Saturday, 3 July 2021 11:35 AM

DNA :- (Deoxyribonucleic acid)

* DNA is long polymer deoxyribonucleotides.
* **Largest** biomacromolecule
* Genetic material in most of organism & molecular basis of inheritance — Eukaryotic cells.
* DNA as an acidic substance present in nucleus was first identified by Friedrich Meischer in **1869**. He named it as nuclein.
* Altman renamed nuclein as nucleic acid because of its acidic properties (phosphoric acid). He also discovered the existance of two types of nucleic acids.
* Due to technical limitition in isolating such a long polymer intact, the elucidation of structure of DNA remained elusive for a very long period of time. (1869 ✓, 1953 ✓)
* length of DNA is usually defined as number of nucleotides (single strand) (or a pair of nucleotide referred as base pairs [bp] (ds)) present in it. It is also characterstic of an organism.

Diploid org. — Somatic cell (Diploid cell) → DNA content (2n) → amount double before cell division; → Gametes (n) → Half amount.

Ex. (1) Bacteriophage ϕ x 174 (virus, ss-DNA) – 5386 nucleotides / s.s. DNA

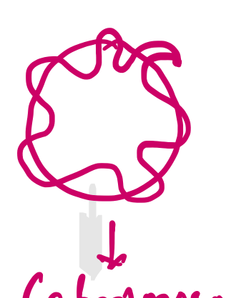
(2) Bacteriophage lamda – 48502 bp

(3) E. coli (Bacteria) – 4.6×10^6 bp

(Haploid) (4) Human content (n) – 3.3×10^9 bp. → $2n = 6.6 \times 10^9$ bp. (ds DNA)

Occurence :-

In prokaryotes (Nucleoid) → ds single circular DNA (Genetic Material) (c̄ out histone ∴ naked DNA) (chromosomal DNA)



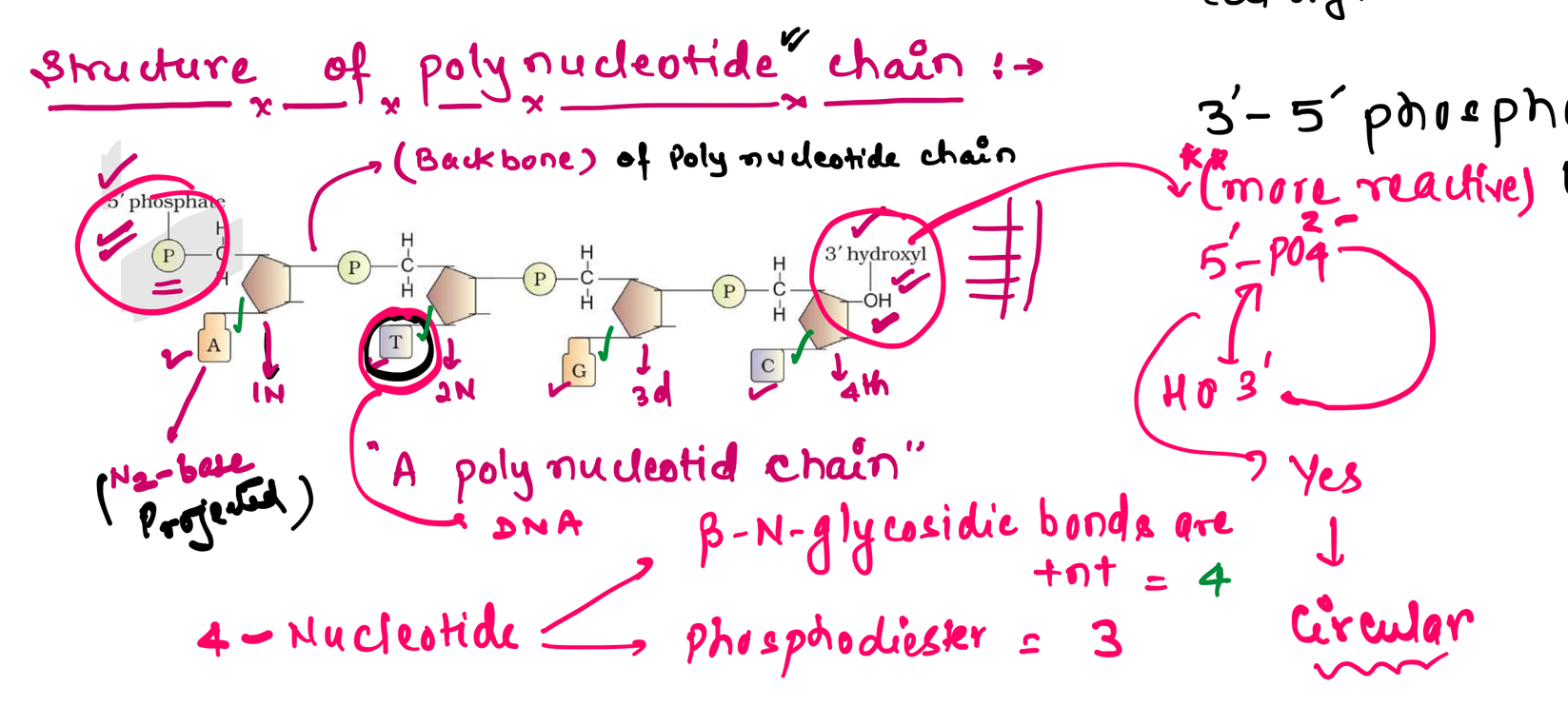
↓ many posses Extrachromosomal small circular dsDNA k/a Plasmid ("Antibiotic Resistance gene")

