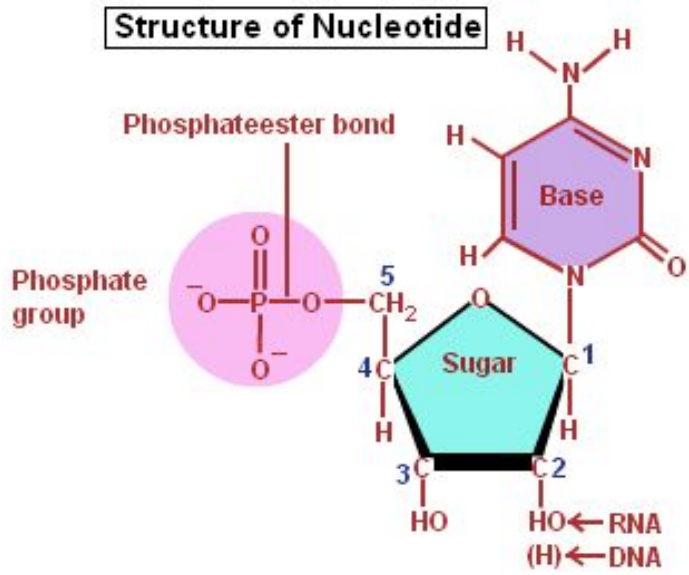
Ribonucleic Acid (RNA)

Types of RNA (Ribonucleic Acid) - pg 208

- Messenger RNA = from DNA to RER
- Transfer RNA = brings amino acids to RER
- Ribosomal RNA = forms the ribosomes

Differences between DNA and RNA nucleotides



Bases = A, G, C and Uracil (U)

Sugar = Ribose

messenger RNA (mRNA)

- Single strand of RNA nucleotides
- Least stable of all RNA molecules

Transfer RNA (tRNA)

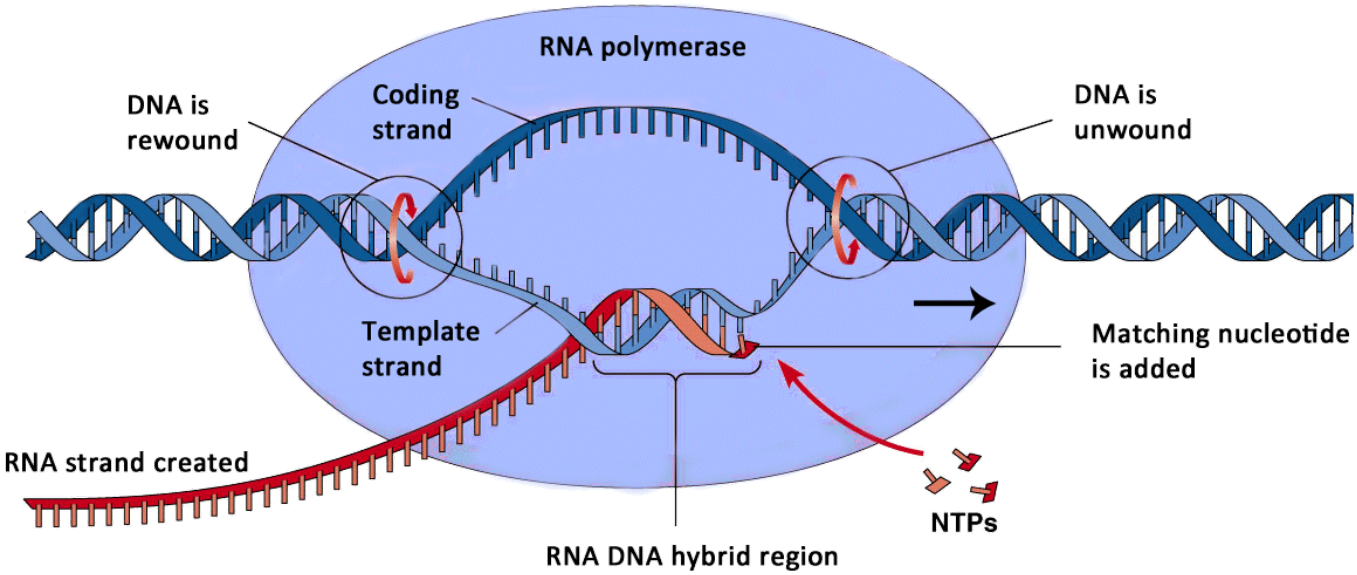
- Single strand of RNA nucleotides
- Folded upon itself using complementary H-bonds
- Clover-leaf structure
- more stable than mRNA

