

Gene Expression Part II: Translation

The process of transcribing an mRNA copy of the DNA code concludes with the exportation of the mature mRNA to the cytoplasm. This nucleotide sequence, however, cannot have corporeal effects until it is translated into the proper amino acid sequence and arranged into a functional protein. The designated amino acids for each three nucleotides- known as the triplet codon- are outlined here:

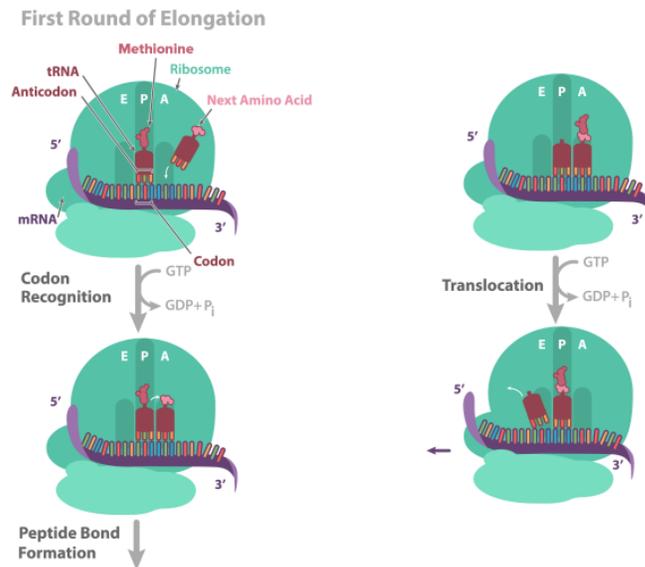
		Second letter				
		U	C	A	G	
First letter	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA } Stop UAG } Stop	UGU } Cys UGC } UGA } Stop UGG } Trp	U C A G
	C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } CGC } Arg CGA } CGG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

Image credit: "The genetic code," by OpenStax College, Biology

As the enzymatic machinery moves along the mRNA molecule, the amino acids are bonded to form a polypeptide with a very specific order of amino acids via these steps:

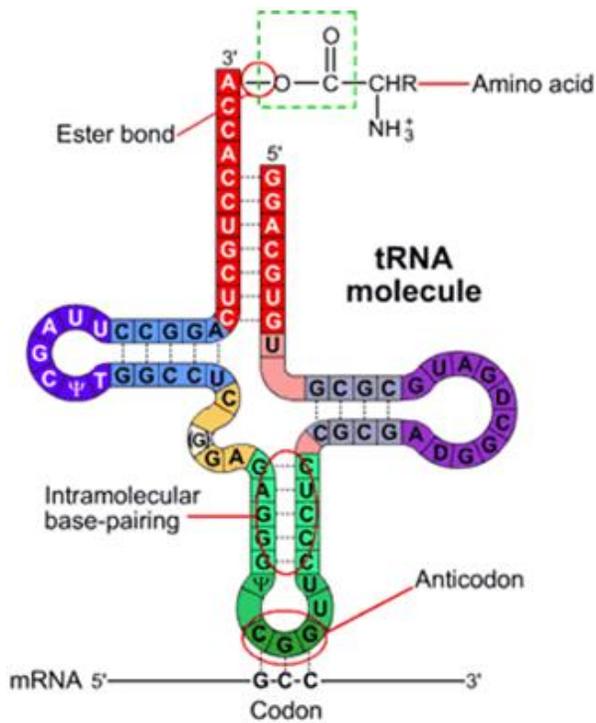
1. Initiation

The large and small subunits of the ribosome assemble in conjunction with the mRNA molecule to form the initiation complex. The large subunit has three sequential sites of binding- in the order E, P, and A along the 5' to 3' direction of the attached mRNA. When the mRNA start codon AUG enters the A site of the ribosome, it signals the beginning of the gene and translation will commence.



2. Elongation

The mRNA is read from 5' to 3' by complementary tRNA molecules whose anticodon recognizes the codon within the A site of binding based on the Watson-Crick base pairing rules that govern the processes of DNA synthesis and transcription, as well. That is to say, A binds to U for RNA (or T in DNA) and C binds G in both nucleic acid types.



The corresponding amino acid is carried by the tRNA and transferred to the growing polypeptide chain. Elongation itself can be broken down into three repeating steps (each of which requires the input of GTP hydrolysis-derived energy) for each additional amino acid-codon recognition at the A site, peptide bond formation at the P site, and translocation as the tRNA exits from the E site.

3. Termination

When the mRNA's sequence reaches a stop codon (UAA, UAG, or UGA), no tRNA will recognize it, and it is instead bound to a release factor. The full polypeptide is then released, requiring the hydrolysis of another GTP to facilitate the energetic expenditure.