Lecture notes

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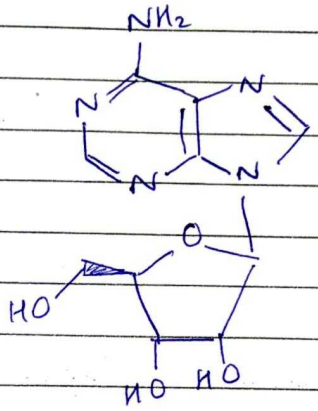
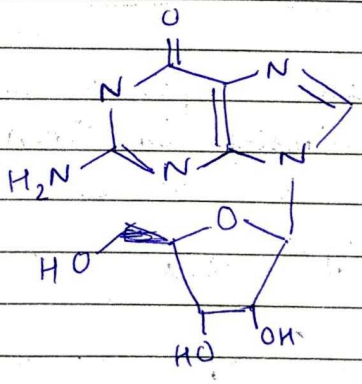
# BIOMOLECULES - 12

## Nucleosides in RNA:

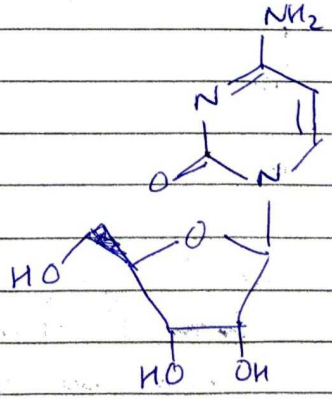
Adenosine:



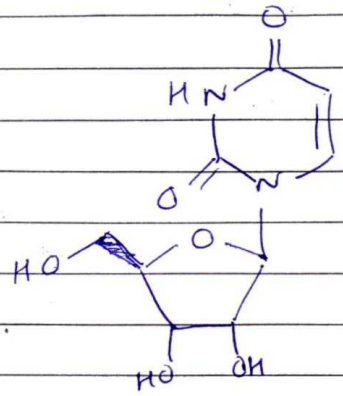

Guanosine:




Cytidine:



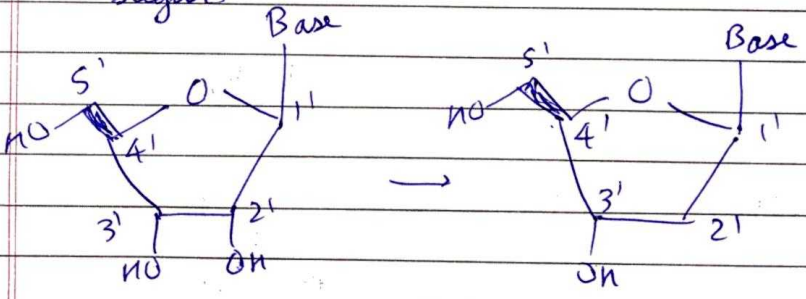
Uridine :



(Nucleoside - Sugar + Base)

Nucleosides in DNA:

These compounds are same ~~as~~ as nucleosides in RNA except that there is no -OH in 2' position of the sugar.




In RNA

In DNA

Name also changes from adenosine to 2'-deoxy adenosine and so on. for other two and thymidine instead of uridine.

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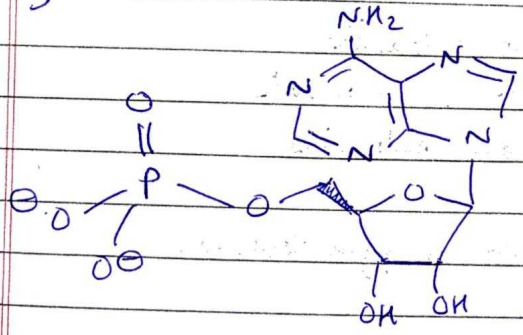
## Nucleotides:

A nucleotide is a nucleoside with an -OH group of the sugar bonded in an ester linkage to phosphoric acid. The nucleotides of RNA are more precisely called ribonucleotides and that of DNA are called deoxyribonucleotides.

