

Genetic code

At molecular level the hereditary unit that contain the genetic information, are made up of nucleotides. This information is first transcribed into the messenger RNA (mRNA) which has a sequence of bases complementary to DNA from which it is copied. Messenger RNA, like DNA is also made up of four different nucleotides excepting that the thymine is replaced by uracil. Since there are twenty amino acids to be coded by only four nitrogenous bases, it is not possible that the four bases could code twenty amino acids. At best, only four amino acids could be coded and 16 would be left out. Similarly a combination of two nucleotide could code only 16 — amino acid ($4^2 = 16$) still four — amino acid have been left out to get coded. However permutation of four bases ($4^3 = 64$) yields more than enough triplets to code for 20 — amino acids.

Thus Gamow (1964) considered triplet codons system to recognise the twenty different amino acids. In the 64 codons dictionary 20 codons are thus seemed to stand for 20 different amino acid 44 triplets mean non sense. But the work of Nirenberg, Khorana & Holley (1962) for which they were given Nobel prize —

Of 1968, have shown that all the 64 codons carries some meaning. The following are the property genetic code.

(i) The code is triplet :- It has been established that the triplet code is the minimum required, as single or doublet may not available to code 20 amino acid.

(ii) The code is degenerate :- For one amino acid more than one triplet codon is available which are synonymous for example -

For - Phenylalanine - UUU, UUC

For Iso leucine - CUU, CUC, CUA

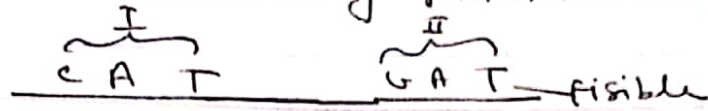
For Glycine - GGU, GGC, GGA, GGG.
are available.

The first amino acid to be incorporated in protein synthesis has found to be f. methionine for which a separate codon AUG is present. Some times, this function is taken away GUG. In most of the cases, the synonymous codons differ only of the base occupying at the third position of triplet.

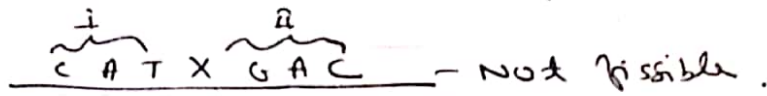
This mutation due to the replacement of third base may go unnoticed, usually referred to wobble effect.

(iii) The code is commaless. - The triplet codon which codes one amino acid, the next codon

automatically code their amino acid and no nucleotide are supposed to be involved in any punctuation.



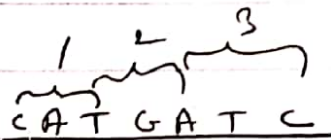
Comma free DNA sequence



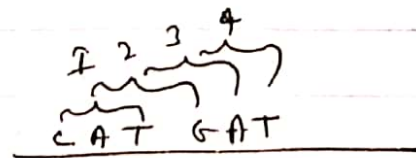
DNA sequence with comma.

(4) The code is non overlapping: - A non overlapping code means that the same letter is not used for two different codons. Where as the overlapping codons means even the coding of four amino acids from six bases. Though in actual practice the code is non overlapping, but some times it can overlapped.

Example - ϕ X 174 (Sanger et al (1977))



Overlapping.



Overlapping.

(6) The code has polarity: - The code is read between fixed start and end point. The point are initiation and terminating point respectively so if it is read in opposite direction, it would specify the different protein because of different sequence of amino acid

As for example: -

UUG	AUC	GUC	UCG
Leu	Ile	Val	Ser
Val	Leu	Leu	Ala

It is thus seen that unless there is polarity, there would be drastic change if the code is read in opposite direction. The available evidence indicates that the message in mRNA is transcribed into 5' to 3' direction.

② Initiation Codon : - The starting amino acid is the synthesis of most of the protein chains in methionine in Eucaryote & n-formyl (f) methionine in pro-caryote. These amino acids tRNA complex binds to the AUG codon which is initiating site. Sometimes GUG which codes for valine act as the initiation codon in bacterial protein synthesis specifically when AUG codon is lost by deletion. At the initiating site if GUG is present it can code n-formyl methionine as in a bacteriophage MS₂ whereas in other positions it will continue to code valine.

③ Termination Codon - Three of the 64 codons do not specify any amino acids & are thus called

These are UAG (amber) UAA (ochre)
UGA (opal) since they bring about
the termination of poly peptide
protein synthesis since they are called
termination codons

(10) The code is universal ∴ The
codon system is not universal among
micro organism but it could be
stranded to all kinds of living
organism, micro or macro, plant or
animals.