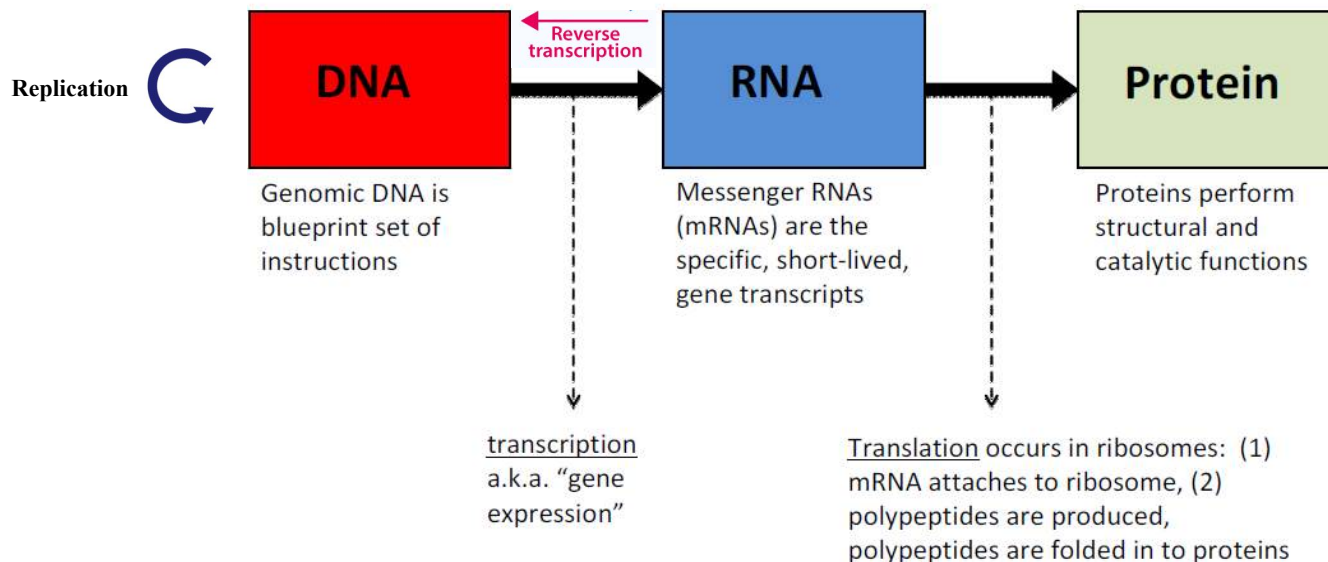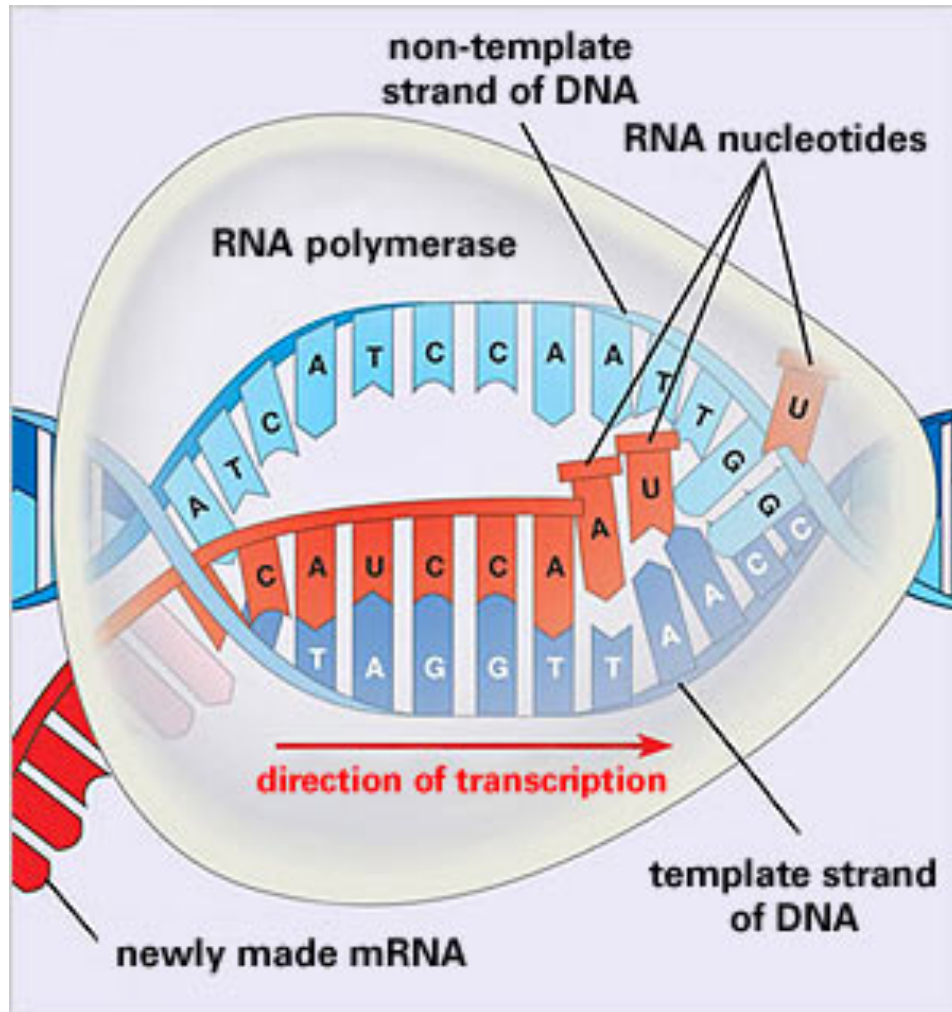# The Molecular and Biochemical Basis of an Organism

