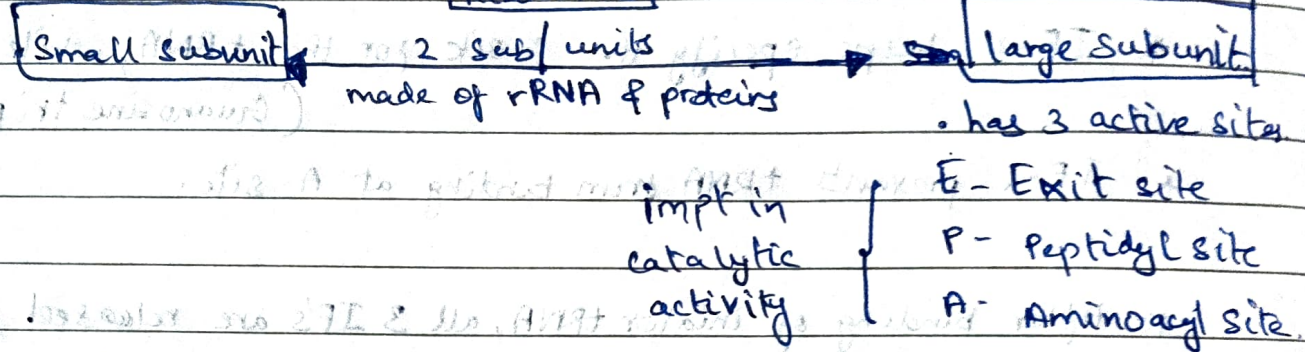


# Protein Synthesis:

## Protein synthesis

- Process of synthesizing amino acids (basic structural unit) in the form of chains, collectively known as polypeptides.
- Synthesis Occurs in Ribosomes.

### Ribosomes



- Functions of ribosome are to read sequence of codons in mRNA. and tRNA - transports amino acids and other essentials in correct sequence.

mRNA - messenger RNA.

tRNA - transport RNA.

- Translation involves 3 phases:

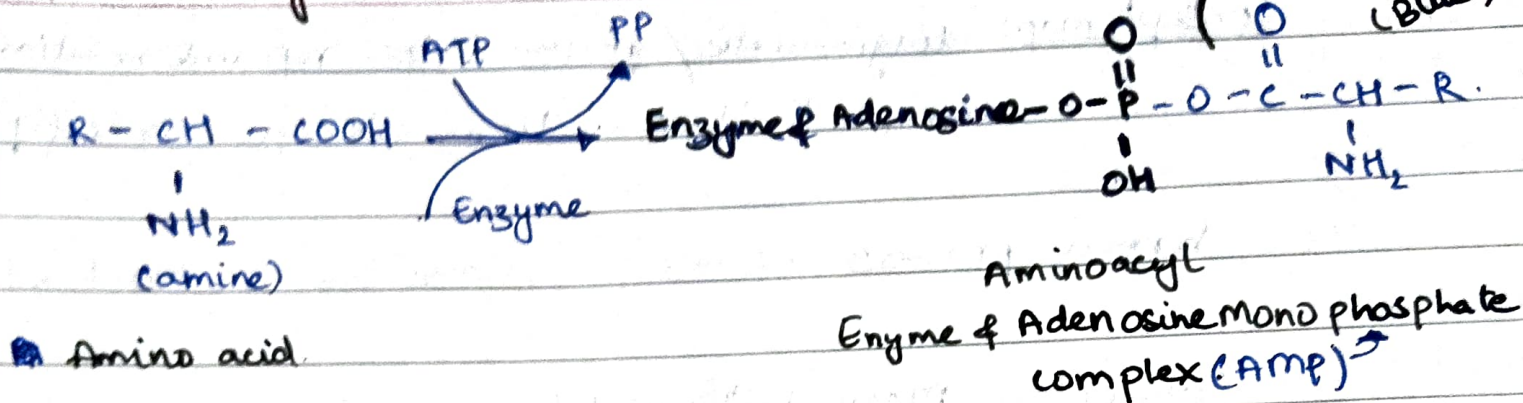
- Initiation
- Elongation
- Termination.

- All ribosomes have 3 binding sites
- Aminoacyl-tRNA binding site [A-site] Name has enough explanation.  
Binding site for aminoacyl tRNA during elongation.

- Peptidyl tRNA binding site [P-site].  
t-RNA linked to the elongating polypeptide chain is bound.

- The exit site [E-site].  
Site where t-RNA relocates from p-site before its release from ribosome.

## Activation of amino acid:



## Reaction with the complex:

### Reaction after complex formation:

Splitting of tRNA bound to amino acid from AMP and enzyme.

## Activation

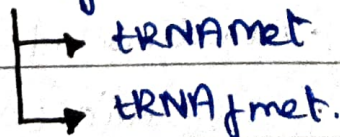
- Occurs in cytosol, catalysed by aminoacyl tRNA synthetases.
- All amino acids (types), activated and bound to 3' end of their specific tRNA in presence of ATP and  $\text{Mg}^{++}$ .

### Initiating amino acid:

- Prokaryotes: N-formylated methionine.
- Eukaryotes: methionine.

\* methionine activated by methionyl-tRNA synthetase.

\* N-formylmethionine uses either of:





## Initiation:

- \* IF-3 (Initiation factor-3) binds to small subunit (30s subunit).
- \* mRNA binds to small subunit in such a way the initiator codon is in P-site, 2nd codon is in A-site.
- \* IF-2 helps specify the P-site for the tRNA, while using GTP. (Guanosine triphosphate).
- \* IF-1 prevents tRNA from binding at A-site.
- \* After binding of initiator tRNA, all 3 IF's are released for the joining of larger subunit of ribosome (50S).
- \* Exit site is located in larger subunit.

## Elongation: 3 steps: i) tRNA binding at A-site.

ii) Peptide bond formation.

iii) Ribosome translocation.

### i) tRNA binding at A-site:

- \* initiator tRNA is at P-site, 2nd tRNA <sup>binds</sup> ~~comes~~ to A-site, facilitated by EF-TU using GTP.

- \* GTP hydrolysed, EF-TU-GDP is released, which enters EF-TS cycle.

### ii) Peptide bond formation:

- \* Amino acid present in tRNA of P-site forms peptide bond with amino acid of tRNA in A-site, catalysed by peptidyltransferase.

### iii) Ribosome translocation:

Both large & small subunit, now bound together, move one codon ahead in 5' - 3' direction on mRNA.

- \* dipeptide t-RNA appears on P-site, next codon comes to A-site, uncharged/already used tRNA leave through E-site into cytosol.
- \* Translocase enzyme changes 3D structure of ribosome and aids 5' - 3' movement.

(repeats)

This process continues till termination.

### Termination

- \* Triggered by any 1 of these stop codons: [UAG, UGA, UAA] which are recognised only by release factors RF1 & RF2.
  - RF1: UAG & UAA
  - RF2: UGA & UAA
- \* Release factor binds to A-site, release of polypeptide chain from P-site, allowing ~~dissociation~~ dissociation of ribosome's subunit.
- \* After multiple translations, mRNA is degraded, nucleotides are reused in transcriptional reactions.