

Translation:

Is the process by which ribosomes read the genetic message in mRNA and produce protein product

Ribosomes: serve as protein factories

tRNA: play a role as adapters that can bind amino acid (a.a) at one end and interact with mRNA at the other end

codon: RNA nucleotides (As, Us, Cs and Gs) that read in a group of three

genetic code: the collection of codons

for 20 amino acids there should be 20 codons (each codon 3 nucleotides)

1 nucleotides give 4 combinations

2 nucleotides give 16 combinations

3 nucleotides give 64 combinations

Start codon: its AUG codon that specifies the amino acid methionine, it acts as a signal the start of protein synthesis

Stop codon: UAA, UAG, UGA (termination codon for protein synthesis)

*the genetic code is described as (degenerate or redundant), because a single amino acid may be coded for by more than one codon, such as proline amino acid has four codons

Pro CCU, CCC, CCA, CCG

*genetic code in all organisms is the same

The ribosome has three active sites:

The A site: is the point of entry for amino acyl tRNA

The P site : is where the peptidyl tRNA is formed in ribosome

The E site: which is the exit site of the uncharged in tRNA after gives it's a.a

The process of translation:

1-Initiation

2-Elongation

3-Termination

1-Initiation:

In prokaryote involves the assembly of the component of translation system , which are:

Two ribosomal subunit 50S and 30S subunit

Mature mRNA to be translated

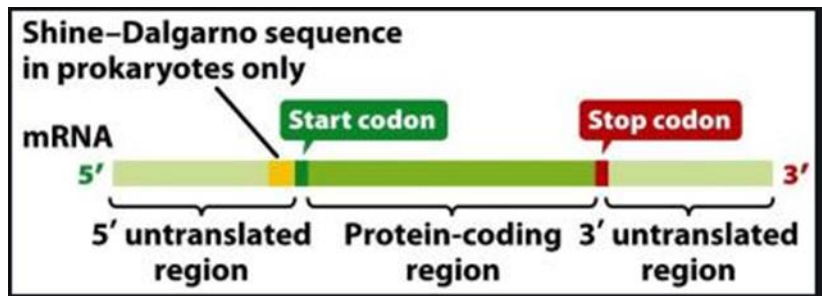
tRNA charged with N-formylmethionine(first a.a)

(GTP) as source of energy

3 prokaryotes initiation factors IF1, IF2,IF3

The 30 S subunit binds to the mRNA in a site called ribosome binding site that consist of two kinds of functional sequence:

- 1- Short sequence of purine-rich region (5-AGGAGGU) is called shine-Dalgarno sequence or leader sequence upstream of initiation codon



2- Initiation codon : the initiation codon in mRNA of prokaryotes is AUG that recognized by tRNA anticodon (UAC), this tRNA carries N Formyl methionine (tRNA)^{met}.

