

MOLECULAR BIOLOGY

Lecture 4- DNA translation and protein synthesis

Presented by

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Translation of DNA

- • Translation is the first stage of protein biosynthesis .
- • In translation, (mRNA) produced by transcription is decoded by the ribosome to produce a specific amino acid chain, or polypeptide, that will later fold into an active protein.
- • Translation occurs in the cell's cytoplasm, where the large and small subunits of the ribosome are located, and bind to the mRNA.

Translation process

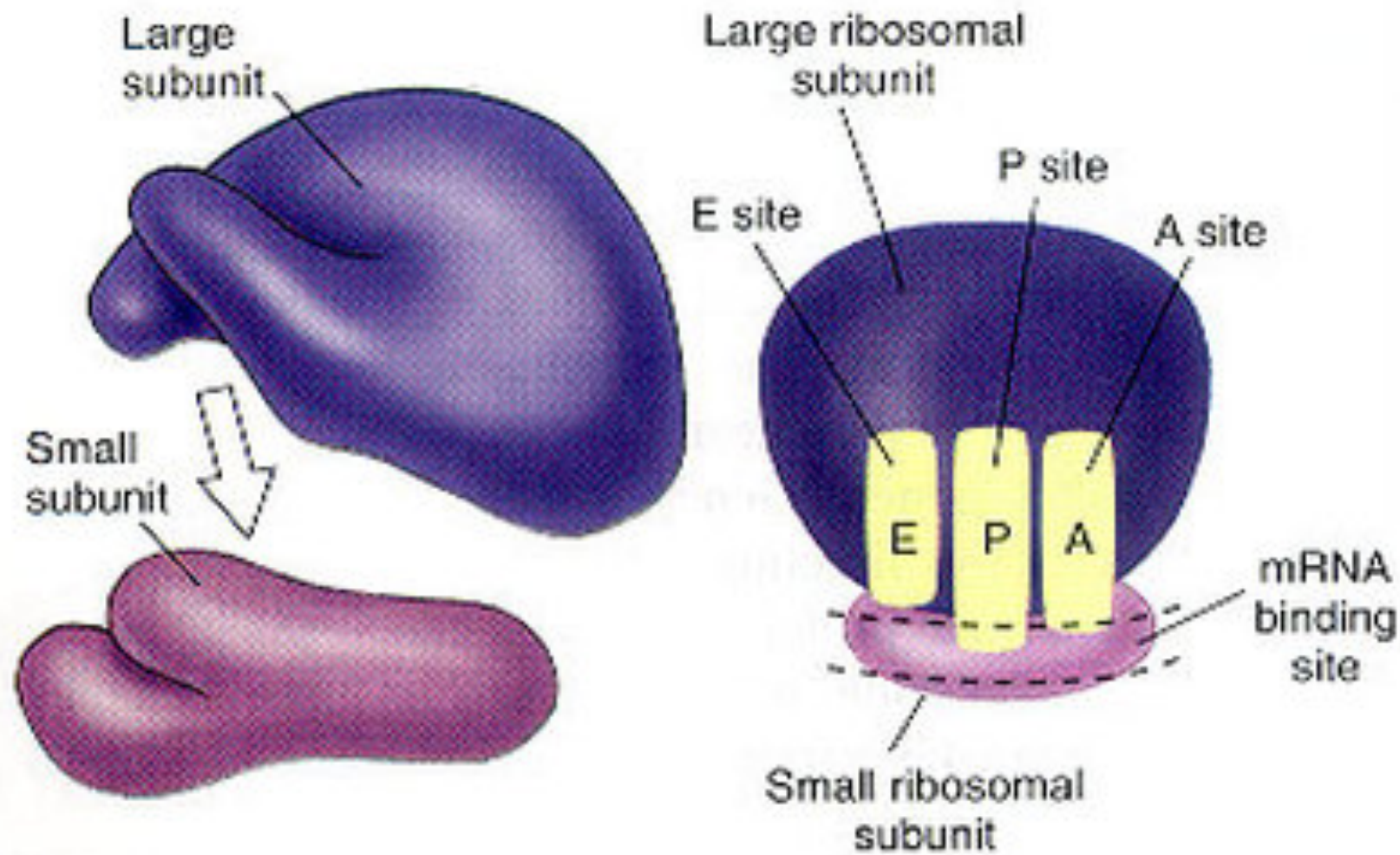
- The ribosome facilitates decoding by inducing the binding of tRNAs with complementary anticodon sequences to mRNA.
- • The tRNAs carry specific amino acids that are chained together into a polypeptide as the mRNA passes through and is "read" by the ribosome.
- • the entire ribosome/mRNA complex will bind to the outer membrane of the rough endoplasmic reticulum and release the nascent protein polypeptide inside for later vesicle transport and secretion outside of the cell.