Protein Synthesis

CENTRAL DOGMA

The central dogma is a framework for understanding the flow of genetic information. It states that DNA makes RNA, and RNA makes protein. Again, the process is way more complicated than this. But, when we talk about the steps that occur during any part of this sequence, we say that it's included in the central dogma.

Transcription

non-template strand of DNA
RNA nucleotides
RNA polymerase
direction of transcription
newly made mRNA
template strand of DNA

A lot like the process of DNA Replication…

1. **RNA Polymerase** unzips the DNA molecule.
2. **RNA Polymerase** then adds **nucleotides** to one side of the DNA making an RNA molecule.
3. The RNA molecule detaches from the DNA strand and makes its way out of the nucleus to perform its different jobs

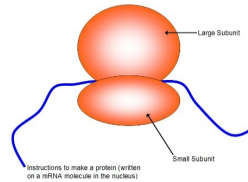Uracil (U) is used in place of thymine (T) during making of RNA strand

CELL MACHINERY REQUIRED FOR PROTEIN SYNTHESIS

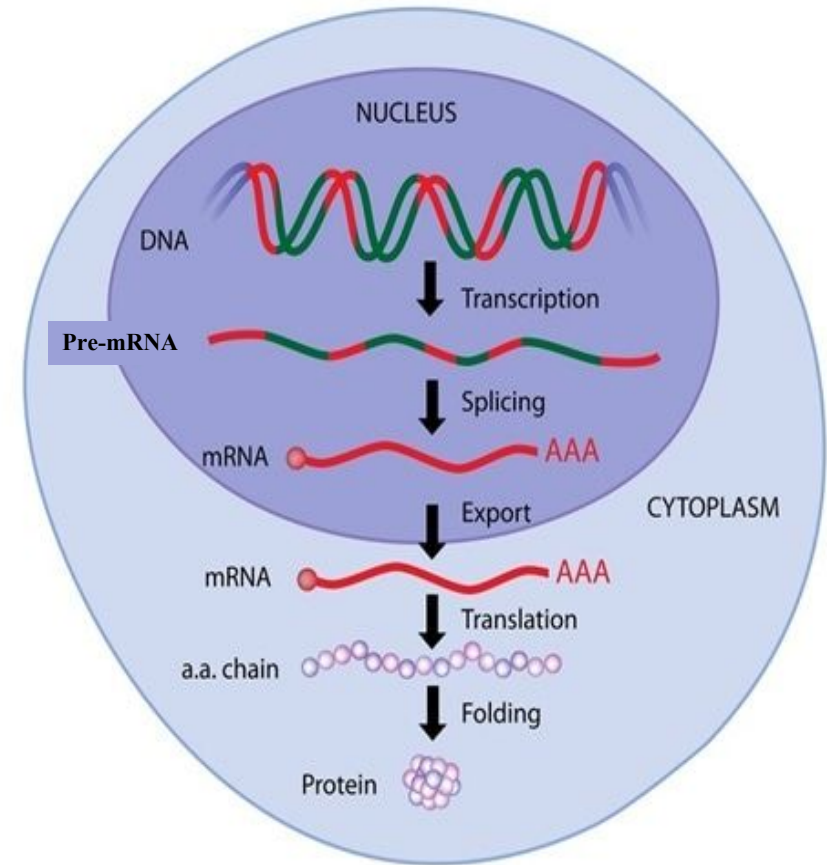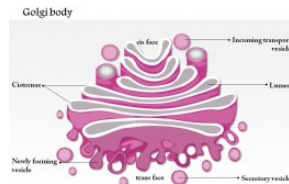THREE ORGANELLES ARE NEEDED TO CREATE A FUNCTIONAL PROTEIN

