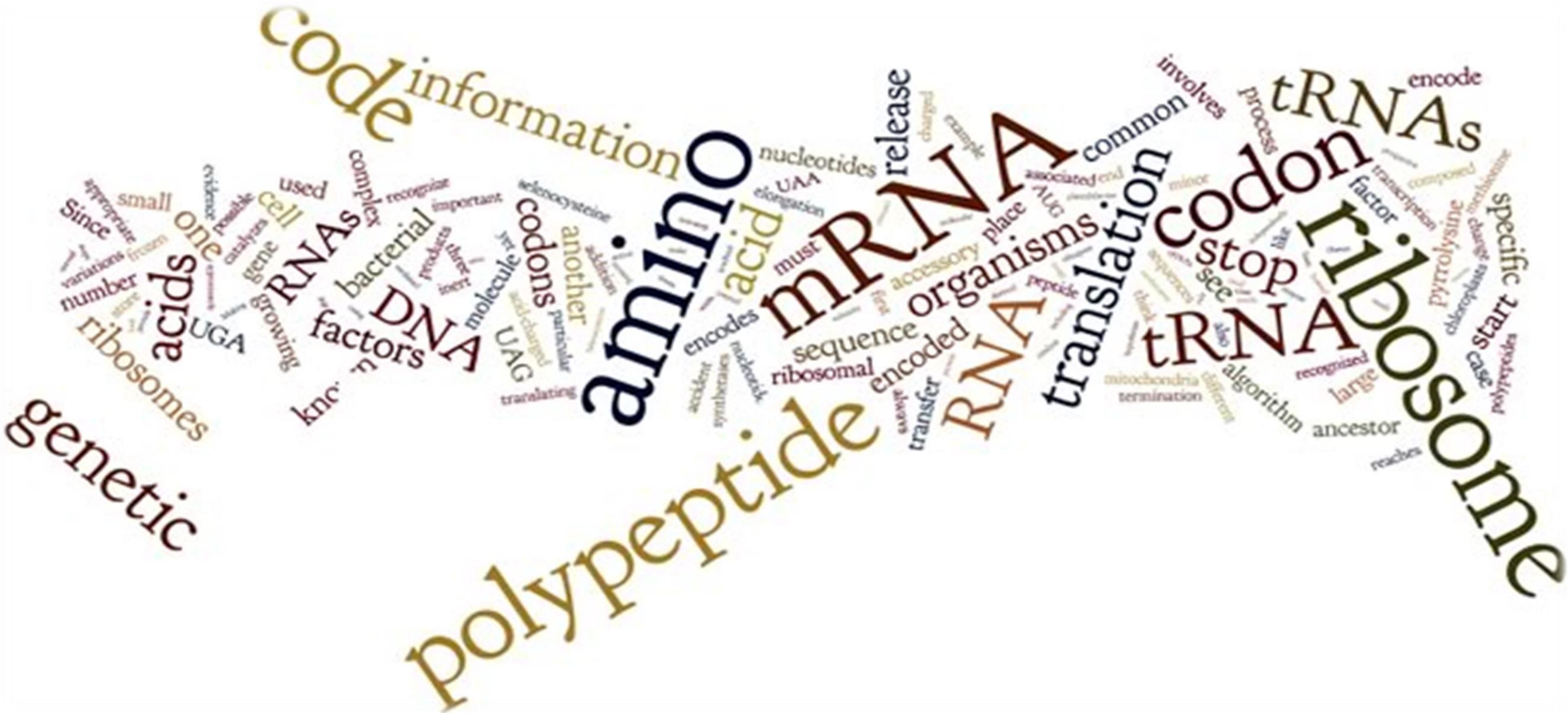
RNA translation (protein synthesis)

