THE NUCLEUS

The nucleus is a centrally located and spherical cellular component which controls all the vital activities of the cytoplasm and carries the hereditary material, the DNA in it. In general, a cell contains a single nucleus, but in some tissue, e.g., early stages of endosperm development and in some organisms, e.g., some protozoa (e.g. Paramecium), some fungi, etc., two or more nuclei are present within a single cell. In contrast, some specialized cells, e.g. RBCs, eye lens cells and sieve tubes (cells) of phloem, do not contain any nucleus.

Nucleus is the storehouse of almost all genetic information needed for the functioning of a cell/organism. It produces, ribosomes, tRNA, and mRNA, which (together with the protein synthesis machinery of cells) produce various structural and enzymatic proteins essential for cellular organisation and biochemical reactions. Thus, nucleus controls the development of almost all the traits of an organism by providing the information

necessary for the synthesis of various structural and functional proteins.

The nucleus consists of the following three (3) structures: chromatin, nuclear envelope and nucleoplasm and nucleolus.

Chromatin - Nucleus being the heart of every type of eukaryotic cell, contains the genes, the hereditary units. Genes are located on the chromosomes which exist as chromatin network in the non-dividing cells, (i.e. during interphase). The chromatin has two forms: euchromatic and heterochromatin. Euchromatins are genetically active while the heterochromatins are not.

Chemically, the chromatin contains a single DNA molecule, equal amount of histone proteins (which are of five (5) types) and variable amount of different types of acidic proteins.

Nuclear envelope and Nucleoplasm - nuclear envelope comprises two nuclear membranes - an inner nuclear membrane which is lined by nuclear lamina and an outer nuclear membrane which is

continuous with rough endoplasmic reticulum. At certain points the nuclear envelope is interrupted by structures called pores or nucleopores. Nuclear pores contain octagonal pore complexes which regulate exchange between the nucleus and cytoplasm. The number of nucleopores is found to be correlated with the transcriptional activity of the cell. For example, in the grog, *Xenopus laevis*, oocytes (which are very active in transcription) have $60\,pores/\mu m^2$ (and up to 30 million pore complexes per nucleus), whereas frog's mature erythrocyte (inactive in transcription) have only about 3 $pores/\mu m^2$ (and a total of only 150 to 300 pores per nucleus).

The nuclear envelope binds the nucleoplasm, which is rich in those molecules which are needed for DNA replication, transcription, regulation of gene actions and processing of various types of newly transcribed RNA molecules (i.e., tRNA, mRNA and other types of RNAs).

Nucleolus - Nucleus contains in its nucleoplasm a conspicuous, darkly stained, circular sub-organelle, called nucleolus. Nucleolus lacks any limiting membrane and is formed during interphase by the ribosomal DNA (rDNA) of nucleolar organizer (NO). Nucleolus is the site where ribosomes are manufactured. It is here where ribosomal DNA transcribes most of rRNA molecules and these molecules undergo processing before their step-wise addition to 70 types of ribosomal proteins (which are synthesized in cytoplasm) to form the ribosomal subunits.

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