**3. Translation**

Proteins are the operational powerhouses of the cells, as well as some of their most important building blocks. Usually, proteins are made up of one or more than one polypeptide chains.

Translation connects **amino acids** forming a **polypeptide chain**, using the information that is stored in **DNA coding regions**. In living organisms 20 different amino acids exist, and polypeptides are formed by various combinations of these amino acids. The sequence in a polypeptide chain is not random and occurs, when cells' structures or organelles called **ribosomes**, read the nitrogenous bases sequence in the mRNA molecule and build the corresponding polypeptide chains accordingly.

**Ribosomes** are enzyme complexes that "read" the mRNA sequence from 5' to 3' orientation, codon by codon in a continuous fashion. **Codons** are groups of 3 ribonucleotides, thus 3 nitrogenous bases, starting at the **starting codon** 5' AUG 3' (5' ATG 3' for the DNA coding sequence), and ending at the termination codons 5' UGA 3', or 5' UAA 3', or 5' UAG 3' (5' TGA 3', or 5' TAA 3', or 5' TAG 3' for the DNA coding sequence). Then ribosomes, whith the help of special RNA molecules called **transfer RNA** (**tRNA**) "translate" those codons to amino acids, according to the **genetic code**, except the termination codons. The first amino acid of the polypeptide sequence, **Methionine**, often serving as the initiator amino acid, corresponds to the 5' AUG 3' starting codon and it is located at the **amino (N-terminus) end (H2N-)**, while the last amino acid is located at the **carboxyl (C-terminus) end (-COOH)** of the polypeptide chain.

Thus, the starting and ending codons define the reading frame of a coding sequence, whose length must be a multiple of three. Central Dogma script checks if a coding DNA sequence starts with 5' ATG 3' and ends with a termination codon, while reading the coding sequence by steps of 3 bases (codons). If the coding sequence fulfills the criteria above, it will be translated according to the [**Standard Genetic Code Table**](https://www.ncbi.nlm.nih.gov/Taxonomy/Utils/wprintgc.cgi?chapter=tgencodes#SG1). If not, the sequence will not be translated.

#### Example 3

For the mRNA of the previous example:

5' AUGGAGCUCUAA 3'

the polypeptide chain will be:

H2N-Met-Glu-Leu-COOH

#### Example 4: Summary of Central Dogma

| **Table 2: DNA Coding Sequence Replication, Transcription and Translation (Central Dogma)** |
| --- |

| **Procedure** | **Macromolecule** | **Starting Edge** | **Starting Codon** | **Codon 1** | **Codon 2** | **Termination Codon** | **Ending Edge** |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | DNA coding | 5' | ATG | GAG | CTC | TAA | 3' |
| Replication | DNA complementary | 3' | TAC | CTC | GAG | ATT | 5' |
| Transcription | mRNA | 5' | AUG | GAG | CUC | UAA | 3' |
| Translation | Polypeptide | H2N | Met | Glu | Leu | - | COOH |