

STRUCTURE OF DNA

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

phosphate group

Deoxy ribose sugar

Nitrogen bases - Adenine } purine

Guanine }

Cytosine }

Thymine }

- Present in only nucleus.

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

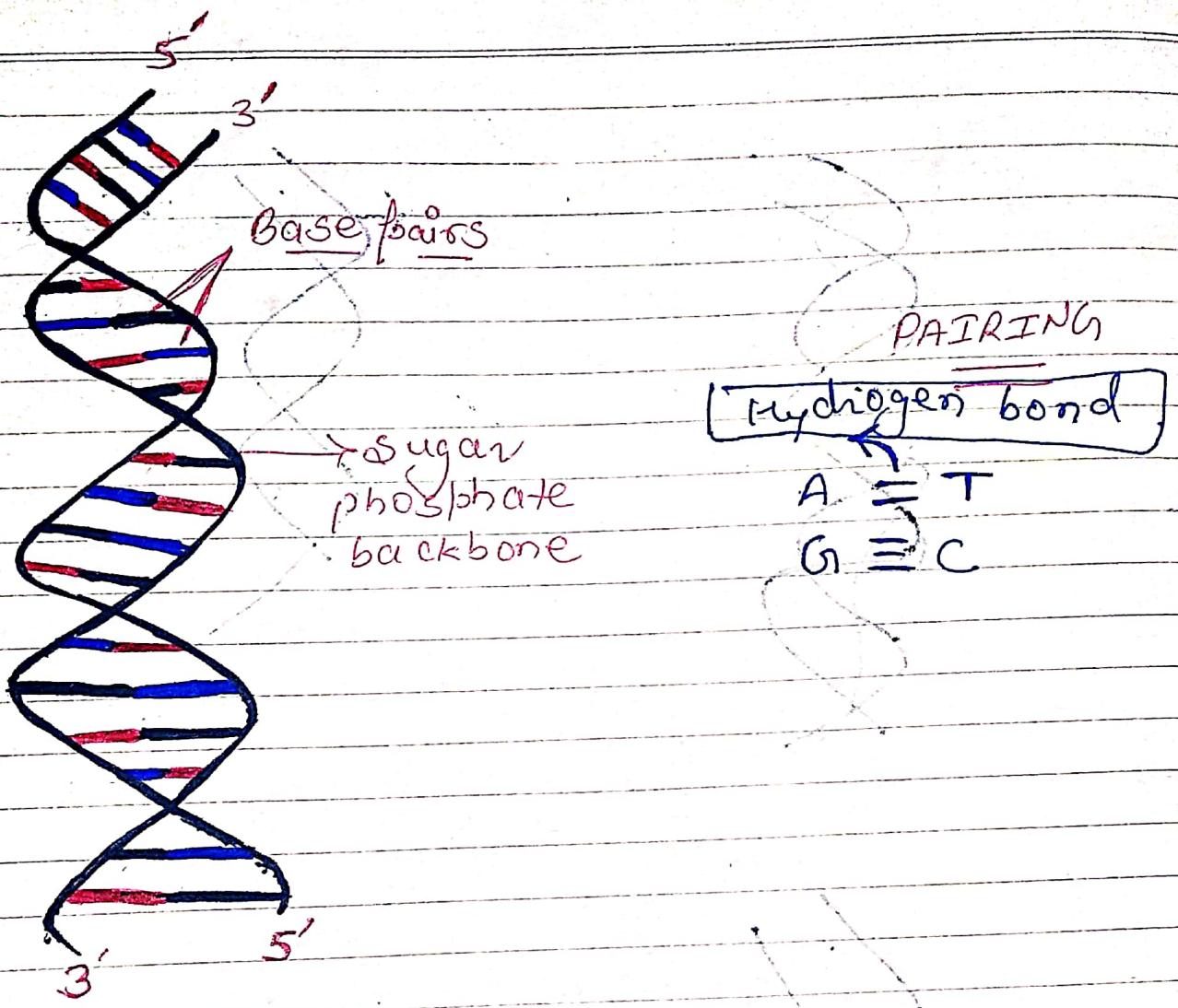
function → : carrying genetic information

: 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.

