The Central Dogma of Biology

- What is the significance?
- What molecules and factors are involved in the process?
- Where does each step of the process take place?

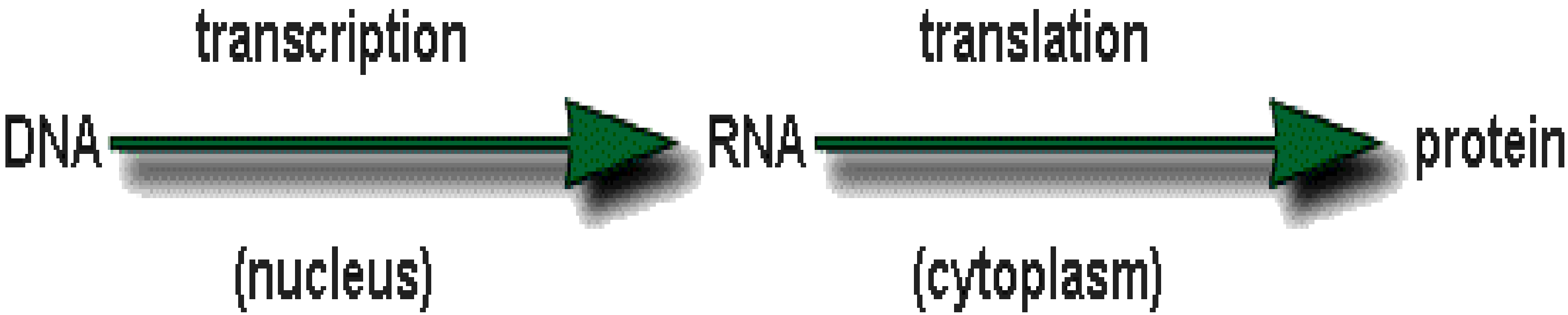
- 1st a video from Bozeman Science

Transcription and Translation

What I know	What I want to know	What I learned

From A to B to C

- If DNA is contained in the nucleus and proteins are made in the cytoplasm, how do these processes interact?

