

Ultrastructure of Nucleus and Its Functions

1. Introduction to Nucleus

- Nucleus is a large membrane-bound organelle found in eukaryotic cells.
- It contains genetic material in the form of DNA organized into chromosomes.
- First described by Robert Brown.
- Known as the control center of the cell.
- Controls most metabolic activities.

Types of Cells Based on Number of Nuclei:

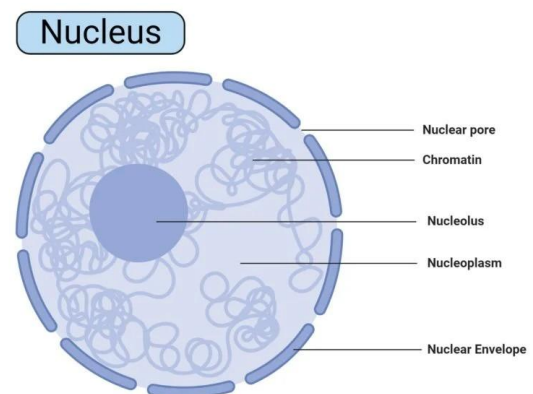
- Anucleate: No nucleus (e.g., human RBC)
- Mononucleate: One nucleus (e.g., Amoeba)
- Binucleate: Two nuclei (e.g., Paramecium)
- Multinucleate: Many nuclei (e.g., Opalina)

Phases of Nucleus:

- Interphase: Metabolic activities
- Mitotic phase: Cell division

2. Structure of Interphase Nucleus

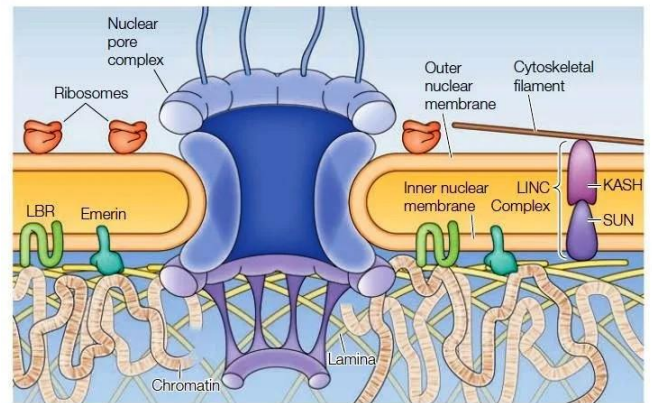
- Nuclear envelope
- Nucleoplasm



- Chromatin
- Nucleolus

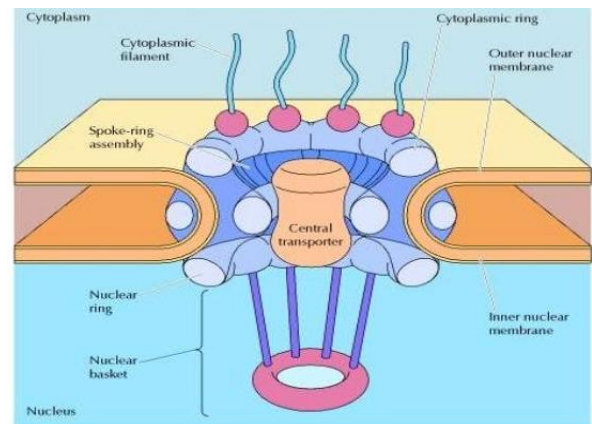
3. Nuclear Envelope

- Double-layered membrane (lipoprotein)
- Outer layer: Ectokaryotheca
- Inner layer: Endokaryotheca
- Space: Perinuclear space (150–300 Å)
- Contains nuclear pores for exchange of materials
- Outer membrane connected to ER and has ribosomes
- Inner membrane has nuclear lamina



4. Nuclear Pore Complex

- Circular pores (200–400 Å diameter)
- Central channel for transport
- Surrounded by protein rings (irises)
- Has cytoplasmic ring, nucleoplasmic ring, spokes, and basket structure



Nuclear pore complex

5. Nucleoplasm

- Semi-fluid substance inside nucleus
- Contains chromatin and nucleolus
- Rich in proteins, enzymes, nucleic acids, and minerals

6. Chromatin Network

- Thread-like structures (chromonemata)
- Condense to form chromosomes during division
- Contains DNA and genes

7. Nucleolus

- Discovered by Fontana (1874)
- Spherical structure inside nucleus
- Synthesizes rRNA and ribosomal subunits
- Disappears during prophase and reappears in telophase

Types of Nucleolus:

- Homogeneous
- Heterogeneous
- Ring nucleolus

Functions of Nucleolus:

- rRNA synthesis
- Ribosome assembly
- Transport of ribosomal subunits

8. Functions of Nucleus

- Controls metabolism
- Responsible for heredity
- Regulates cell differentiation
- Site of DNA replication and transcription
- RNA synthesis (rRNA in nucleolus)

- Exchange of materials
- Initiates protein synthesis