

## ULTRASTRUCURE OF NUCLEUS AND ITS FUNCTIONS

### NUCLEUS-

Nucleus is the large membrane bound organelle found in eukaryotic cells that contain genetic material in the form of multiple linear DNA molecules organised into structures called chromosomes.

- Nucleus was first described by Robert brown.
- It is often referred to as central unit of cell.
- Majority of cells genetic material is present in nucleus.
- Most of the metabolic activities which takes place in the cell is initiated by nucleus.

Generally a cell contains single nucleus. But sometimes 2 or more nuclei are also present. Based on Number of nucleus, cells are classified into 4 types-

- Anucleate cell - in a nuclear cell, nucleus is absent. Example- RBC in man.
- Mononucleate cell- Single nucleus is present. Example- amoeba, typical animal cell.
- Binucleate cell - 2 nuclei are present. Of these, one nucleus is small (micronucleus) and other nucleus is large (macronucleus). Example - Paramecium
- Multinucleate cell- contains many nuclei. The multinucleate cells are called syncytial cells in animals and coenocytes in plant cells. Example- opalina

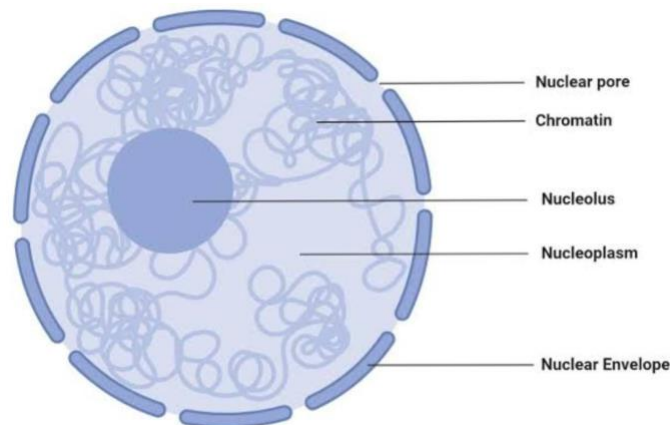
The nucleus occurs in 2 phases

1. Mitotic phase - nucleus which is involved in cell division.
2. Interphase nucleus- nucleus which is involved in metabolic activities.

### STRUCTURE OF INTERPHASE NUCLEUS

Interphase is the period of the cell between 2 divisions. Nucleus of the interphase cell is called interphase nucleus.

- The interphase nucleus is surrounded by an envelope called nuclear membrane/nuclear envelope.
- The nuclear membrane encloses a granular semi solid substance called nucleoplasm.
- Nucleoplasm contains chromosome or chromatin and nucleus.