Ribosomal RNA (rRNA)

- Used to make ribosomes - each subunit has rRNA and associated proteins
- rRNA is synthesised in the nucleolus

Transcription (pg 211, Fig 1)

Transferring the information from DNA (gene) to mRNA

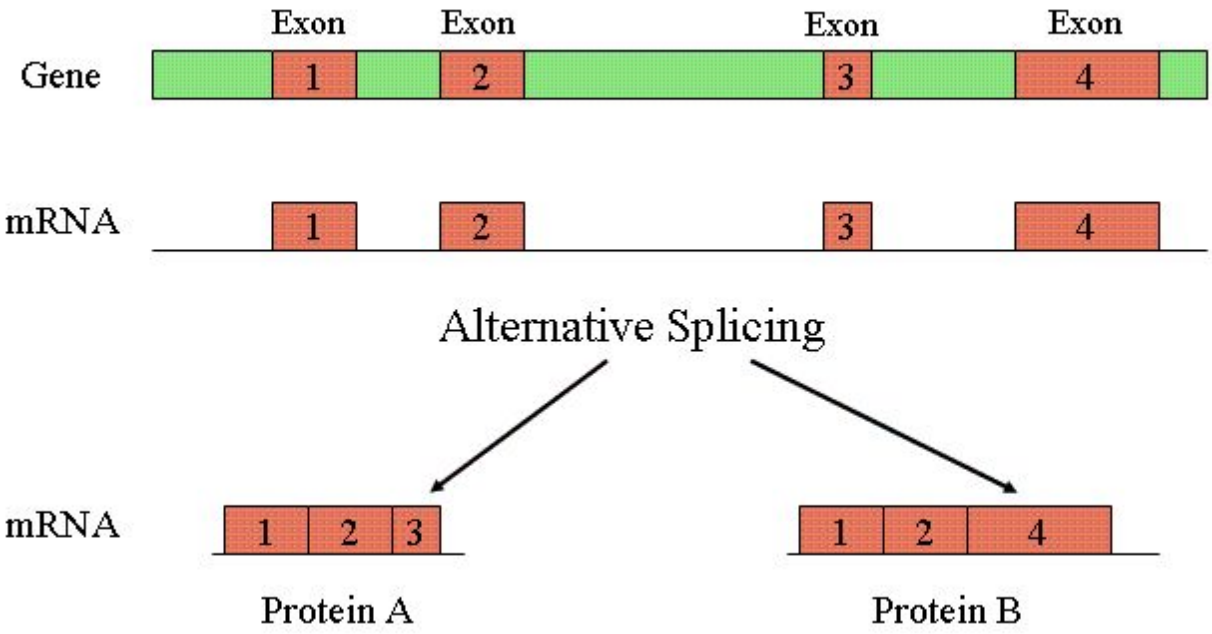


- DNA unwound - DNA helicase breaks H-bonds
- Free nucleotides bind to the template strand
- RNA Polymerase binds the promoter region
- moves along the DNA template strand, joining the sugar-phosphate backbone of the nucleotides, via a condensation reaction = mRNA

mRNA is complementary to the template strand
mRNA is an exact copy of the coding strand, except T is replaced by U

Splicing in Eukaryotes

- Eukaryotes make large number of proteins
- Not possible to fit all variants of each protein on DNA
- Splicing used to generate different variants of the protein from the ***same gene***



