

## **Subject: Zoology**

### **Cell Biology**

#### **Name of the Topic : Ribosomes**

#### **RIBOSOMES**

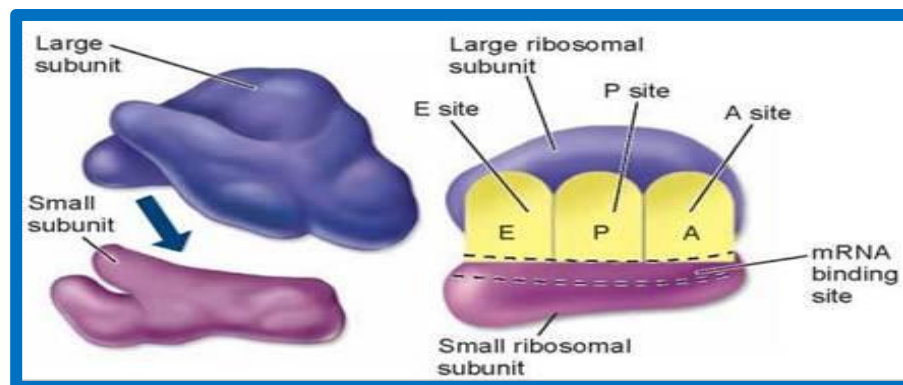
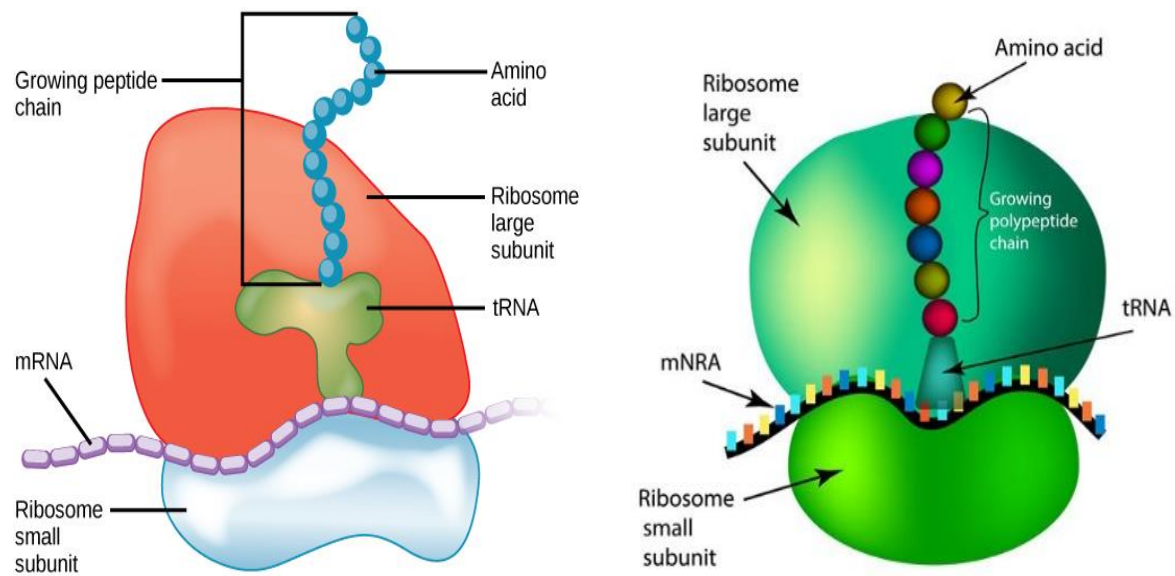
Ribosomes were discovered by Robinson and Brown (1953) in plant cells and Palade (1955) in animal cell. Palade has also coined the term Ribosomes. These are **known** as the protein assemblers of a eukaryotic cell. These cell organelles consist of RNA and proteins. Depending on the protein production level of a particular cell, ribosomes number may be in the millions. They are first observed by Claude in 1941. They are present in all living cells which synthesize proteins. In prokaryotic cells, ribosomes are found in the cytosol. In eukaryotic cells, ribosomes are found free in the cytosol (monosomes), or bound to the outer surface of the membrane of both the rough endoplasmic reticulum and the nuclear envelope. Some are scattered in the cytoplasm. They are also present in some cell organelles' like mitochondria and chloroplast.

Each ribosome is composed of two subunits. Ribosomal subunits are synthesized by the nucleolus. The sub units remain freely in the cytoplasm. In the beginning of protein synthesis these two become associate and at the end of the protein synthesis they will dissociates. Ribosomes contain RNAs proteins, enzymes and metal ions like Mg, Ca, Mn, Fe and etc. In eukaryotes the ribosomes are synthesized from the nucleus and then transported to the cytoplasm, where as in prokaryotes they are synthesized in the cytoplasm itself. Ribosomes may occur in rosettes or helical groups called polyribosomes. The ribosomes (monosome) of a polyribosome are connected with a 01-20 Å<sup>0</sup> thick strand of mRNA and are formed during periods of active protein synthesis.