Phosphate group

Ribose sugar

Nitrogen bases → Adenine

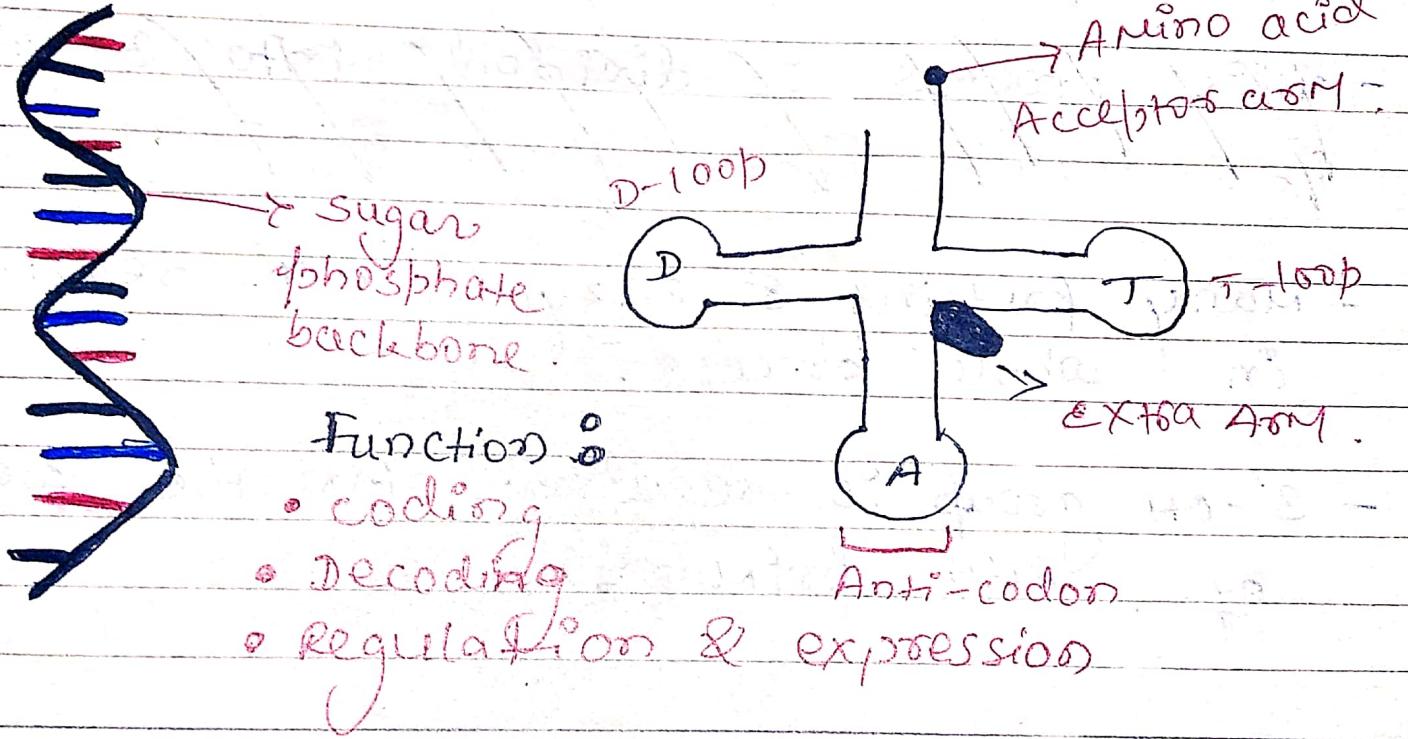
Guanine

Cytosine

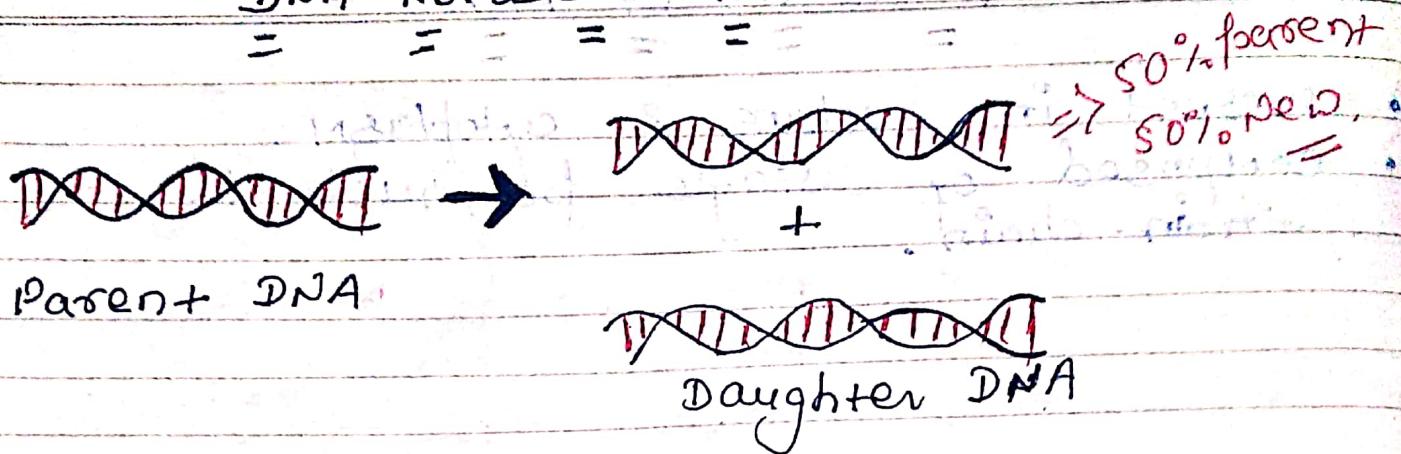
Uracil.

Types of RNA

- mRNA (carries info from DNA → Ribosome) 5-10%
↳ messenger protein synthesis
- tRNA (involved in protein synthesis in Ribosome)
↳ ribosomal (60-85%)
- rRNA (transfer amino acids in protein synthesis)
↳ transfer (10-15%)
↳ Amino acid



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. α : Synthesis of RNA primers for both leading & lagging strands of DNA.

→ DNA poly. β : Involved in the repair of DNA.

→ DNA poly. γ : Replication of Mitochondria DNA.

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

4) Topoisomerase : Relieves overswinding 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

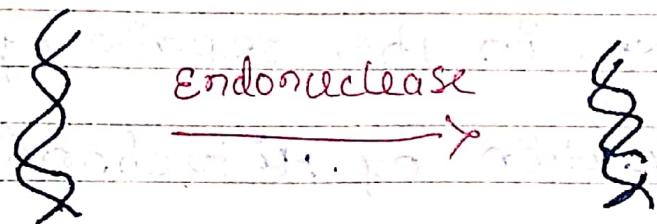
Step 1: Origin of Replication (Ori).