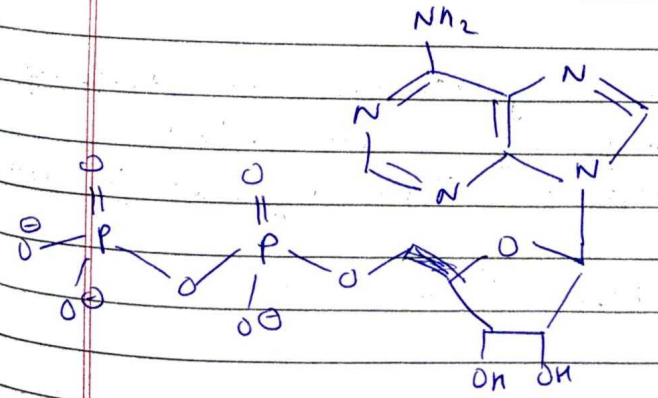
Nucleoside = base + sugar
Nucleotide = base + sugar + phosphate

( Remember, in alphabetic order, 't' comes after 's'. So Nucleo't'ide will be more complex than Nucleo's'ide. )

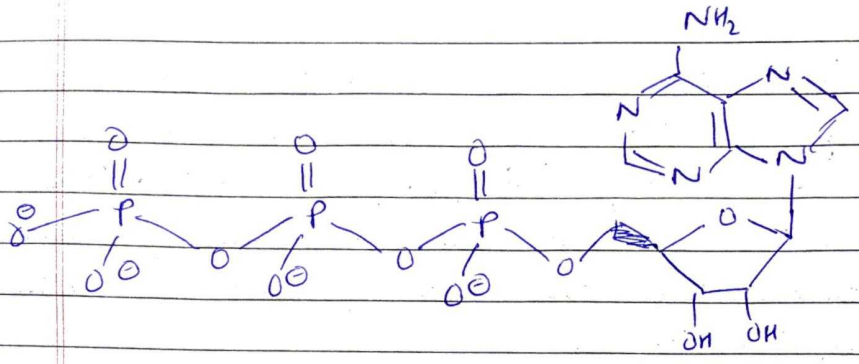
eg.



Adenosine 5'-monophosphate (AMP)



Adenosine 5'-diphosphate (ADP)



Adenosine 5' - triphosphate (~~ADP~~ ATP)

## Nucleic acids are composed of nucleotide subunits:

Nucleic acids are composed of long strands of nucleotide subunits.

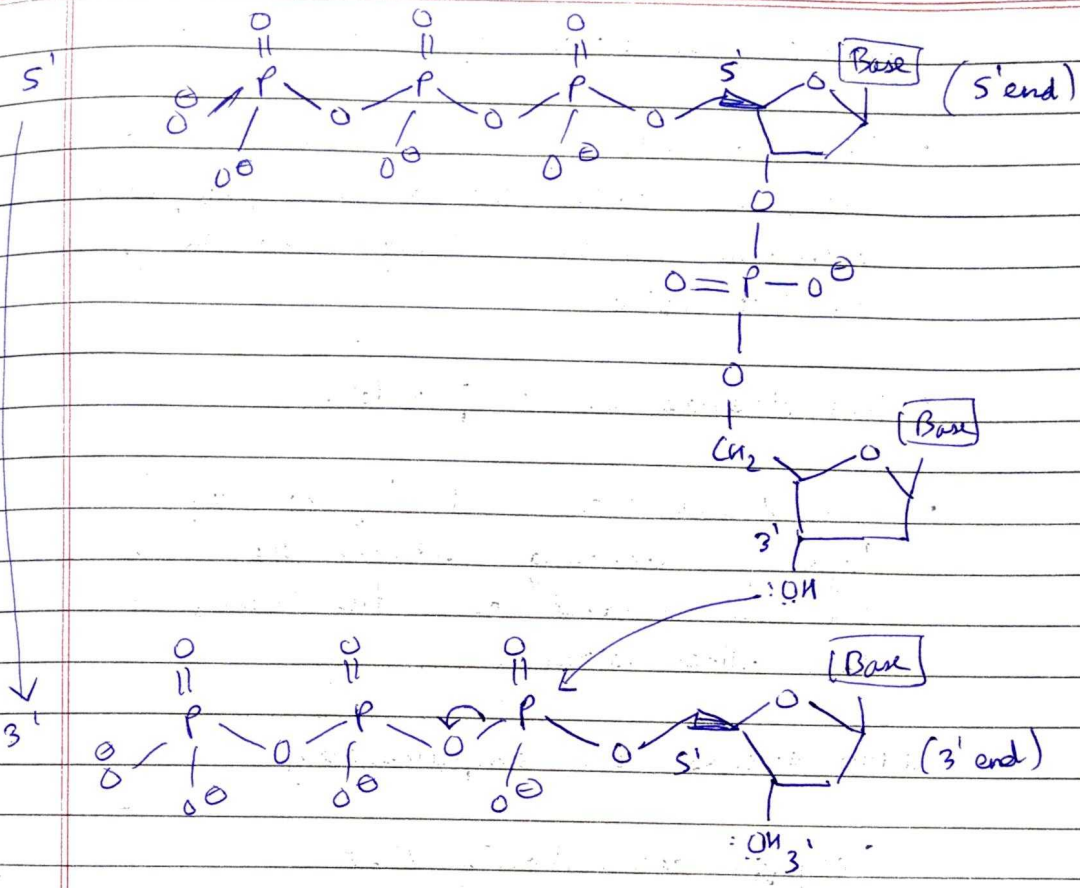
Dinucleotide - two subunits
Oligonucleotide - 3 to 10 subunits
Polynucleotide - many subunits.

