

PUC 1ST YEAR –SEMESTER-2

UNIT I: Cell Biology

Module No 7: Nucleus – Structure and Functions

The vital part of the cell that controls all the activities is the nucleus. It is described as the dynamic centre of the cell, or control centre of the cell. The nucleus was discovered by Robert Brown in 1831. Generally there will be one nucleus in one cell. Some protozoans like *Chaos*, *Pelomyxa* etc, *Vaucheria* (Algae) have many nuclei. But the nucleus is absent in mammalian RBC. The size of the nucleus varies from 2-15 μm or larger in diameter.

The nucleus is in the center of most cells. In plant cells, with the formation of large vacuole the position of nucleus is shifted from the center to the periphery of the cell.

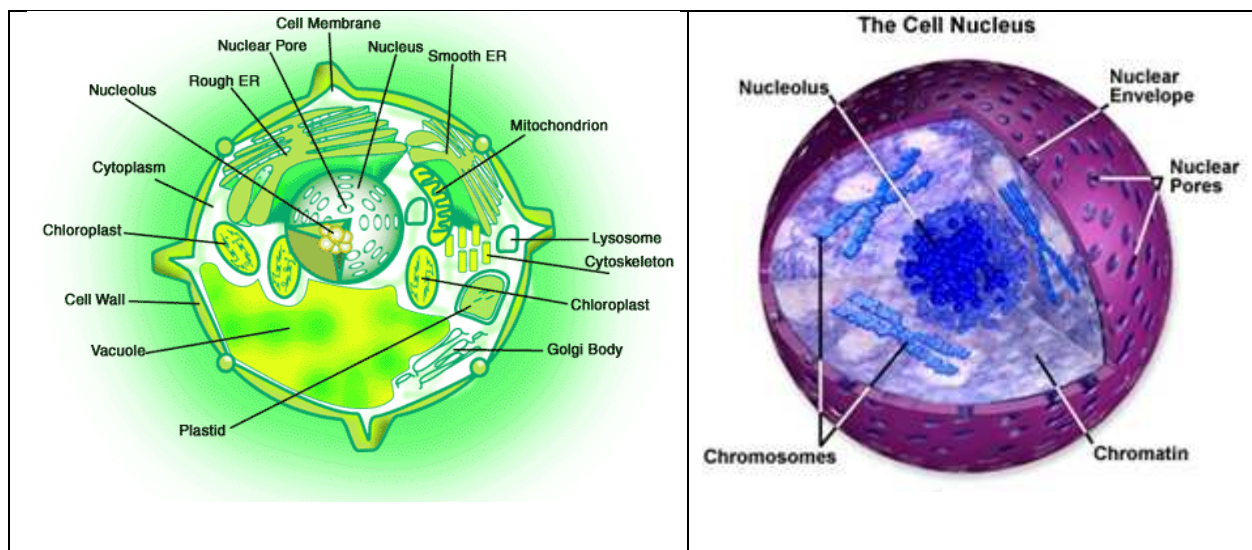
The nucleus is the largest membrane-bound organelle. Specifically, it is responsible for storing and transmitting genetic information. The nucleus is composed of the following structures – Nuclear membrane, nucleolus, nucleoplasm and chromatin fibres.

Nuclear membrane:

The nuclear membrane is composed of two membranes joined at regular intervals to form circular openings called nuclear pores. The outer membrane is attached to the ribosomes and is continuous with endoplasmic reticulum. The inner membrane is smooth. The pores allow RNA molecules and proteins controlling DNA expression to move through the pores into the cytosol. The nuclear membrane controls the transport of several ions across it.

The transparent semi-solid substances filled inside the nucleus is called nucleoplasm. In this nucleoplasm chromatin threads, nucleoprotein granules, nucleolus etc., are suspended. The nucleoplasm has proteins, enzymes, minerals, large amount of phosphorus and nucleic acids. A dense granule is present in the nucleoplasm called the nucleolus.

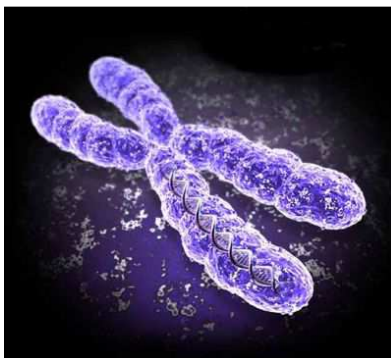
Plant Cell



Chromosomes:

The nucleus of a cell contains a darkly staining material called chromatin. Chromatin is resolved into fine elongated thread like structures called chromosomes during cell division. Chromosomes are defined as dense rod like bodies which are capable of self duplication and possess individuality. Chromosomes contain hereditary material DNA and many nucleoproteins. The number of chromosomes remains constant in a given species. They are described as vehicles of heredity.

