

## STRUCTURE OF DNA

- composed of 2 - Polynucleotide chain - coiled & -formed double helix.

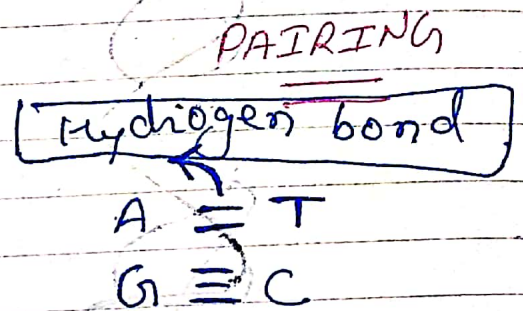
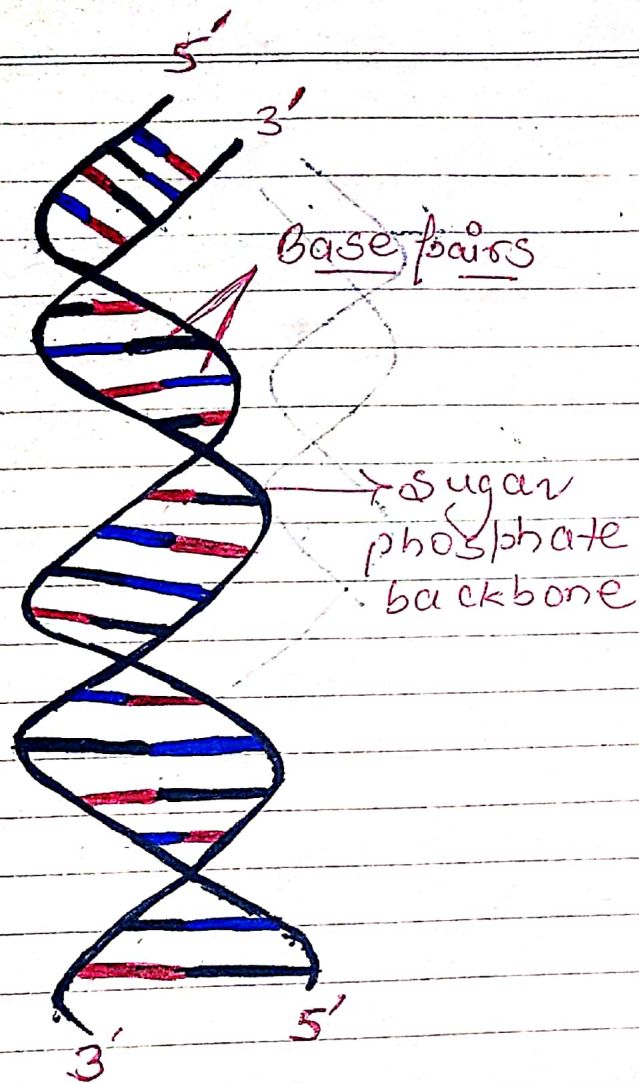
Phosphate group  
Deoxy ribose sugar

Nitrogen bases - Adenine } Purine  
Guanine }  
Cytosine } Pyrimidine  
Thymine }

- Present in only nucleus.
- Molecular structure was first identify by francis crick & james watson in 1953.

Function →

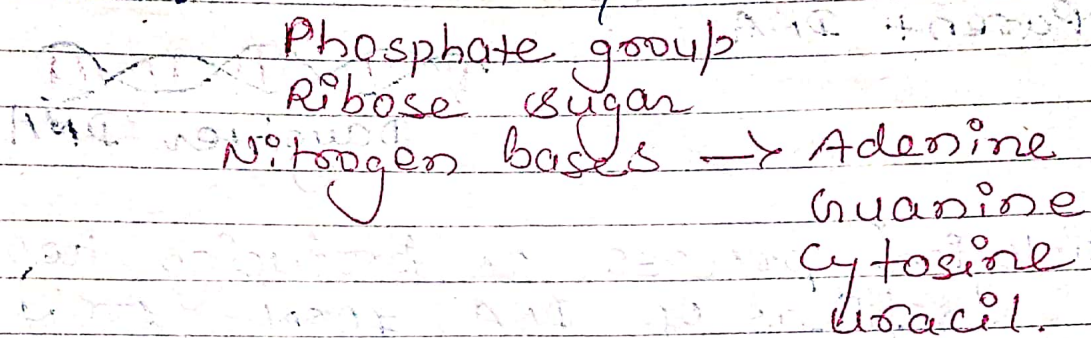
- Carrying genetic information
- It controls body function
- Stores all information
- synthesis of RNA, proteins & enzymes
- codes for character.



- Double helical structure
- Both strands are in anti parallel manner
- DNA is a polymer of polynucleotides i.e., composed of sugar, phosphate & nitrogenous base.

## Structure of RNA

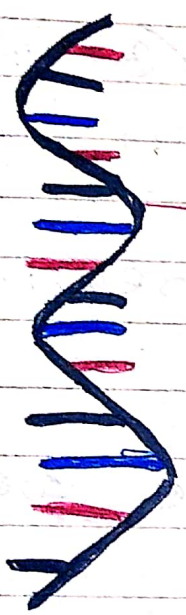
- present in nucleus & cytoplasm.
- composed of single polynucleotide chain.