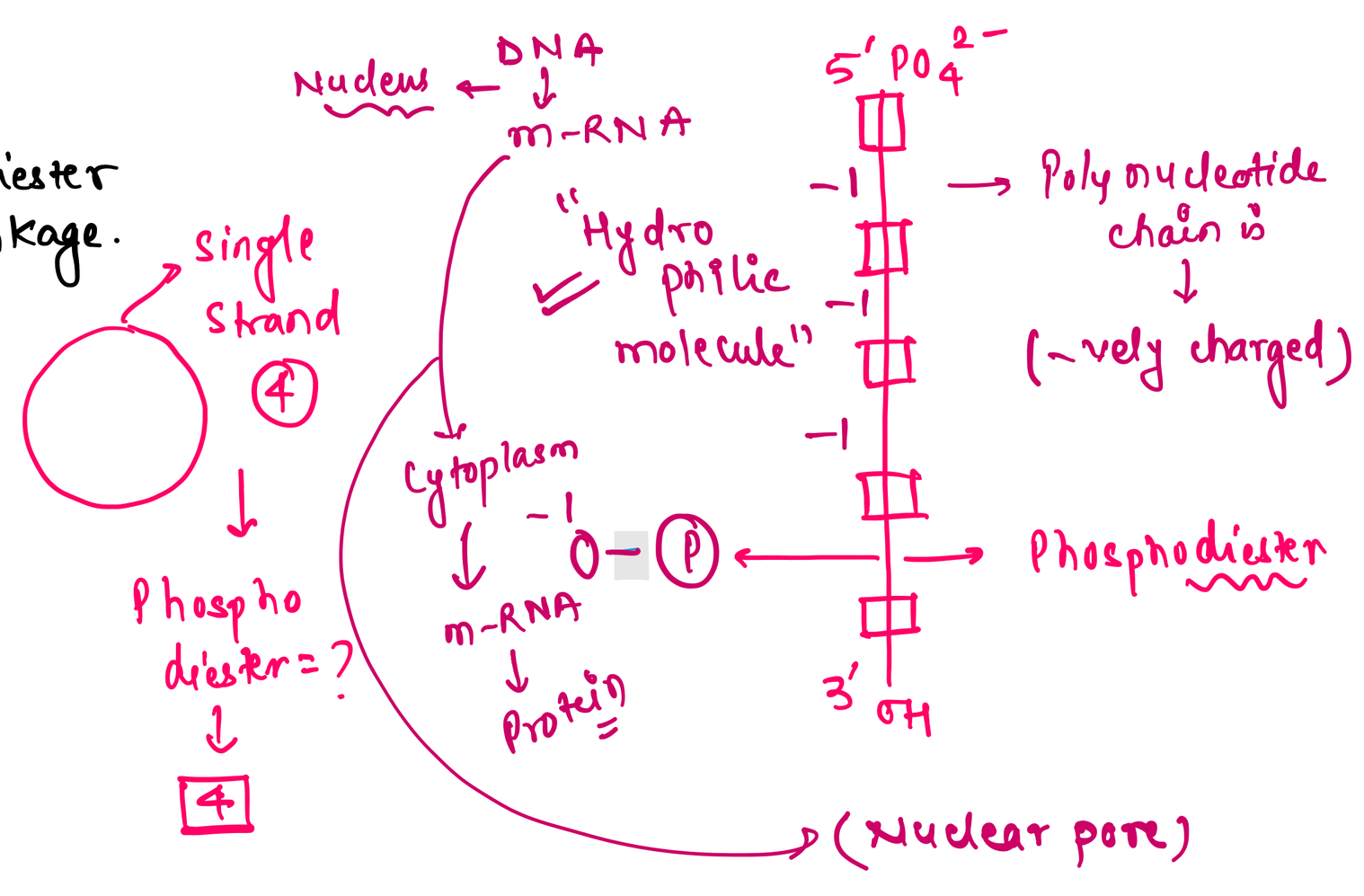
In Eukaryote → ds linear DNA with Histone protein in nucleus.

