Chapter-6 Molecular Basis of Inheritance

↱ act as a Genetic Material
DNA → Deoxyribonucleic acid } organic
RNA → Ribonucleic acid } bimacromol.
↳ act as a genetic Material → Eg → Retrovirus (HIV) (Human Immuno Deficiency)

RNA function · Structural
· Catalytic molecule
· Adapter (TRNA)

The DNA is a long polymer deoxyribonucleiotides (monomeric unit)
The no. of nucleotides (no. of base Pair) length of DNA measure.

Eg → Bacteriophage (Viruses which eat Bacteria)
↳ inbuilt Mechanism (Restriction Enzyme)

5386 nucleotides, lambda 48502 (base Pair)
No. of nucleotides 48502 x 2

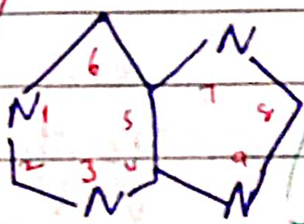
Escherichia coil has 4.6×10^6 bp

haploid content of human DNA is 3.3×10^9 bp
(Genomic) → haploid set of chromosome

diploid $(3.3 \times 10^9) \times 2$

Structure of Polynucleotide chain →

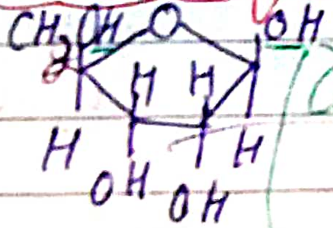
Nucleotide → Nitrogenous base → Purine – double Ring



1, 3, 7, 9 (Hetero-cyclic ring)

Nucleotide → Pentose sugar

ribose



(Cis form) → Pyrimidine – Single Ring

Eg → Adenine, Guanine

β- ribosugar → RNA

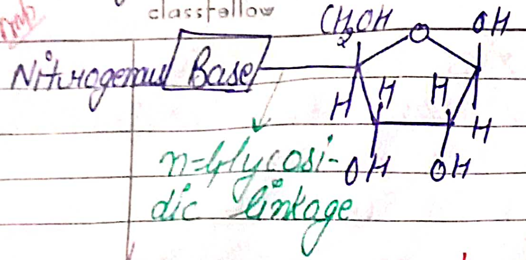
1, 3 (Heterocyclic ring)

Eg → U (RNA), T (DNA), Cytosine (Both)

Phosphate gp (PO_4^{3-})

(process) Gel Electrophoresis → towards Anode (+ve)

Nitrogen base linked ribose sugar through n-glycosidic linkage.



Nucleoside

adenosine → Nucleoside → RNA

deoxyadenosine → Nucleoside → DNA

Guanosine → Nucleoside → RNA

deoxyguanosine → Nucleoside → DNA

Cytidine → Nucleoside → RNA

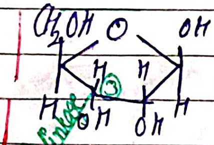
Uridine → Nucleoside → RNA

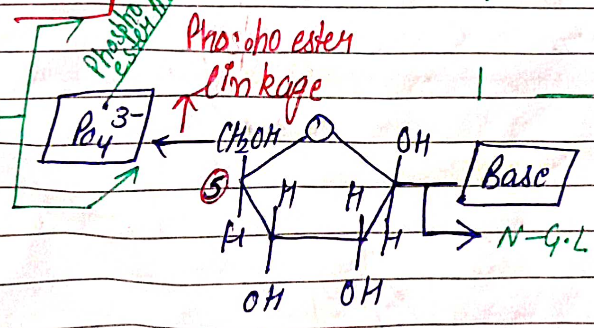
deoxycytidine → Nucleoside → DNA

deoxythymidine → Nucleoside → DNA

Phosphate
(5) Carbon attach
(3) Carbon

Phosphodiester linkage





β- ribose Sugar

when a phosphate gp is linked to 5'–OH of a nucleoside through phosphoester linkage, a corresponding nucleotide is formed.

Uracil is present in RNA at the place of Thymine.

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⇒ DNA & RNA backbone made up of Sugars & Phosphates.

RNA → OH
DNA → H

Thymine → (5-methyl uracil)

↳ acidic in nature

identified by → Friedrich Meischer in (1869)
↳ Nuclein (name)

Chargaff Rule → A+G = T+C
Double Standard DNA → Purines = Pyridimines

Who gave the Str. of DNA?
James Watson and Francis Crick.

who produce X-ray diffraction data produced
In 1953, James Waston and Francis Crick based on the X-ray diffraction data produced by Maurice Wilkins and Rosalind Franklin proposed double helix model for the Str. of DNA.

Base pair
Complementary to each Other

A = T → 2 Hydrogen bond
G ≡ G → 3 Hydrogen bond

The Salient features of the Double helix Str. of DNA →

(a) DNA is made up of two polynucleotide chains in which backbone is made up of Sugar Phosphate and bases projected inside it.