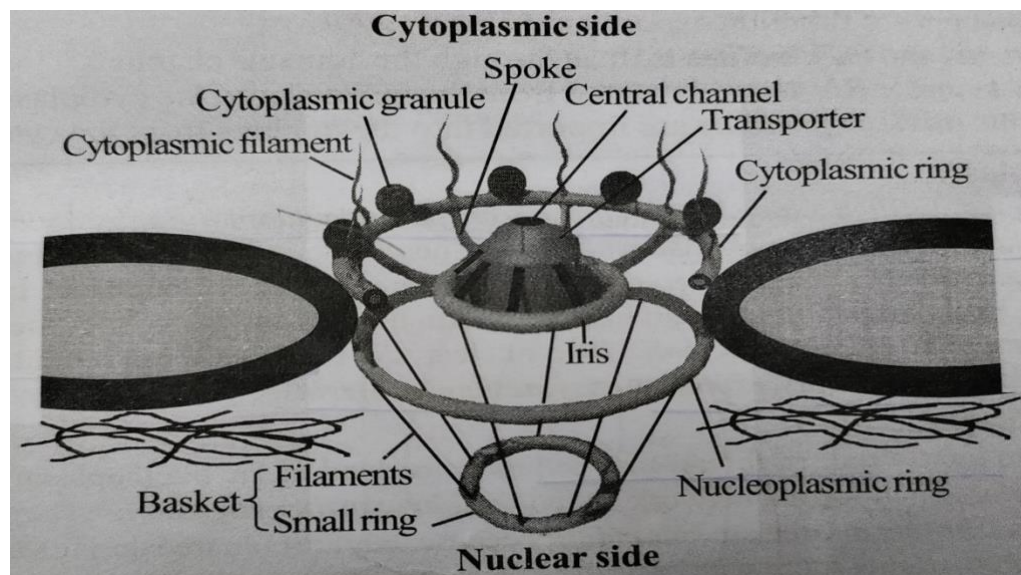


### Nuclear envelope-

1. Nucleus separated from the rest of the cytoplasm by a semipermeable membrane called nuclear envelope
2. It is double layered membrane made of lipoprotein.
3. Outer layer is called ecto karyotheca and inner layer is called endo karyotheca.
4. They are separated by perinuclear space which is about 150 to 300 Å. Each layer is about 70 to 80 Å thick.
5. Nuclear membrane has a fluid mosaic structure similar to that of plasma membrane.
6. Inner nuclear membrane is lined by a fibrous material called nuclear lamina (composed of filament protein called lamin).
7. Outer nuclear membrane is lined with ribosomes. Outer membrane communicates with endoplasmic reticulum at several points.
8. Nuclear membrane contains many pores called nuclear pores. These pores form passageways between nucleoplasm and cytoplasm.

### Nuclear pore complex-

1. The nuclear membrane contains many pores which are circular in shape. Each pore is 200 to 400 Å in diameter.
2. Nuclear pores are arranged randomly in most of animal cells, in clusters in lymphocytes and oocytes.
3. The nuclear pore has a complex organization. So the entire structure of nuclear pore is called nuclear pore complex.
4. The nuclear pore is circular in surface view. In the center of the pore, there is a passage called central channel.
5. The central channel is surrounded by a central hub called transporter. The transporter is made up of 2 proteinaceous rings called irises.
6. Each iris is made up of 8 arms the 2 irises open sequentially like the diaphragm of a camera play on the cytoplasmic side the nuclear pore is provided with an octagonal wrinkled cytoplasmic ring.
7. It is connected to the transporter by 8 spokes. Similarly on the nuclear side the nuclear pore is provided with another octagonal ring called nucleoplasmic ring.
8. The space between the spokes is called as aqueous channel.
9. On the nucleoplasm side the nuclear pore is provided with a basket. The basket consists of a small ring, 8 filaments connecting the small ring and the nucleoplasmic ring.
10. The number of cytoplasmic granules and cytoplasmic filaments are attached to the cytoplasmic ring.



### Nucleoplasm-

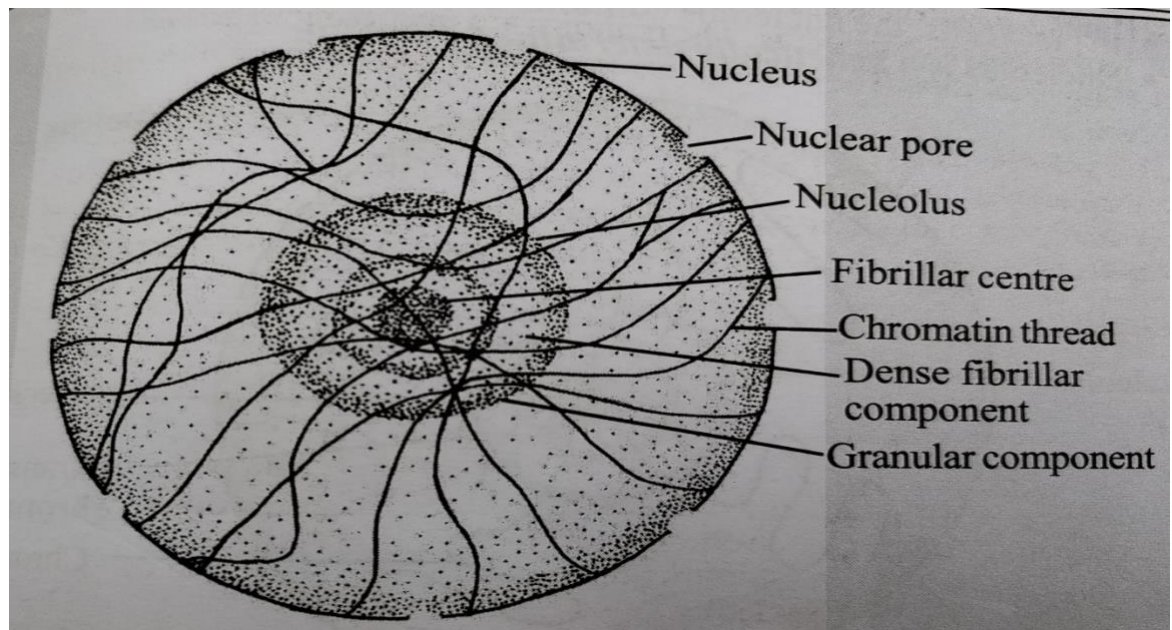
1. Nucleus is filled with homogeneous, transparent acidophilic substance known as nucleoplasm.
2. Chromatin threads remain suspended in nucleoplasm.
3. There are one or more definite structure called nucleoli in nucleoplasm.
4. The nucleoplasm contains organic and inorganic substances like nucleic acids, proteins, enzymes and minerals.

