MOLECULAR BASIS OF INHERITANCE

GENETIC CODE

GENETIC CODE AND IT'S SALIENT FEATURES

GENETIC CODE :

It represents relationship of sequence of Amino acids in polypeptide and sequences of nucleotides of mRNA/DNA.

Genetic code was discovered by **Nirenberg and Matthaei**.

Crick (1961) stated that deletion or addition of one or two bases in DNA disturbs the DNA functioning.

Nirenberg and Matthaei argued that **single codon** can specify **four aminoacids ($4^1 = 4$) Double codon** can specify **$4^2 = 16$ aminoacids** that are not sufficient for the coding of essential 20 amino acid. **Triplet codon** can specify **$4^3 = 64$ aminoacids**. That are sufficient for 20 amino acids.

George gamow gave concept of **Triplet codon**. He also **coined** the term **Genetic code.**

FEATURES OF GENETIC CODE :

(i) **Triplet codon :** Genetic code is Triplet codon composed of three adjacent nitrogen bases.

Codon - A sequence of three nucleotides specifying an amino acid

(ii) **Start signal or Initiation codon :** It is mostly **AUG (Methionine codon)**. But in prokaryotes it can be GUG and UUG (Lewin 2000), In all cases they specify Methionine. GUG and UUG specify different amino acids inside the polypeptide chain (GUG - Valine, UUG- Leucine).

(iii) **Stop signal or Termination codon :** Polypeptide chain termination is signalled by three termination codon **UAA (ochre), UAG (Amber) and UGA (opal)**. they do not specify any amino acid and hence are called **non sense codons**.

Table Assignment of mRNA codons to Amino Acids

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

(iv) Non ambiguous codon : Normally one codon specifies only one amino acid and not any other.

(v) Non overlapping code : A nitrogen base is a constituent of only one codon.

(vi) Universal code : A codon specifies the same amino acid in all organisms from virus to human.

(vii) Commaless : There are no pauses so that genetic code reads continuously. If a nucleotide is deleted or added, the whole genetic code will read differently.

(viii) **Colinearity :** The sequence of codons of DNA/mRNA correspond to the sequence of amino acids in a polypeptide.

(ix) **Related codons :** Amino acids with similar properties have related codons Ex: aromatic amino acids tryptophan (UGG), Phenylalanine (UUC, UUU), and tyrosine (UAC, UAU).

(x) **Degeneracy of codons :** Since there are 64 triplet codons and only 20 amino acids, the incorporation of some amino acids is influenced by more than one codon only **Tryptophan (UGG) and Methionine (AUG)** are specified by **single codons**. All other amino acids are specified by 2–6 codons. The latter are called degenerated codons.

Wobble hypothesis (crick, 1966) : In degenerated codons the first two nitrogen bases are similar while the third one is different. The third nitrogen base has no effect on coding actually 5' end base of t-RNA anticodon is able to wobble and get paired with even noncomplementary base of m-RNA **Ex: CCA, CCC, CCG, and CCU all specify amino acid proline.**

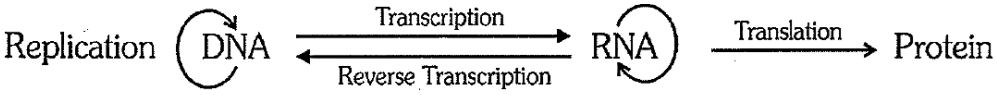
Central dogma :

It is the unidirectional flow of information that proceeds from DNA to mRNA and then decoding information present in m-RNA in the formation of polypetptide chain or protein (translation).

The concept of **central dogma** was proposed by **crick** in 1958.

Commoner (1968) propounded concept of **circular flow of information (from DNA RNA Protein RNA DNA).**

It means, it includes transcription and translation.



Reverse Transcription :-

- The formation of DNA from RNA is known as Reverse- transcription. It was discovered by Temin and Baltimore in Rous- sarcoma virus. So it is also called Teminism.

- ss-RNA of Rous-Sarcoma virus (Retro virus) produces ds-DNA in host's cell with the help of enzyme reverse transcriptase (DNA-polymerase). This DNA is called e-DNA (Complimentary DNA).