### Types of RNA :

- mRNA (carries inform<sup>n</sup> from DNA — Ribosome) 5-10%  
→ messenger protein synthesis
- rRNA (involve in protein synthesis in Ribosome)  
→ ribosomal: (60-85%)
- tRNA (transfer amino acids in protein synthesis)  
→ transfer (10-15%)

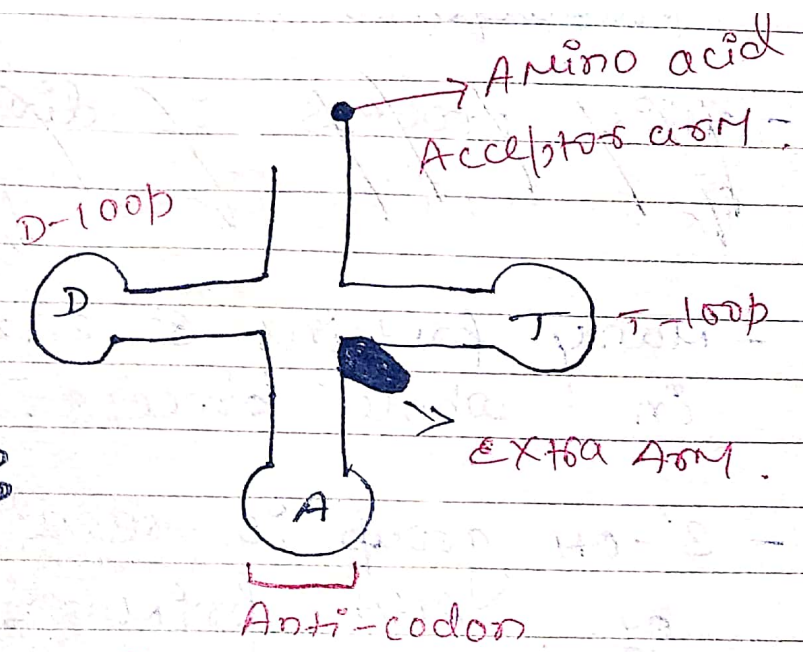
Amino acid



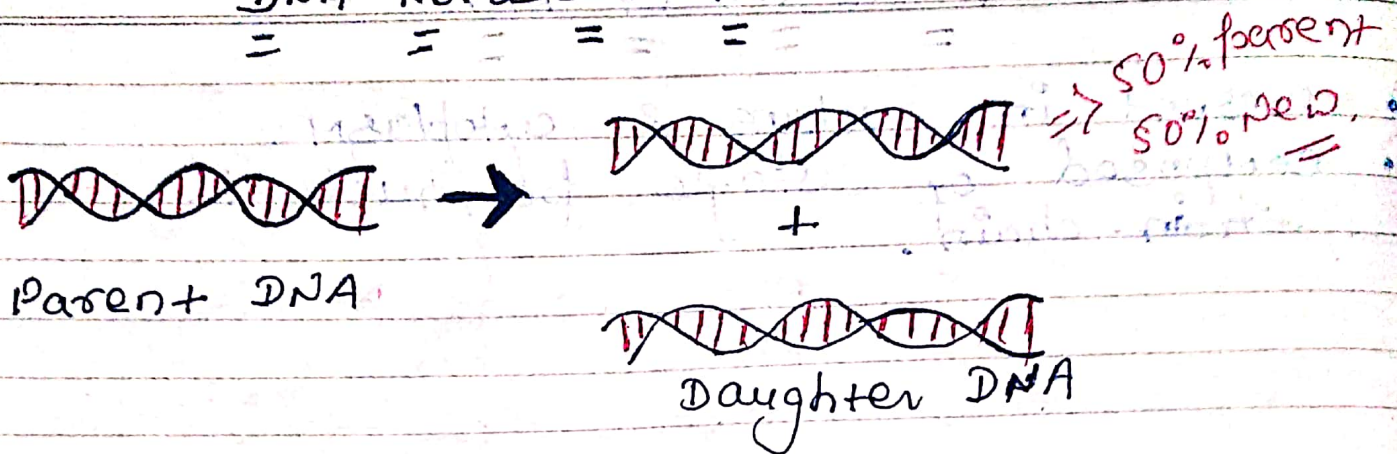
→ sugar phosphate backbone.

Function :

- coding
- Decoding
- Regulation & expression



## DNA REPLICATION



- Biological process of producing two identical replicas of DNA from original DNA molecule.

### • Semiconservative replication

- Original DNA molecule serves as a template for the producing complementary strand.
- This process is extremely rapid.
- Process is fundamentally similar in prokaryotes & eukaryotes.

⇒ Enzymes involved in DNA Replication :

1) Helicase : During DNA replication they separate double-stranded DNA into single strands.

2) DNA polymerase :

→ DNA poly.  $\alpha$  : Synthesis of RNA primers for both leading & lagging strands of DNA.

→ DNA poly.  $\beta$  : Involve in the repair of DNA

→ DNA poly.  $\gamma$  : Replication of mitochondria DNA.

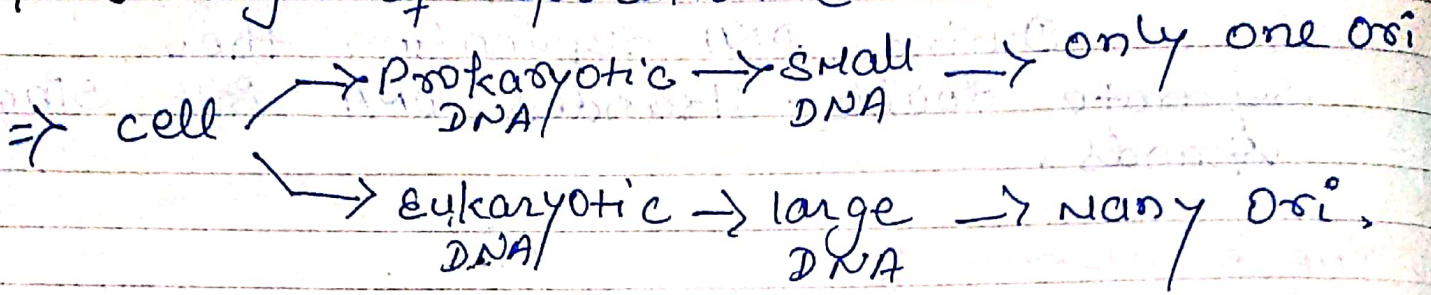
3) DNA ligase : Replace primers & joints of Okazaki fragments of lagging DNA.

