Genetics

Biology Dept.3rd stage
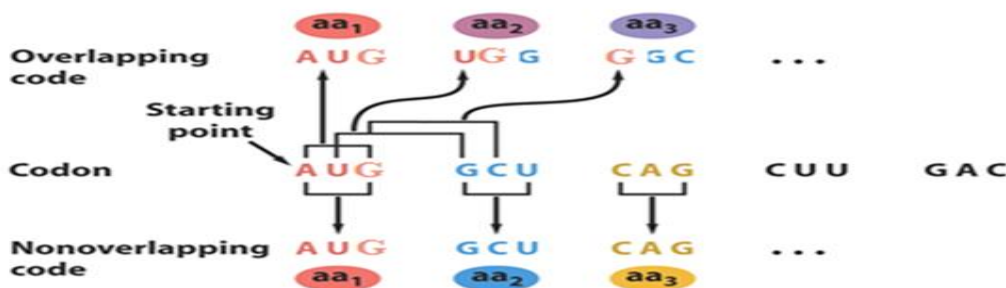
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Lec-4-

3-The code is non-overlapping:

In translating mRNA molecules the codons do not overlap but are "read" sequentially (Fig. 38.27). Thus, a non-overlapping code means that a base in a mRNA is not used for different codons, it has been shown that an overlapping code can mean coding for four amino acids from six bases.

However, in actual practice six bases code for not more than two amino acids. For example, in case of an overlapping code, a single change (of substitution type) in the base sequence will be reflected in substitutions of more than one amino acid in corresponding protein. Many examples have accumulated since 1956 in which a single base substitution results into a single amino acid change in insulin, tryptophan synthelase, , haemoglobin, et

How is the reading frame read?

c.

4. The code is non-ambiguous:

Non-ambiguous code means that a particular codon will always code for the same amino acid. In case of ambiguous code, the same codon could have different

meanings or in other words, the same codon could code two or more than two different amino acids. Generally, as a rule, the same codon shall never code for two different amino acids.

However, there are some reported exceptions to this rule: the codons AUG and GUG both may code for methionine as initiating or starting codon, although GUG is meant for valine. Likewise, GGA codon codes for two amino acids glycine and glutamic acid.

5. The code has polarity

The code is always read in a fixed direction, i.e., in the 5′→3′ direction. In other words, the codon has a polarity. It is apparent that if the code is read in opposite directions, it would specify two different proteins, since the codon would have reversed base sequence:

Codon :	UUG	AUC	GUC	UCG	CCA	ACA	AGG
Polypeptide:→Leu		Ile	Val	Ser	Prof	Thr	Arg
	Val	Leu	Leu	Ala	Thr	Thr	Gly←

6. The code is degenerate:

More than one codon may specify the same amino acid; this is called degeneracy of the code. For example, except for tryptophan and methionine, which have a single codon each, all other 18 amino acids have more than one codon. Thus, nine amino

acids, namely phenylalanine, tyrosine, histidine, glutamine, asparagine, lysine, aspartic acid, glutamic acid and cysteine, have two codons each. Isoleucine has three codons. Five amino acids, namely valine, proline, threonine, alanine and glycine, have four codons each. Three amino acids, namely leucine, arginine and serine, have six codons each .

The code degeneracy is basically of two types: partial and complete. Partial degeneracy occurs when first two nucleotides are identical but the third (i.e., 3′ base) nucleotide of the degenerate codons differs, e.g., CUU and CUC code for leucine, Complete degeneracy occurs when any of the four bases can take third position and still code for the same amino acid (e.g., UCU, UCC, UCA and UCG code for serine).

7. Some codes act as start codons:

In most organisms, AUG codon is the start or initiation codon, i.e., the polypeptide chain starts either with methionine (eukaryotes) or N- formylmethionine (prokaryotes). Methionyl or N-formylmethionyl-tRNA specifically binds to the initiation site of mRNA containing the AUG initiation codon. In rare cases, GUG also serves as the initiation codon, e.g., bacterial protein synthesis. Normally, GUG codes for valine, but when normal AUG codon is lost by deletion, only then GUG is used as initiation codon.

