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Genetic Code

Introduction:

A genetic code is one such set of rules which determines how the sequence of the proteins of amino acids should go. Although it is a much harder topic, or even a concept to get a good grasp on, it is important that a student of biology pays much attention to it. While not many students skip it, even the nes that do, it is easier for them to study if they take help from a few outside sources.

There are certain rules that define a genetic code, that is one helpful part of a living organism. It helps the living cells in the translation of information that can be found with the DNA as well as RNA sequences, that is genetic material. A complex molecule that leads the way in order to complete such a translation, is known as ribosomes.

The source of different characteristics of a living being is coded in the genes. Genetic information is thus passed from one generation to the other in the form of code. It decides the traits of an organism, whether it is a bacterium or a human being. The entire life process is controlled by the genetic code one possesses. Here, we will learn what genetic code is and its characteristics.

What is genetic code?

The information transferred or passed from the parent generation to the offspring is called genetic code. The process begins at the cellular level when the genes get split into the parental reproductive cells and then get united to form a hybrid set of genes during fertilization.

Apart from the union of the male and female reproductive cells in sexual reproduction, there are other means of reproducing young ones where genetic code is passed. For instance, in asexual reproduction, the splitting of the cells of one parent-cell to form daughter cells is also the process of passing genetic information from one generation to another.
This is an intricate process of replicating and transcribing genes. The biochemical process of copying a very complex set of nucleic acids or genetic material within the reproductive cells and their union with the other half of the reproductive cell results in the formation of genetic information. In a nutshell, the answer to what is genetic code is the set of information passed from a parental generation to the offspring in the form of genes to conduct various physiological functions.

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Characteristics of Genetic Code

The intricate process of decoding genes and then recording to form a new set of genes in the offspring is fascinating. The entire biochemical process comprises millions of chemical reactions occurring within a minute yet controlled environment of a cell.

To understand its features, first, we need to observe the scientific discovery and theories behind it. George Gamow, a renowned physicist proposed that the four genetic bases (guanine, adenine, thymine, and cytosine) are the primary constituents of the code for 20 existing amino acids. Hence, the combination of these bases will occur in the set of three resulting in 43 or 64 combinations. These combinations are called codons.

Renowned biochemist Har Gobind Khorana developed a brilliant method to synthesize artificial RNA by defining the combination of these bases and took a step ahead to decipher a genetic code. Marshall Nirenberg, another geneticist developed a cell-free environment to synthesize protein and to decipher this code. Severo Ochoa, a brilliant biochemist, discovered an enzyme that can synthesize RNA with proper sequence without using DNA templates.

Let us move forward to understand the salient features of genetic code now.

- Each codon thus has 3 bases producing 64 codons. Out of these 64 codons, only 61 are capable of producing amino acids. The rest 3 are used as stop codons during the process of translation.
- One codon is responsible to direct the reactions for producing an amino acid. Hence, the process is absolutely specific and focused.
- Some of the amino acids can have multiple codons for production. This is called the degeneracy of genetic code. For example, Valine (Val) has four different sequential codons for production. They are GUA, GUC, GUU, and GUG.
- Codons are responsible for the formation of mRNA. On the other hand, mRNA is responsible for the generation of genes.
- Another prime feature of the genetic code is that it is universal. It means that one codon will lead to the formation of one amino acid. For instance, Phenylalanine (Phe) has the genetic code UUU. It is universal across all living beings. It means that the Phe of a bacterium will be similar to that of a human being.
- Sometimes, codons have dual functions too. For instance, AUG is the genetic code for Methionine (Met). It also acts as an initiator or start codon.
- The standard genetic code is universal virtually among all extant life forms.

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Genetic Code - Properties

It is a must that the genetic codes properties are known by all the students who are in touch with their Biology, or who study it:

- They are mostly triplet coded
- They are unambiguous as well as universal in nature
- They have a degenerate code
- They contain start and stop codons
- They showcase polarity
- Their code is mostly non overlapping
- They are commaless, hence have no indication of an end or a beginning

Mutations of Genetic Codes

Not every individual is similar. In fact, it has been observed that a particular physiological trait goes missing. It happens when the genetic codes get rearranged and deleted during transcription and replication. The different segments of DNA get rearranged and deleted during the process resulting in mutations.

Genes are gained and lost in the process resulting in new physical traits of an organism. Let us consider an example. If Valine (Val) is replaced by Glutamine (Gln) in a particular gene sequence, the individual will develop sickle cell anemia, a blood disorder.

Wrapping up, the genetic code of an organism depends on the genes received from the parental generation and the way it is produced from replication and transcription. We have learned how the bases form codons and how they direct the genesis of amino acids. These amino acids are units of protein that form the genetic material of an organism following a proper sequence.

1. What is meant by genetic code?

When it comes to giving an explanation regarding the topic of genetic code, one can say that it is actually a set of rules which the living cells use. This helps the organisms to convert the information that they have in the form of encoding of genetic material, into proteins. Translation or protein synthesis is accomplished by the ribosome, which links amino acids in an order which is specified by the mRNA, using tRNA molecules to carry amino acids and to read the mRNA codons at a time.

It is shown in the very definition of the genetic code, the specification of three nucleotides as well as their sequences. These are what specify which amino acid must be added during the translation next.

2. What are the important features of genetic code?

Genetic code is a very important part of Biology, not just for students but also for life, itself. So, it is a must that you get to know the various features of it, which are:

- **The genetic code does not have any indication of either beginning or ending of a codon. It is written without a coma.**
- **The genetic code is actually a single base, translating to the fact that it does not or cannot overlap, getting involved in the formation of one codon or more.**
- **The code is basically degenerate. This means that any amino acid has the possibility of getting coded by one triplet codon or even more.**
- **It is read from 5' to 3'**

3. What are the following codons?

- ***Chain initiation codons***
- ***Chain termination codons***
- ***Sense codons***
- ***Non-sense codons***

Chain initiation codons: AUG and GUG codons are translation chain initiation codons in E.coli. They code for valine and methionine and occur immediately after the terminator codons.

Chain termination codons: UAA, UAG, and UGA are termination codons as they do not code for any amino acid. They are also called stop codons.

Sense codons: 61 codons of the genetic code table are known as the sense codons. All of them code for particular amino acids.

Nonsense codons: As UAA, UAG, and UGA do not code for any amino acid, they are also known as nonsense codons.

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4. What do you mean by degenerate genetic code?

Every amino acid has a single codon to follow for genesis. However, some amino acids have multiple codons to create a redundant or degenerate structure. This is called degeneracy of genetic code. One of the best examples we can pull here is the set of alternative genetic codes mitochondria have. This alternate code is slightly different from the rest.

5. Does genetic code overlap?

According to the theories and scientific establishment of the genetic codes, there is a chance of overlapping in the code. A nucleotide will have only one codon to follow for its synthesis inside the cells. It also means that two neighbor codons cannot generate the same nucleotide. In fact, we have studied that the genetic code is similar for the amino acids for all organisms. Only very rare instances have been noticed that show variations. Hence, it can be concluded that genetic code overlapping generally does not occur in nature. Meaning that there are a couple of codons found together which cannot obtain or generate the nucleotide of the same nature.