- DNA transcribed into pre-mRNA
- pre-mRNA made up of introns (non-coding sequences) and exons (coding sequences)
- during splicing (in the nucleus), introns removed, exons joined together = mRNA
- combination of exons joined determines tertiary structure of the protein

Translation

Transferring the information from mRNA to polypeptide

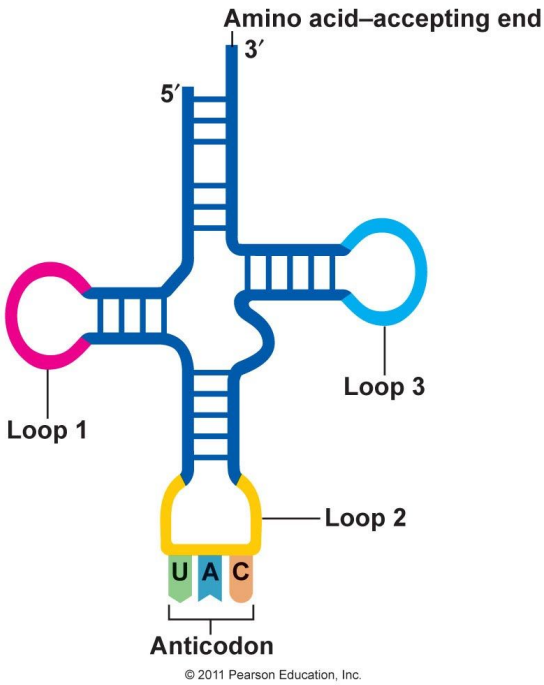
Three bases on RNA = 1 codon

The first codon on all RNA molecules is called the START codon

The last codon on all RNA molecules is called the STOP codon

Codons are non-overlapping

Role of tRNA



➔One end has ANTI-CODONS - complementary to codons on RNA

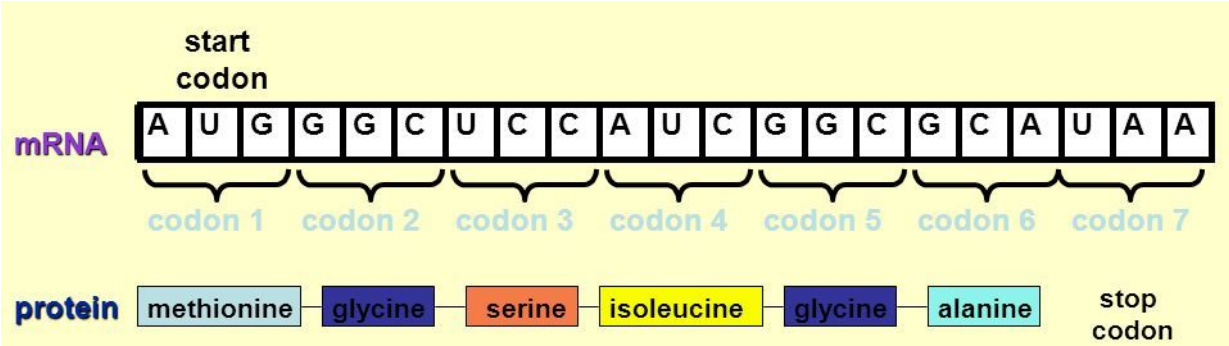
➔Other end has an amino acid binding site

