

RNA translation (protein synthesis)

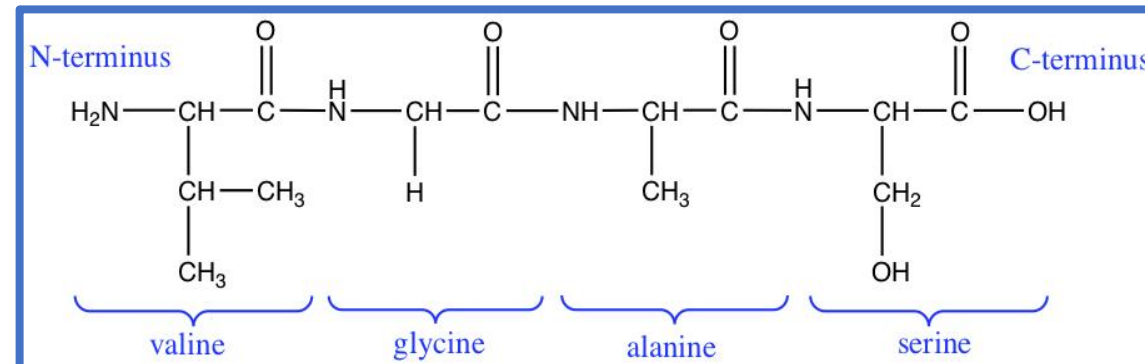
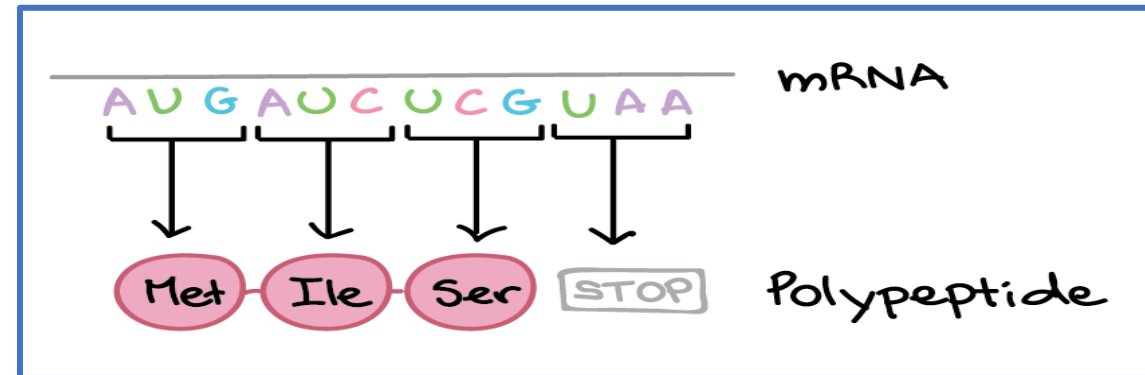


RNA translation

- RNA translation is a process that produces a protein from an mRNA template via the genetic code.
- The process takes place in the cytoplasm.
- Requires another RNA, called tRNA, rRNA.
- Protein synthesis is operated by cell organelle called **ribosome**.

The genetic code

- • The genetic code = triplets of RNA bases
- (called codons)
- Each codon encodes 1 amino acid.
- mRNA is read from 5' to 3'.
- The protein is made from the -NH₂
- end to the COOH end.



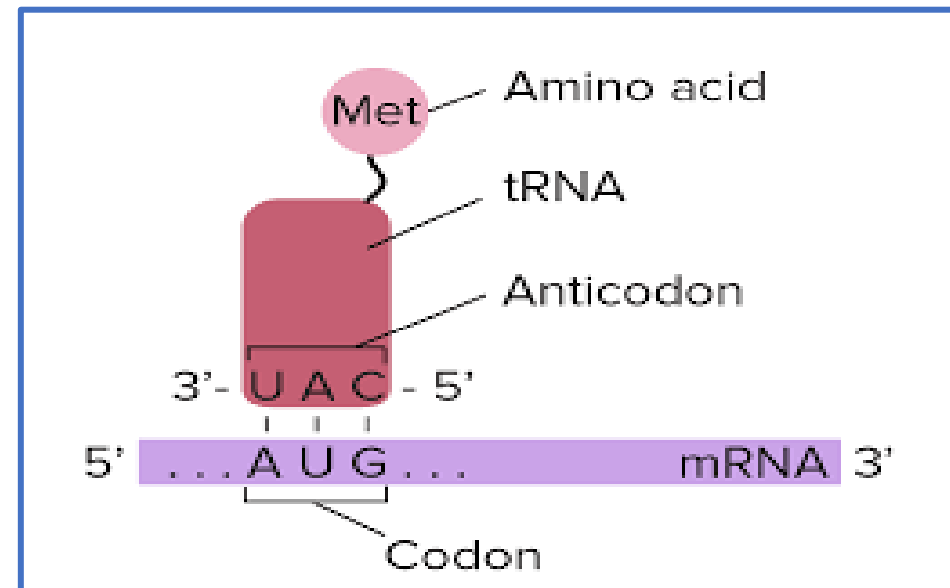
Transfer RNA (tRNA)

- In any case of unknown language change you need someone who
- understand both languages à **interpreter**
- In RNA translation you need an interpreter to translate **CODONS** into
- **amino Acids.**
- These interpreters are the tRNAs (small RNAs present throughout
- living cells)
- Each tRNA has a sequence called **ANTICODON** that base-pairs with a
- specific **CODON** on a mRNA