DNA & RNA are polynucleotides.

## Biosynthesis of nucleic acids:

Nucleic acids are biosynthesized from nucleoside triphosphates, using enzymes called DNA polymerase for DNA and RNA polymerase for RNA.

Direction of synthesis 5' to 3'




## Primary structure of nucleic acid:

The primary structure of nucleic acid is the sequence of bases in the strand.

Remember that the nucleotide at the 5' end has an unlinked 5' - triphosphate group and the nucleotide at the 3'-end has an unlinked 3'- hydroxyl group.

eg. ATGAGCCATAGCCATT

↑ 5' end

↑ 3' end

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## Secondary structure of DNA :

- DNA consists of two strands of ~~subunits~~ nucleotides with the ~~*~~ sugar phosphate backbone on the outside and the bases on the inside.

- The strands are antiparallel.

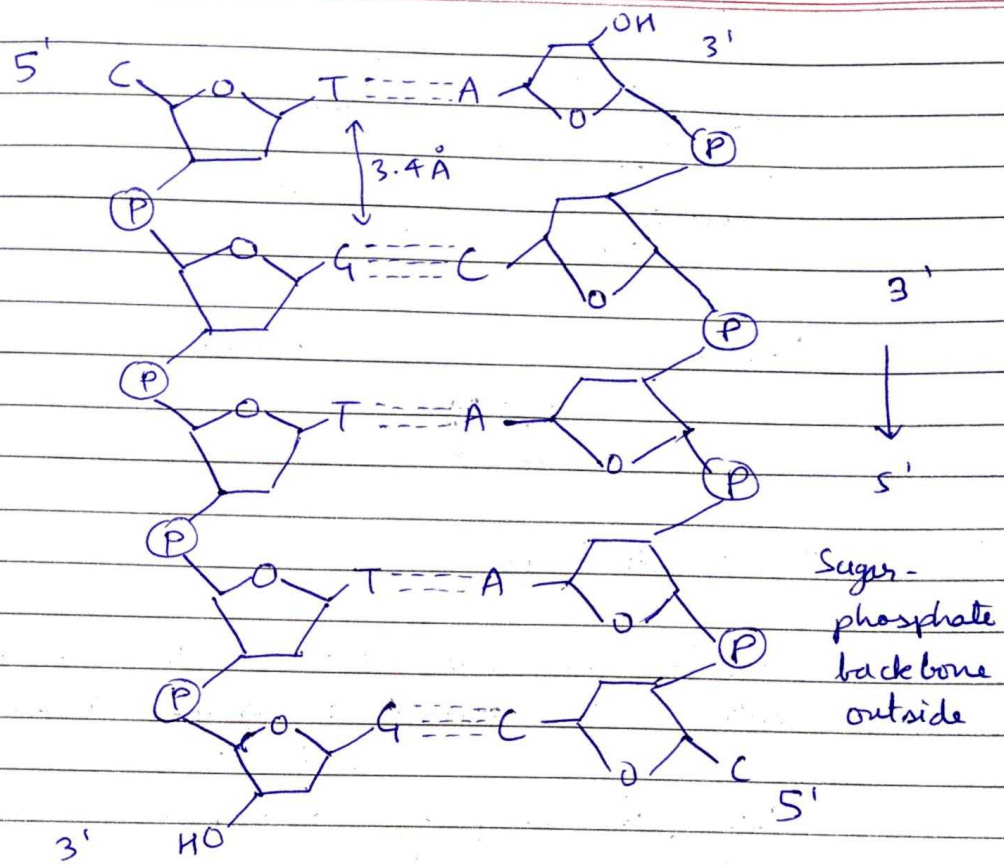
- The strands are held together by hydrogen bonding between the bases on one strand and the bases on the other strand.