NUCLEUS
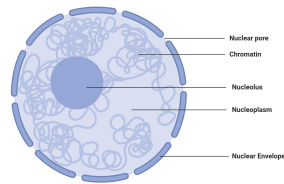
RIBOSOMES

GOLGI APPARATUS

Requirements for Transcription

a gene segment on the DNA

many free floating RNA nucleotides

the enzyme RNA polymerase

Transcription - Steps

Initiation: Begins at a site called promoter. Recognised by the presence of a TATA box. RNA Polymerase enzymes binds here. The region before this is known as **Upstream** and the region after will be transcribed and is known as **Downstream**

Elongation: As the RNA moves downstream unwinding of DNA happens and the new RNA strand gets synthesized. The direction of synthesis is always 5' to 3'

Termination: RNA will stop adding complementary sequences once it receives a stop signal. RNA polymerase leaves the DNA strand. mRNA falls of. this form of RNA is known as pre-mRNA.

mRNA editing- Splicing

There are some parts of the DNA sequence that aren't involved in coding for proteins. These parts are called **introns**, and the introns must be removed from mRNA.

The parts of DNA that are involved in coding are called Exons

Pre-mRNA has to be edited in order to remove the introns and make a complete coding set. This is achieved by a process called splicing
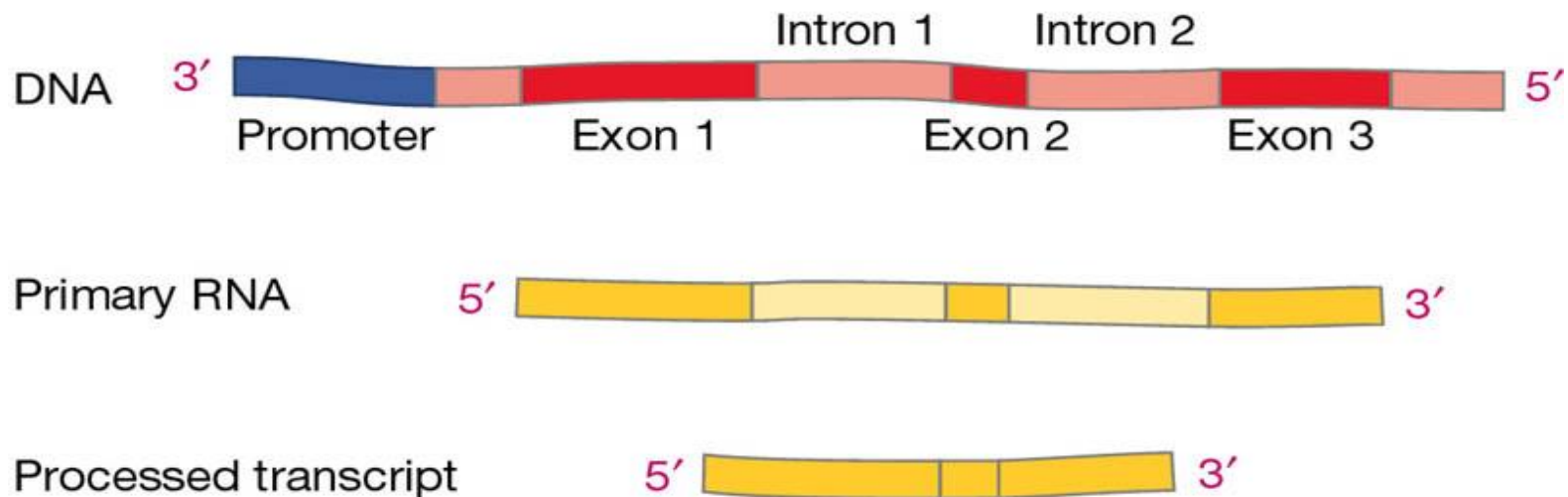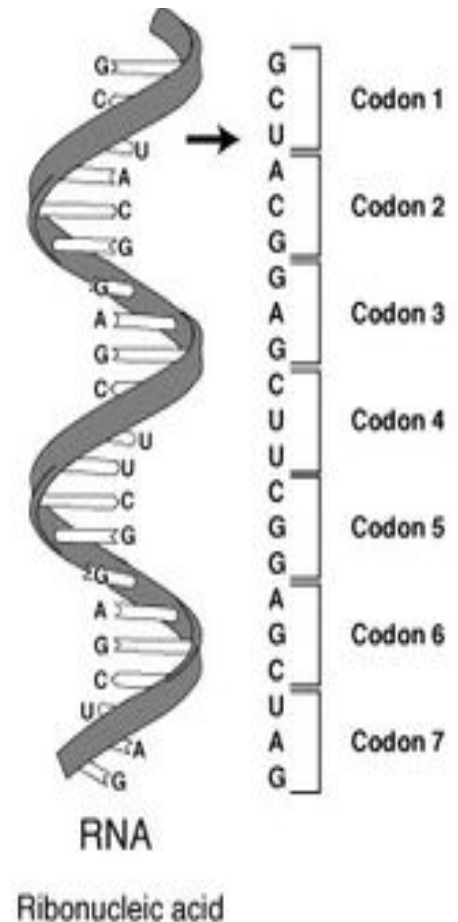
Translation
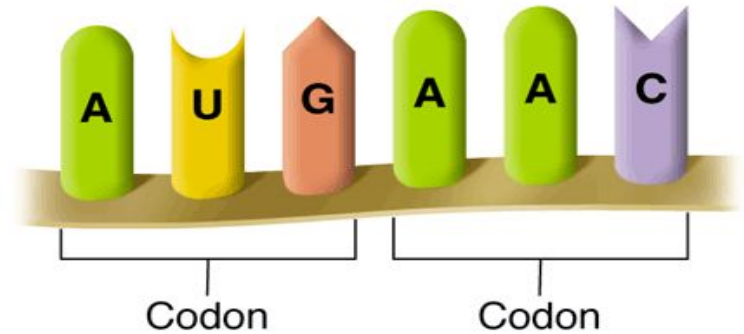
1. How the code is read:

   a. Every 3 bases on mRNA represents a code for an amino acid = <u>codon.</u>

   b. Amino acids are abbreviated most times by using the first 3 letters of the amino acid's name.