└ ds circular DNA → In mitochondria, → In Plastid (Semiautonomous cell organelle.)

* Some viruses also contain DNA.

Structure of polynucleotide chain :-





Structure of DNA :- (B-DNA) (A, B, C, D, Z) (most abundant DNA found in living system)

* It was in 1953 that James watson and francis crick, based on x-ray diffraction data produced by Maurice wilkins and Rosalin franklin proposed very simple but famous **double Helix** model for the structure of B DNA.

"Watson, crick, wilkins Got Nobel Prize in 1962 in Medicine or Physiology for double helical Model of DNA"

Chargaff's Rule :-

Erwin chargaff (1950) gave important generalisation about DNA (Double stranded) structure. k/a chargaff's Rules.

(1) Purines & Pyramidines are always equal in amount i.e $A+G = T+C$ ($A=T$, $G=C$)

(2) Amt of 'A' equal to "T" and $G=C$

(3) The base ratio $A+T/G+C$ is constant for a species but may very from one species to another. (This ratio can be used to identify the species)

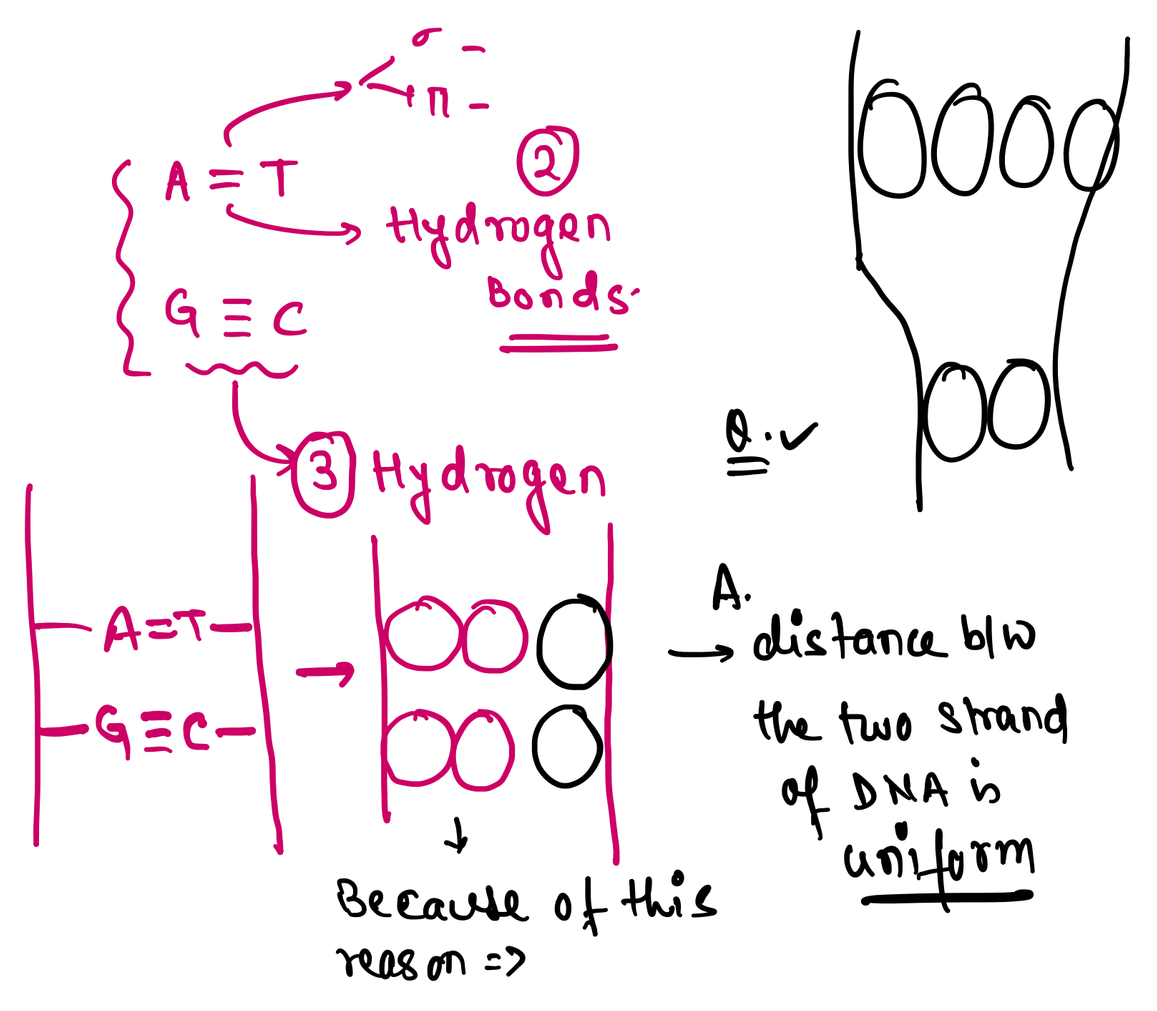
→ for double stranded DNA, the ratio between Adenine and Thymine and Guanine and cytosine are constant and equals one.