4) Topoisomerase : Relieves overwinding ~~strands~~ ahead of replication fork by breaking, rejoining of DNA strands.

key point : DNA replication takes place in nucleus of cell. It takes place in S-phase of cell division.

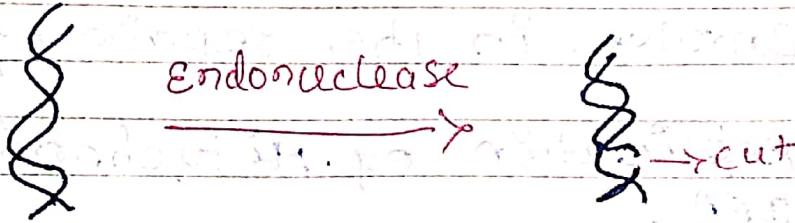
# Steps of DNA Replication

Step 1: Origin of Replication (ori).



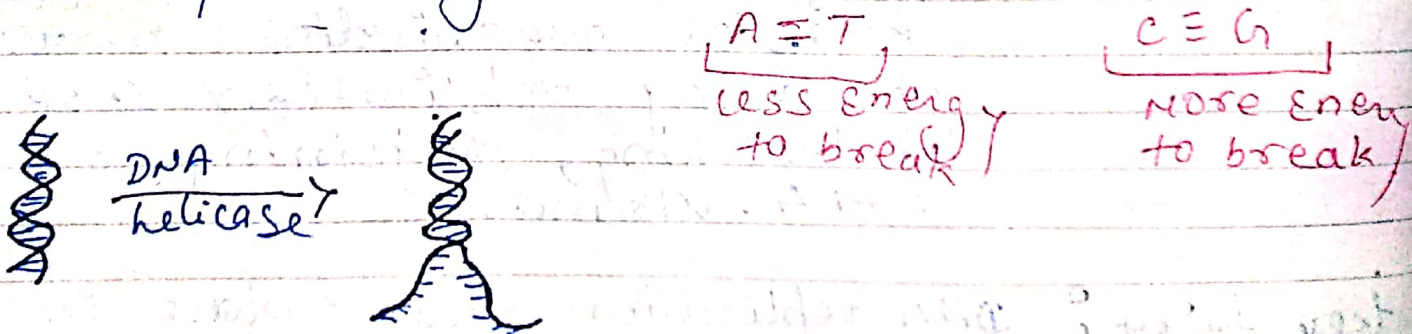
Step 2: Cut/Incision of DNA.

- It is done at the ori [Enzyme → Endonuclease]

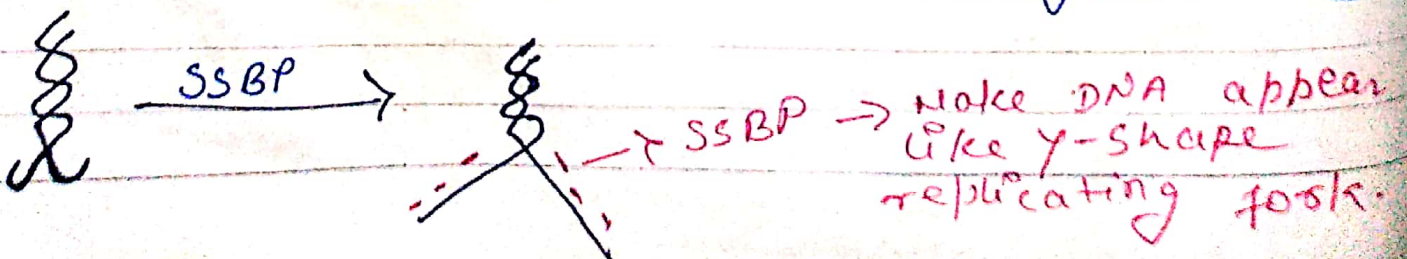


Step 3: unwinding of DNA.

- It is done by the help of enzyme DNA helicase.
- Done by breaking all the H-bond.



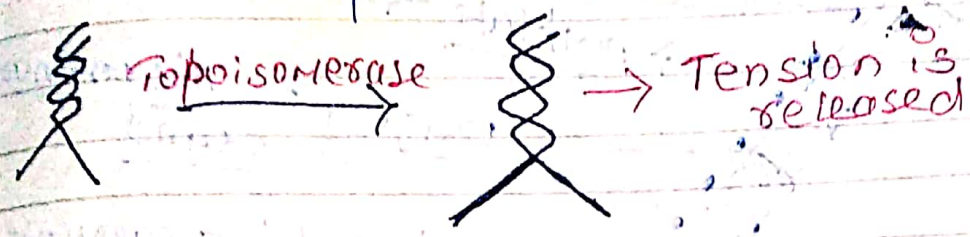
Step 4: use of single stranded binding proteins (SSBP) [To prevent intercoiling of DNA].



Step 5: Release of tension caused due to unwinding of DNA.