## DNA strands are complementary :

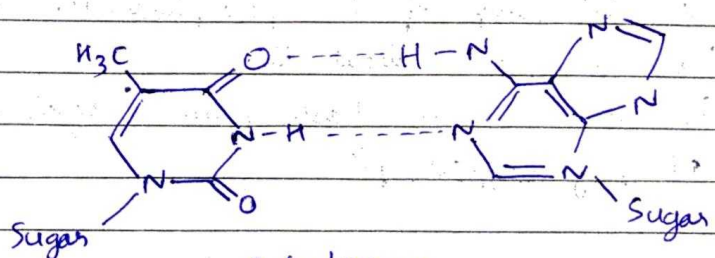
Chargoff's data showing that

[adenine] = [thymine] and
[guanine] = [cytosine]

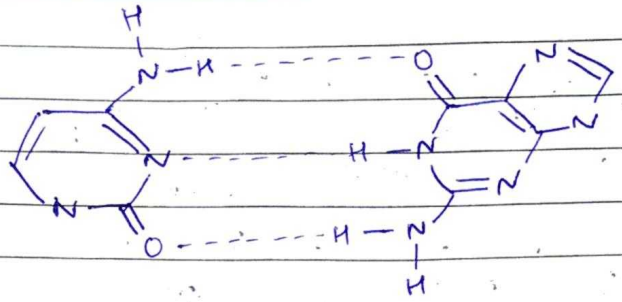
If you know the sequence of bases in one strand, you can figure out the sequence of bases in the other strand.




## Hydrogen bonding dictates base pairing :




Thymine — 2-hydrogen bonds. — Adenine



Cytosine Guanine

3- hydrogen bonds.

## The Double Helix :

The two antiparallel DNA strands are twisted into a helix around a common axis.

Base pairs are planar and parallel to each other.

Double helix resembles a circular staircase
base pairs - rungs
sugar - phosphate backbones - handrails.

The OH group of the phosphodiester linkage has a $pK_a$ about 2.
So if is in its basic form (negatively charged) at physiological pH.

Negatively charged phosphates repel nucleophiles thereby preventing cleavage of phosphodiester bonds.

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## DNA and heredity:

1. The sequence of bases in DNA provides a blueprint for the synthesis of RNA.

Synthesis of RNA from DNA blueprint is called transcription.

Transcription: DNA ⟶ RNA

2. The sequence of bases in RNA determine the sequence of amino acids in protein

Protein synthesis from RNA blueprint is called translation.

Translation: mRNA ⟶ Protein

3. The RNA's used for protein Biosynthesis:

Although DNA molecules have billions of base pairs, RNA molecules rarely have more than 10,000 nucleotides.

There are several kinds of RNA

- messenger RNA (mRNA)
  Sequence of bases in mRNA determine the sequence of amino acids.

- ribosomal RNA (rRNA)
  This is a structural component of ribosomes. These are the particles on which biosynthesis of proteins takes place.

- transfer RNA (tRNA)
  This is the carrier of amino acids used for protein synthesis.