      - Met = methonine
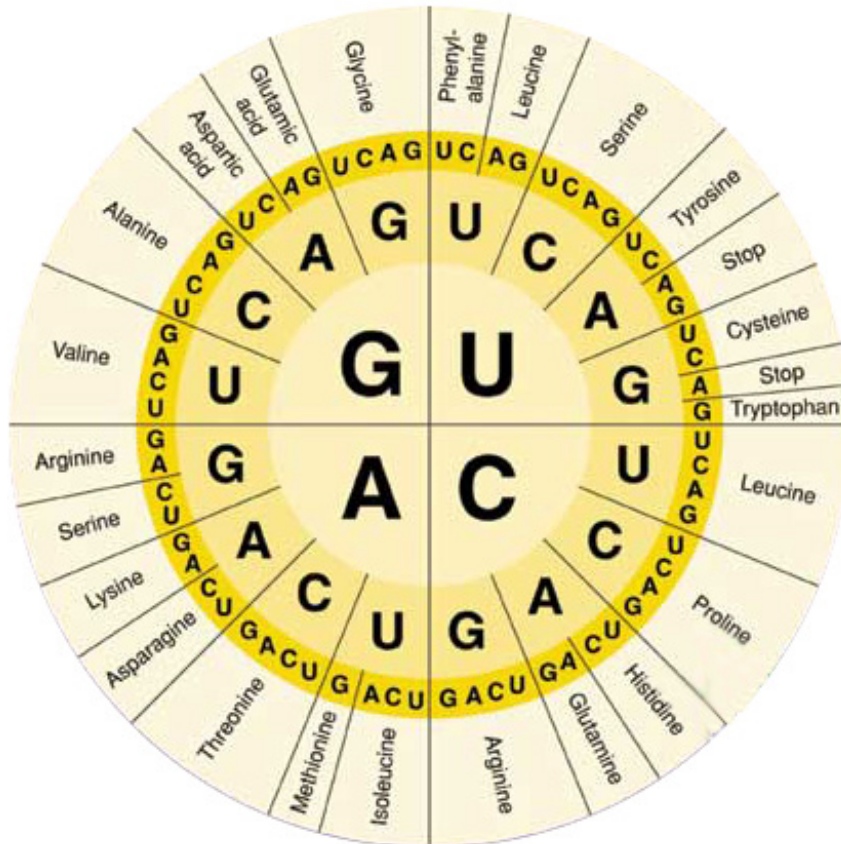   - Leu = leucine

Codon   Codon

Codon 1
Codon 2
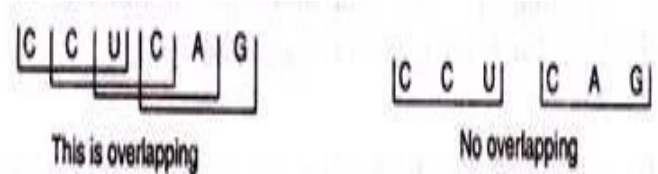Codon 3
Codon 4
Codon 5
Codon 6
Codon 7

RNA

Ribonucleic acid

The Codon Chart

Examples:

AUG = Methionine

CAU = Histidine

UAG = Stop

	U	C	A	G	
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic acid	Glycine	U
	Valine	Alanine	Aspartic acid	Glycine	C
	Valine	Alanine	Glutamic acid	Glycine	A
	Valine	Alanine	Glutamic acid	Glycine	G

The Genetic Code Properties

- Code is a Triplet: codons for amino acids comprise three letter words, 4 x 4 x 4 or $4^3 = 64$

- The Code is Degenerate: more than one codon for a single amino acid

- The Code is Non-overlapping:

- The Code is Comma Less: no nucleotide or comma (or punctuation) is present in between two codons

- The Code is Unambiguous: A given codon always codes for a particular amino acid

- The Code is Universal: universal in all kinds of living organisms

Translation

1. Edited mRNA attaches to a ribosome
2. As each codon of the mRNA molecule moves through the ribosome, the tRNA brings the proper amino acid to the ribosome.
   – Notice the anticodon on tRNA – it is complementary to the mRNA codon
   – The amino acids are joined together by chemical bonds called peptide bonds to build an amino acid chain called a "polypeptide"
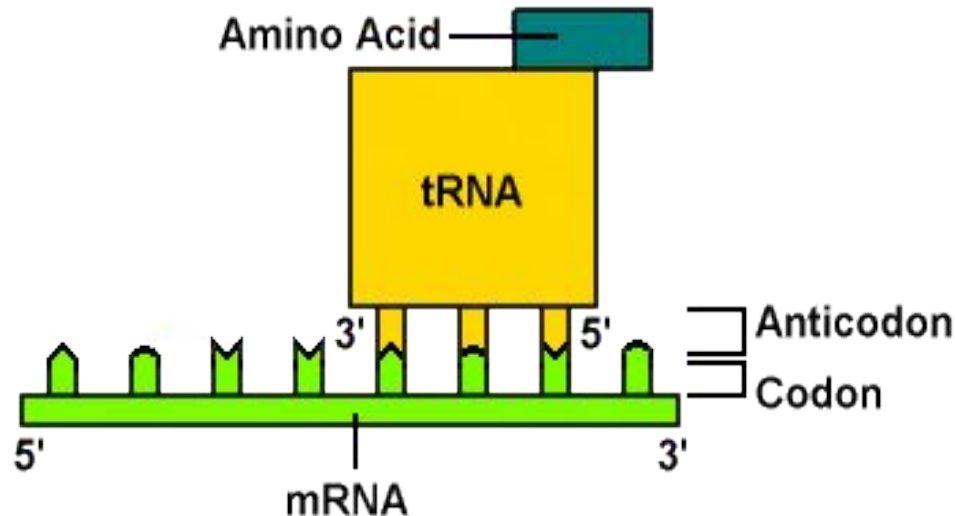
Translation-Regulation