- Due to unwinding, the upper DNA can undergoes tension/stress

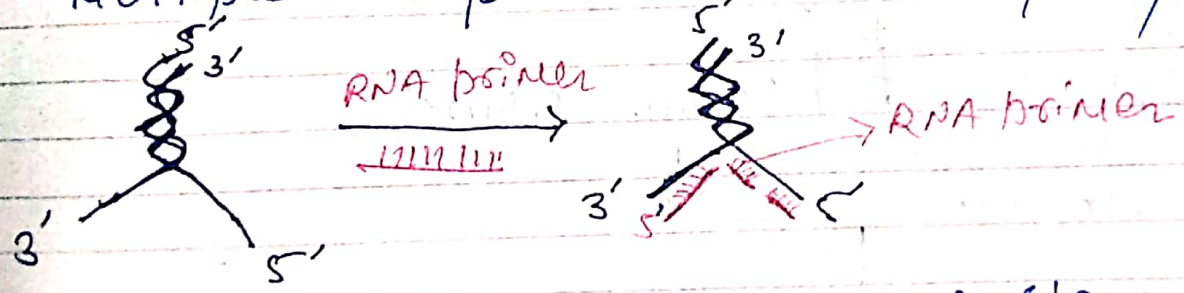
- To release by using enzyme **topoisomerase**.



Step 6: Formation of RNA primer.

- RNA primer is a small fragment of RNA synthesis by help of enzyme **DNA primase**.

- The only problem of RNA primer is it always binds only to 3'-end of RNA & on 5'-end multiple RNA primer is added by very difficulty.



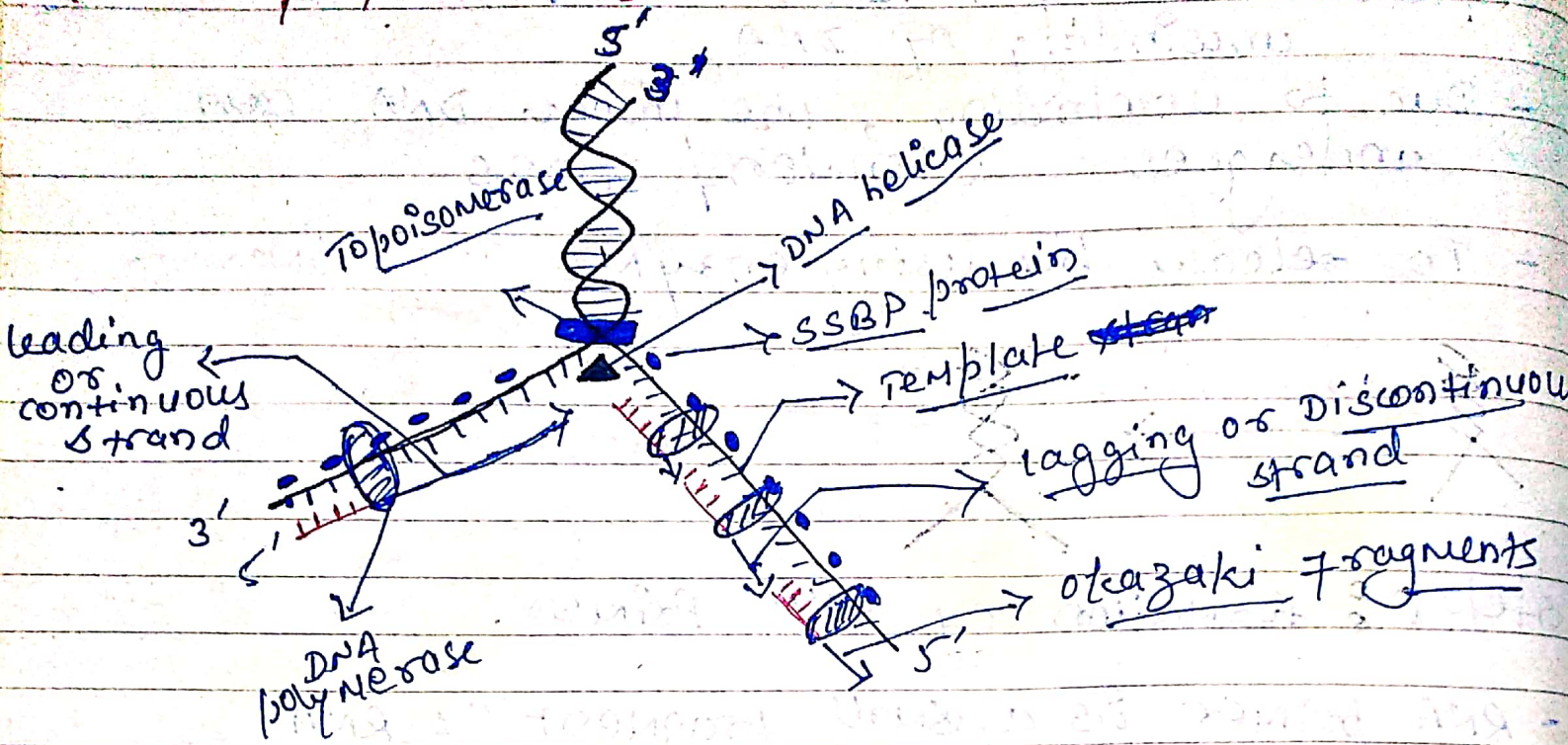
Step 7: synthesis of new DNA strand.

• It is done by help of enzyme **DNA polymerase**.

