Saumya Rani
Dept. of Zoology, A.h. college

GENETIC-CODE

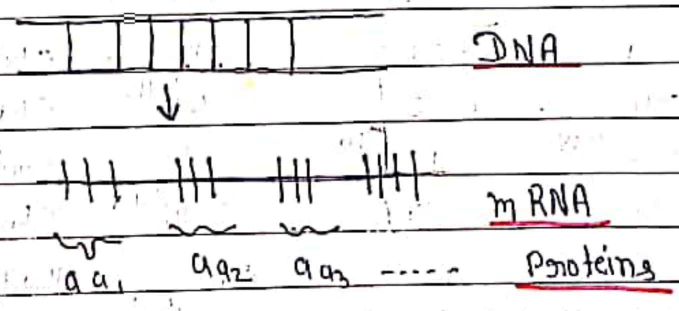
B.Sc. Part III VI
(GENETICS)

Introduction :—

Though made up of four types of nucleotides. The nucleotides of DNA can be positioned in countless ways. Thus a DNA chain of only ten nucleotide length can have 4^{10} or 1,048,576 types of strands. As a single DNA molecule has several thousand nucleotides, a limitless specifity can be incorporated in the DNA.

There is an intimate connection betn genes and synthesis of polypeptides or enzymes. Genes are made up of nucleotides arranged in a specific manner. In modern technology, a gene refers to a cistron of DNA. A cistron is made of a large no. of nucleotides. Arrangement of nucleotide or their nitrogen bases is connected with the synthesis of proteins by influencing the incorporation of amino acid in them.

Definition →: The relationship between the sequence of amino acid in a polypeptide and nucleotide sequence of DNA or mRNA is called "Genetic Code".



The concept of genetic code was given by GAMOW (1957) who first suggested that the information contains in DNA is first transmitted in RNA in the form of coded massage.

Khorana (1964) synthesised copolymers of nucleotides like UGUGUGUG------ and observed that they stimulated the formation of polypeptides having alternately similar amino acid as cysteine - valine - cysteine. This is possible only if three adjacent nucleotides specify one amino

acid (e.g. val) the other base the second amino acid (e.g. (cys))

GUG UGU GUG UGU GUG

Val – Cys – Val – Cys – Val.

Finally all the codons were worked out. In this some amino acids are specified by more than one codon. The code language of DNA and mRNA are complementary. Thus the two codons for phenyl-alanine are UUU and UUC in case of mRNA while they are AAA and AAG for DNA.

Fig: Table

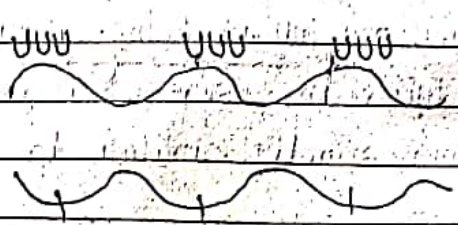
First Base	Second Base U	Second Base C	Second Base A	Second Base G	Third Base
U	UUU] Phe	UCU]	UAU] Tyr	UGU] Cys	U
	UUC]	UCC]	UAC]	UGC]	C
	UUA] Leu	UCA] Ser	UAA stop	UGA stop	A
	UUG]	UCG]	UAG stop	UGG Trp	G
C	CUU]	CCU]	CAU] His	CGU]	U
	CUC] Leu	CCC]	CAC]	CGU] Arg	C
	CUA]	CAC] Pro	CAA] Gln	CGA]	A
	CUG]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

Table → Assignment of mRNA Codons to amino acid.

CHARACTERISTIC :-

(i) Code is Triplet → The triplet nature of genetic code was first proved by Heinenberg cracking of genetic code using Poly-V-System.

The first codon discovered was UUU for Phenylalanine (Phe)-



Poly A - Poly-lysine i.e AAA codes for Lys

Poly C - Poly-Proline i.e CCC codes for Pro

The complete 64 codons dictionary for 20 amino acids was worked out by Heinenberg, Holly and Khorana.

(ii) Code is Comma-less and non-overlapping →:

A commaless code means that there is no pauses between only two nucleotide of m-RNA codon and each base is read continiously in a group of three.

A non-overlapping code means that each base of triplet codon can be read only ones, so that the no. of amino-acids, will be exactly 1/3rd of the no. of nucleotide present in m-RNA.

(iii) Code is degenerate →:

The degeneracy of genetic code means that an amino acid may be coded by more than one codons (called synonymous of codon dictionally)

e.g - for Phe. UUU, UUC

Except methionine and Tryptophan amino acids are coded by two or more codons.

(iv) Code is non-ambiguos →: The non ambiguouity of genetic code means that no codon can code for

Scanned with CamScanner

Exception
GUG — Normally code for Valine
— may also code for formulated methionine

(V) Universal code →: The genetic code is applicable universally, i.e— a codon specifies the same amino acid from virus to a tree or human being. Thus mRNA from chick oviduct introduced in Escherichia coli produces ovalbumin in the bacterium exactly similar to one formed in chick.

(VI) Related codons → Amino acids with similar properties have related codons.
e.g.- Aromatic amino acids: tryptophan (UGG), Phenylalanine (UUC, UUU), Tryosine (UAC, UAU)

(VII) Colinearity → Both polypeptide and DNA or mRNA have a arrangement of their components. Further the sequence of triplet nucleotide bases in DNA or mRNA corresponds to the sequences of amino acids in the polypeptide manufactured under the guidance of the former change in amino acid sequence of polypeptide.

(VIII) Cistron - Polypeptide parity → Portion of DNA called cistron (= gene) specifies the formation of a particular polypeptide. It means that the genetic system should have as many cistrons as the type of polypeptides found in organism.

P.K.