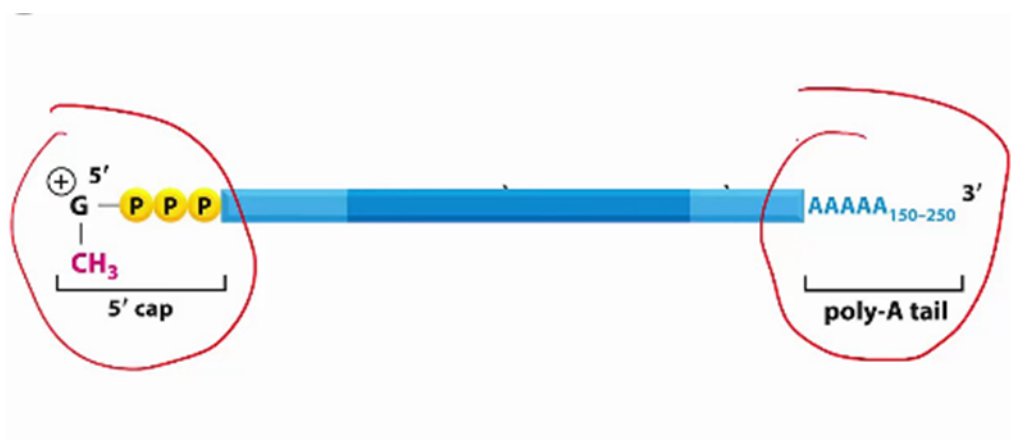
*30S subunit binds to mRNA

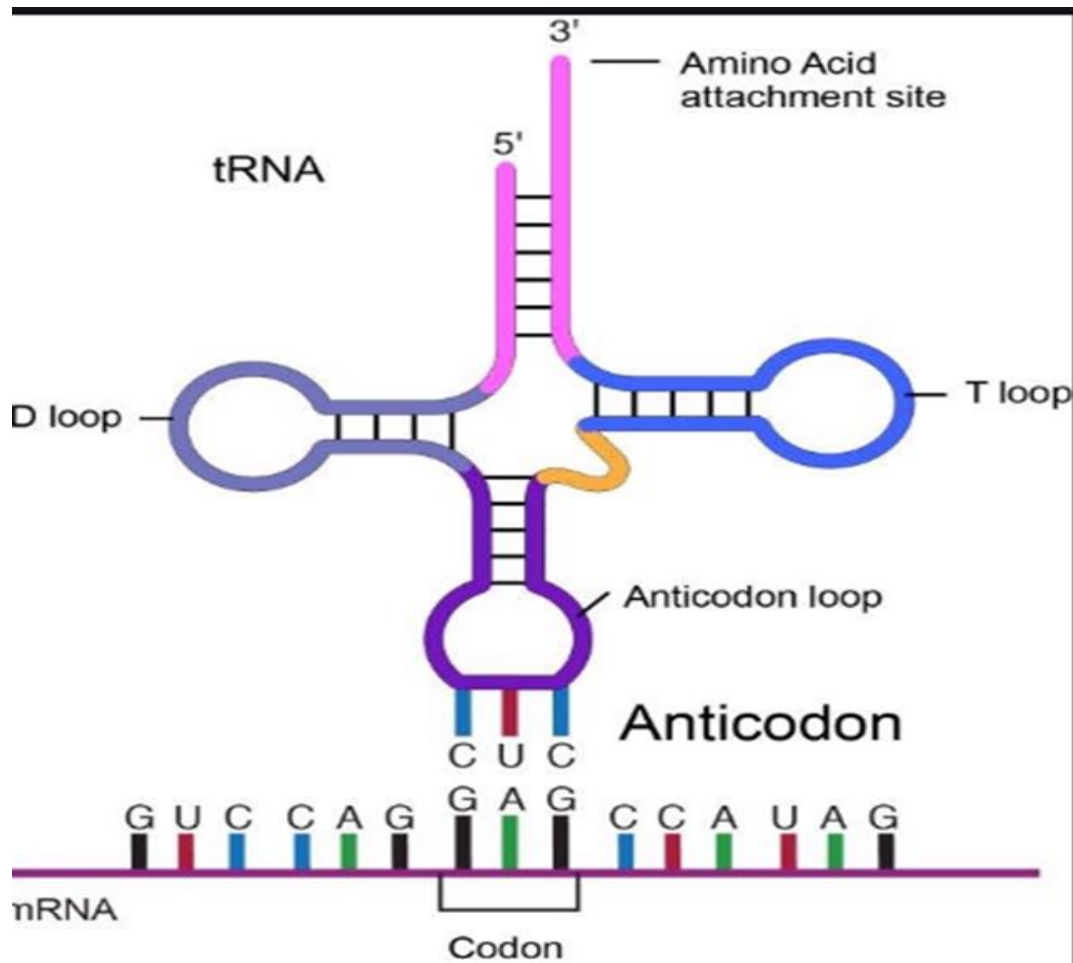
tRNA with anticodon (UAC) paired with start codon AUG
the large subunit 50S completes the complex,

in eukaryotes translation includes (2 initiation factors)

tRNA carrying methionine (tRNA)^{meth}, attaches small ribosomal subunit(40S).

then together bind to 5 end of mRNA by recognizing 5 G cap of the mRNA , find AUG





notes:

the third base in mRNA codon can undergo non-watson and crick base pairing with first base of tRNA anticodon

the mRNA codons first 2 bases form H-bond with corresponding bases on tRNA anticodon

because in genetic code , there are 61 possible codons for translation each codon requires tRNA molecules (anticodon)

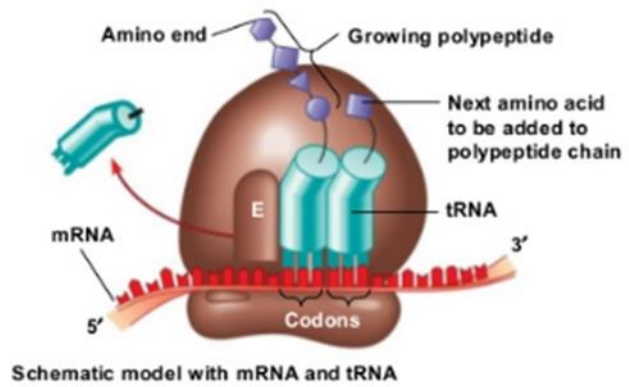
if each tRNA mol. Paired with complementary mRNA codon using usual Watson and crick base pairing, so 61 type of tRNA required (one tRNA for each codon), but there are 40-60 tRNA in a cell, and fewer than 45 types in most organisms, therefore, tRNA types must pair with more than one codon

tRNA charging:

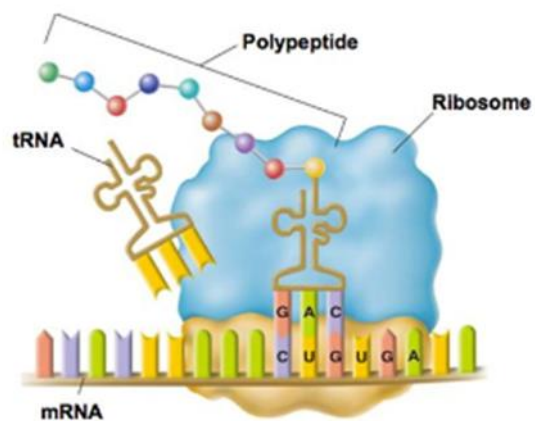
the process by which tRNA charged with amino acid , all the tRNA have the same three bases (CCA), at their 3 ends, and terminal adenosine is the target for charging.

2-Elongation:

- Addition of a.a to the OH end of the growing chain
- Starts when the f met-tRNA enter Psite, causing conformational change which opens A site for new amino acyl tRNA to bind new a.a
- Now p site contains the first a.a (f met), in beginning of peptide chain and A site has next amino acid to be added to peptide chain
- The reaction catalysed by enzyme
- Now movement of ribosome three nucleotides (one codon) down mRNA 5→3, therefore tRNA carrying elongated polypeptide translocate from A site to P site , the process called (translocation)
- The discharged tRNA (tRNA with no a.a) moves to E site and leaves ribosome, ribosome translate the remaining until reach the stop codon



Ribosome translates 5' to 3' on mRNA. Polypeptide chain grows amino end first, carboxyl end last.



3-Termination:

It occurs when one of three termination codons (UAA, UGA, and UAG), moves in to the A site, these codon not recognized by any tRNA, but it recognized by protein called release factors(RF1, RF2MRF3), it promote hydrolysis the bond between the tRNA and polypeptide

Finally: protein folded into proper three dimensional conformations to work.