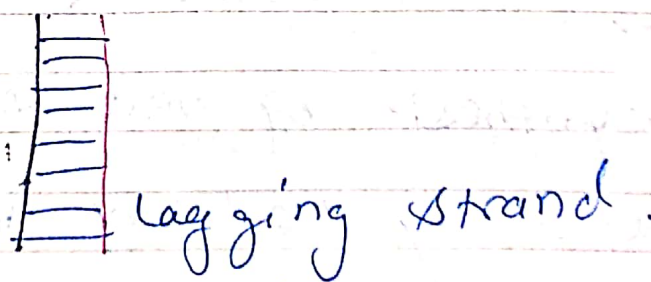
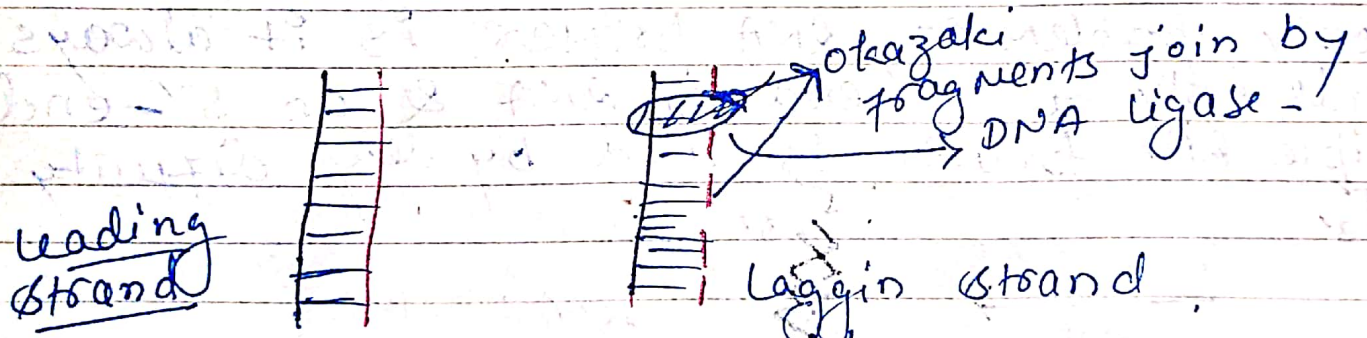
• DNA polymerase can add nucleotide only in 5'—3' direction. [not template]



→ DNA polymerase



↓

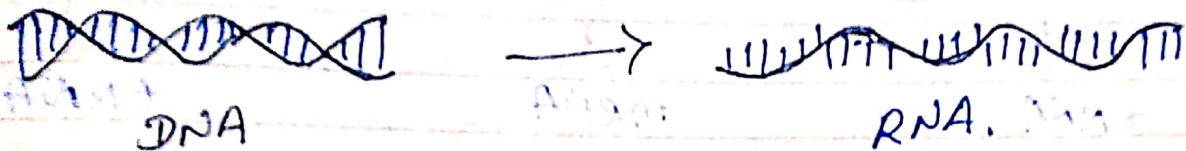


50% comes from parent  
50% newly synthesis

Semiconservative

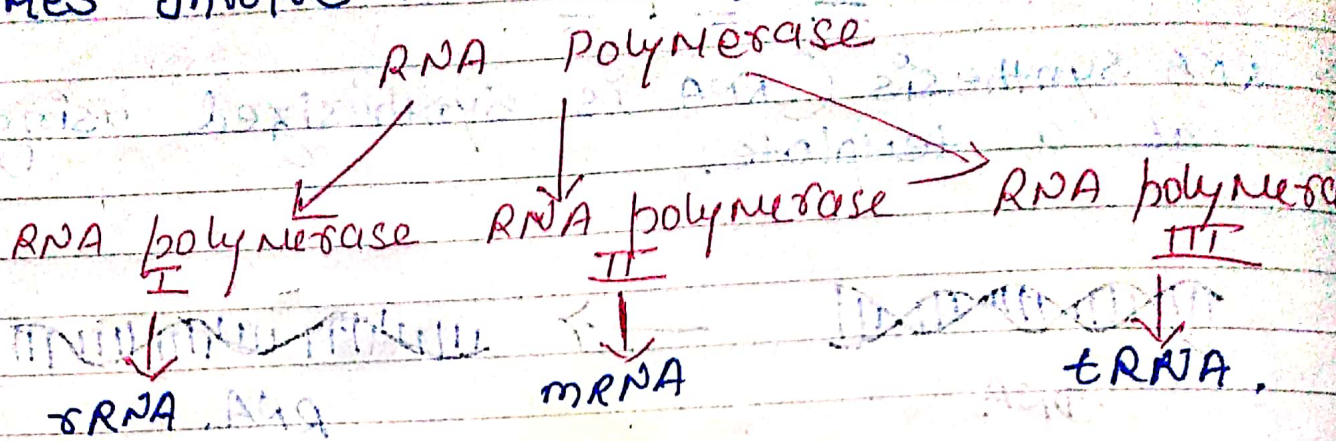
## Transcription

→ RNA Synthesis (RNA is synthesized using DNA as a template.)



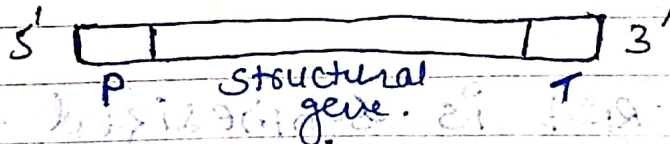
- Particular gene or group of genes are copied at any time.
- Transcription process is highly selective (specific sequence transcript only).
- specific sequence are present in DNA template which makes the beginning point & end point of the DNA which is to be transcribed.
- hnRNA & Pre RNA is synthesized first after post transcriptional modification it converts into mRNA, tRNA, rRNA.
- RNA is synthesised in 5'-3' direction, so DNA template is read in 3'-5' direction.
- steps involve in transcription process
  - i) Initiation
  - ii) Elongation
  - iii) Termination

# ⇒ Enzymes Involve in Transcription:

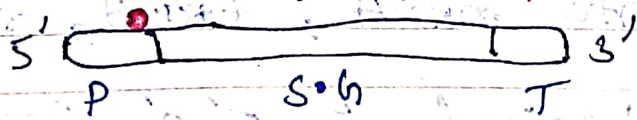


- Requirements:
- Promoter: present at 5' end
  - Terminator: present at 3' end
  - structural gene: Gene to be transcribed
  - Initiation factor:  $\sigma$
  - Termination factor: Rho