⇒ cell → Prokaryotic → small → only one Ori.
DNA DNA

⇒ eukaryotic → large → many Ori.
DNA DNA

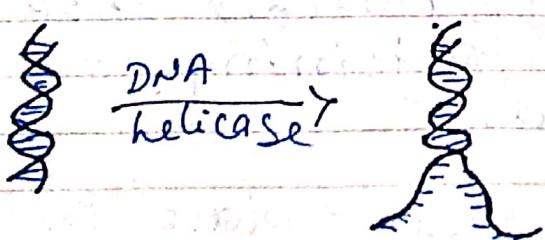
Step 2: Cut / Incision of DNA.

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



Step 3: unwinding of DNA.

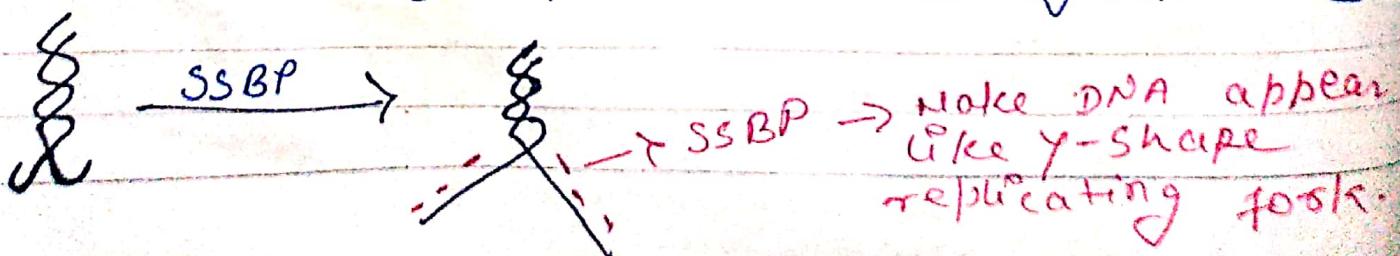
- It is done by the help of enzyme DNA helicase.
- Done by breaking all the H-bond.



$A \equiv T$,
less energy
to break

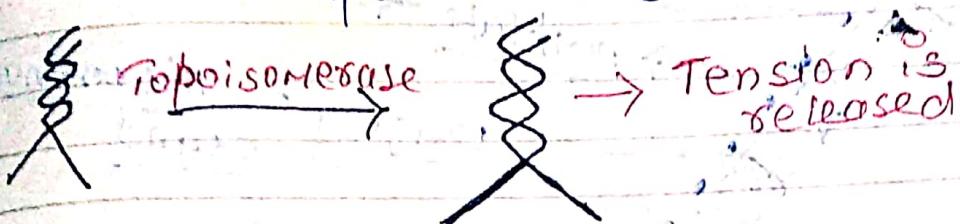
$C \equiv G$,
more energy
to break

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



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

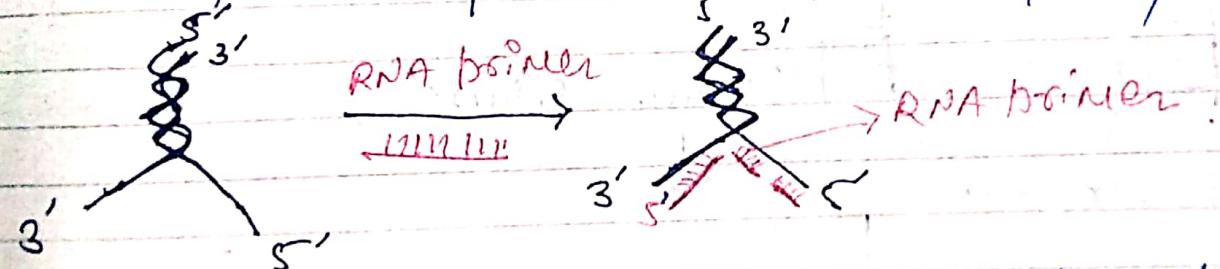
- Due to unwinding, the upper DNA can undergoes tension / stress
- To release by using enzyme **Topoisomerase**.



Step 6: Formation of RNA primers.