Ribosomes

Ribosomes are small particles consisting of RNA and associated with proteins that function to synthesize proteins. **Ribosomes** can be found floating within the cytoplasm or attached to the endoplasmic reticulum . There are two types of ribosome:

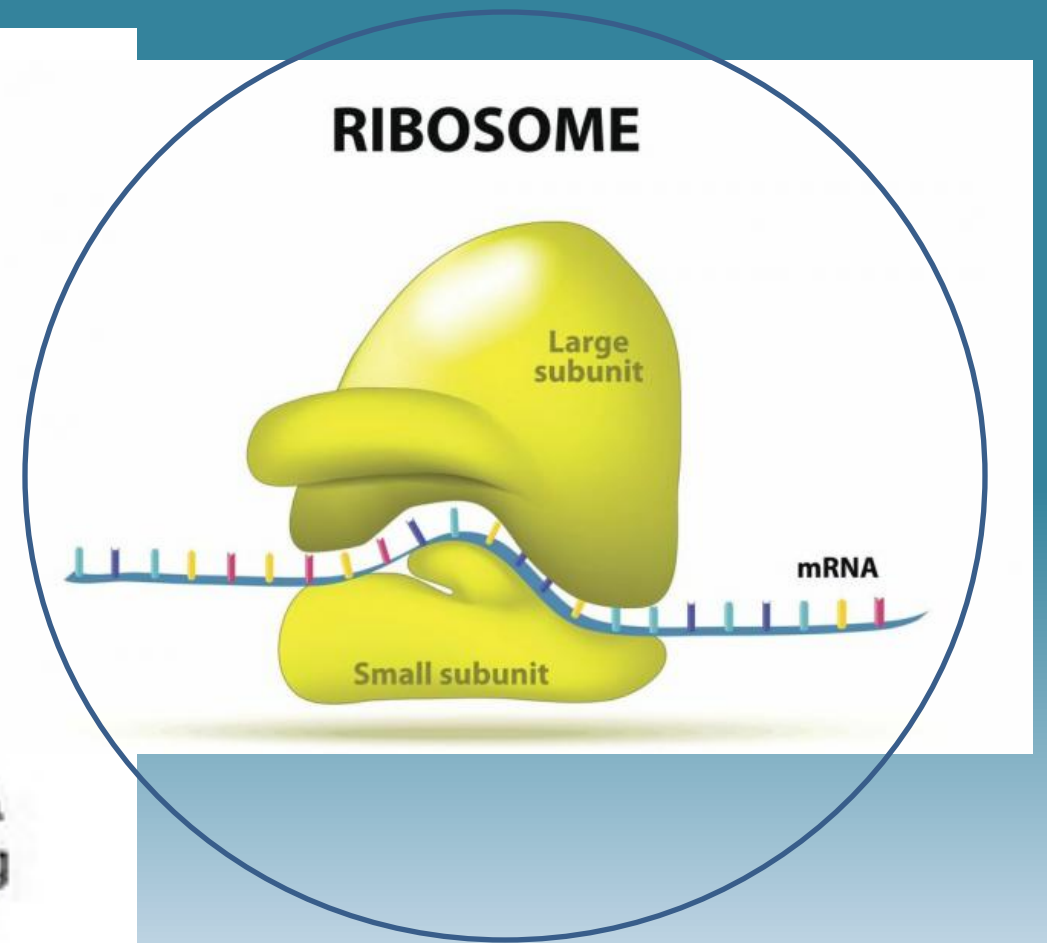
1- Prokaryotic ribosomes (**70S**) is smaller than eukaryotic Ribosomes . It is composed of two subunit (large subunit **50S** and small subunit **30S**).