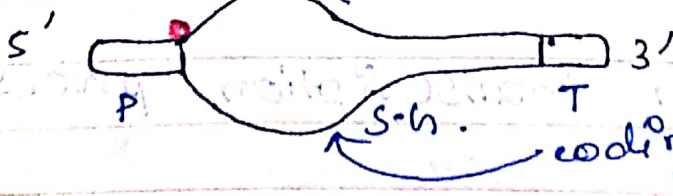
## Transcription



RNA poly II

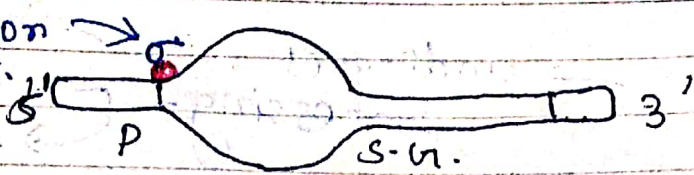


template/non-coding strand

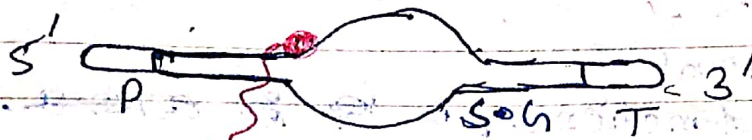


- but process cannot start unless initiation factors (sigma) ( $\sigma$ ) bind.

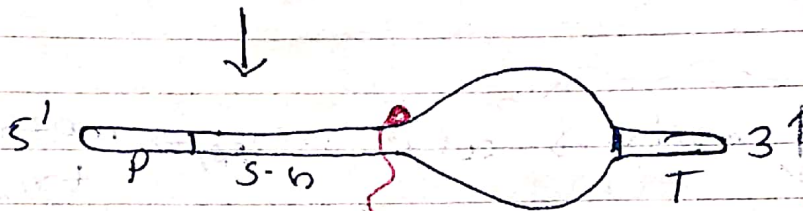
Sigma  
initiation  
factor.



σ - starts process afterwards it leaves



→ Elongation



→ Termination

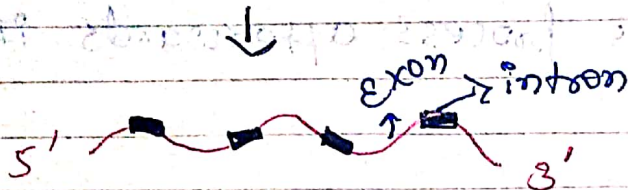
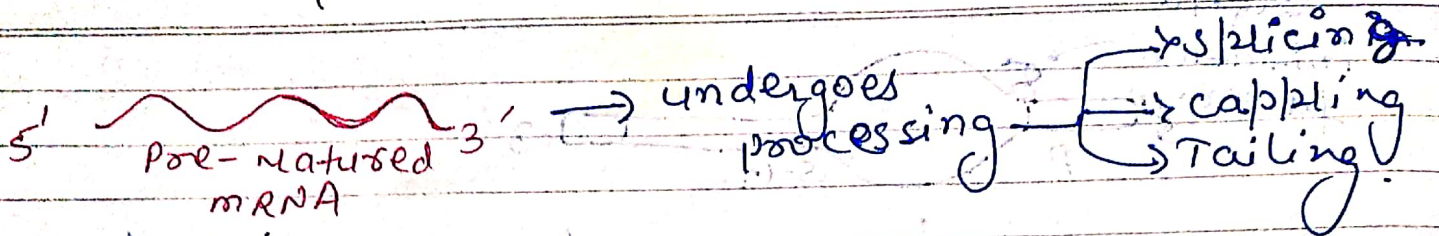


Addition rho



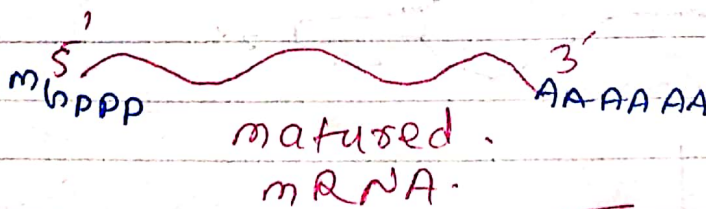
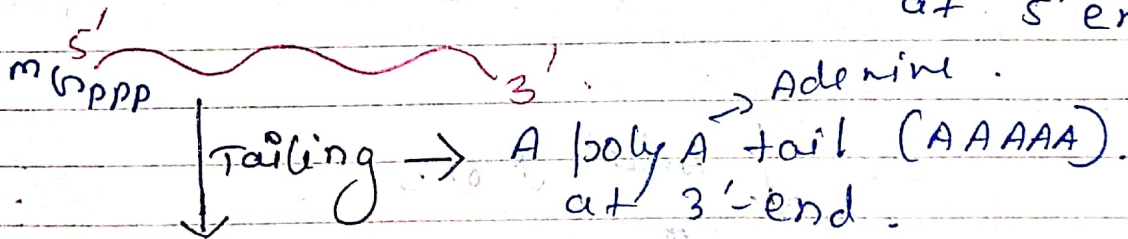
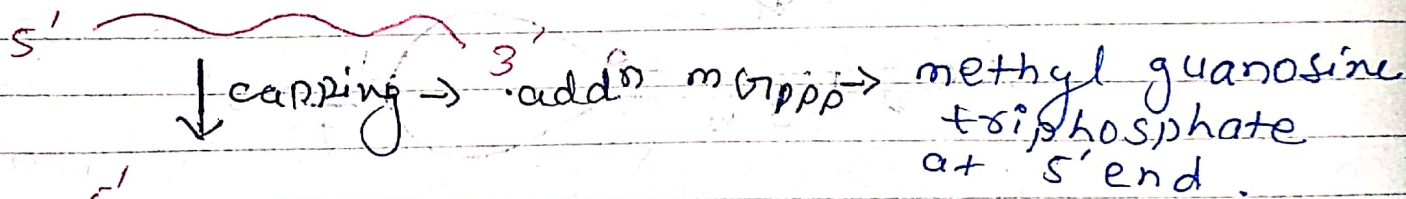
mRNA  
Pre  
(matured)

Prokaryotic → Not need processing  
 Eukaryotic → need processing



- Exon is functional
- Intron is non-functional. ~~Q~~ ~~R~~ ~~S~~ ~~REMOVE~~

Splicing: Removal of introns



## Genetic code

The three nucleotide base sequence in DNA or RNA are known as codon: CCU, UCU, UAU.