8. Some codes act as stop codons:

Three codons UAG, UAA and UGA are the chain stop or termination codons. They do not code for any of the amino acids. These codons are not read by any tRNA molecules (via their anticodons), but are read by some specific proteins, called release factors (e.g., RF-1, RF-2, RF-3 in prokaryotes and RF in eukaryotes). These codons are also called nonsense codons, since they do not specify any amino acid.

Genetic Code: Where to begin and stop?
• Synthesis of all polypeptide chains in prokaryotic and eukaryotic cells begins with the amino acid **methionine**.
    –In most mRNAs, the **start (*initiator*) codon** specifying this amino-terminal methionine is AUG.
    –Exceptions: GUG in prokaryotes and CUG in eukaryotes
• The three codons UAA, UGA, and UAG do not specify amino acids but constitute **stop (*termination*) codons** that mark the carboxyl terminus of polypeptide chains.
• The sequence of codons that runs from a specific start codon to a stop codon is called a ***reading frame***.
–This precise linear array of ribonucleotides in groups of three specifies the precise linear sequence of amino acids in a polypeptide chain.

Reading frame
UCAUGGGCACCGGAGUGAAACGCUGAGGGUG
↓
Functional Protein
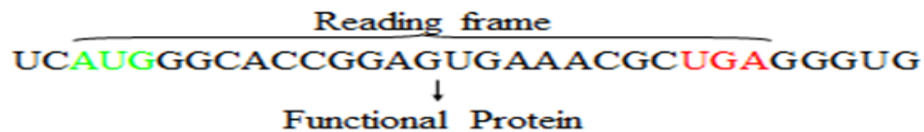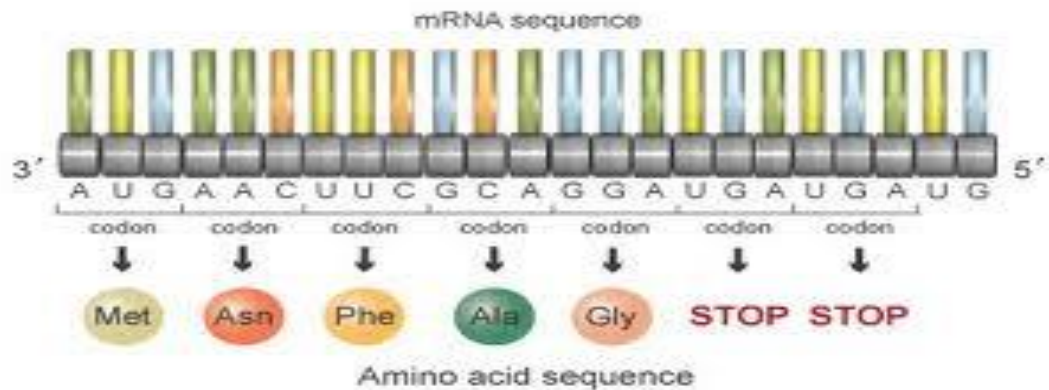
9. The code is universal:
Same genetic code is found valid for all organisms ranging from bacteria to man. Such universality of the code was found that E. coli (Bacterium), Xenopus laevis (Amphibian) and guinea pig (mammal) amino acyl-tRNA use almost the same code

10. Isoaccepting tRNAs are tRNAs with different anticodons that accept the same amino acid; wobble allows the anticodon on one type of tRNA to pair with   more than one type of codon on mRNA.

mRNA sequence

3′   A U G A A C U U C G C A G G A U G A U G A U G   5′

codon   codon   codon   codon   codon   codon   codon

Met   Asn   Phe   Ala   Gly   STOP   STOP

Amino acid sequence

What is a chromosome?

In the nucleus of each cell, the DNA molecule is packaged into thread-like structures called chromosomes. Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure.

Chromosomes are not visible in the cell's nucleus—not even under a microscope—when the cell is not dividing. However, the DNA that makes