(b) Two chains have anti-parallel polarity one 5' à 3' and with 3' à 5'.

(c) The bases in two Strands are paired through H-bonds. Adenine and Thymine forms double hydrogen bond and Guanine and Cytosine forms triple hydrogen bonds.

$$A = T$$
$$G \equiv C$$

(d) Two chains are coiled in right handed fashion. The Pitch of helix is 3.4 nm and roughly 10 bp in each turn. The distance b/w a b.p equal to 0.34nm.

Pitch = No. of bp in a turn × the distance b/w a bp

1 turn = 10 bp
bp = 0.34 nm

Pitch = 10 × 0.34
= 3.4 Nm

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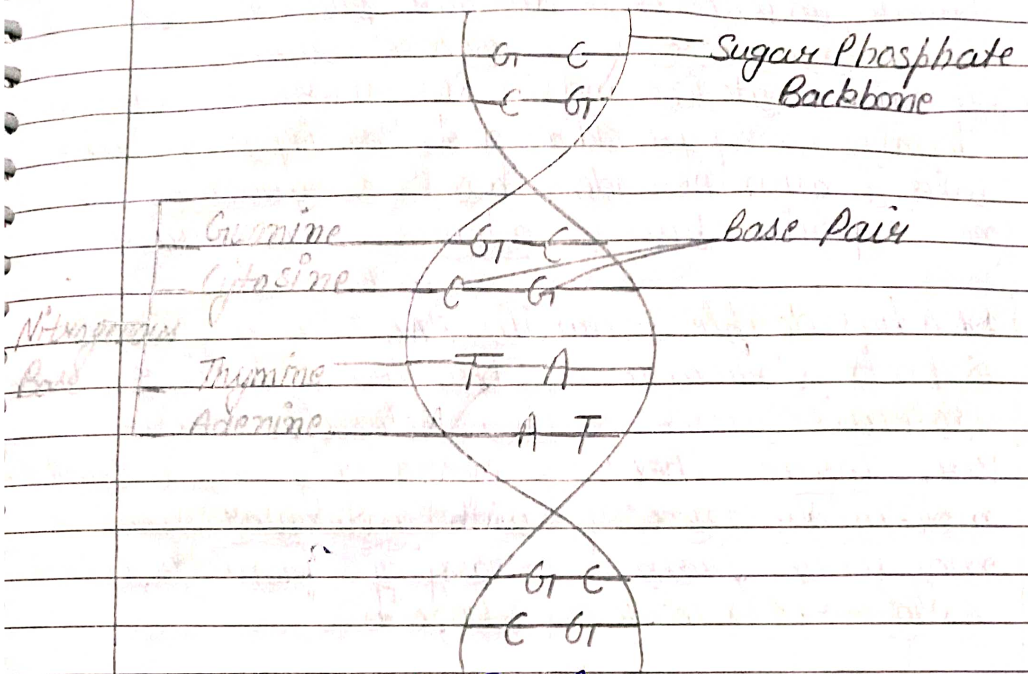
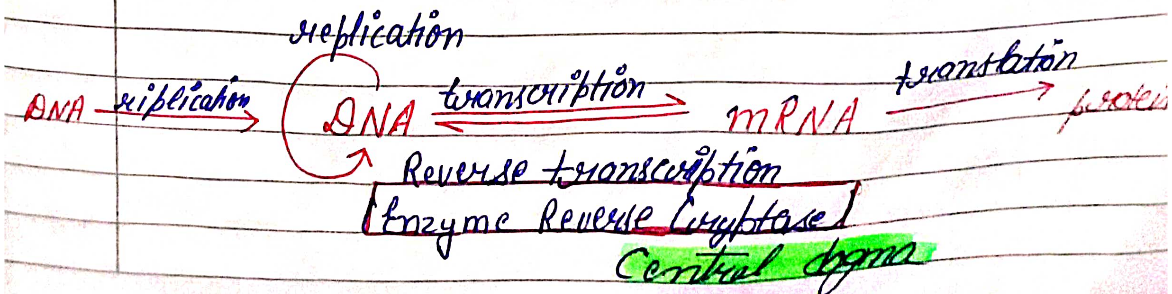


DNA

(e) The Plane of one base pair Stacks over the other in double helix to confer Stability

- Francis Crick proposed the Centeral dogma in molecular biology, which States that the genetic information flows from DNA --> RNA --> Protein.



DNA	RNA
(i) Sugar present is deoxyribose.	(i) Sugar present is ribose sugar.
(ii) Contains cytosine and thymine as pyrimidine bases & guanine & adenine is purine bases.	(ii) RNA contains cytosine and uracil pyrimidine bases & guanine & adenine as purine bases.
(iii) DNA has double strand α helix structure.	(iii) RNA has a single stranded α helix structu[re]
(iv) Molecules are very large their molecular mass may vary from $6 \times 10^6 - 16 \times 10^6$ u	(iv) Molecules are comparatively much small[er] with molecular mass ranging from 20,000 – 40,000.