- collection of codons known as genetic code.
- nucleotides bases (A, G, C & U) that determine the sequence of amino acids in proteins.
- codons consist of 4 nucleotide bases. So, 64 different codons possible.

Codone

↓  
coded sequence

↓  
61 codons code  
for 20 amino acids.

↓  
non coded sequence

↓  
UAG, UGA & UAA  
(stop codon)

- codon AUG & sometimes GUG are initiating codons.

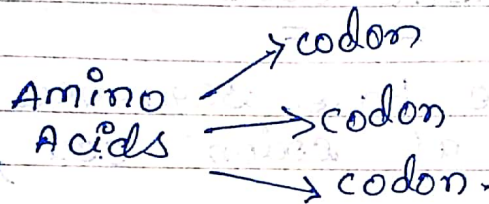
→ characteristic :

1) **universal** : Same codons are used for the same amino acids in all living organisms.

2) **specificity** : Particular codon always codes for <sup>same</sup> particular amino acids

eg ⇒ UGG is codes for tryptophan.

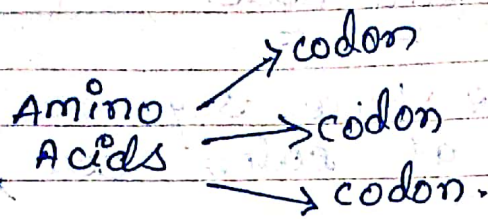
3) Degenerate :



- Amino acids have more than one codon
- There are 64 codons to code for only 20 amino acids.

eg → Glycine has four different codons.

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- Amino acids have more than one codon.
- There are 61 codons to code for only 20 amino acids.

eg ⇒ Glycine has four different codons.

TRANSLATION  
= = = =  
(Protein synthesis)

DNA  
↓  
RNA  
↓  
Protein synthesis

- Formation of protein from mRNA is known as Translation / Protein synthesis / Polypeptide synthesis.

### → Requirements :

① Amino acids

② Ribosomes → They have two sub units  
eg ⇒ 60s (big) & 40s (small)



③ m-RNA → has genetic information in the form of codon.

④ t-RNA → transfer amino acids to growing peptide chain. It has anticodons which easily recognize the codon of mRNA.



⑤ Energy source  $\rightarrow$  ATP & GTP

⑥ Protein factors  $\rightarrow$  Need for initiation, elongation & termination.

steps involve in protein synthesis

① Activation of Amino acids (a step process)

② Protein synthesis proper  $\rightarrow$  (initiat<sup>n</sup>, elongat<sup>n</sup>, terminat<sup>n</sup>)

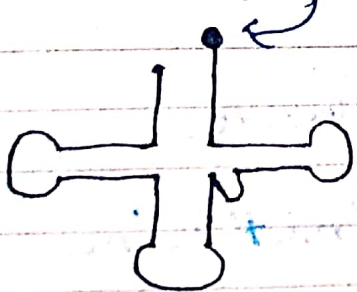
① Activation of amino acids

Amino acids + Enzyme utilizing ATP  
(Aminoacyl t-RNA Synthetase)