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

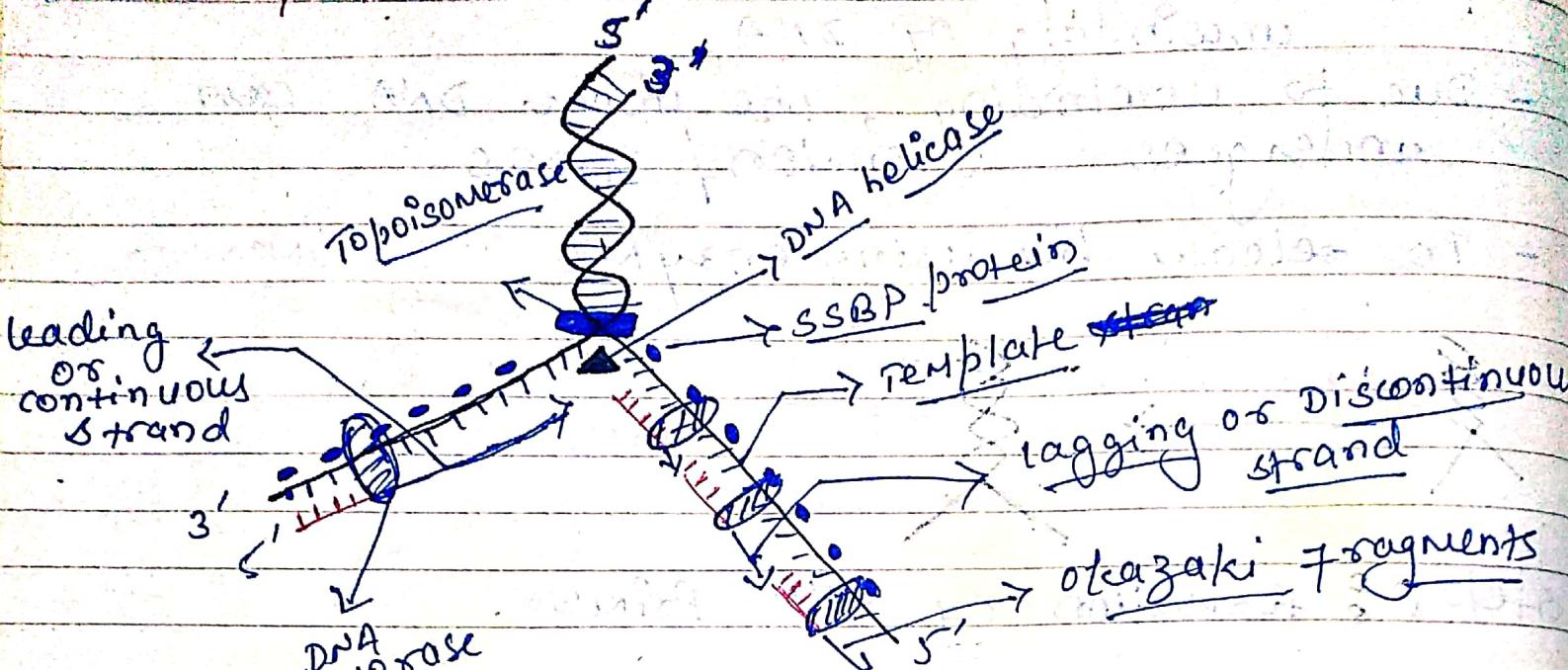
- The only problem of RNA primers is it always binds only to 3'-end of RNA & on 5'-end multiple RNA primer is add by very difficulty.