➔Each anti-codon sequence is specific for ONE amino acid

➔A tRNA carrier the amino acid to the mRNA

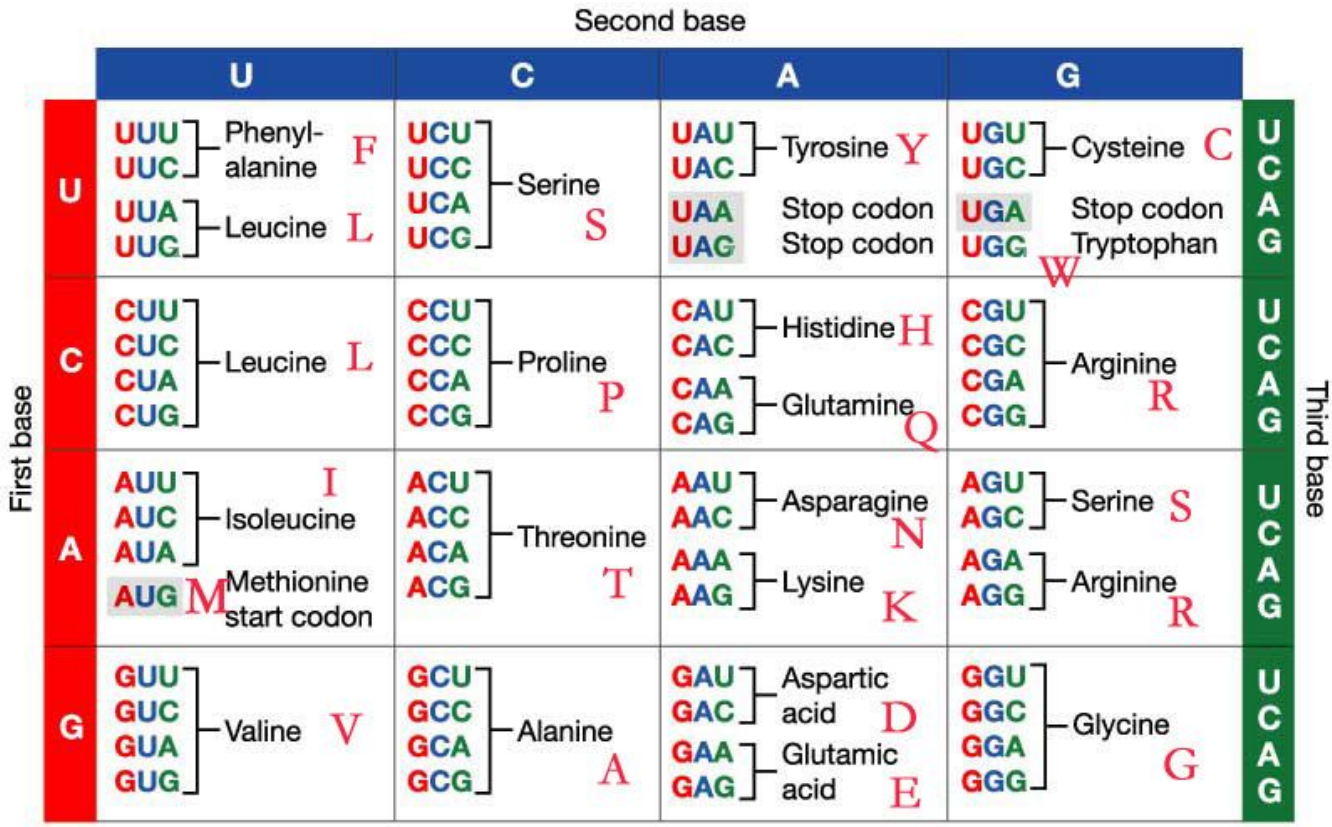
A tRNA only binds to one complementary codon on mRNA, therefore we can say that a codon on mRNA “codes” for one amino acid

The sequence of bases on the mRNA determines the sequence of amino acids in the polypeptide



Codon Table

We can use the codon table to determine which amino acid will be coded by the mRNA base sequence