2- Eukaryotic ribosomes (**80 S**)is larger than prokaryotic Ribosomes . It is composed of two subunit (large subunit **60S** and small subunit **40S**).



Ribosome Subunits

The smaller subunit fits into a depression on the surface of the larger one. The A, P, and E sites on the ribosome play key roles in protein synthesis.



Stages of translation

***The initiation stage of translation** brings together mRNA, tRNA bearing the first amino acid of the polypeptide, and two subunits of a ribosome. The start codon in all mRNA molecules has the sequence AUG and codes for methionine.

***In the elongation stage** The last tRNA validated by the small ribosomal subunit (*accommodation*) transfers the amino acid it carries to the large ribosomal subunit which binds it to the one of the precedingly admitted tRNA (*transpeptidation*). The ribosome then moves to the next mRNA codon to continue the process (*translocation*), creating an amino acid chain.

***The final stage** is termination when the ribosome reaches a stop codon in the mRNA..

*In the **elongation** stage the mRNA is bound to the complete two subunit ribosome,

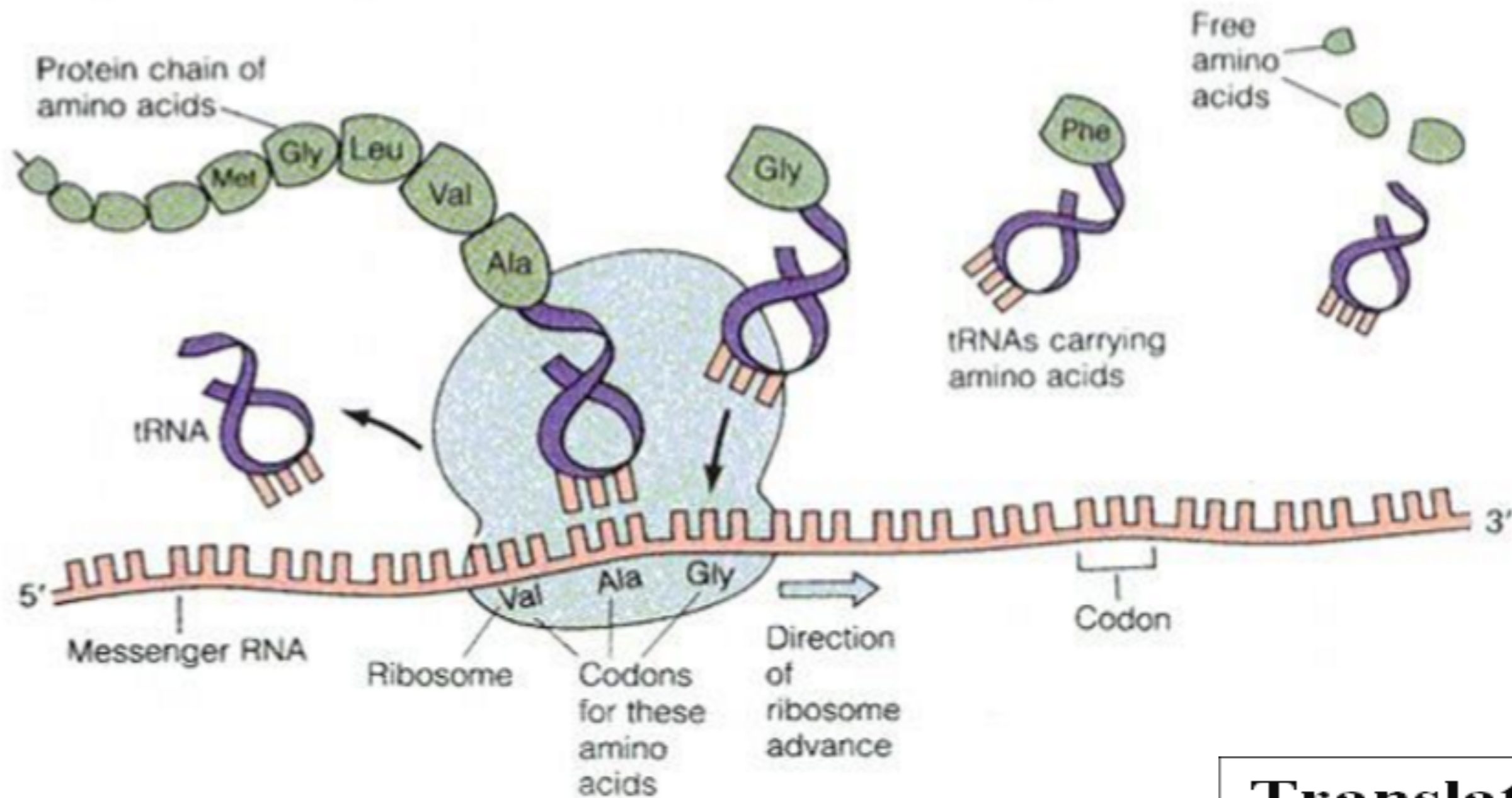
– with the initiating tRNA in the P site, and the A site free for binding to the next tRNA.

