

NUCLEUS

1. Introduction

The **nucleus** is a membrane-bound organelle present in all eukaryotic cells. It was first described by **Robert Brown (1831)**. It acts as the **control center of the cell** because it stores genetic material (DNA) and regulates cellular activities.

- Absent in prokaryotes (instead they have a nucleoid region).

2. Occurrence

- Present in all **eukaryotic cells**
- Usually single nucleus per cell (e.g., human cells)
- Exceptions:
 - **Multinucleated cells** – skeletal muscle fibers
 - **Binucleated cells** – liver cells
 - **Anucleated cells** – mammalian RBCs

3. Shape, Size and Position

- **Shape:** Spherical or oval (may vary)
- **Size:** 5–10 μm in diameter
- **Position:**
 - Central in animal cells
 - Peripheral in plant cells (due to large vacuole)

- membranes

Functions:

- Separates nucleoplasm from cytoplasm
- Protects genetic material
- Regulates transport

(B) Nuclear Pores

- Present in nuclear envelope
- Made of protein complex called **Nuclear Pore Complex (NPC)**
- Allow selective transport of:
 - RNA
 - Ribosomal subunits
 - Proteins

(C) Nucleoplasm

- Semi-fluid matrix inside nucleus
- Contains:
 - Chromatin
 - Nucleolus
 - Enzymes
 - Nucleotides

Function: Medium for nuclear processes like DNA replication and transcription.

(D) Chromatin

Chromatin = DNA + Histone proteins

Types:

1. **Euchromatin**
 - Lightly stained
 - Transcriptionally active
2. **Heterochromatin**
 - Darkly stained
 - Transcriptionally inactive

During cell division, chromatin condenses to form **chromosomes**.

(E) Nucleolus

- Dense, spherical body
- Non-membranous
- Rich in RNA and proteins

Function:

- Site of rRNA synthesis
- Ribosome assembly

6. Functions of Nucleus

1. Stores genetic information (DNA)
2. Controls cellular metabolism
3. Site of DNA replication
4. Site of transcription (RNA synthesis)
5. Ribosome formation (nucleolus)
6. Regulates cell division
7. Controls protein synthesis indirectly

7. Karyoplasm and Nuclear Matrix

- **Karyoplasm:** Another name for nucleoplasm
- **Nuclear matrix:** Network of protein fibers providing structural support

8. Cell Cycle and Nucleus

- During **interphase:** Nuclear membrane intact
- During **mitosis:** Nuclear membrane disappears
- Reappears in telophase

9. Differences Between Prokaryotic and Eukaryotic Nucleus

Feature	Prokaryotic	Eukaryotic
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Feature	Prokaryotic	Eukaryotic
Nuclear membrane	Absent	Present
Nucleolus	Absent	Present
DNA	Circular	Linear
Histones	Absent	Present