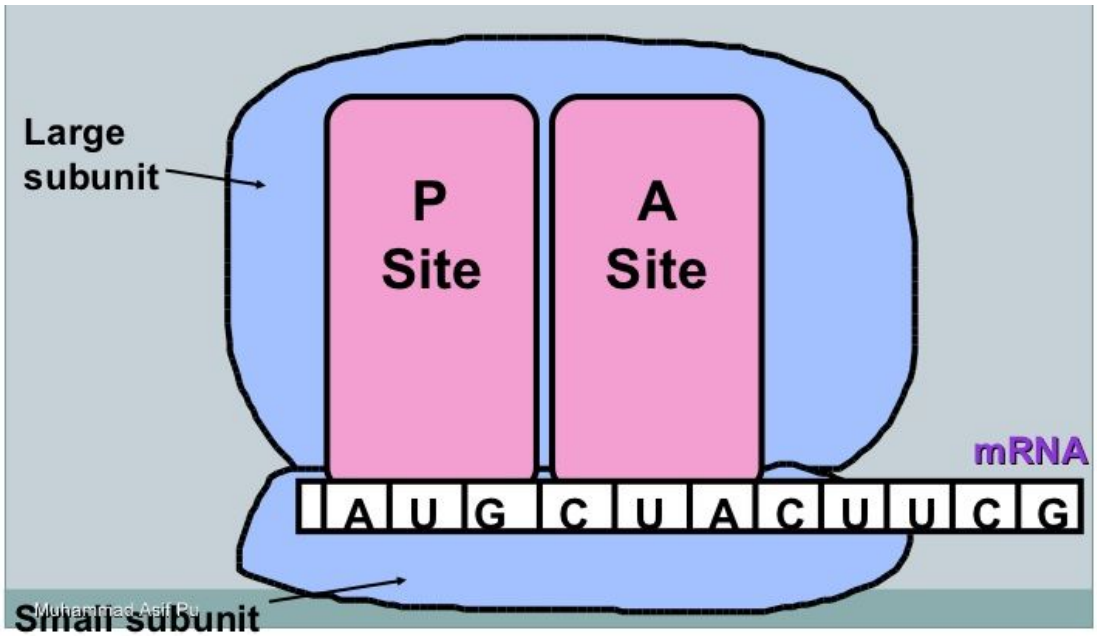
64 codons - One start codon

Three stop codons - do not code for any amino acids, 61 anti-codons

Degeneracy of the genetic code

More than one codon can code for the same amino acid

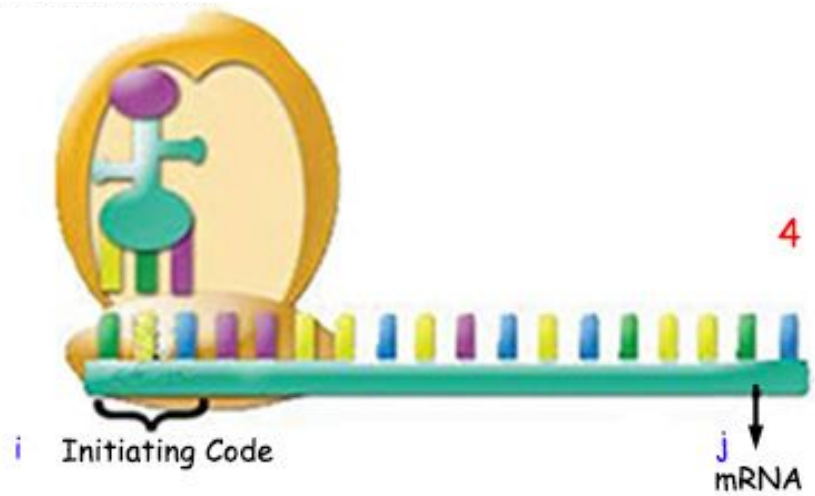
Role of Ribosomes



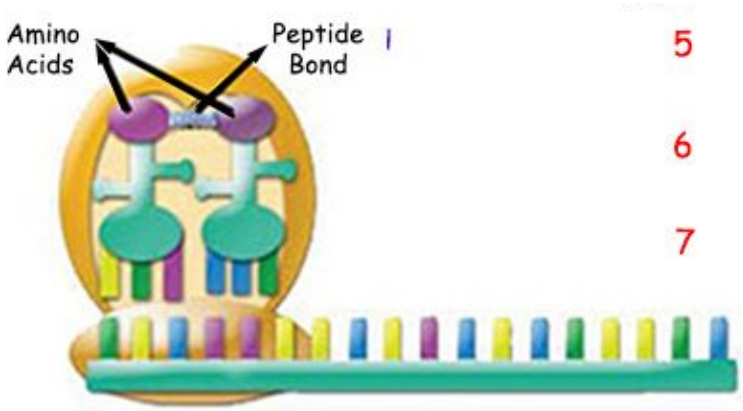
- Two binding sites for tRNA within the large subunit
