**Dr. Rima Kumari: Date: 02/11/2020**

Online class and e- content for M.Sc. IIIrd year students

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| Date and Time | Online class medium  | E. content topic |
| 02/11/202001:00 p.m to 01.40 p.m | Via Google meetLink: Meeting URL: https://meet.google.com/rhy-zxfo-puz | **Cell Organelles:** **Nucleus ,** **Cytoskeleton system: Microtubules and Microfilaments** |

**Nucleus**

Nucleus is the dominant organelle controlling all the activities of the eucaryotic cell. The procaryotes have nuclear regions in the cytoplasm as opposed to eucakyotes, that have a prominent well defined nucleus. Some cells have more than one nucleus, as for example, rat liver cells have 2-3 nuclei per cell. There are variations in the size and shape of the nucleus. However, some: cells lack nucleus at maturity such as RBCs and Sieve tube cells (transport cells in vascular plants).

Nucleus was considered to have a single membrane till the use of electron microscope. Under EM, nucleus is found to be composed of two membranes known as "nuclear envelope". The outer and inner membranes are separated by a narrow space called the perinuclear space. The outer membrane remains in contact with endoplasmic reticulum and the inner membrane surrounds the nuclear contents: At certain places, the nuclear envelope is interrupted by the presence of small structure called "pore"' The pores are enclosed by circular structures called annuli. The pores and annuli together constitute the pore complex. Both the membranes of the envelope are in continuity around these pores, The pores help in the exchange of material between nucleoplasm (nuclear fluid) and cytoplasm. Without these pores RNA could not leave the nucleus. The nuclear envelope is a dynamic structure. It is not just a physical barrier, but regulates the passage of ions and small molecules. During a cell division, the nuclear envelope disappears and reappears during nuclear reorganisation.

Nucleoplasm contains a number of structures like nucleolus, chromatin and chromatin network (chromosomes). The nucleolus is a spherical structure' which is not separated from the rest of the nucleoplasm by a membrane. It is prqduced from and is associated with a specific nucleolar organising region (NOR) on a chromosome. In the nucleolus the rRNA is synthesised and the ribosomal subunits, rRNA and proteins are partially assembled. The nucleoli are larger and more numerous in cells that are actively involved in protein synthesis.

During the resting stage of the cell, the chromosomes are uncoiled in a loose, indistinct network called "chromatin". Chromosome contains DNA, RNA and protein. The types of \* protein present are histones and non-histones



Histones protein

nuclear membrane

Perinuclear spaces

**The nucleus is composed of a double membrane called nff:cs** ,. **envelope which encloses a fluid called nucleoplasm. In cross-iection, the individual nuclear porer are seen to exthd through the two membrane layers of the envelope.**

**CYTOSKELETAL SYSTEM**

Eucaryotic cells have distinct shapes and a high degree of internal organisation. Moreover, they are capable of changing their shape, of repositioning their internal organelle\ and in many cases. of migrating from one place to another. These properties of shape, internal organisation and movement depend on complex networks of protein filaments in the cytoplasm that serve as the "bone and muscle" of the eucaryotic cell, which constitutes the cytoskeletal system of the cell. Cytoskeleton maintains the cell shape and helps in the cell movements, the structure and function of centriole, cilia and flagella. Microtubules and microfilaments are the basic elements of cytoskeleton.

**Centrioles and Basal Bodies:** Centrioles are usually found near the cell nucleus and occur in pairs. Nine sets of identical triplets of microtubules arranged in a radial manner is an important characteristic of centriole. Basal bodies are structurally similar to centrioles but they produce cilia and flagella unlike centrioles.

**Cilia and Flagella**

Cilia and flagella are the locomotor organelles that help to propel a cell towards or away from the materials surrounding the cell. Cilia are generally shorter in size and are more in number than flagella. Flagella usually occur alone or in small groups. The structure of flagella and cilia are similar. Each contains a circle of nine pairs of microtubules with two single microtubules in the centre called as axoneme. Proteins unite the microtubules with axoneme and with each other.



Fig. : a) Diagram of centriole: A centriole has nine sets of identical triplets, each triplet consists of 3 microtubules, one complete (a) and two incomplete (b, c) and the triplets are arranged parallel to one another and in cross-section appear to be arranged like the vanes on a pinwheel. There is no membrane surrounding the centriole. Strands of material extend inwards from each 'a' tubule and join together at the central hub. These strands, when seen in cross-section, give the centrioles the appearance of a 'cartwheel'.

b) Diagram of a cilium or flagellum seen in cross-section. Cilia and flagella contain the **'9+2'** arrangement of microtubules. Nine double microtubules surround the central sheath of two singlet microtubules. One microtubule of each doublet of a subfibre is composed of 13 protofilaments. The **R** subfibre is incomplete consisting of 11 protofilaments. Radial spokes from each subfibre A extend to the central sheath. Adjacent doublets are joined by interdoublet links extending from each A subfiber are two arms an 'outer' arm and an 'inner' arm which contain a protein dynein that can break down ATP.

**Microtubules and Microfilaments**

Tubules are the most prominent structural filaments. They are long, hollow cylinders which are polymers of protein tubulin. They help to maintain the cell shape and are important for intracellular movement. Microtubules form dynamic structures such as asters and spindles (related to cell division) and complex organelles such as centrioles, basal bodies, cilia and flagella. During cell division, the microtubules radiate out from the cell centre which is microtubule organising centre and is located near the nucleus. These microtubules are the aster and spindles which play an important part in equal distribution of the chron~osomesto the new cells.

Microfilaments are found in close proximity of microtubules and form a network close to the cell membrane. They are made-up of actin and are in continuity with the network of the cytosol. They are the smallest of the cytoplasmic filamentous structure. They perform some cytoskeletal and contractile function and help in cellular motion.

In addition to microtubules and microfilaments, a number of cells contain a cytoskeletal component consisting of filaments of an intermediate which help in anchorage and movement.