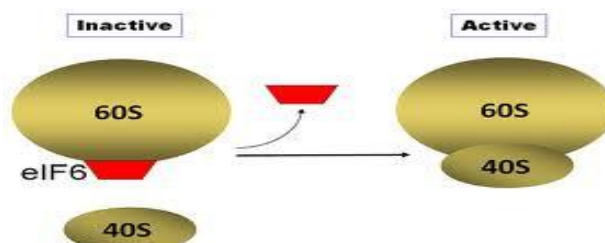
**Molecular structure of Ribosomes:** The ribosomes are spheroid structures with a diameter of 150 to 250 Å. Ribosomes are typically composed of two unequal subunits, a large dome shaped subunit and an ovoid small subunit a ridge and a stalk. The smaller subunit possesses a platform, cleft, head and base. The smaller subunits fits over the larger one at one end like a cap. These are of 2 types namely 70S and 80 S Ribosomes. S refers to **Swedberg unit**, and it can be noted as Sedimentation Co efficient of the Ribosome. The larger subunit has a groove for pushing out the

newly synthesized polypeptide. There are two reactive sites in the larger subunit called P site (Peptidyl/donar site) and A.site (Aminoacyl/acceptor site). Most probably the aminoacyl tRNA complex is attached to the acceptor site and the tRNA carrying peptide chain is attached to the donar site.

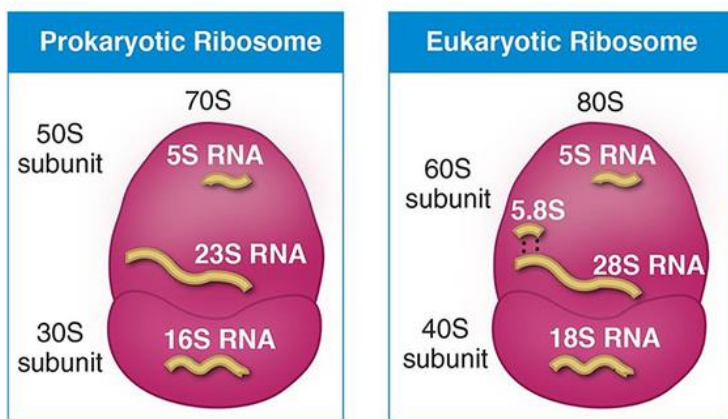
## STRUCTURE OF RIBOSOME



The association of sub units occurs in a high concentration of Mg ions and the dissociation is due to the low concentration of Mg ions.



## Types of Ribosomes:



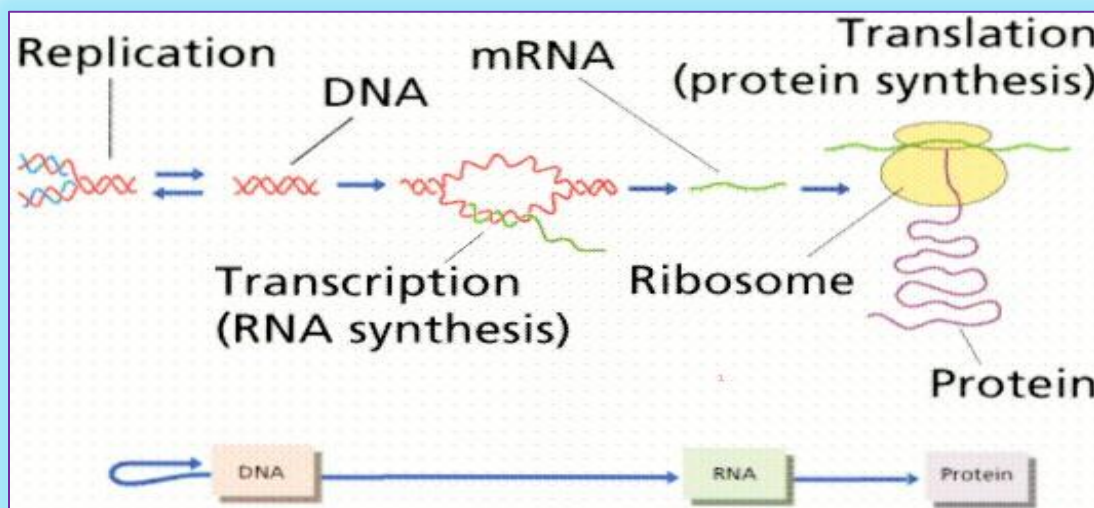
| 70 S RIBOSOMES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 80S RIBOSOMES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| <ol style="list-style-type: none"> <li>1. They found both in prokaryotes and eukaryotes.</li> <li>2. The ribosomes are found freely inside the cytoplasm they are comparatively smaller with a length of (200—290 Å) &amp; a diameter of (170— 210 Å).</li> <li>3. 70S ribosomes are comparatively lighter, 2.7—3.0 million Daltons.</li> <li>4. 70S ribosomes are synthesized in the cytoplasm of prokaryotes</li> <li>5. The two subunits are 30S and 50S. The sedimentation coefficient is 70.</li> <li>6. The rRNAs of 70S ribosomes are 23S + 5S (larger subunit) and 16S (smaller subunit).</li> <li>7. The ribosomes contain more of rRNA than protein (60:40).</li> </ol> | <ol style="list-style-type: none"> <li>1. They occur only in eukaryotic cells.</li> <li>2. They occur inside the cytoplasm of eukaryotes either freely or attached to ER.</li> <li>3. The ribosomes are larger in size with a length of (300—340 Å) and breadth (200—240 Å).</li> <li>4. They are comparatively heavier, 4.0—4.5 million Daltons.</li> <li>5. 80S ribosomes are synthesized inside the nucleolus.</li> <li>6. The two subunits are 40S and 60S. The sedimentation co-efficient is 80.</li> <li>7. The ribosomes possess less of rRNA as compared to protein (40: 60).</li> </ol> |