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



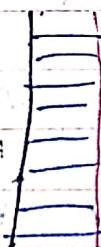
DNA
polymerase

leading
strand



okazaki fragments
join by
DNA ligase -

lagging strand



lagging strand

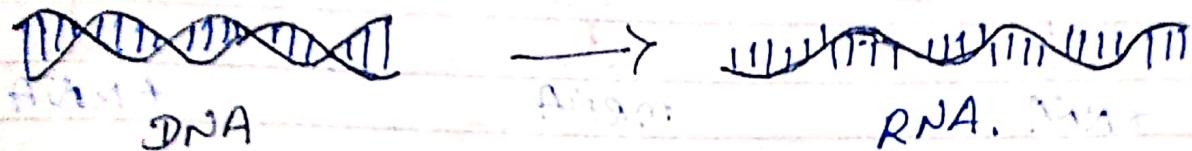
50% comes from parent

50% newly synthesis -

semiconservative

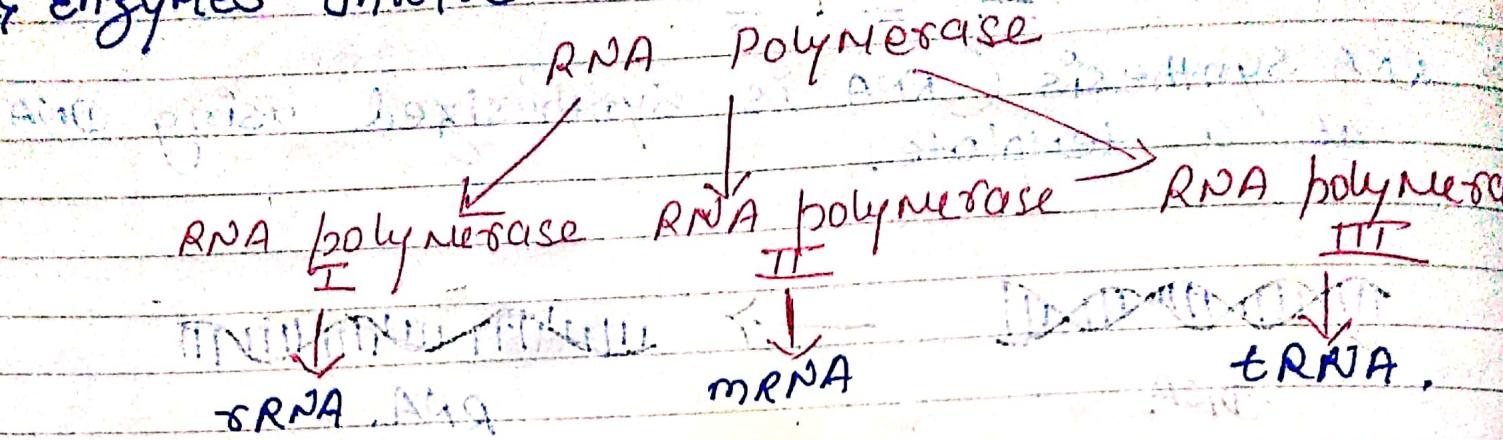
Transcription

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

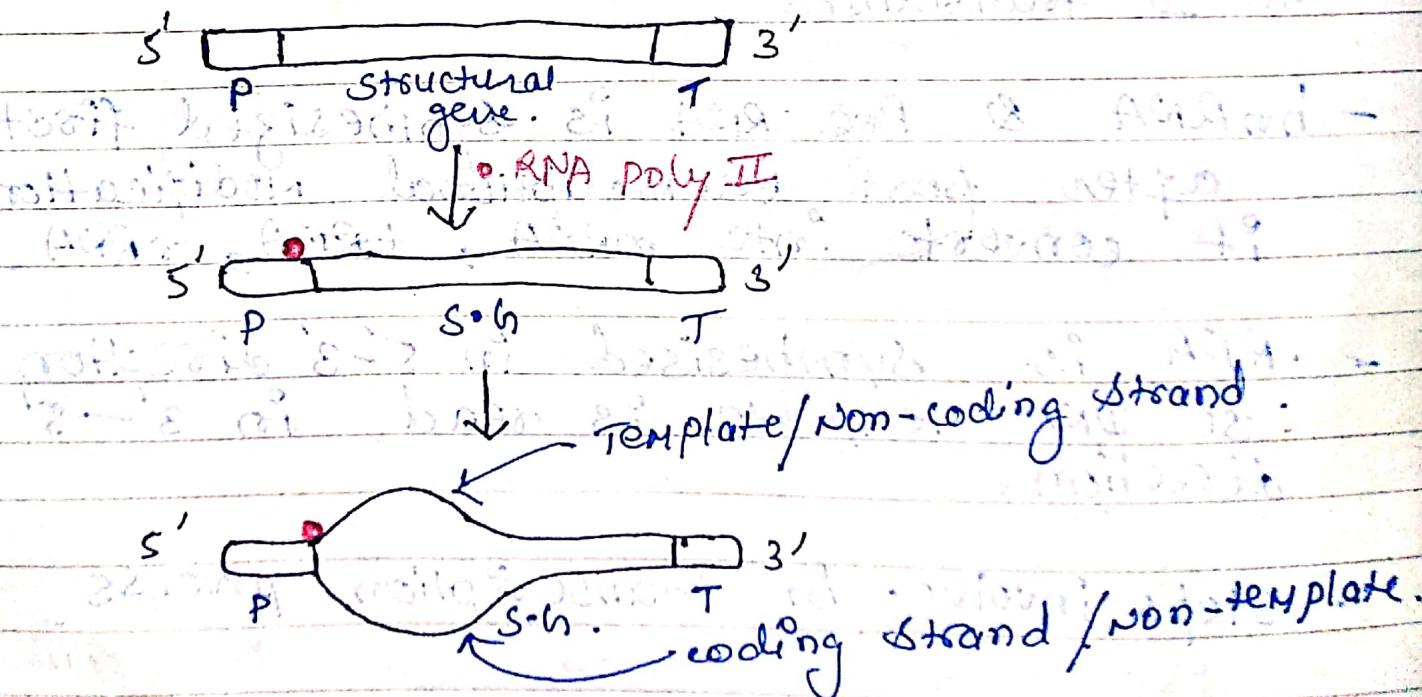


- Particular gene or group of genes are copied at ~~any~~ ^{that} time.
- Transcription process is highly selective (specific sequence transcript only).
- Specific sequence are present in DNA template which makes the beginning point & end point of the DNA which is to be transcribed.
- hnRNA & Pre RNA 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 Involved in Transcription



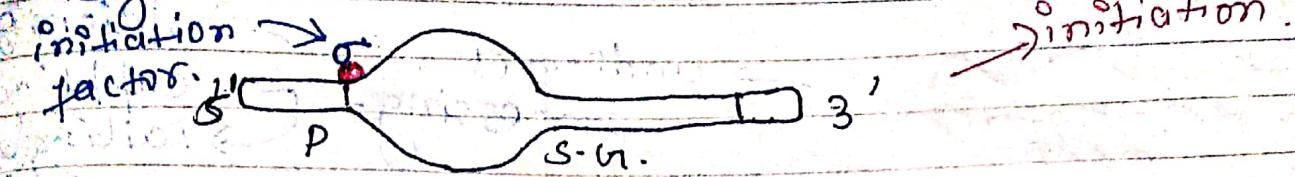
- Requirements:
- Promoter: present at 5' end
 - Terminator: present at 3' end
 - Structural gene: Gene to be transcribed
 - Initiation factor: σ
 - Termination factor: Rho



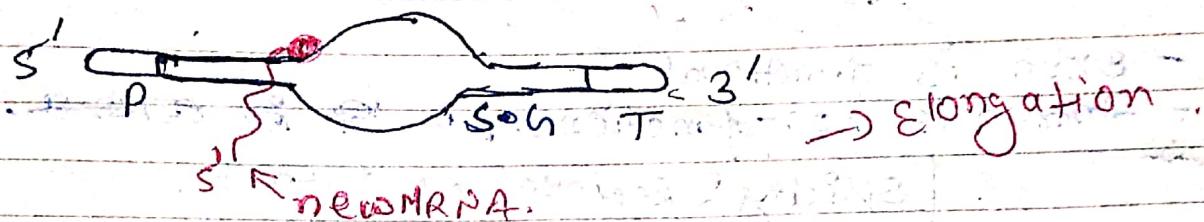
- But process cannot start unless initiation factor (σ) binds.

