Nucleolus:

- The nucleolus is the only organised body present in the nucleus .
- In course of cell division, it usually disappears by late prophase, reforms during telophase and retains up to late prophase of the next cell cycle .
- In certain cases, it may persist till metaphase or later (e.g., Spirogyra, Pea and a number of animal cells in culture).
- Under the light microscope the suitably stained nucleolus is seen as a dense body of variable size and shape.
- Its presence in the nucleus was first recognised by Fontana in 1874.
- The nucleolus is formed in the nucleolar organising region of the chromosome(s).
- It is now well-established that the nucleolus is the site for the synthesis and biogenesis of ribosomal nucleic acid (rRNA) in eukaryotes.
- Nucleolus is the small intra-nuclear dense globular organised body disappearing by late prophase and reforming at telophase in the nucleolar organising region of the chromosome(s) and is the side for the

synthesis and biogenesis of ribosomal ribonucleic acid.

- Nucleolus is usually a-spheroidal body situated within the nucleus, either in a central or peripheral position.
- It is found in close association with the nucleolar organizer region of two or more chromosomes (Fig. 1). One or many nucleoli may be present in a nucleus.

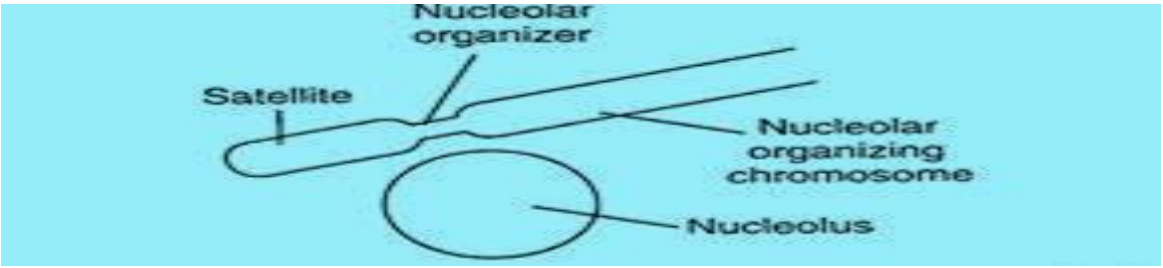

Fig.1 Chromosome and Nucleolus.

Ultrastructure of Nucleolus:

The ultra-structure of the nucleolus shows four chief components:

1. An amorphous matrix.
2. Nucleolar associated chromatin.
3. Fibrils .
4. Granules .

1. Amorphous matrix:

- The matrix or pars amorpha of the nucleolus is homogenous. It contains scattered granules and fibrils.

2. Nucleolar associated chromatin:

- Chromatin associated with the nucleolus contains DNA which serves as a template for rRNA synthesis.
- Surrounding the nucleolus like a shell is perinucleolar chromatin.
- Projecting into the nucleolus from the perinucleolar chromatin are septa like trabeculae, called intra-nucleolar chromatin.

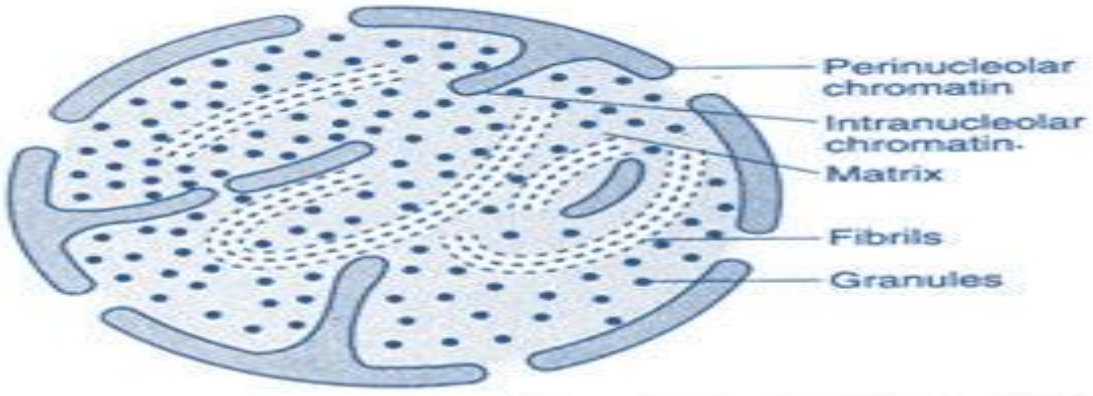

Fig.2 Ultrastructure of Nucleolus.

3. Fibrils :

- The fibrils are 80-100Å in diameter and constitute pars fibrosa.
- They contain RNA and are probably the precursors of the granules.
- Granules are of 150 – 200Å diameter which constitute the pars granulosa.
- These granules contain protein, RNA and are precursors of ribosomes.

4. Granules:

- The granules appear to be vesicles with a light central core and a dense peripheral structure.
- They are connected together by a thin filament, forming a structure (the primary nucleolonema) resembling a string of beads.
- The primary nucleolonema undergoes folding to form the secondary nucleolonema.