### Chromatin reticulum or chromatin network-

1. They are lightly stained threadlike bodies embedded in the nucleoplasm called chromonemata, which form network called chromatin network.
2. They represent chromosomes. Chromosome is derived from Greek language, Chrome - colour and soma - bodies. It is named so because they are coloured during staining.
3. Chromatin network readily stains with basic dyes.
4. During cell division chromatin network is condensed to form thick ribbon like structures called chromosomes.
5. Chromosomes carry long pieces of DNA which contains genetic material called genes.

### Nucleolus-

1. Nucleolus was discovered by Fontana in 1874.
2. They are the round spherical or Oval bodies found in the nucleoplasm.
3. Nuclei are distinct in interphase nuclei. They disappear at prophase, remain in distinct during metaphase and anaphase and reappear during telophase.
4. Nuclei occupy a fixed position. They are often associated with the nucleolar organising portion of chromosomes.
5. Number of nuclear libraries from species to species. It depends on the number of chromosome sets in the nucleus play.
6. Size of nucleolus is related to synthetic activity of the cell.
7. The important function of nucleolus is synthesis of ribosomal RNA and protein. The RNA produced inside the nucleus first passes into nucleoplasm and from there it is pass to cytoplasm of the cell.



*Nucleolus are classified into 3 types based on the distribution of granules. They are-*

- a. Homogeneous nucleolus- granules are uniformly distributed throughout the nucleolus*
- b. Heterogeneous nucleolus- granules occur in groups.*
- c. Ring nucleolus - granules are arranged along the periphery of the nucleolus in the form of a ring*

*Functions of nucleolus-*

- 1. Nucleolus synthesises rRNA.*
- 2. It assembles small and large subunits of ribosome by combining rRNA and proteins.*
- 3. It exports subunits of ribosomes to the cytoplasm for assembling ribosomes.*

#### FUNCTIONS OF NUCLEUS

- 1. Metabolism- nucleus controls majority of the activities of cells. It is a regulatory organelle in cell metabolism.*
- 2. Heredity- since the nucleus contains DNA molecules in its chromosomes, it plays a significant role in heredity.*
- 3. Differentiation- it controls cell differentiation during the embryonic development. The presence of nuclear enzymes such as DNA polymerase, DPN synthase etc; points to the fact that DNA replication and transcription occur mainly in the nucleus.*
- 4. RNA synthesis- the synthesis of ribosomal RNA takes place in the nucleolus.*
- 5. Exchange of materials- nuclear membrane is concerned with the exchange of materials between the cytoplasm and nucleoplasm.*
- 6. Nuclear membrane provides a surface for the attachment of structural elements of the cytoplasm such as microtubules and microfilaments.*
- 7. Nucleus contains the initiating factor for protein synthesis.*