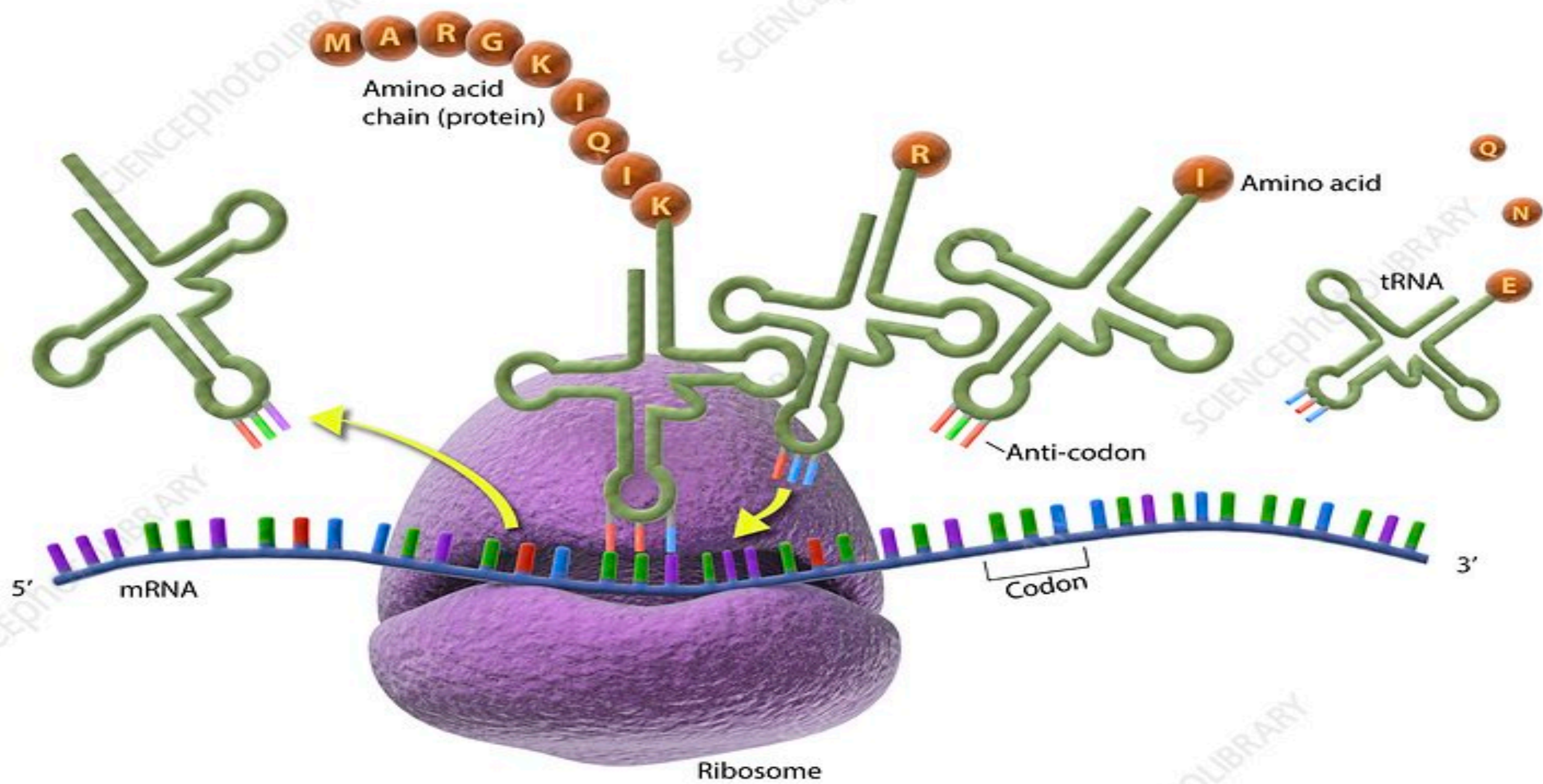
- The ribosome moves along the mRNA in a 5' to 3' direction, in a step-wise process, recognizing each subsequent codon.