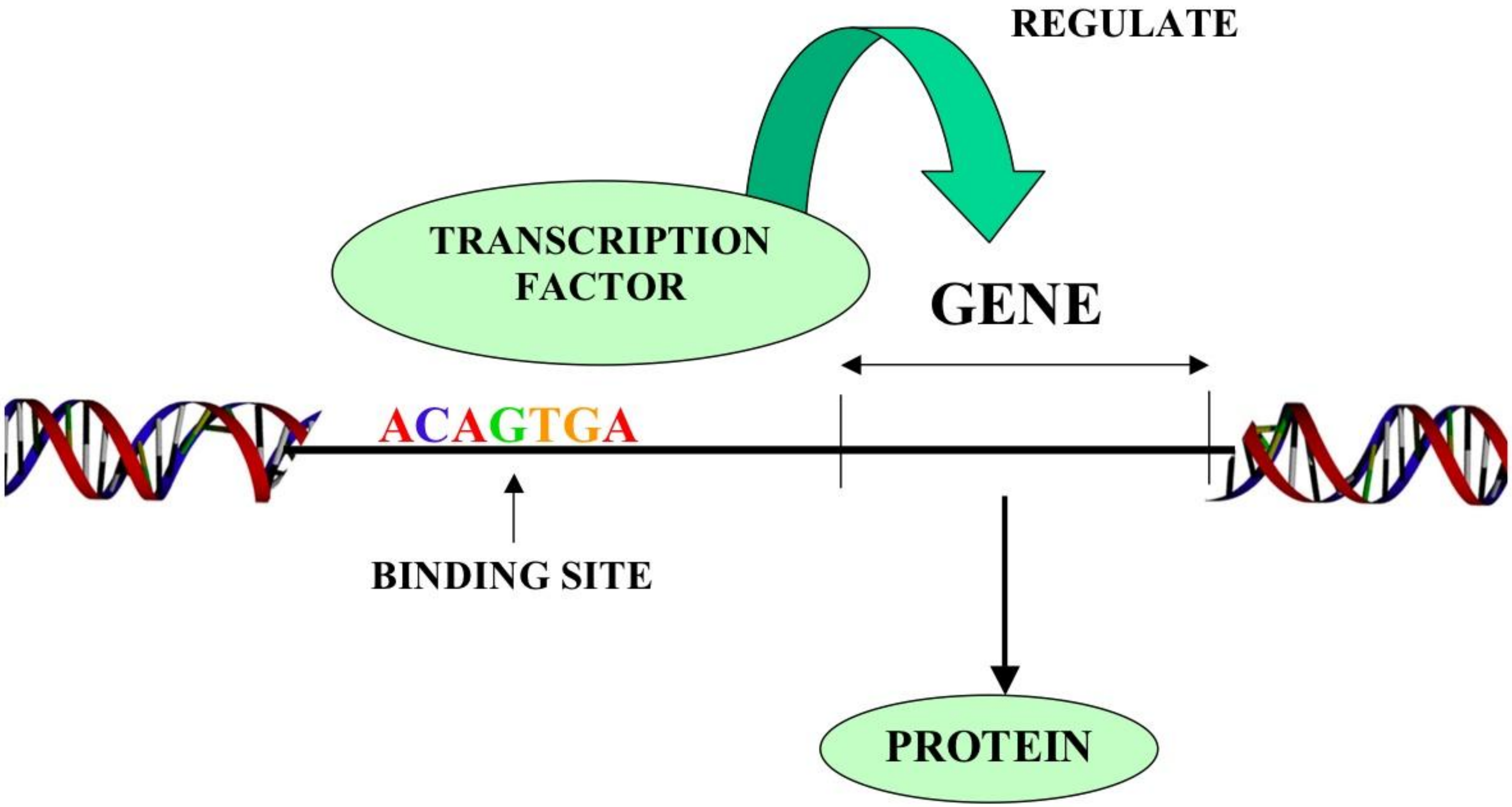


Background

- DNA is composed of four bases and double-stranded
  - Adenine
  - Thymine
  - Cytosine
  - Guanine
- Genes encode for protein
- Human genome encodes for around 30,000 genes
- Approximately 97% of our DNA are introns- "Junk DNA"
- RNA is single-stranded and contains uracil instead of thymine
- **What do you think triggers transcription to occur?**

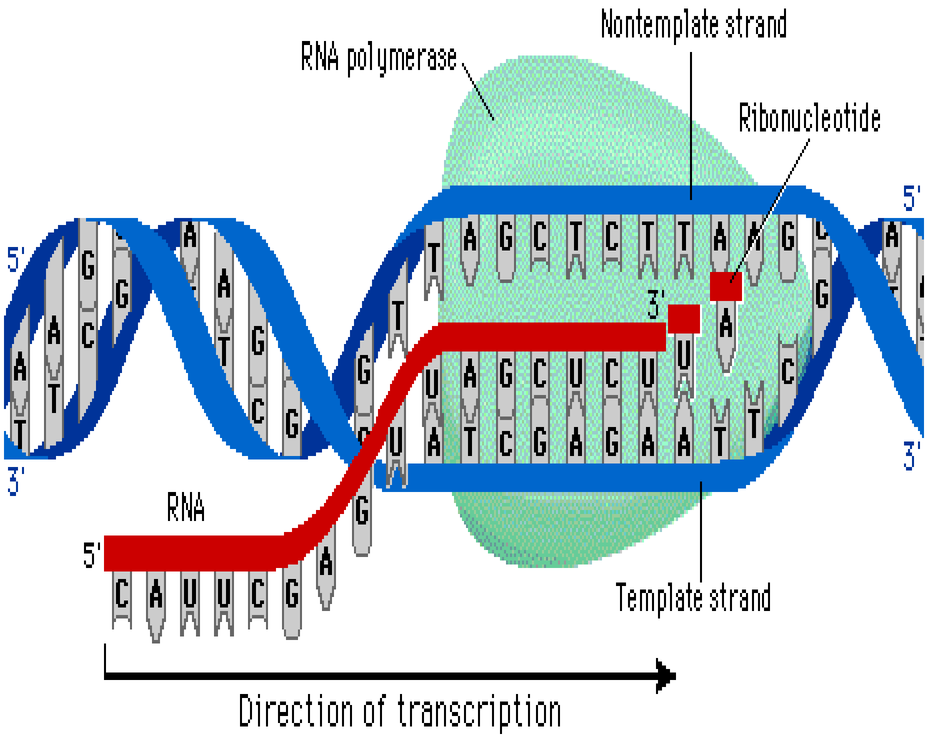
Transcription Factors!

Legend: A transcription factor molecule binds to the DNA at its binding site, and thereby regulates the production of a protein from a gene.