- mRNA can fit into the gap between the large and small subunit

Using mRNA, tRNA and Ribosomes in Translation

Step 1: Ribosome binds to, and covers codons 1 and 2 on mRNA (including the start codon). tRNA complementary to first codon binds to mRNA.

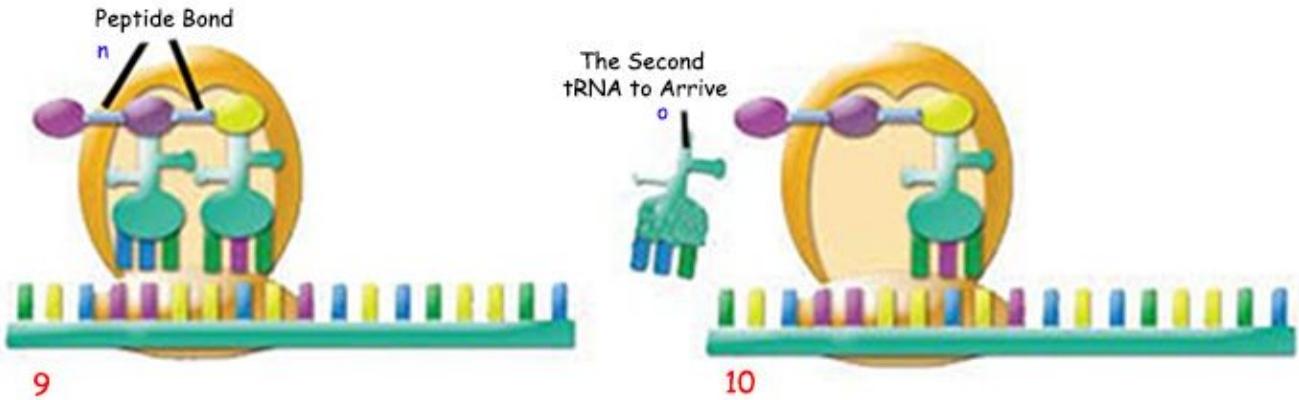


Step 2: Second tRNA arrives and binds to second codon. A peptide bond forms between amino acids 1 and 2