sigma

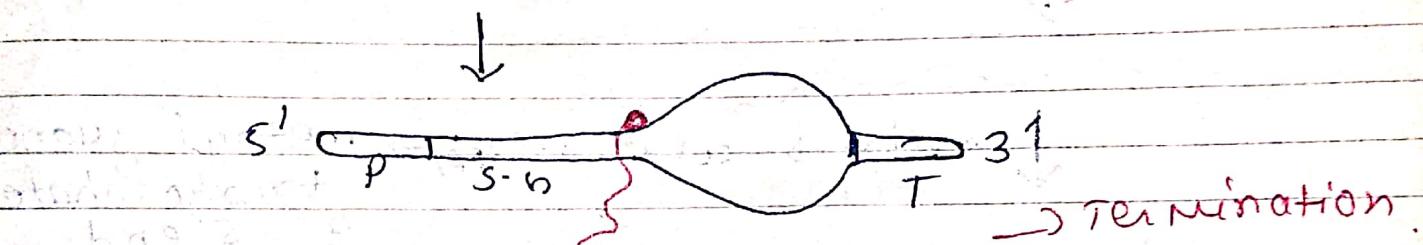
initiation factor.



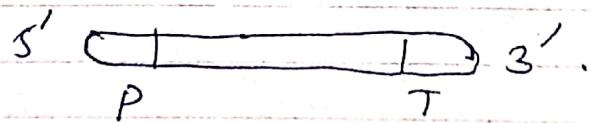
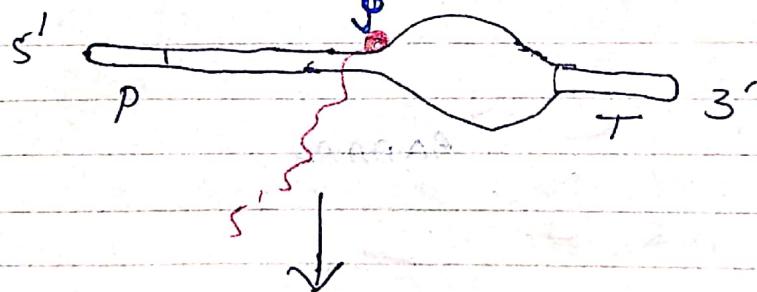
↓ σ - starts process afterwards it leaves



new mRNA.

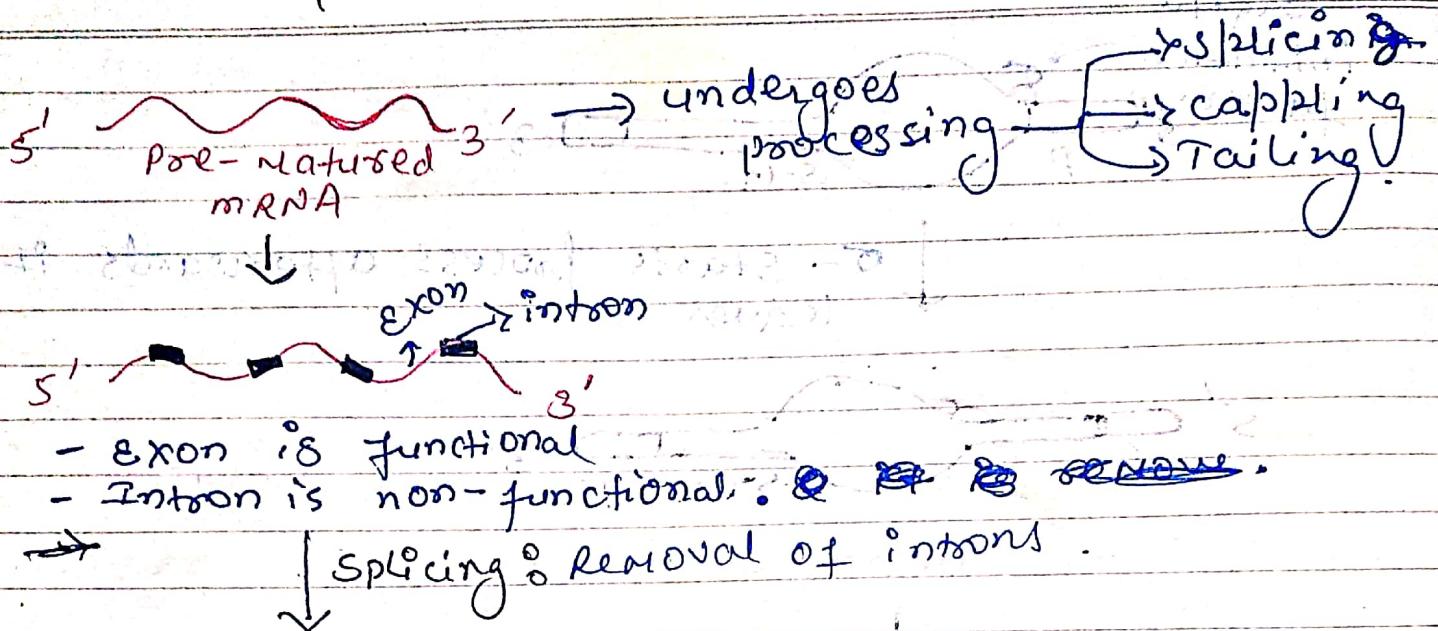


Add σ rho



σ
mRNA.
Pre
(Matured)

Prokaryotic \rightarrow not need processing
Eukaryotic \rightarrow need processing



5' $\xrightarrow{\text{capping}} 3'$ add m₇Gppp \rightarrow methyl guanosine triphosphate at 5' end.