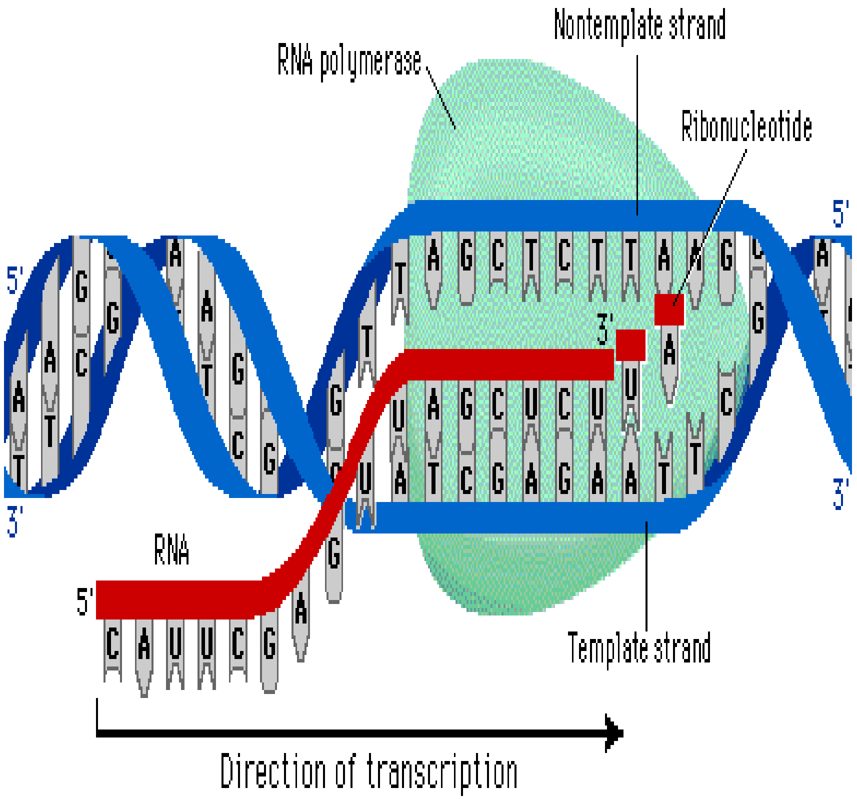
The Steps of Transcription

- A team of enzymes and proteins bind to the promoter, or starting region, of a gene.
- These enzymes and proteins unzip the DNA double helix just at the region of the gene.
- The enzyme RNA polymerase uses one of the DNA strands to make an RNA copy of that one gene.

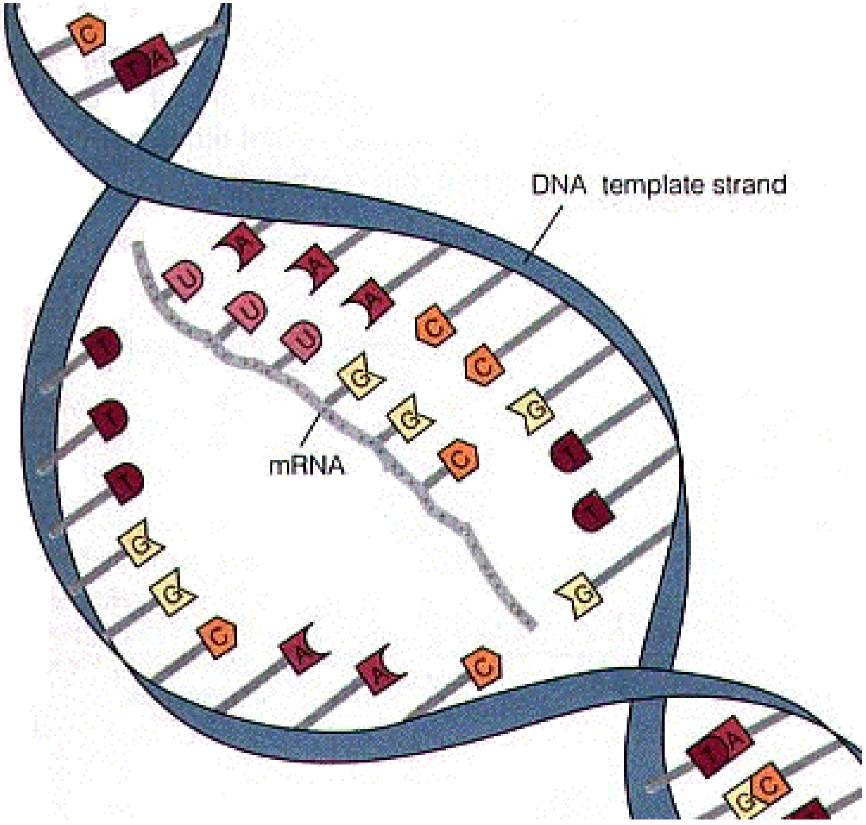


The Steps of Transcription cont.

- This copy, which contains the instructions to make 1 protein, is called mRNA or messenger RNA.
- After the mRNA is made, it is trimmed down to a final size, and shipped out of the nucleus!
- When the mRNA gets into the cytoplasm, it encodes for protein.