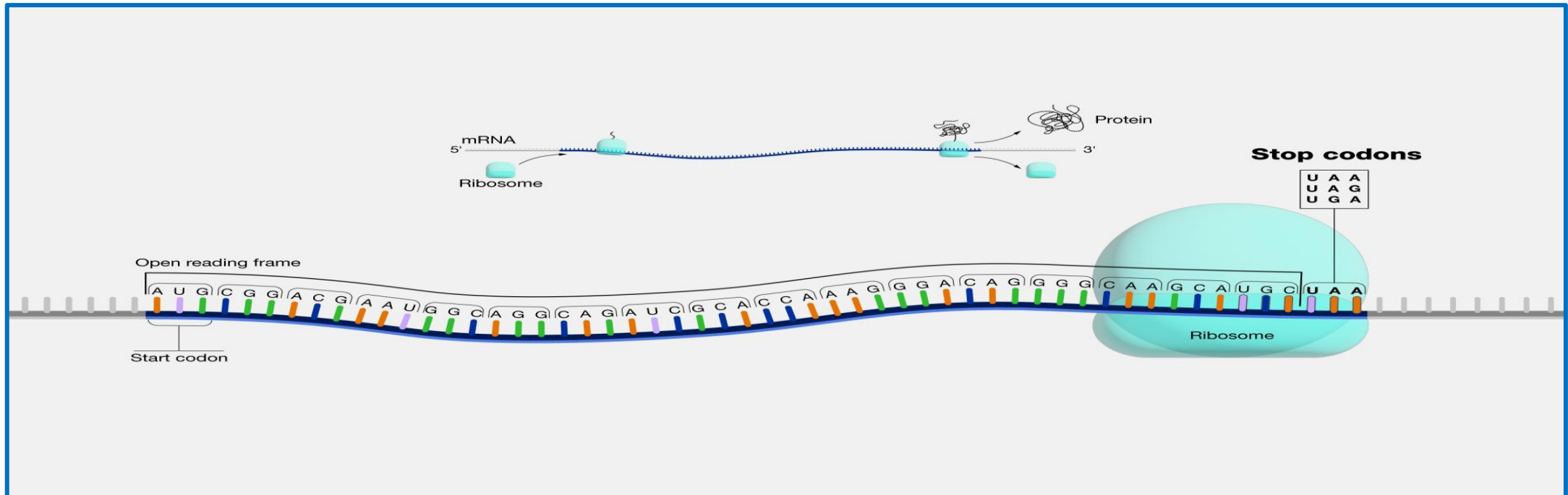
- Each tRNA base-pairs with **1 mRNA codon** a time.
- For example:
- mRNA codon 5' **AUG** 3'
- tRNA anticodon 3' **UAC** 5'
- After **codon-anticodon** matching, the tRNAs covalently binds the
- Correct amino acid and carries it to the ribosome for the protein synthesis

- For example: the mRNA codon 5'**AUG**3' encodes for the amino acid
- **methionine**, then:
- 1. the particular tRNA that has the anticodon 3'**UAC** 5' base-pairs with this codon.

Amino Acid			Codons						
W	Trp	Tryptophan	TGG						
Y	Tyr	Tyrosine	TAC	TAT					
C	Cys	Cysteine	TGC	TGT					
E	Glu	Glutamic acid	GAA	GAG					
K	Lys	Lysine	AAA	AAG					
Q	Gln	Glutamine	CAA	CAG					
S	Ser	Serine	AGC	AGT	TCA	TCC	TCG	TCT	
L	Leu	Leucine	TTA	TTG	CTA	CTC	CTG	CTT	
R	Arg	Arginine	AGA	AGG	CGA	CGC	CGG	CGT	
G	Gly	Glycine	GGA	GGC	GGG	GGT			
F	Phe	Phenylalanine	TTC	TTT					
D	Asp	Aspartic acid	GAC	GAT					
H	His	Histidine	CAC	CAT					
N	Asn	Asparagine	AAC	AAT					
M	Met	Methionine	ATG						
A	Ala	Alanine	GCA	GCC	GCG	GCT			
P	Pro	Proline	CCA	CCC	CCG	CCT			
T	Thr	Threonine	ACA	ACC	ACG	ACT			
V	Val	Valine	GTA	GTC	GTG	GTT			
I	Ile	Isoleucine	ATA	ATC	ATT				
X	STP	Stop codon	TAA	TAG	TGA				



- 2. It then covalently binds the amino acid **Methionine** (**tRNA^{MET}**).
- 3. It finally shuttles to the ribosome where the amino acid will be released and added to the growing protein.
- First codon = **START** codon
- Always 5'AUG3' codon = start codon for N-terminus Met



interpretation mRNA to Protein

- 1. Read mRNA sequence: 5' AUGAAAACU.....3'
- 2. Identify codons: 5' AUG/AAA/ACU/.....3'
- 3. Match codons with amino acids
 - • AUG = Met (M)
 - • AAA = Lys (K)
 - • ACU = Thr (T)
- 4. Continue until you find the stop codon (UAA or UAG or UGA)
- Note: stop codons **do not code** for any amino acid; they just stop
- translation

		Second base					
		U	C	A	G		
First base	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } Ser UCC } UCA } UCG }	UAU } Tyr UAC } UAA Stop UAG Stop	UGU } Cys UGC } UGA Stop UGG Trp	Third base	U
	C	CUU } Leu CUC } CUA } CUG }	CCU } Pro CCC } CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } Arg CGC } CGA } CGG }		C
	A	AUU } Ile AUC } AUA } AUG Met start	ACU } Thr ACC } ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }		A
	G	GUU } Val GUC } GUA } GUG }	GCU } Ala GCC } GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } Gly GGC } GGA } GGG }		G

Recap

- Each tRNA anticodon base-pairs with the corresponding mRNA codon
- Each tRNA binds the corresponding amino acid and delivers it to the ribosome.
- The ribosome brings all amino acid together and join them covalently in the correct ordered sequence
- The tRNA is then released and can re-enter the translation loop when needed