Function of Nucleolus:

1. The nucleolus is one of the most active sites of RNA synthesis and the source of ribosomal RNA (rRNA).
2. The chromatin in the nucleolus contains genes or ribosomal DNA (rDNA) for coding ribosomal RNA.

3. The fibrils represent the origin of ribosomal RNA, and the granules the next stage.
4. The granules in turn are the precursors of ribosomes (Fig.3).

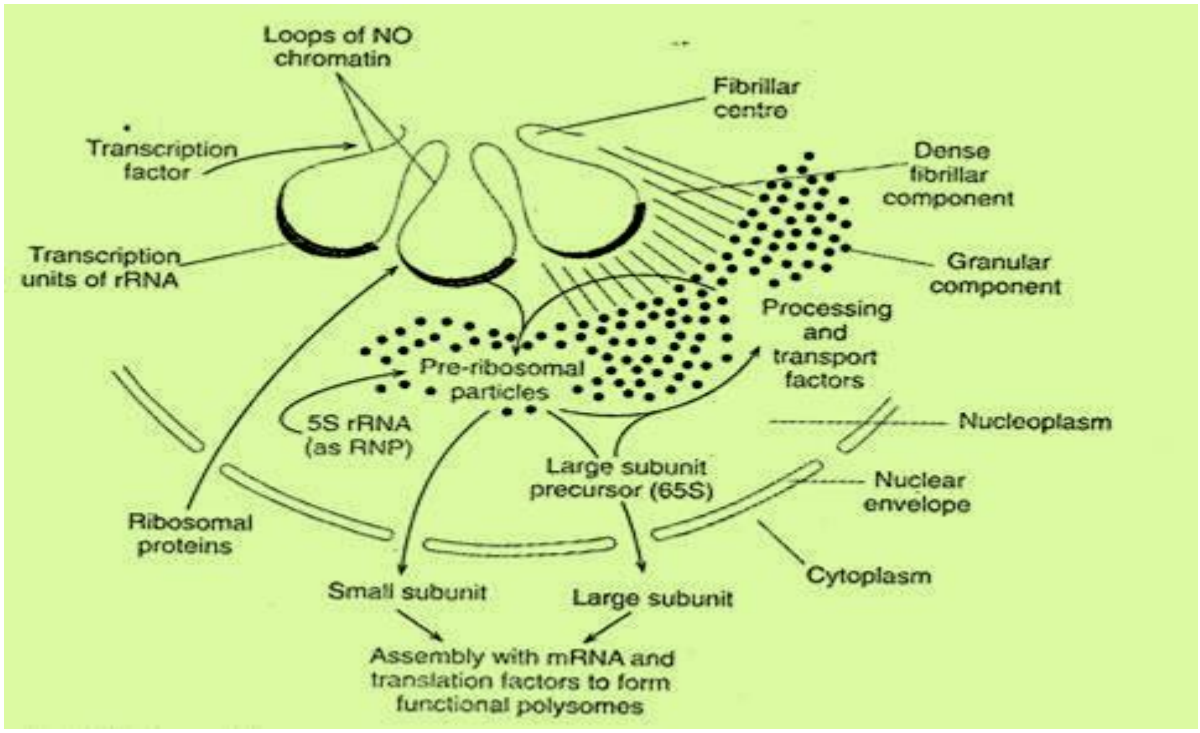

Fig.3 Three different regions of nucleolus and their involvement in protein synthesis.

Ribosome Biogenesis:

In eukaryotes the site of synthesis of most of the ribosomal RNA (rRNA) is the nucleolus. The nucleolar organizer contains many copies of ribosomal DNA (repetitive DNA). Several distinct types of rRNA have been isolated from cells.

Of these only four classes, namely 28S, IBS, 5.8S and 5S have been found in the ribosomes. The other types are intermediate stages in the formation of the RNA of the ribosomes. Nucleolar DNA transcribes 45S precursor which on processing results 28S, 18S and 5.8S RNA (Fig. 4). 5S RNA is transcribed outside the nucleolus.