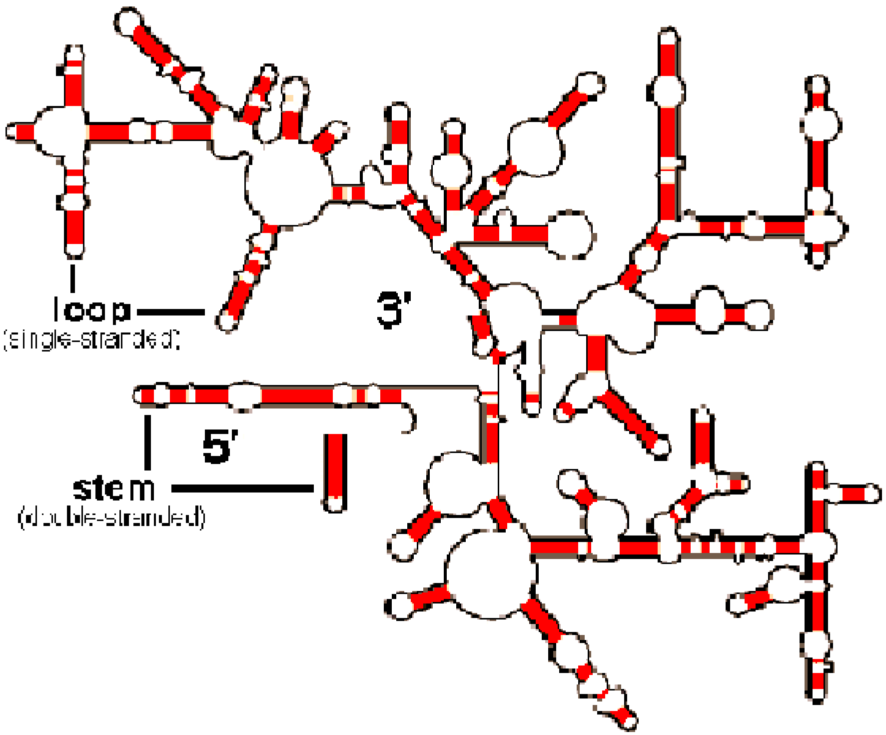


RNA Used in Protein Synthesis



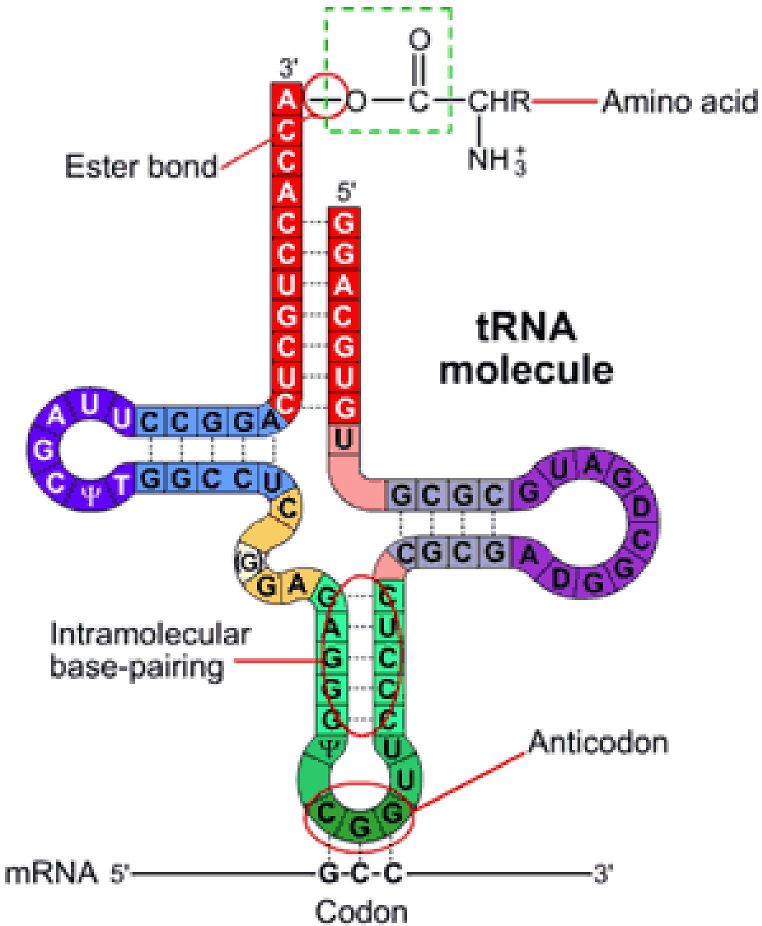
- messenger RNA (mRNA). A copy of the gene that is being expressed. Groups of 3 bases in mRNA, called "codons" code for each individual amino acid in the protein made by that gene.

RNA Used in Protein Synthesis



- Ribosomal RNA (rRNA). Four different RNA molecules that make up part of the structure of the ribosome. They perform the actual catalysis of adding an amino acid to a growing peptide chain.