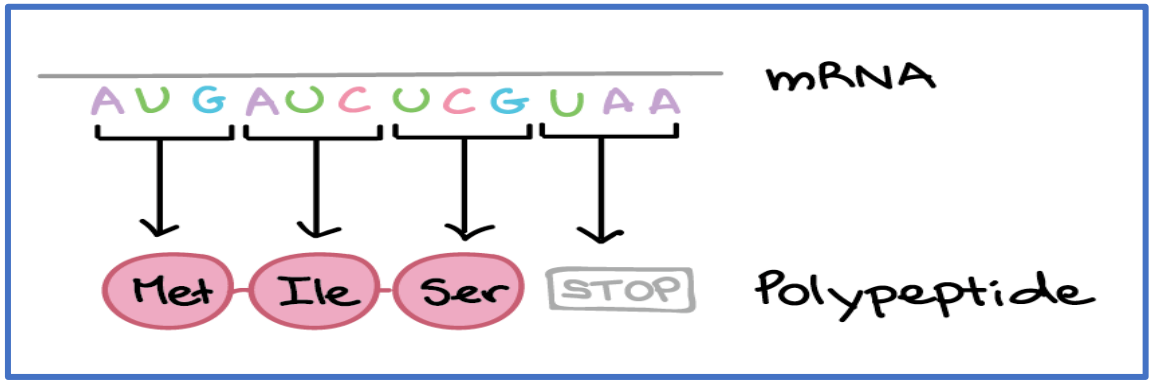


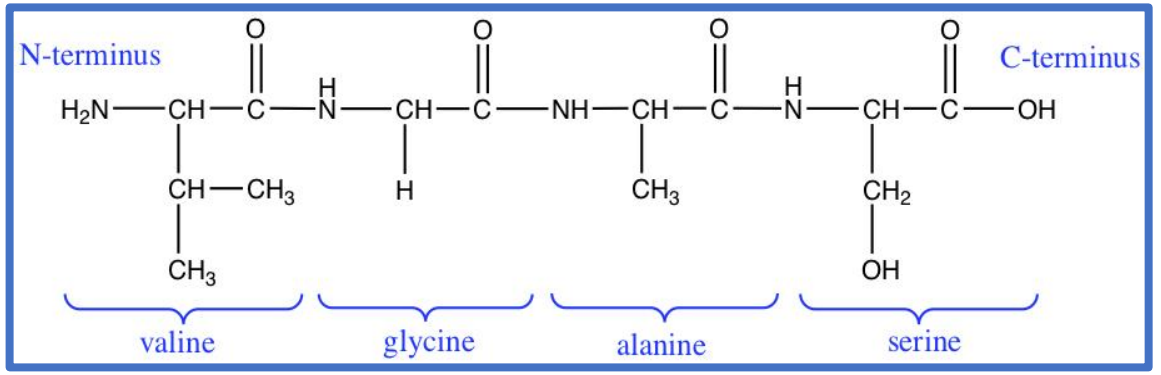
RNA translation

- 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)

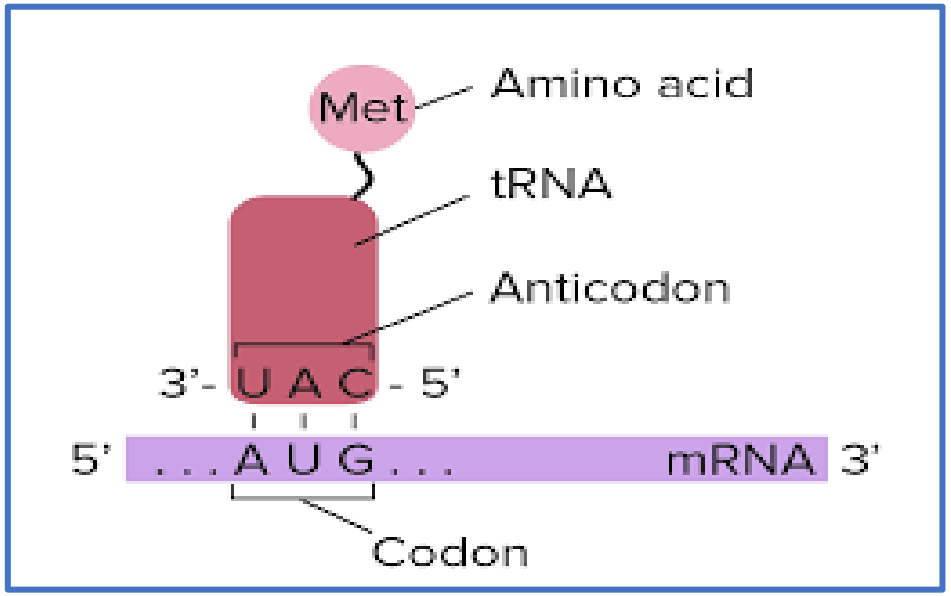
- In any case of unknown language change you need someone who
- understand both languages à **interpreter**
- In RNA translation you need an interpreter to translate CODONS into
- amino Acids.
- These interpreters are the tRNAs (small RNAs present throughout
- living cells)
- Each tRNA has a sequence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

- Each tRNA base-pairs with 1 mRNA codon a time.