- **<u>Start codons</u>**: found at the beginning of a protein
  - Only one - AUG (methionine)
- **<u>Stop codons</u>**: found at the end of a protein (end of a polypeptide chain)
- Three stop codons that do not code for any amino acid therefore making the process stop : UAA, UAG,UGA
- The rRNA hs two subunits 30S and 80S.
- mRNA binds to 30S unit. the tRNA for Methionine binds at the start codon and initiates the translation process. later on 50S joins to form iniatiation complex.
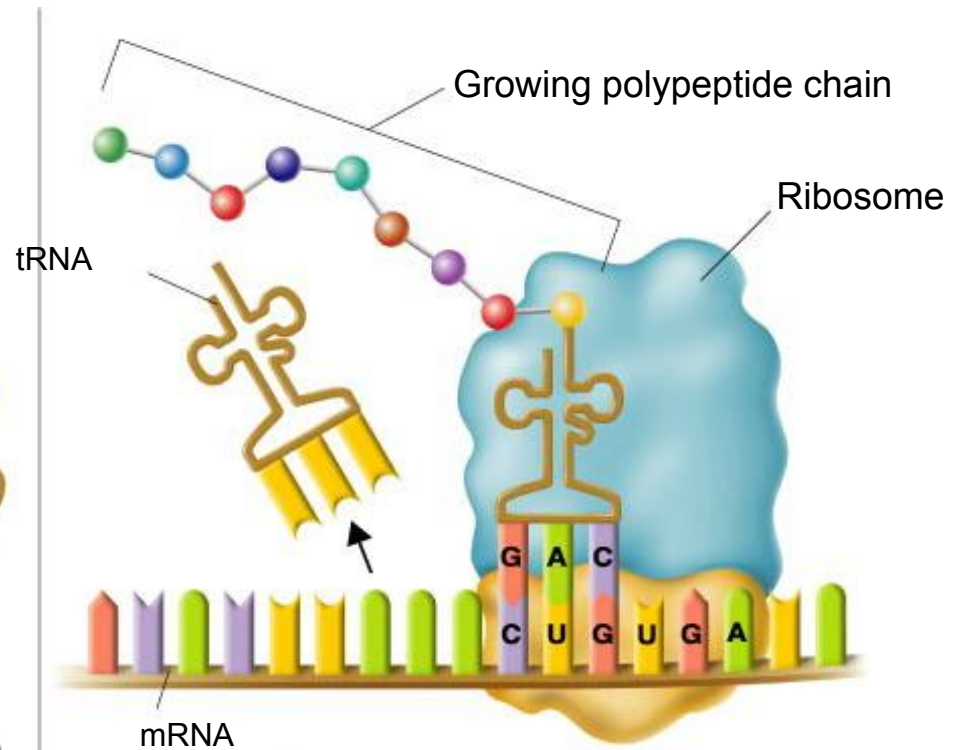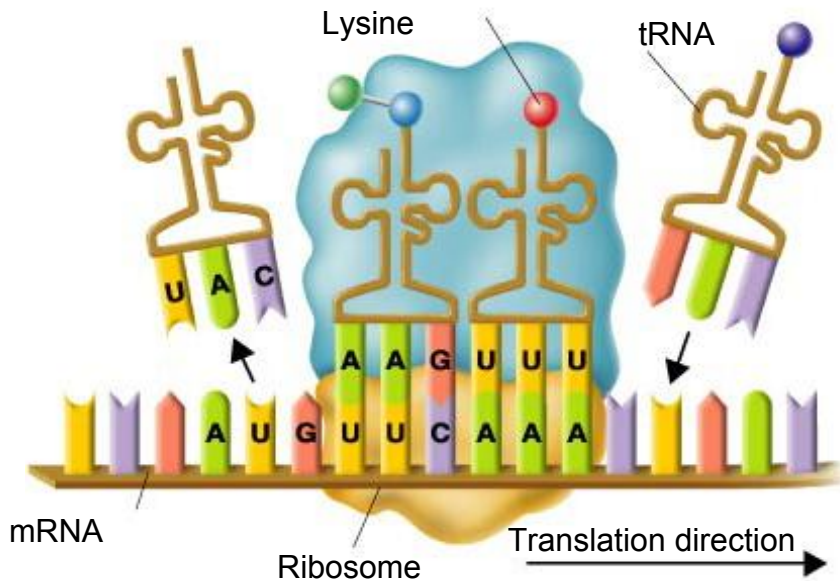- have two sites P or peptidyl site and A or Aminoacyl site.