RNA Used in Protein Synthesis

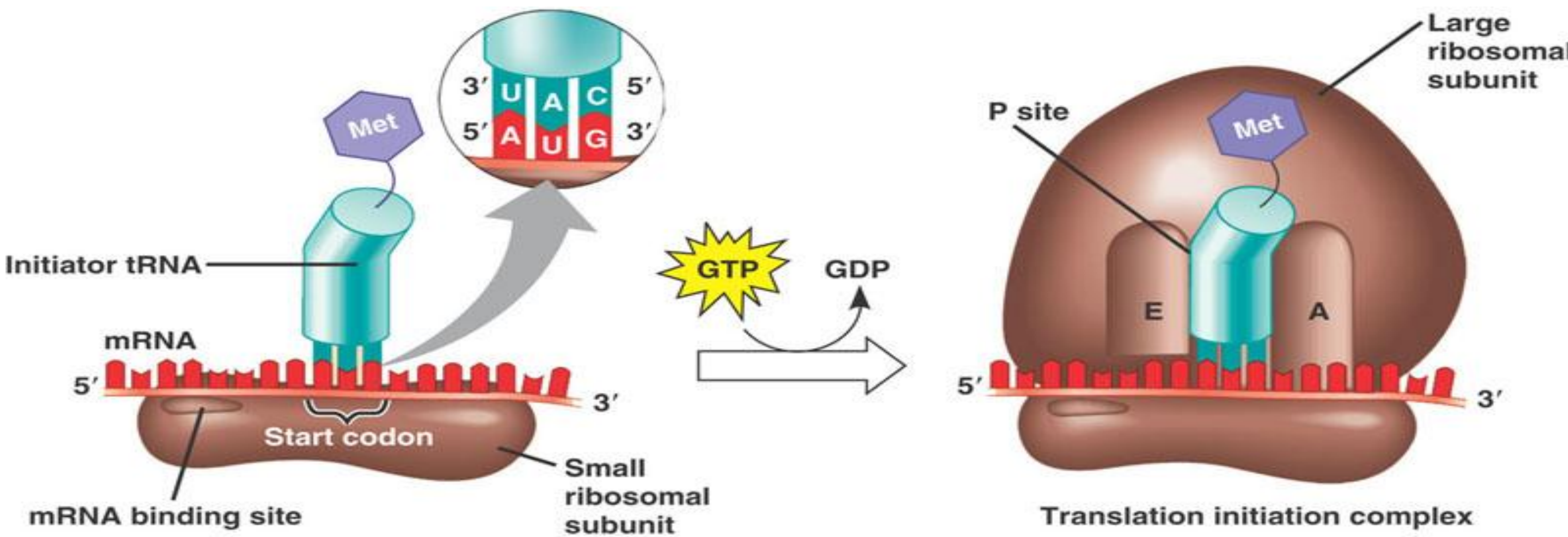


- Transfer RNA (tRNA). Small RNA molecules that act as adapters between the codons of messenger RNA and the amino acids they code for.

Steps of Translation-Initiation

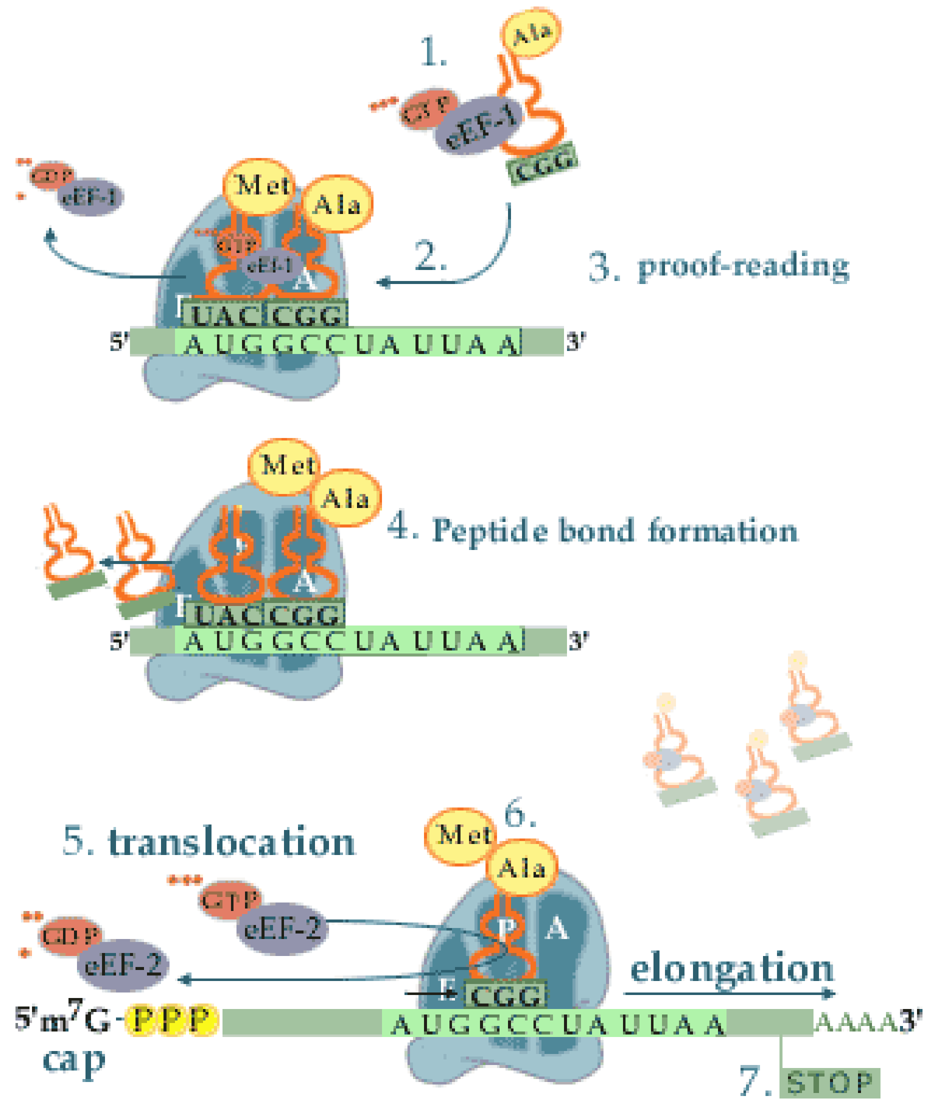
1. Initiation: mRNA enters the cytoplasm and becomes associated with ribosomes (rRNA + proteins).