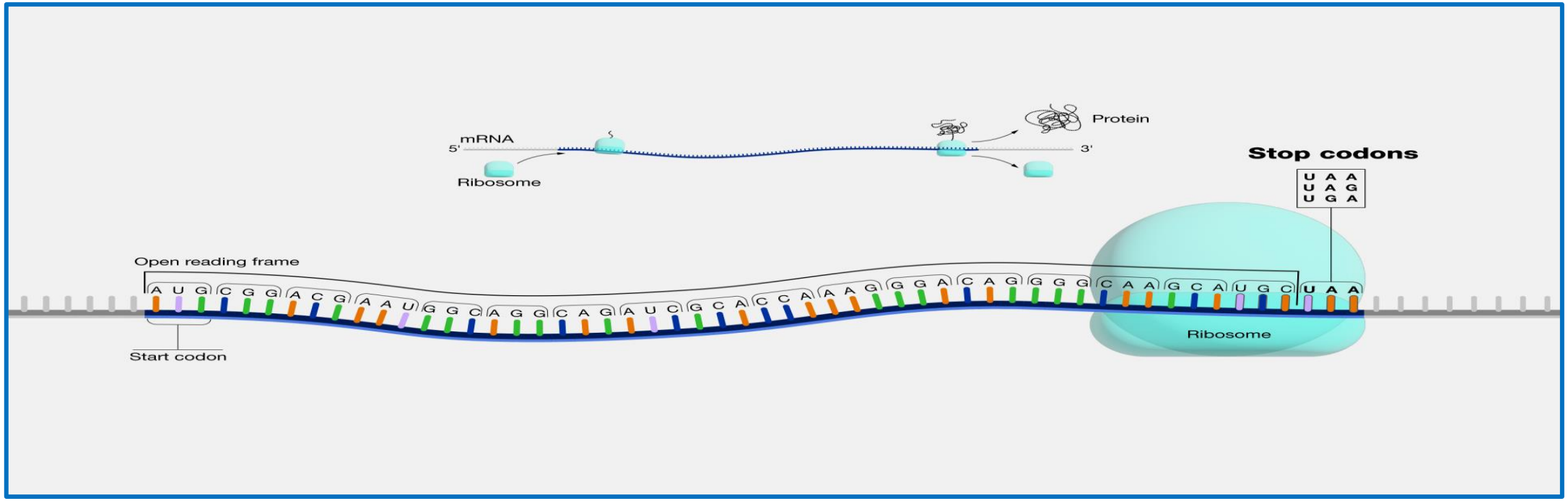
- For example:
- mRNA codon 5’ AUG 3’
- tRNA anticodon 3’ UAC 5’
- After codon-anticodon matching, the tRNAs covalently binds the
- correct amino acid and carries it to the ribosome for the protein
- synthesis

- For example: the mRNA codon 5’AUG3’ 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			

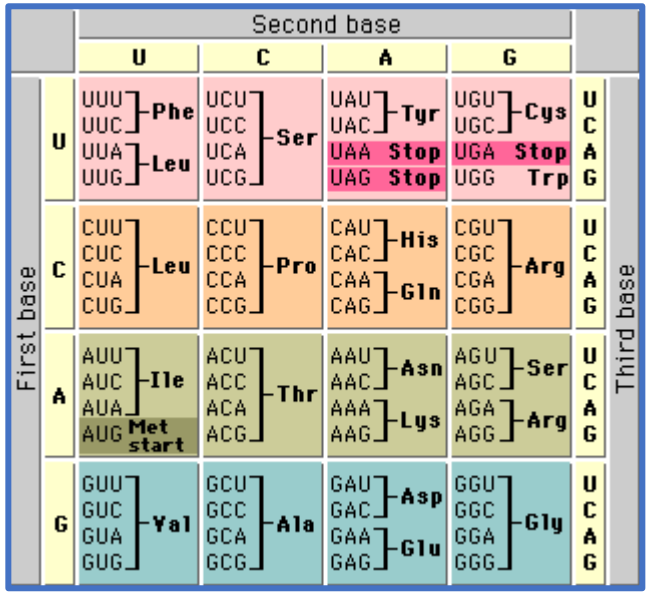


- 2. It then covalently binds the amino acid Methionine (tRNA ^{MET}).
- 3. It finally shuttles to the ribosome where the amino acid will be released and added to the growing protein.
- First codon = START codon
- • Always 5'AUG3' codon = start codon for N-terminus Met



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



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