step 1

Enzyme-AMP-amino acid complex

transfer amino acid

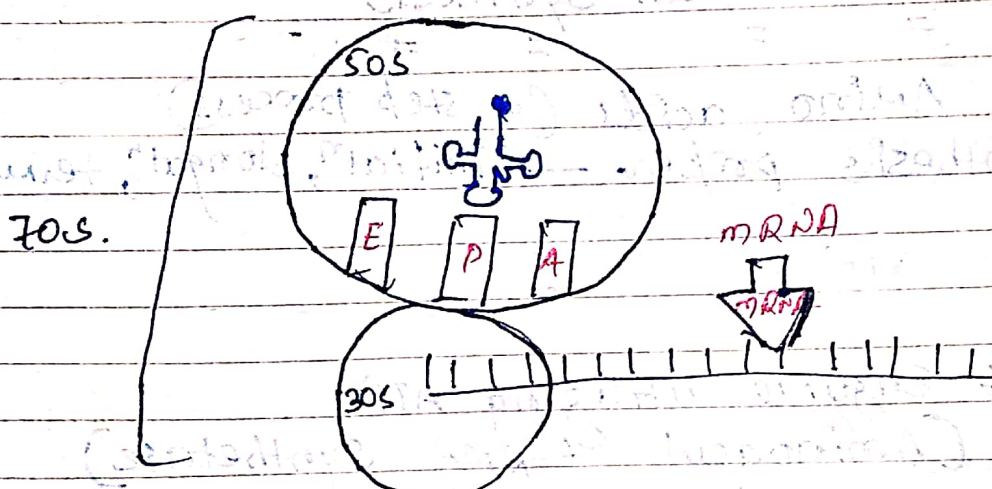


Aminoacyl t-RNA

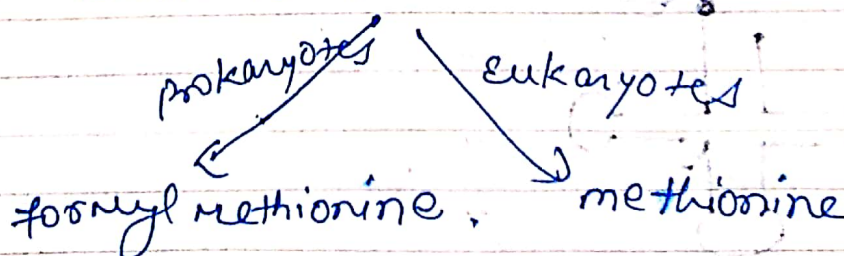
## ② Protein Synthesis

→ step 1: Initiation

E - Exit site  
P - Peptidyl site  
A - Aminoacyl site

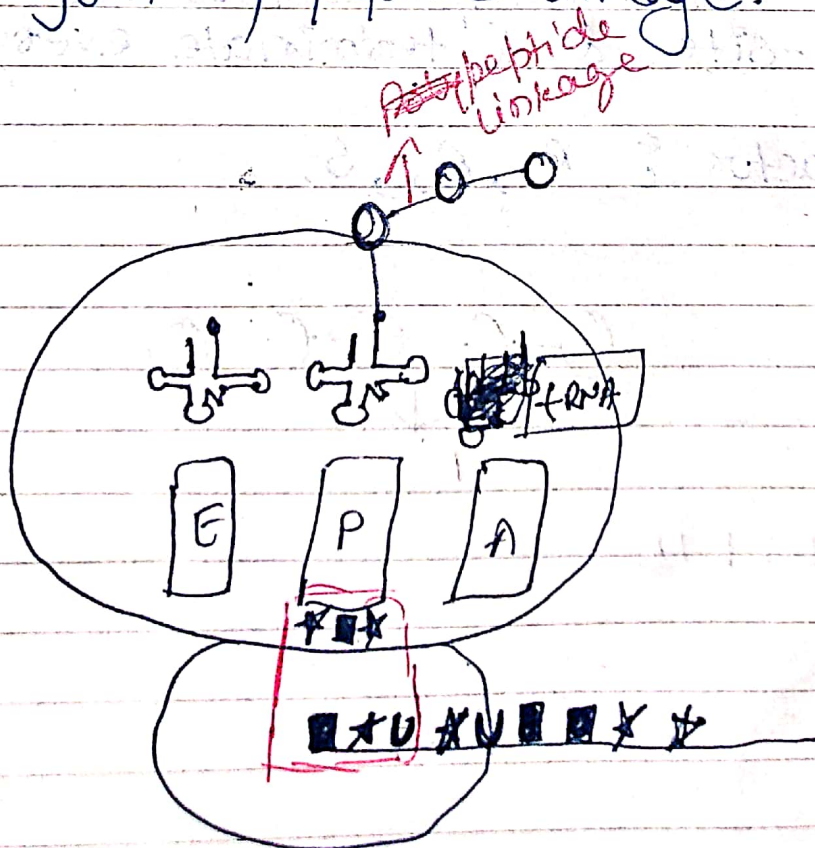


- mRNA also bind smaller subunit (30S)
- (50S) ribosome provide site for binding
- when t-RNA comes they always attached first P-site but after t-RNA comes & they join A-site then P-site then E-site.
- The start codon is AUG



## Step 2: Elongation

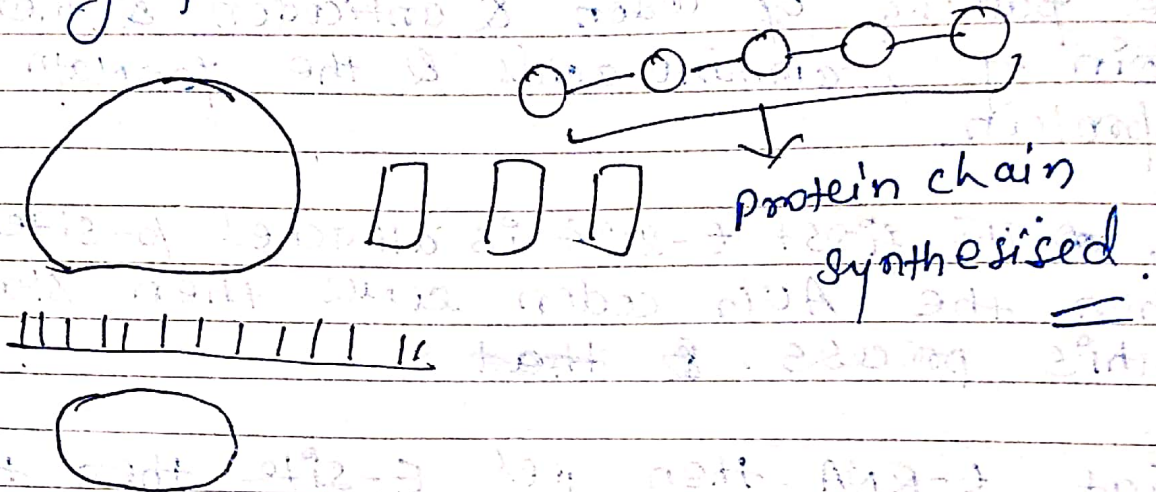
- Elongation is done by formation of peptide linkage.
- t-RNA brings ~~amino~~ amino acids & a/c to code the pairing of codon & anticodon & then join of amino acids & the format of protein.
- So, the first t-RNA is attached to E-site & when the AUG codon comes then start this process. ~~the~~
- That t-RNA then goes E-site then they gave their amino acids to A-site.
- This process is continue & many amino acids join by peptide linkage.



### Step 3<sup>o</sup> Termination

- At this step terminating factors come & join at A-site & terminate everything.

terminating factors  $\rightarrow R_1, R_2, S.$



### Step 3<sup>o</sup> Termination

- $\rightarrow$  At this step terminating factors comes & join at A-site & terminate everything.

$\rightarrow$  Terminating factors  $\circ R_1, R_2, S.$