DNA is usually ds. RNA is usually ss. "Not Applicable to ss DNA, ss RNA"

$$\frac{A+G}{T+C} = 1$$

$$\frac{A+T}{G+C} = \text{Const.} \ (7)$$

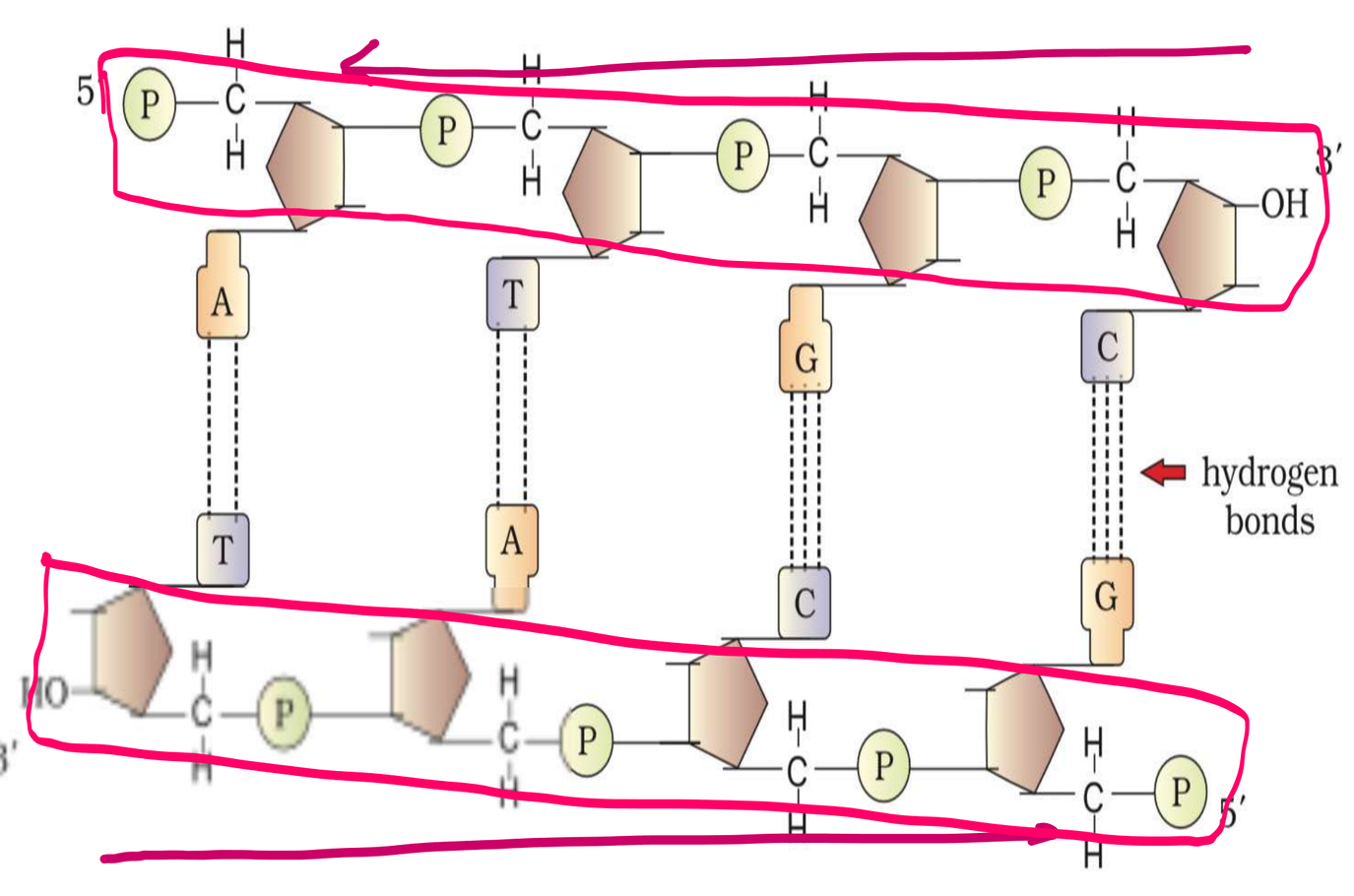
$$\frac{A}{T} \ \& \ \frac{G}{C} = 1$$



The salient features of the Double-helix structure of DNA. "(B-DNA)"

1. It is made up of two polynucleotide chains, where the back bone is constituted by sugar-phosphate, and the bases projects inside.

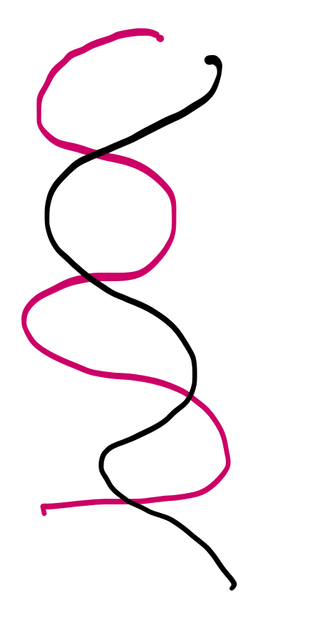
2. Two chains have anti-parallel polarity. Means if one chain has polarity 5'→3', the other has 3'→5'.



3. The bases in two strands are paired through H-bond forming bP.

A = T → Two H-bond; G ≡ C → Three H-bond

⇒ Purine always comes opposite to pyrimidine, this generates approximately uniform distance b/w two strands of the helix.