5' m₇Gppp $\xrightarrow{\text{Tailing}} 3'$ Adenine \rightarrow poly A tail (AAAAA) at 3'-end.

5' m₇Gppp $\xrightarrow{\text{matured}}$ 3' AAAAAA
mRNA

Genetic code

= = =

- The three nucleotide base sequences in DNA or RNA are known as codon: UCU, UCV, UAU.

- collection of codons known as genetic code.
- Nucleotide 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

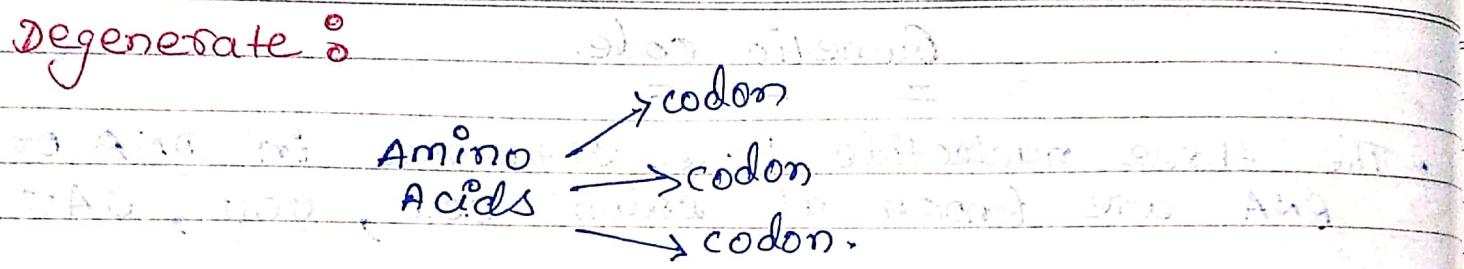
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1) Universal : Same codons are used for the same amino acids in all living organisms.

2) Specificity : Particular codon always codes for ^{same} particular amino acids.

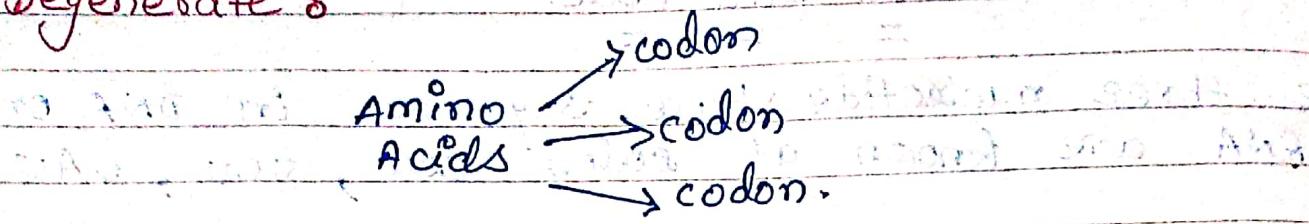
Eg ⇒ UGG is codes for tryptophan.

3) Degenerate



- Amino acids have more than one codon.
 - There are 61 codons to codes for only 20 amino acids.
- eg) glycine has four different codons.

3) Degenerate:



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

e.g. Glycine has four different codons.

TRANSLATION
= = = =
(Protein synthesis)

DNA
↓
RNA
↓
Protein synthesis

- Formation of protein from mRNA is known as Translation / protein synthesis / Poly/peptide synthesis

→ Requirements:

- ① Amino acids
- ② Ribosomes → They have two sub units
e.g. 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 factor \rightarrow Need for initiation, elongation & termination.

\rightarrow Steps involve in protein synthesis

① Activation of Amino acids (a step process)

② Protein Synthesis proper \rightarrow (initiatⁿ, elongatⁿ, terminatⁿ)

① Activation of amino acids.

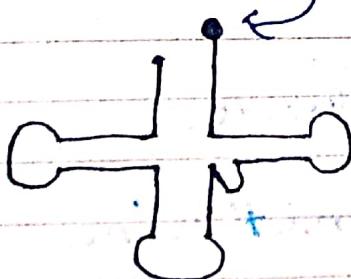
Amino acids + Enzyme utilizing ATP

(Aminoacyl t-RNA Synthetase)

