is exclusively responsible for maintaining the identity of different species of organisms.
- Every aspects of cellular information is under the control of DNA.
- The DNA is organized into **genes**, the fundamental units of genetic information.
- The genes control the protein synthesis through the mediation of RNA

FUNCTIONS OF RNA

- mRNA transfers genetic information from genes to ribosomes to synthesize proteins.
- rRNA provides structural framework for ribosomes.
- tRNA transfers amino acid to mRNA for protein synthesis.
- hnRNA serves as precursor for mRNA and other RNAs.

DNA

RNA

Proteins