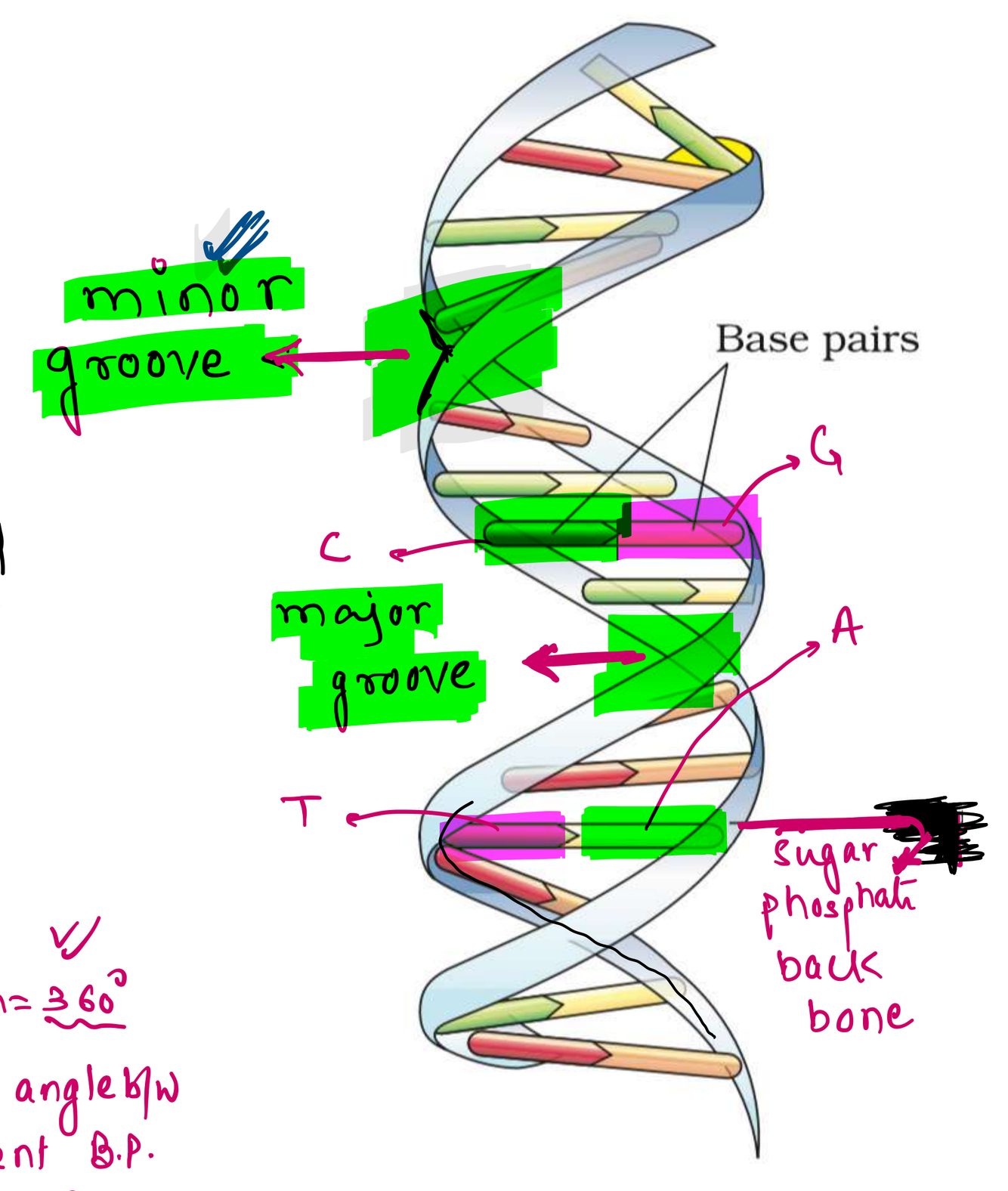


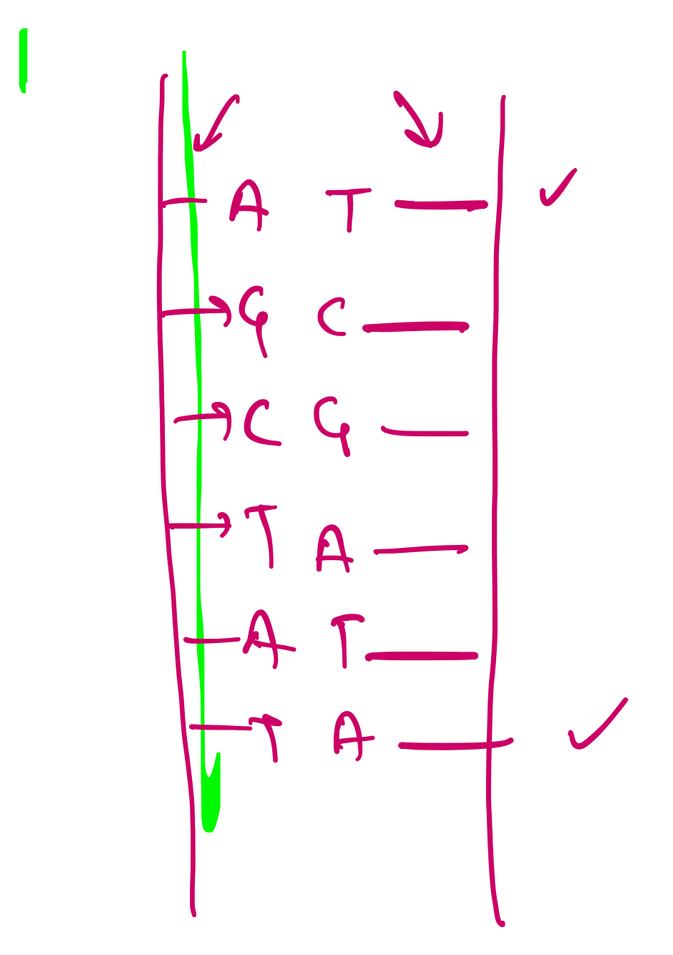
4. Two chains are coiled in helical fashion. The coiling is right Handed. Coiling produce major and minor groove alternately. (B-DNA → Right Handed DNA.)