-tRNAs, each carrying a specific amino acid, pair up with the mRNA codons inside the ribosomes.



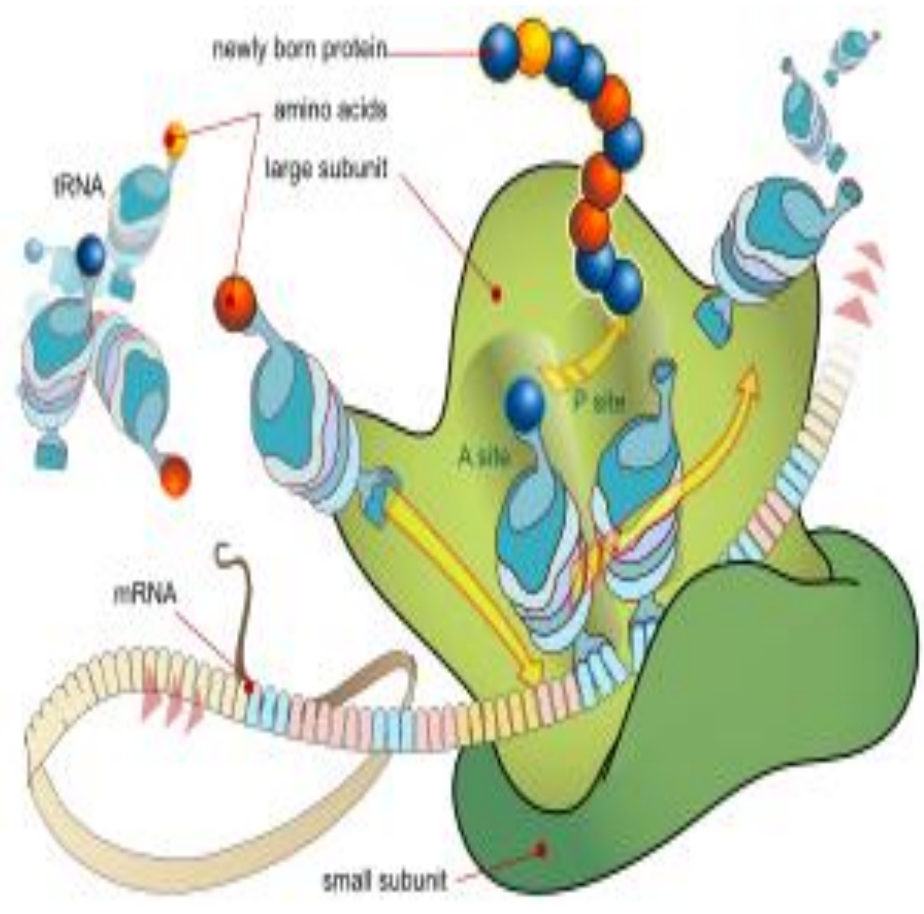
Steps of Translation-Elongation

2. Elongation: addition of amino acids one-by-one:
- As the ribosome moves along the mRNA, the tRNA transfers its amino acid to the growing protein chain, producing the protein - codon by codon!



