

Nucleic Acid Structure

DNA: Deoxyribonucleic acid

Usually double stranded (ds)

Functions to store genetic information:

All eukaryotes and prokaryotes

Many viruses (bacterial, plant, animal)

Chloroplasts and mitochondria

RNA: Ribonucleic acid

Usually single stranded (ss)

Variety of specialized functions

*mRNA: **Messenger RNA** (final product of most genes)
Carries genetic information to ribosome
Information translated to AA sequence in protein*

*tRNA: **Transfer RNA** (product of tRNA genes)
Binds to specific amino acid and mRNA codon
Brings proper AA to ribosome for translation*

*rRNA: **Ribosomal RNA** (product of rRNA genes)
Component of ribosome
Facilitates mRNA binding to ribosome*

*snRNA : **Small nuclear RNA** (eukaryotes)
Component of spliceosome
Involved in RNA processing*

*hnRNA: **Heterogeneous nuclear RNA** (eukaryotes)
Initial product of transcription of most genes
Later processed to form "mature" RNAs*

*Catalytic: RNAs with enzymatic activity (Ribozymes)
Exception to dogma that all enzymes = proteins
Some modify themselves (self-splicing introns)
Some modify other substrates (Ribonuclease P)
Important implications for early evolution of life*

*Template: RNAs that Direct Synthesis of DNA
Example: RNA component of telomerase
Enzyme that makes chromosome ends*

Viroid: *Unusual, infectious RNAs in plants
Smaller and more reduced than viruses
Do not code for proteins
Cause disease symptoms in plants*

Genome: *Genetic material of RNA virus (TMV; HIV)*

Conclude: **RNAs have many different functions**

However: *All nucleic acids are related in structure*

Nucleotide: **[P] – [S] – [NB]**

P = Phosphate group

S = Pentose sugar

N = Nitrogenous base

Pentoses: 5-Carbon Sugars

DNA: Deoxyribose [-H] on 2' carbon atom

RNA: Ribose [-OH] on 2' carbon atom

Phosphates attach to 5' and 3' carbon atoms

Nitrogenous base attaches to 1' carbon atom

Nitrogenous Bases:

Purines: *Double heterocyclic ring
Adenine (A) and Guanine (G)*

Pyrimidines: *Single heterocyclic ring
Cytosine (C)
Thymine (T) in DNA
Uracil (U) in RNA*

Nucleoside: **[S] – [NB]**

Nucleotide: *Nucleoside + Phosphate(s)*

Nucleoside triphosphate:

NTP: ATP, GTP, CTP, UTP

dNTP: dATP, dGTP, dCTP, dTTP

Structure: [PPP]-[S]-[NB]

Nitrogenous base pairing:

Between purine on 1 strand and pyrimidine on complementary strand

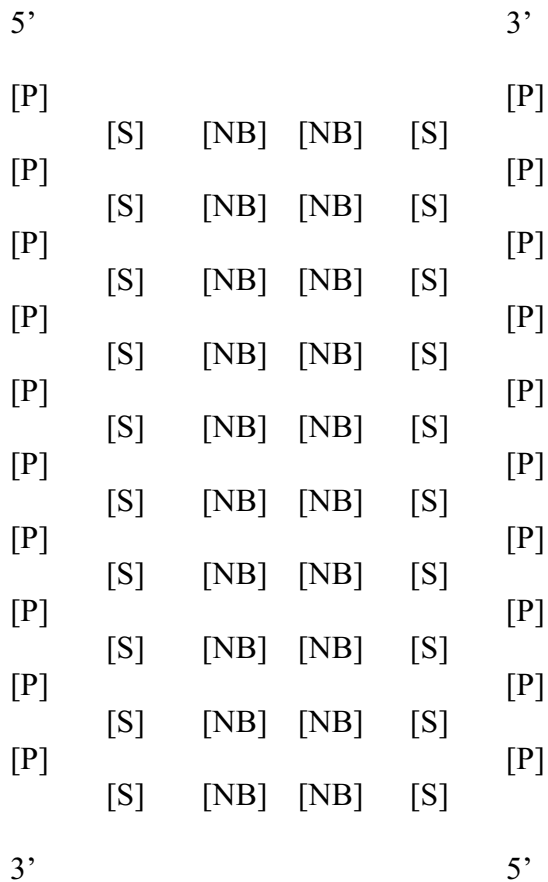
A : T and G : C

Hydrogen Bonding: *A:T = 2 and G:C = 3 H bonds*



Location: Between bases on complementary strands

ds DNA: Paired Strands are Anti-parallel



Physical Properties of ds DNA:

Structure determined by X-ray crystallography

Right-handed double helix

Width ~ 20 Angstroms (2 nm)

Length ~ 3.4 Angstroms / bp

10 bp / complete turn of double helix

Major and minor grooves – binding sites

Hydrophilic (charged) backbone

Hydrophobic core of stacked bases

Several related structural forms (A,B,Z....)

*Differ in: Tightness of bp stacking
 Number of bp per turn
 Biological significance*