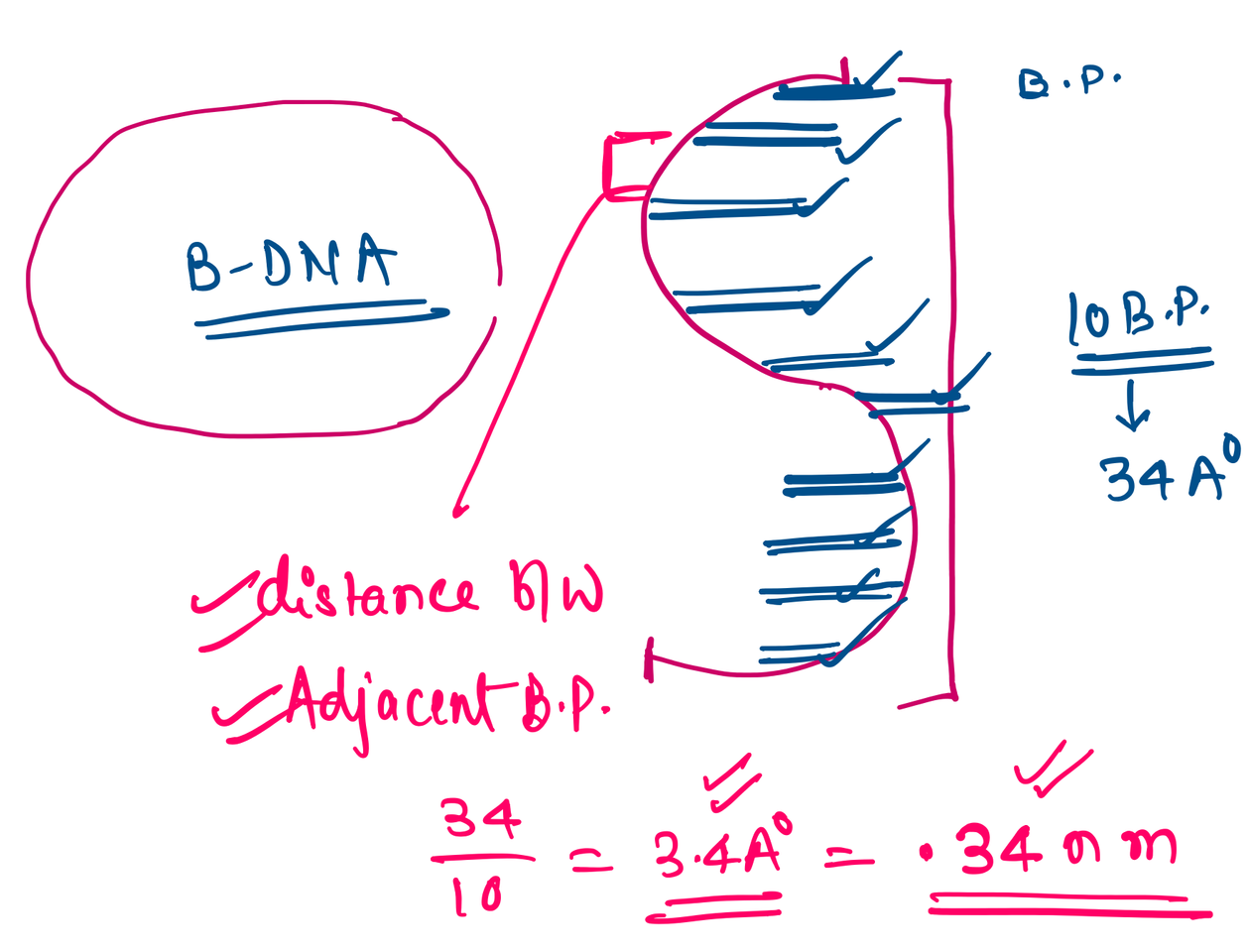
5. The pitch of the helix is 3.4 nm. ($1nm = 10^{-9}m$) → 34 Å and there are roughly 10 bP in each turn. Consequently, the distance b/w a bP in helix is approx 0.34 nm.

6. The plane of one base pair stacke over the other in double helix. This in addition to H-bond, confers stability of the Helical structure.

