UNIVERSITY BATNA 02
FACULTY OF NATURAL AND LIFE SCIENCES
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RIBOSOMES AND SYNTHESIS OF PROTEINS

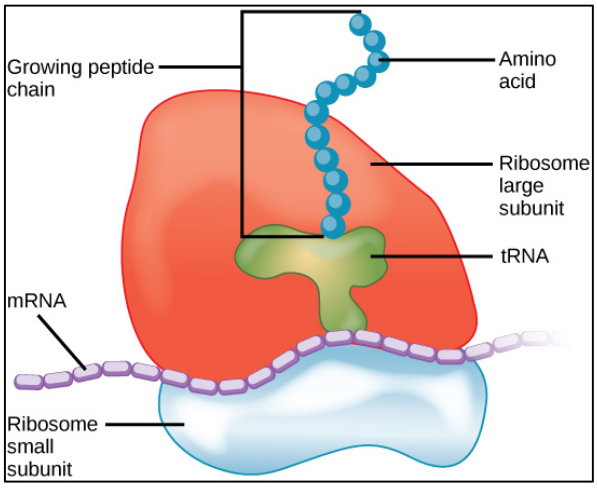
The genetic information in living systems is stored in the genome sequences of their DNA (deoxyribonucleic acid). A large part of these sequences encode proteins which carry out most of the functional tasks in all extant organisms.

The DNA information is made available by transcription of the genes to mRNAs (messenger ribonucleic acids) that subsequently are translated into the various amino acid sequences of all the proteins of an organism.

Ribosomes

Are the sites in a cell in which protein synthesis takes place. Cells have many ribosomes, and the exact number depends on how active a particular cell is in synthesizing proteins. For example, rapidly growing cells usually have a large number of ribosomes.

Ribosomes are complexes of rRNA molecules and proteins (**ribonucleoprotein complexes**). Sometimes, ribosomes are visible as clusters, called polyribosomes. In eukaryotes (but not in prokaryotes), some of the ribosomes are attached to internal membranes, where they synthesize the proteins that will later reside in those membranes, or are destined for secretion . Although only a few rRNA molecules are present in each ribosome, these molecules make up about half of the ribosomal mass.



Components of the ribosome.

The bacterial (70S) ribosome consists of a small (30S) and a large (50S) subunit, with molecular weights of about 800 000 and 1 500 000 Dalton (Da), respectively, where S stands for the Svedberg unit for sedimentation velocity.

The 30S subunit consists of about 20 different proteins and a sequence, 16S, of ribosomal RNA (rRNA) containing about 1600 nucleotides. The 50S subunit consists of about 33 different proteins, a 23S rRNA sequence with about 2900 nucleotides, and a 5S rRNA sequence with about 120 nucleotides.

Ribosomes from eukaryotes are larger and more complex than those from prokaryotes, but from everything we know ribosomes from all three kingdoms of life function according to the very same principles.

The ribosome has three binding sites for tRNA, the A (aminoacyl) site, the P (peptidyl) site and the E (exit) site, formed in the inter subunit interface

Nucleolus

Within a cell's nucleus is a special structure called the nucleolus that houses the ribosomal machinery. It is separate from the rest of the nucleus because of the specialized function Internuclear structures do not have membranes. It does not contain chromosomes and is able to shuttle ribosomes and ribosomal RNAs out of the nucleus and into the cytoplasm where protein synthesis occurs. Once in the cytoplasm, the ribosomal RNAs become a part of the ribosome and are responsible for shuttling messenger RNAs through the ribosome to be translated into proteins

Ribosome biogenesis

Is a critical, greatly elaborated and well-coordinated cellular process in the life cycle of a cell, required for a correct cellular activity and function. It starts in the **nucleolus**, a special compartment within the nucleus, and requires **four different kinds of rRNAs**, about **80** Ribosomal Proteins (RPs **)** and the activity of **three RNA polymerases**,