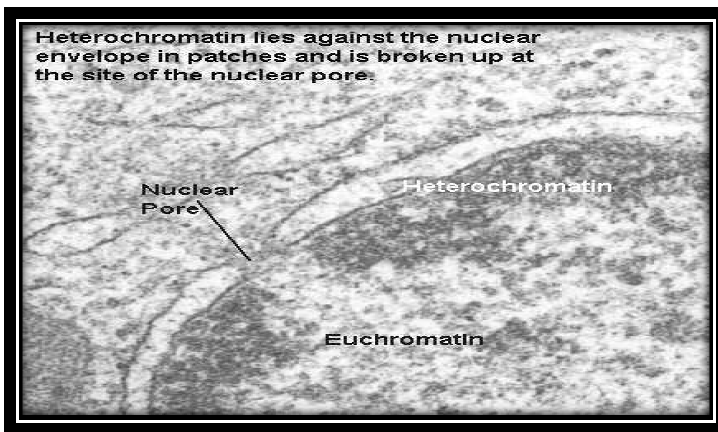
Chromosomes are of two types: Somatic (body) chromosomes or autosomes and sex chromosomes or allosomes. In human beings there are 22 pairs of somatic chromosomes common in males and females and one pair of sex chromosomes (XX or XY).



Chromatin:

Chromatin fibres are thread like structures present in the nucleoplasm in a coiled manner. These thread like structures are called chromatin fibres. During cell division these fibres become the chromosomes. The chromosomes show differential staining. The darkly stained regions were called heterochromatic and are said to be made up of heterochromatin and light regions were called euchromatic and are said to be made up of euchromatin.

Heterochromatin and euchromatin differ structurally as well as in chemical composition. Heterochromatin is dark staining, genetically inert (i.e., devoid of the genetic material DNA) and rich in RNA. Euchromatin, on the contrary, is light – staining and genetically alive due to the presence of the active genetic material – DNA. It has, therefore, a direct genetic significance.



Heterochromatin is of two types

1. Constitutive heterochromatin – It is present in all autosomes of both the sexes. It helps in the synapses of the homologous chromosomes during meiosis.

2. Facultative heterochromatin – It is called sex chromatin because it is present generally in the cells of females only.

Nucleolus:

Within the nucleus are present one or two dense spherical bodies called nucleoli. It is a nuclear component without any limiting membrane. It is very rich in RNA and proteins. It is concerned with protein synthesis and origin of ribosomes. Nucleolus is also called as endosome or karyosome.

Functions of the Nucleus:

Nucleus is described as the dynamic centre of the cell or heart of the cell. Nucleus controls all the functions of the cell and consequently the characters of that organism. The nucleus contain maximum amount of DNA of the cell. So the nucleus controls not only various metabolic activities but also the hereditary characters of the individuals. Nucleus is also responsible for regulation and control of the protein synthesis.

Check Points

- The cell has one or more nuclei. The nucleus is the brain of the cell.
- It is bounded by two membranes, which together constitute the nuclear envelope interrupted by pores.
- Inside the nuclear membrane, the space is packed with fluid called Nucleoplasm.
- The Nucleoplasm contains the chromatin made up of DNA and one or two Nucleoli.
- RNA is primarily found in nucleolus.
- The DNA coils with proteins called histones and form condensed structure.

- The Chromatin strands coil and become chromosomes during cell division.
- Each species of organism has a specific number of chromosomes in each cell.
- The chromosomes which control the sex of an organism are called sex chromosomes/allosomes while others are referred to as autosomes.

Object Type Questions:

1. Functions of nucleolus in a nucleus are

- A. Synthesis of RNA protein
- B. Secretary
- C. Synthesis of DNA

D. Protein synthesis and origin of Ribosomes

2. The nuclear membrane is a

- A. One membrane structure
- B. Double membrane structure**
- C. Three membrane structure
- D. Four membrane structure

3. The correct male human chromosome number is

- A. 48
- B. 21 pairs autosomes and 2 pairs of sex chromosomes
- C. 45 autosomes + one X

D. 22 pairs + X+Y

4. Centromere is associated with

- A. Duplication of Chromosomes
- B. Movement of chromosomes**
- C. Formation of RNA

D. Replication of DNA

5. Nucleolus is rich in

A. DNA and proteins

B. RNA and proteins

C. DNA and lipids

D. RNA and lipids

6. The principal site of synthesis of ribosomal RNA is

A. Golgi body

B. Endoplasmic reticulum

C. Nucleolus

D. Cytoplasm

7. The space between the nuclear membrane and nucleolus is filled with a substance called

A. Nucleoplasm

B. Cytoplasm

C. Chromatin

D. None

8. The number of chromosomes in a single Somatic cell of man is

A. 46

B. 23

C. 56

D. 44

9. Nucleus was discovered by

A. Robert Brown

B. Robert hook

C. Schwann

D. Schleider

Short Answer Questions:

1. Differentiate chromatin from chromosomes.
2. What is the function of a cell nucleus? How does it perform its function?
3. Give an account on nucleolus.
4. Briefly describe the structure and functions of nucleus.
5. What is a chromatin? Differentiate euchromatin and heterochromatin.
6. What are the functions of chromosome?
7. How many types of chromosomes are known? Define them.

Long Answer Questions:

1. Give an account on the structure of nucleus?