Ribosomes

Bălescu Alexandru 344

Ribosomes are an extremely specialized subcellular structure. They can be found in both **prokaryotic** and **eukaryotic** cells (cells with a nucleus).

Ribosomes are made of **protein and RNA**, they can be viewed as macromolecular “machines” found in **every cell** (on average, a mammalian cell has 10 million ribosomes). Ribosomes perform protein synthesize and read the RNA, formally known as mRNA translation.

Ribosomes are comprised of **2 sub-units**: large subunit and small subunit. Both of these subunits have protein and RNA, more specifically ribosomal RNA (rRNA). The location of the ribosomes throughout the cell is going to determine which type of protein will be made: the free-floating ribosomes synthesize proteins that are going to be used inside the cell and the ribosomes that are on the membrane synthesize proteins that are going to be used outside of the cell. The **free-floating ribosomes** are able to move any place inside the cytosol, however they are not present inside the cell nucleus or other organelles. The ribosomes that are on the membrane, also known as **membrane-bound ribosomes**, are placed, in the case of eukaryotic cells, in a region of the ER (endoplasmic reticulum) named the “rough ER”. The freshly made polypeptide chains are directly inserted in the ER by the ribosome, going thorough a process called vectorial synthesis, after which they are moved to their destined location through the secretory pathway. The protein generated by the membrane-bound ribosomes is utilized in some other organelles.

Let’s analyze the translation process that takes places inside the ribosome:

The mRNA passes between the large and the small subunits. This way **the ribosome reads messenger RNA**. More accurately described, the mRNA has a series of **codons** and the ribosome decodes these codons in order to produce protein. As the ribosome traverses each codon (made from 3 nucleotides), it **pairs the codon with the corresponding amino-acid** that has been provided by the tRNA. The result of this pairing is a **polypeptide** **chain** that will become a **protein**. However, another question arises: how does a ribosome know where to start and stop processing the mRNA? The answer circles back to the codons. Much like a Turing Machine reading from a strip, the ribosome starts reading from the mRNA after encountering a **start codon** AUG and keeps on reading until it encounters a **stop codon** UAG, UAA, UGA.

After the protein has been successfully produced by the ribosome, the long polypeptide chain will then **fold** in order to produce a 3D structure. The reason for this bizarre step is that the protein, in its untangled, straight form is quite unstable, and by folding, it will become a biologically functioning protein.

Briefly said, the process through which a ribosome converts a sequence of mRNA into a protein can be simply described in 4 steps: **initiation, elongation, termination and recycling**.

**Initiation**: the small subunit finds a sequence of mRNA and after that a large subunit is found

**Elongation**: as the formed ribosome is reading the sequence, starting with the start codon, it pairs each codon with a corresponding amino-acid, resulting into a polypeptide.

**Termination**: The above process is repeated until the stop codon is encountered and the long polypeptide chain is released.

**Recycling**: The ribosome breaks apart into subunits that can be reused.