Translation - Initiation
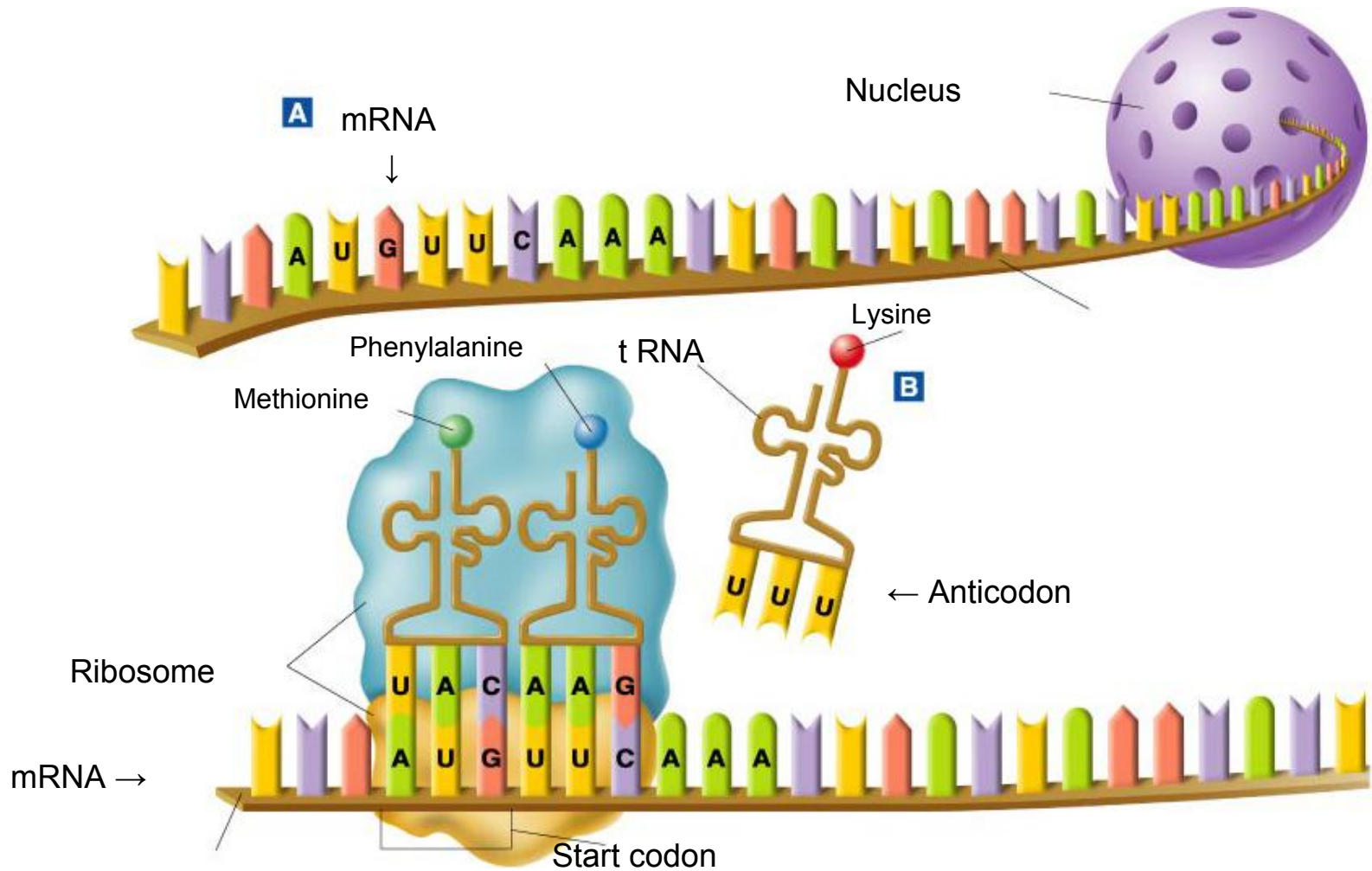
Translation - Elongation and Termination

C The Polypeptide "Assembly Line"

D Completing the Polypeptide

Thus formed protein is the primary form. It undergoes many post-translational modifications further to become an active protein.

Thank You