- The peptidyltransferase enzyme then catalyzes the formation of a peptide bond between the free N terminal of the amino acid at the A site, and the Carboxyl end of the amino acid at the P site, which is actually connected to the tRNA.

- This disconnects the tRNA f Met from the amino acid, and the tRNA at the A site now carries two amino acids, with a free N terminal and the Carboxyl terminal of the second aa connected to its tRNA

- *The final stage is **termination** when the ribosome reaches a stop codon in the mRNA.. One of the three **stop codons (UAA, UGA, UAG)** enters the A site. No tRNA molecules bind to these codons so the peptide and tRNA in the P site become hydrolysed releasing the polypeptide into the cytoplasm.





RNA codon table

1st position	2nd position				3rd position
	U	C	A	G	
U	Phe Phe Leu Leu	Ser Ser Ser Ser	Tyr Tyr stop stop	Cys Cys stop Trp	U C A G
C	Leu Leu Leu Leu	Pro Pro Pro Pro	His His Gln Gln	Arg Arg Arg Arg	U C A G
A	Ile Ile Ile Met	Thr Thr Thr Thr	Asn Asn Lys Lys	Ser Ser Arg Arg	U C A G
G	Val Val Val Val	Ala Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	U C A G

Amino Acids

Ala: Alanine
Arg: Arginine
Asn: Asparagine
Asp: Aspartic acid
Cys: Cysteine

Gln: Glutamine
Glu: Glutamic acid
Gly: Glycine
His: Histidine
Ile: Isoleucine

Leu: Leucine
Lys: Lysine
Met: Methionine
Phe: Phenylalanine
Pro: Proline

Ser: Serine
Thr: Threonine
Trp: Tryptophane
Tyr: Tyrosine
Val: Valine

The end