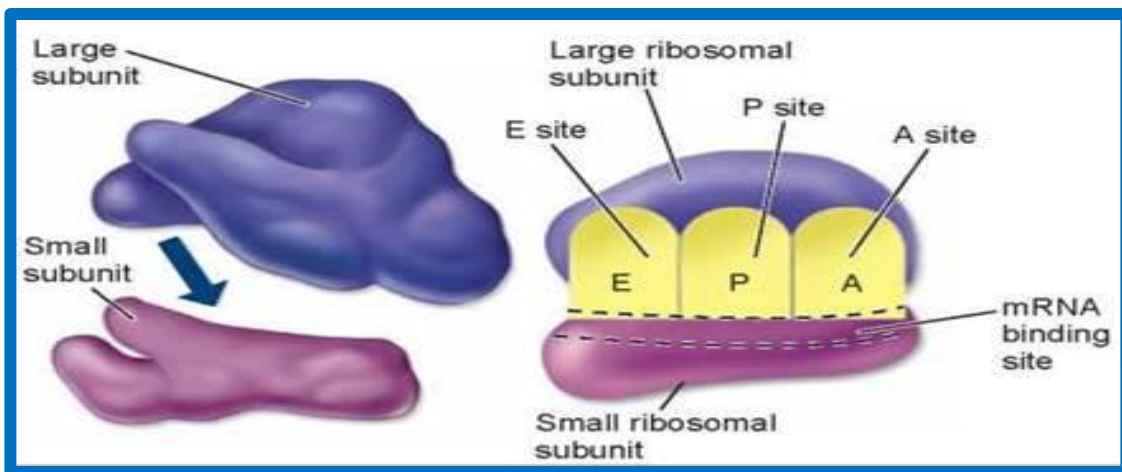
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|------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| 8. Protein synthesis is inhibited by antibiotics like chloramphenicol. | 8. Protein synthesis is not inhibited by common antibiotics like chloramphenicol. |
|------------------------------------------------------------------------|-----------------------------------------------------------------------------------|

### Functions:

1. They actively participate in protein synthesis.
2. They act as template, bringing together different components involved in the synthesis of proteins.
3. They also have protective functions Eg: The mRNA strand which passes between the two subunits of the ribosomes is protected from the action of the nucleases.
4. Polypeptide chains are also protected by the action of protein digesting enzymes.

**Protein Assembly:** Ribosomes are the working benches in the translation step of protein synthesis. Protein synthesis occurs by the processes of transcription and translation. In transcription, the genetic code contained within DNA is transcribed into an RNA version of the code known as messenger RNA (mRNA). In translation, a growing amino acid chain, also called a polypeptide chain, is produced. Ribosomal RNA helps to link amino acids together to produce the polypeptide chain.





The polypeptide chain undergoes several modifications before becoming a fully functioning protein. Proteins are very important biological polymers in our cells as they are involved in virtually all cell functions. So, if the ribosomes are removed proteins required within the cell like the enzymes and proteins required outside the cell like structural proteins won't be manufactured in the body and it'll eventually cause degeneration of the whole body.

#### Reference:

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