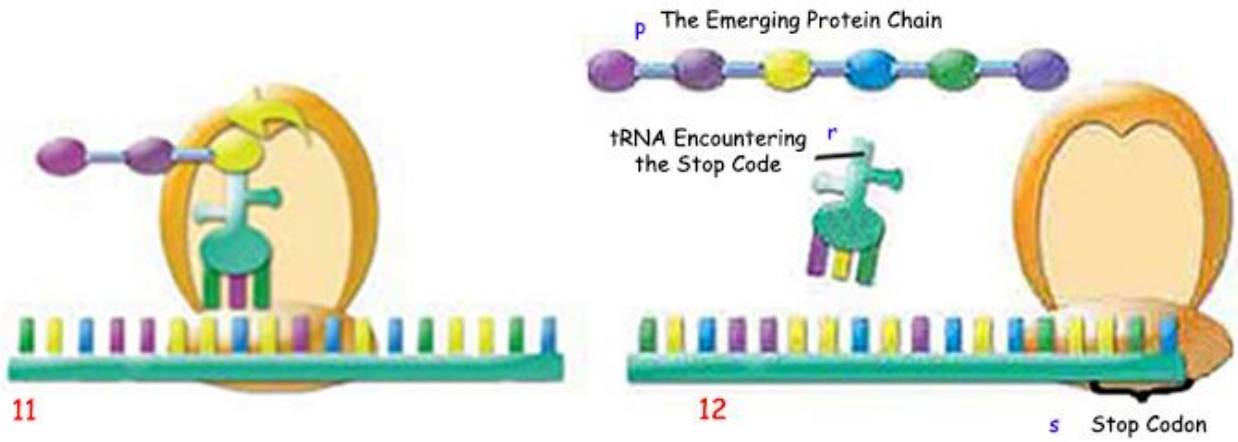


Step 3: First tRNA departs, leaving amino acid behind. Ribosome now moves along the mRNA and covers codons 2 and 3.

Step 4: tRNA complementary to codon 3 joins on. A peptide bond is formed between amino acids 2 and 3.

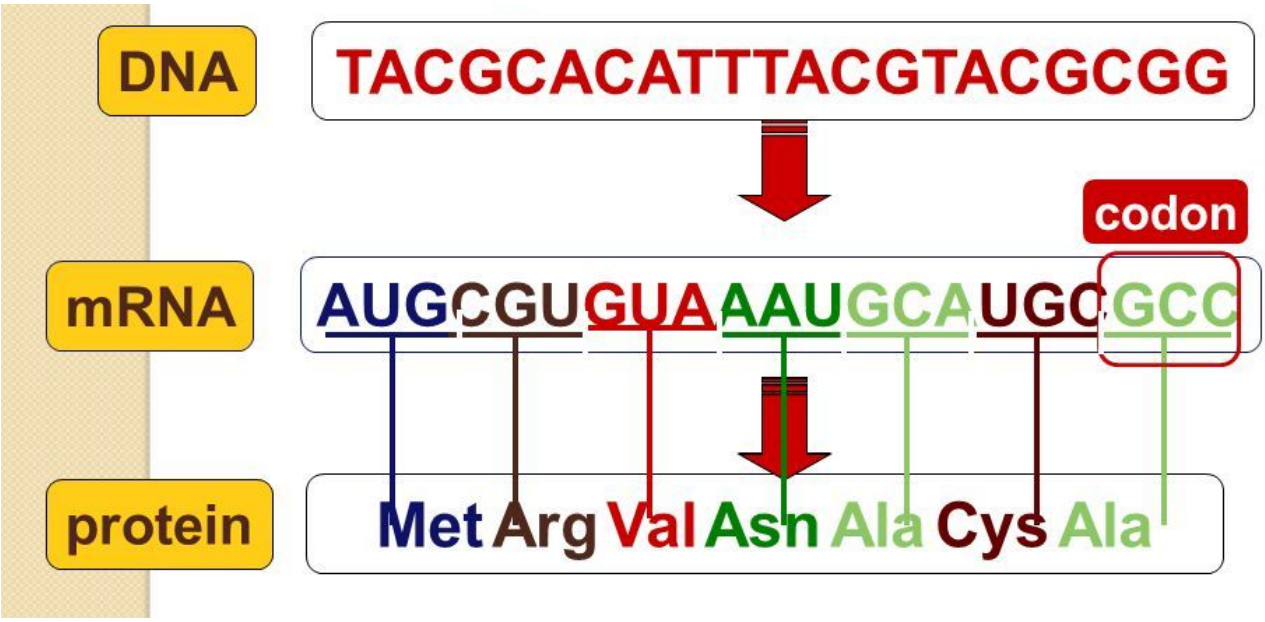


This process is repeated, creating a growing polypeptide chain.



The polypeptide is released when the ribosome reaches the last codon - the STOP codon.

It moves from the RER to the Golgi, where it is folded into its tertiary structure.



Sequence of bases on the DNA determines the sequence of amino acids in the polypeptide

Sequence of amino acids in the polypeptide determines how it folds into its tertiary structure

Any change in DNA (mutation) may change the tertiary structure of the protein