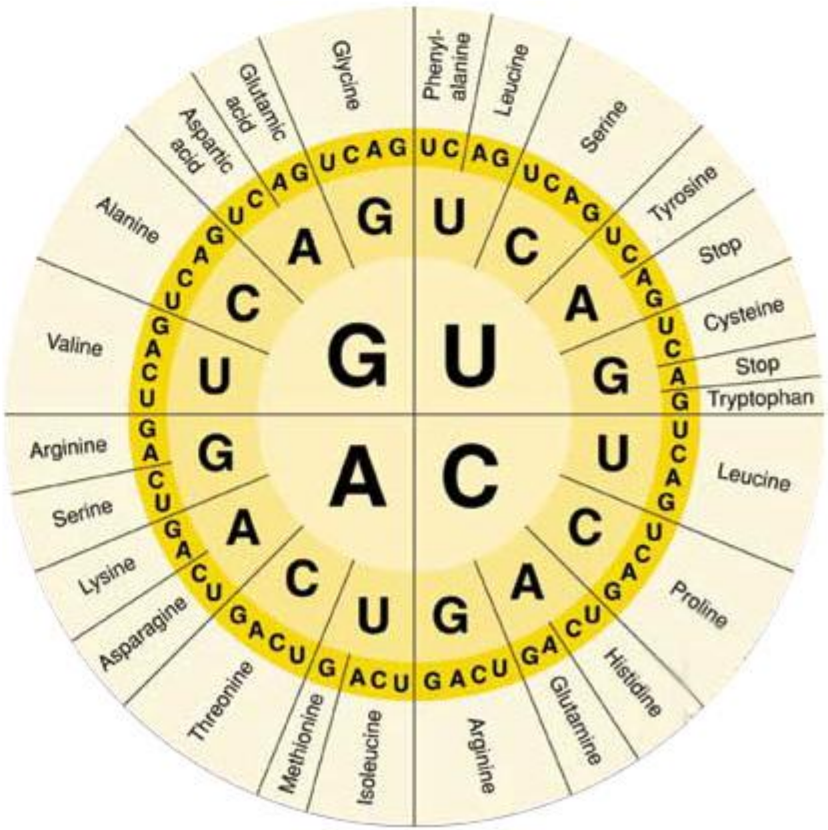
Steps of Translation-Termination

3. Termination: when the ribosomes hits a stop codon - UAA, UGA, or UAG - the ribosome falls apart!



Transcription and Translation - YouTube

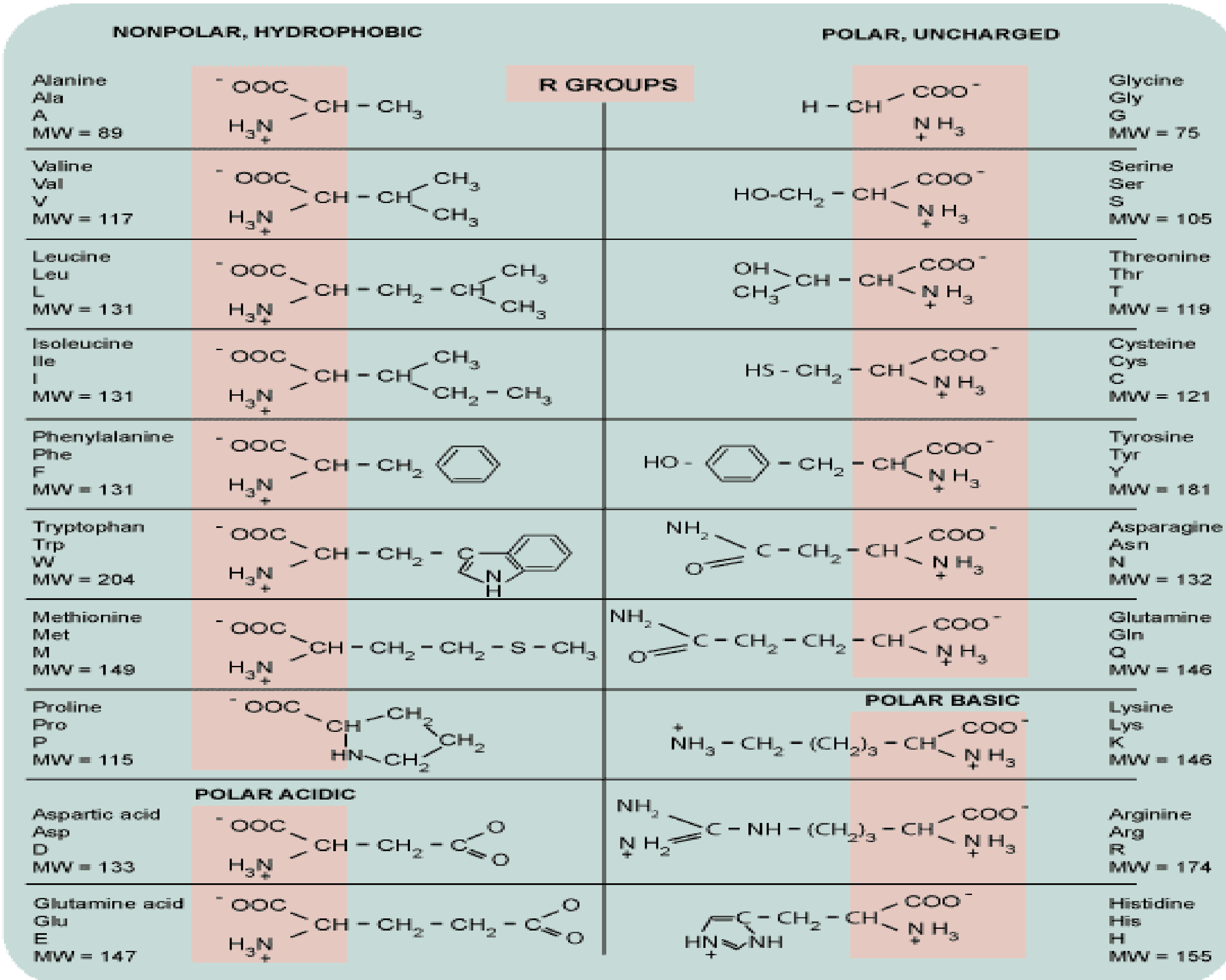
Amino Acid Wheel and Chart

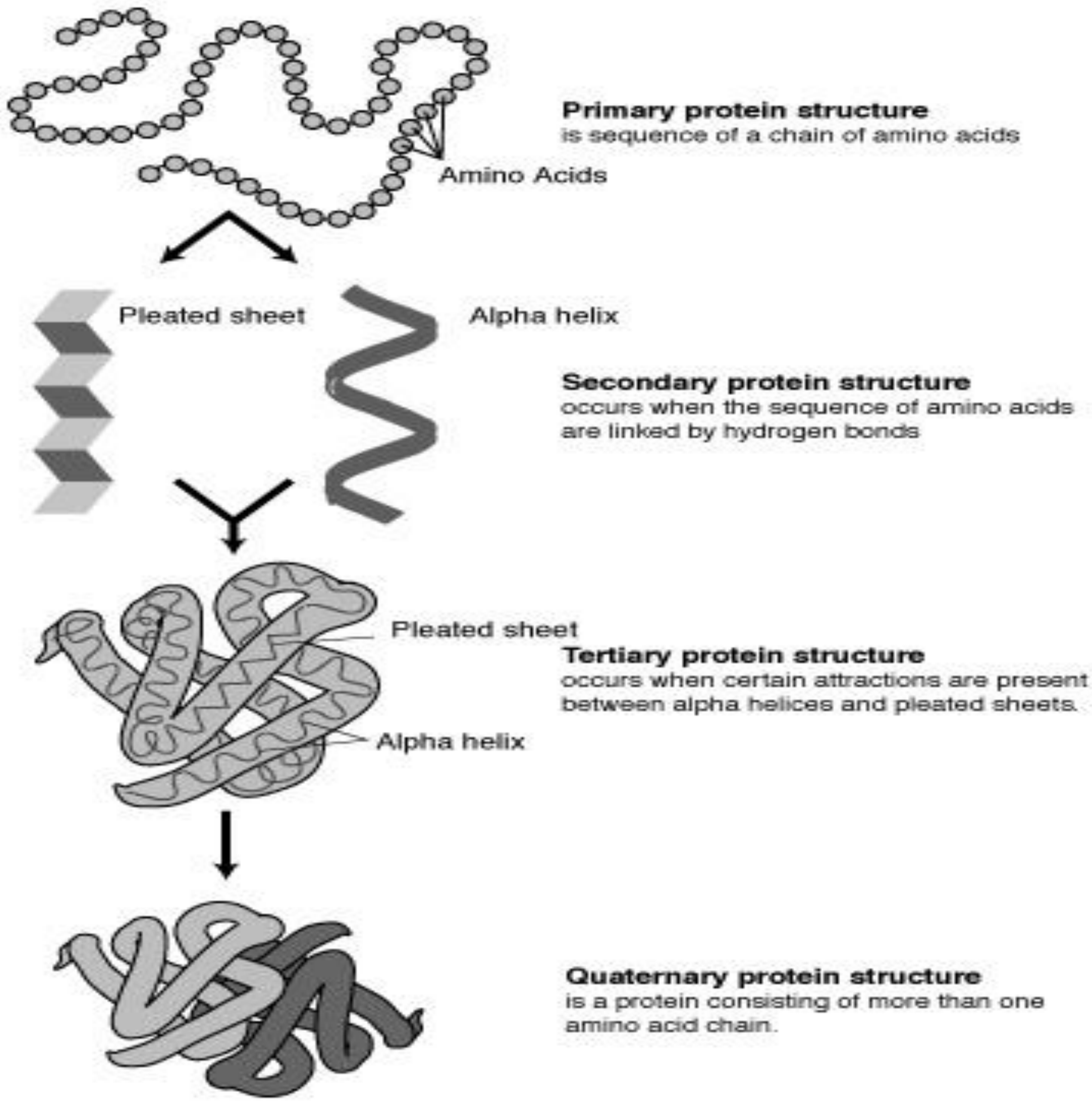


First Letter	Second Letter				Third Letter
	U	C	A	G	
U	phenylalanine	serine	tyrosine	cysteine	U
	phenylalanine	serine	tyrosine	cysteine	C
	leucine	serine	stop	stop	A
	leucine	serine	stop	tryptophan	G
C	leucine	proline	histidine	arginine	U
	leucine	proline	histidine	arginine	C
	leucine	proline	glutamine	arginine	A
	leucine	proline	glutamine	arginine	G
A	isoleucine	threonine	asparagine	serine	U
	isoleucine	threonine	asparagine	serine	C
	isoleucine	threonine	lysine	arginine	A
	(start) methionine	threonine	lysine	arginine	G
G	valine	alanine	aspartate	glycine	U
	valine	alanine	aspartate	glycine	C
	valine	alanine	glutamate	glycine	A
	valine	alanine	glutamate	glycine	G

[Protein synthesis: an epic on the cellular level - YouTube]

Amino Acid Structures





Primary protein structure
is sequence of a chain of amino acids
Amino Acids
Pleated sheet
Alpha helix
Secondary protein structure
occurs when the sequence of amino acids are linked by hydrogen bonds
Pleated sheet
Tertiary protein structure
occurs when certain attractions are present between alpha helices and pleated sheets.
Alpha helix
Quaternary protein structure
is a protein consisting of more than one amino acid chain.