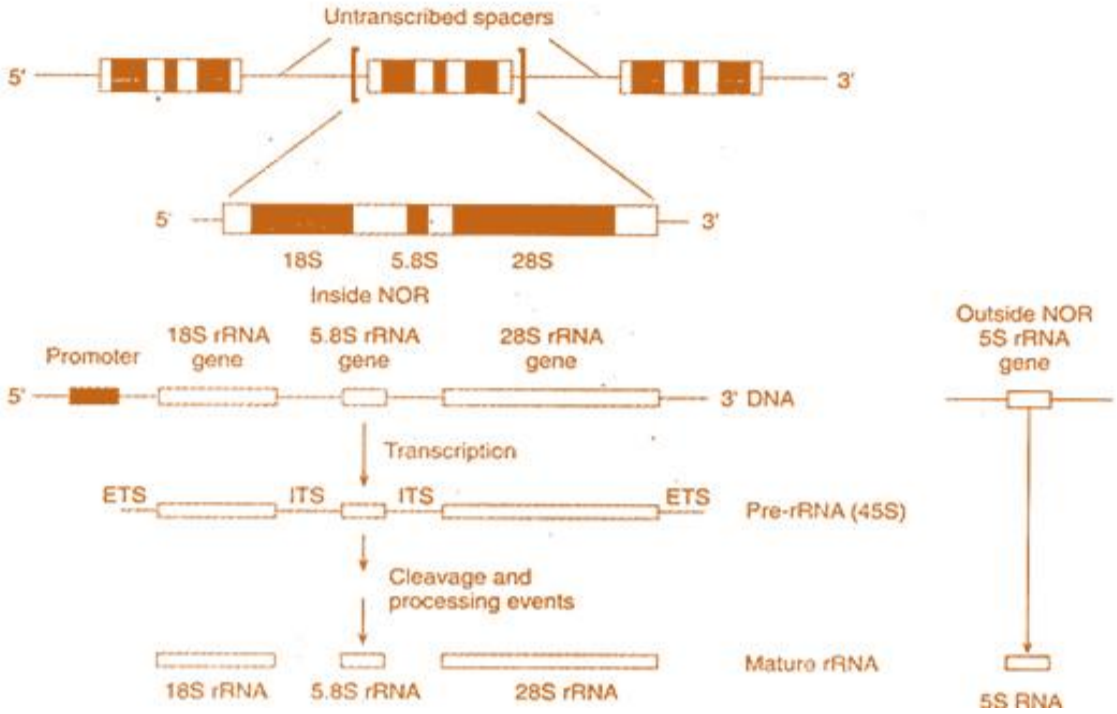

Fig.4 Organization of eukaryotic rRNA gene; and transcription, processing of eukaryotic rRNA genes (after Winter, Hickey & Fletcher).

Ribosomal proteins are synthesized in the cytoplasm and trans-located to the nucleus where they become associated with RNA. Structural core proteins first associate with

45S RNA to form ribonucleoprotein particles. Other proteins are probably bound later.

Ribonucleoprotein particles on processing ultimately form 40S and 605 subunits of the ribosome. In prokaryotes, the DNA transcribes 30S rRNA precursors which are trimmed to form 16S, 23S, 5S RNA. These become associated with protein to form 30S and 50S subunits of the ribosome (Fig. 5).

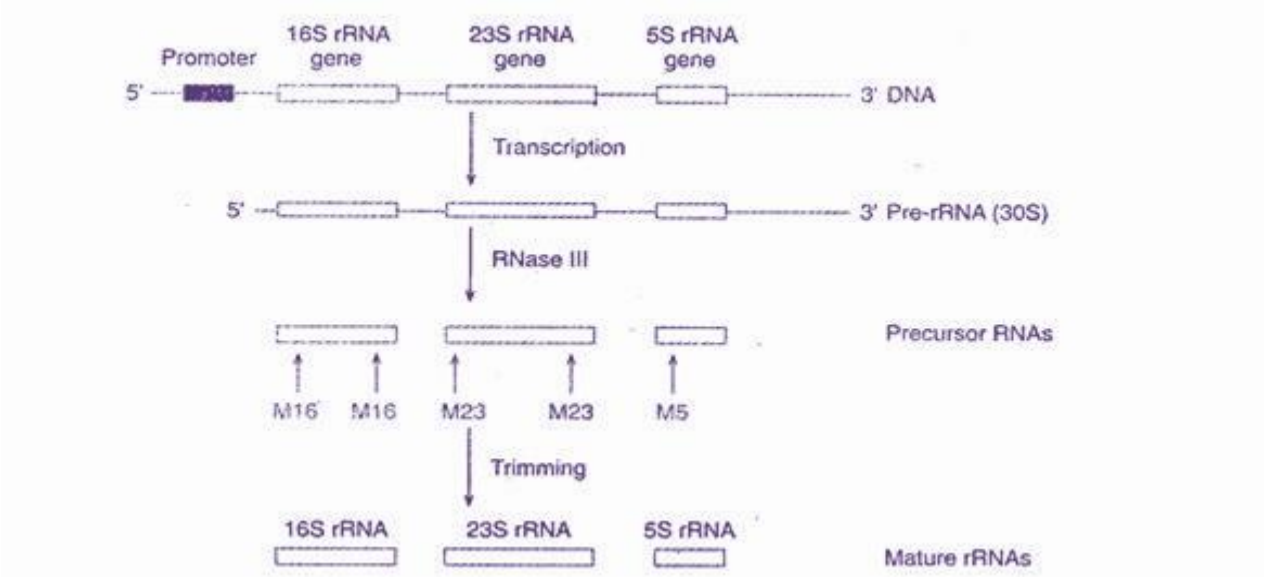

Fig.5 Transcription and processing of rRNA genes in Prokaryotes (after Winter, Hickey & Fletcher).