Steps of ribosome biogenesis

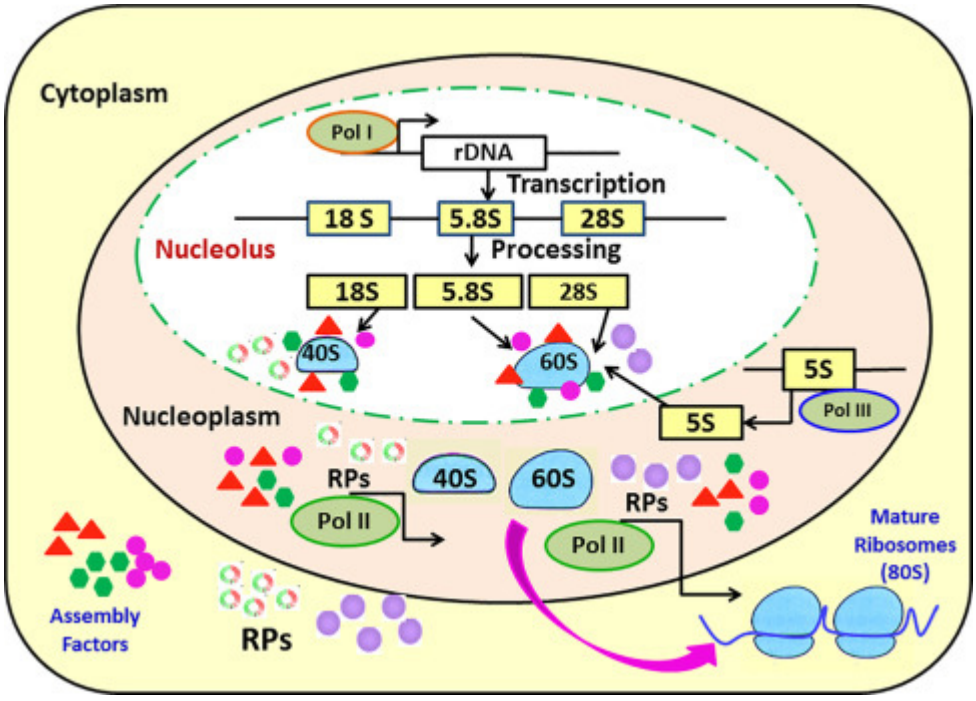
Ribosomes are classified according to the sedimentation coefficient expressed in **Svedbergs** (S). Eukaryotic ribosomes are larger that prokaryotic ribosomes and this is also reflected by their **coefficient of sedimentation**.

Mammalian ribosomes indeed have a coefficient of 80S, and a diameter of 22nm. They are formed by **two ribonucleoprotein subunits**: the **large subunit** (60S) catalyzes the

formation of peptide bonds, and the **small subunit** (40S) is accountable for decoding mRNA sequences into aminoacid chains.

Four rRNAs (18S, 28S, 5.8S and 5S) and about **80 ribosomal proteins** (RPs) are part of the ribosome structure. The rate of rRNA transcription is a limiting factor in the production of ribosomes.

The process starts in the nucleolus, with the transcription of the polycistronic precursor 45/47S pre-rRNA by the RNA polymerase. **The 45/47S pre-rRNA** is later modified and processed by small nucleolar RNAs (snoRNAs) and other protein cofactors, including RPs, giving rise to the three rRNAs: 18S, 28S and 5.8S. Meanwhile, outside the nucleolus but still within the nucleoplasm, a second rRNA molecule, the **5S**, is transcribed by **RNApolymeraseIII**.



These steps are paralleled by the transcription of RP mRNAs by RNA polymerase II, followed by their translation in the cytoplasm. At this stage, the different RPs are imported through the **nucleolar pores** in the nucleus, where they associate with the 45/47S pre-rRNA and process it into the two subunits, the 40S and the 60S. Once the ribosomal subunits are formed, they exit the nucleus through the nuclear pores and enter the cytoplasm, ready to start executing their function.