1 pitch = 360°. what is angle b/w adjacent B.P. 36°



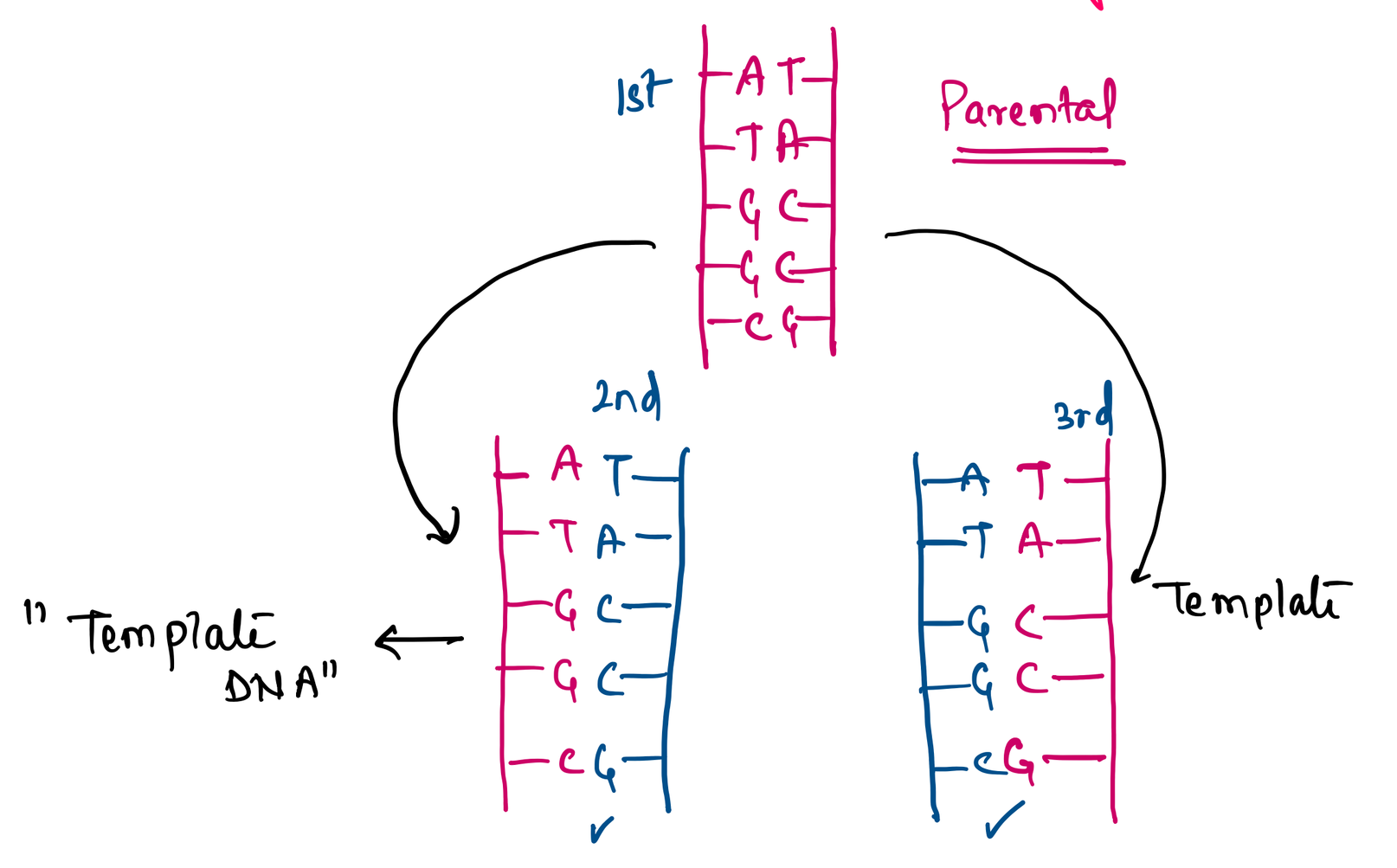




$$\frac{34}{10} = 3.4 Å = .34\ nm$$

"Base pairing confers a unique property to the polynucleotide chains. The chains are not identical but complementary to each other, means by knowing the sequence of one strand we can find the sequence of another opposite strand."

("Hallmark is Base pairing")



Also if each strand form a DNA (suppose consider it as parental) act as template for synthesis of a new strand, the two double stranded DNA thus produced would be identical to the parental molecule. Because of this, the genetic implications of the structure of DNA became very clear.

Human diploid cell ⇒ $2 \times 3.3 \times 10^{+9}$ B.P.

⇒ 6.6×10^9 B.P.

* length of DNA (of single cell) = $6.6 \times 10^9 BP \times 3.4 \times 10^{-10} m$ = 2.2 m ⇒ Nucleus

* length of E. coli DNA = $4.6 \times 10^6 BP \times 3.4 \times 10^{-10} m$ = 1.56 mm