Functional Difference

DNA	RNA
(i) DNA has unique property of replication.	(i) RNA does not replicate
(ii) DNA controls the transmission of hereditary effects.	(ii) also control RNA controls the synthesis of prote[in]

Packaging of DNA Helix

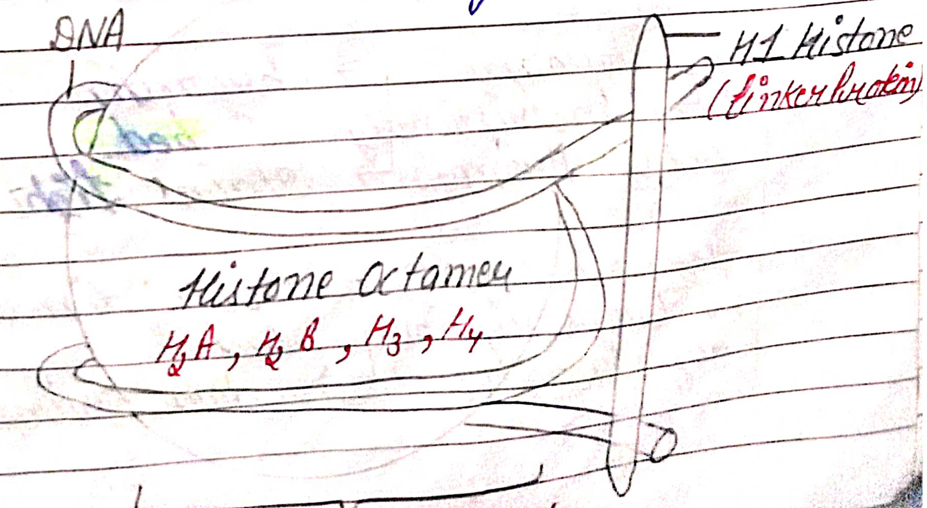
- In Eukaryotes, histones, positively charged protein organized to form 8 molecules unit called Histone Octomer. → basic protein

- The Negatively charged DNA is wrapped around the histone octomer to form nucleosome.

- Histones are rich in the basic (nature) amino acid residues lysines and arginines.
- Both the amino acid residues carry in their side chains.

- In Prokaryotes, well defined nucleus is absent and negatively charged DNA is combine with some positively charged proteins called Nucleoids.

- Single nucleosome contains about 200 base pair. Chromatins is the repeating unit of nucleosome.



Ques Theoretically, how many such beads (nucleosomes) do you imagine are present in a mammalian cell?

⇒ Mammalian cell 6.6×10^9 bp.

1 Nucleosome → 200 bp

200 Nucleosome → $\frac{1}{200} \times 6.6 \times 10^9$

$= \frac{6.6 \times 10^9}{2 \times 10^2}$

$= \frac{33 \times 10^9}{2 \times 10^3}$

$= 33 \times 10^{9-3}$

$= 33 \times 10^6$ nucleosome

Non-histone Chromosomal (NHC) proteins

Large group of heterogeneous proteins that play a role in organization and compaction of the chromosome into higher order structures.

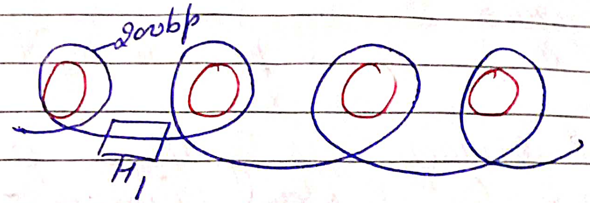
Euchromatin → chromatin are loosely packed → stains light

↳ Transcriptionally active chromatin

Heterochromatin → Chromatin are densely packed → dark stains

↳ Transcriptionally inactive

Histone Octahedral
↳ rich in lysin & Arginine protein
↳ Basic Amino acid



The Search for Genetic Material

discover nuclein by Meischer

- Transforming Principle → Principle (Transformation)

1928, Fredrick Griffith →(experiment) Streptococcus pneumoniae (fluid filled in alveoli)

- Living organism (bacteria) had changed in Physical form → Transformation

don't mucous poly. Coat ←	R-Strain Rough (Non-virulent)	S-Strain → mucous (polysaccharide) coat Smooth (Virulent) (Pneumonia)

S Strain → Inject into mice → Mice die
R Strain → Inject into mice → Mice live (Bacteria if present)

Griffith was able to kill bacteria by heating them.

S Strain (heat-killed) → Inject into mice → mice live (Absence of Bacteria)