step 1

Enzyme-AMP-amino acid complex

transfer
amino acid

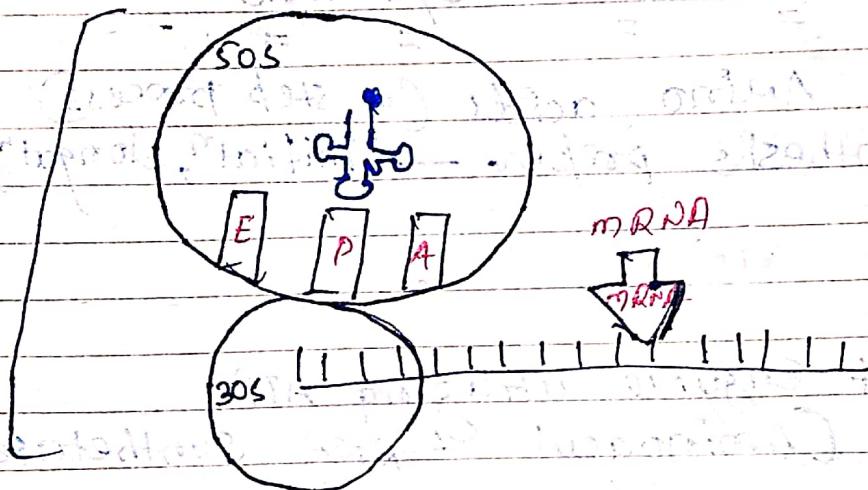


Aminoacyl t-RNA

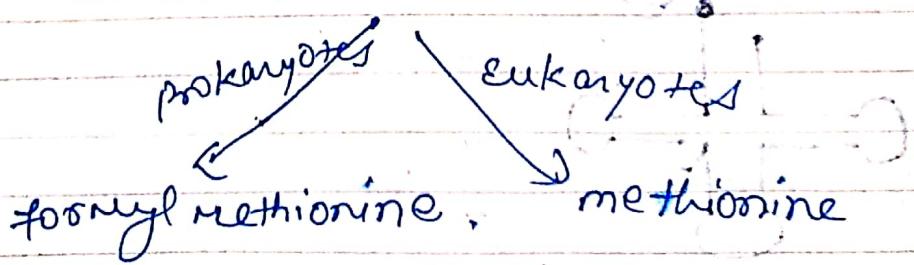
② Protein Synthesis

→ Step 1^o Initiation

E - Exit site
P - Peptidyl site
A - Aminobacyl site

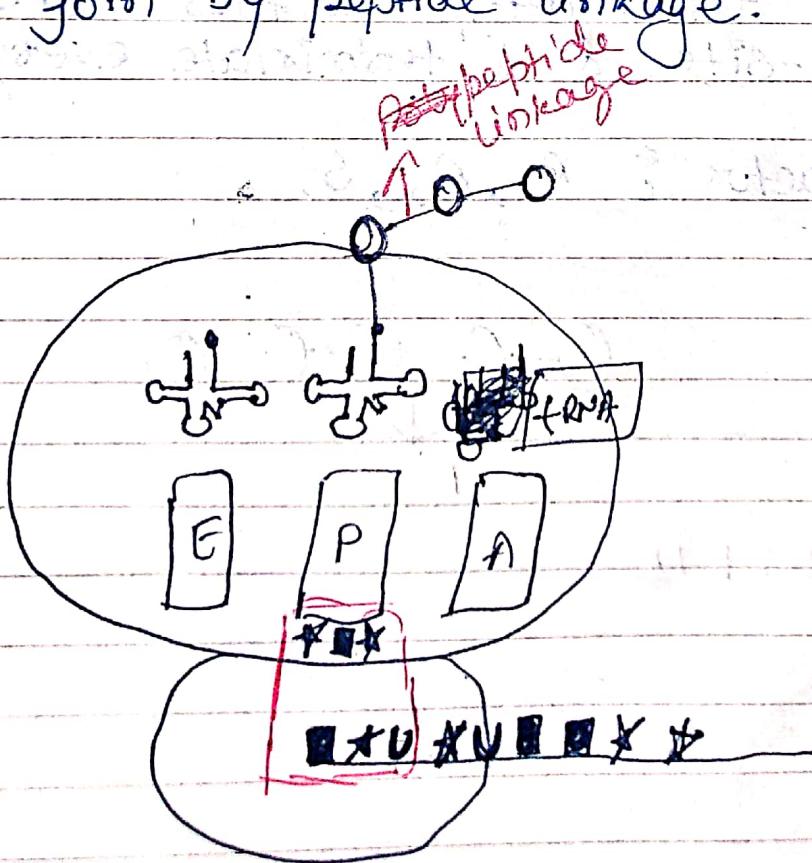


- mRNA also bind smaller subunit (30s)
- (50s) ribosome provide site for binding
- when t-RNA comes they always attached first P-site but after t-RNA comes & they join A-site then P-sites then E-site.
- The start codon is AUG



Step 2 : Elongation

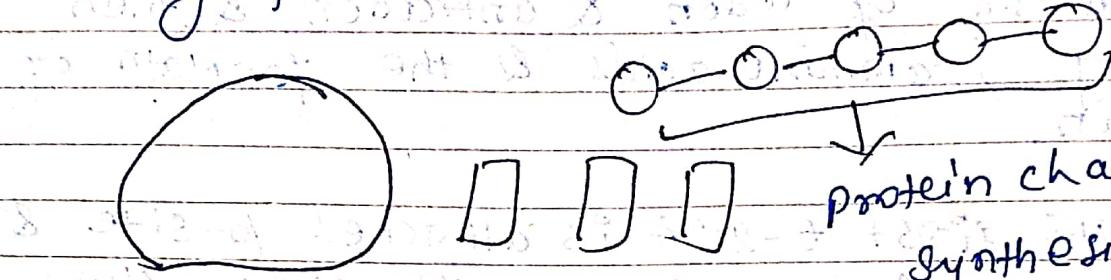
- Elongation is done by formation of peptide linkage.
- t-RNA brings ~~the~~ amino acids & also to code the pairing of codon & anticodon & then join of amino acids & the formation of protein.
- So, ~~the~~ the first t-RNA is attached P-site & when the AUC codon comes then start this process. ~~& that~~
- 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° Termination

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

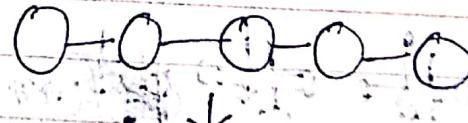
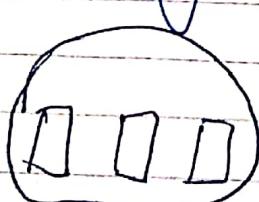
terminating factor $\rightarrow R_1, R_2, S$.



Step 3° Termination

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

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



Protein chain Synthesised

