Topic: Eukaryotic Cell

B.Sc. Botany Hons. III

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Eukaryotic cell (Continued)

Origins of Mitochondria and Chloroplasts

The nucleus of the eukaryotic cell is not the only organelle that contains DNA and is enclosed by two membranes: The mitochondria of all cells and the chloroplasts of plant cells contain DNA and are surrounded by two membranes.

The DNA of these organelles directs the synthesis of certain proteins that are necessary for the function of the organelles. This DNA is similar to DNA found in bacteria.

Mitochondria and chloroplasts are thought to have evolved by a process known as endosymbiosis, in which bacteria were engulfed in the primitive eukaryotic cell, where they manufactured adenosine triphosphate (ATP), the nucleotide responsible for most of the chemical energy needed for metabolism, or captured energy from sunlight for the eukaryotic cell, establishing a mutually beneficial, or symbiotic, relationship with the eukaryotic cell.

Several lines of evidence support the endosymbiotic theory for the origin of mitochondria and chloroplasts. First, these organelles have areas of specialized cytoplasm called nucleoids that contain the DNA, much as bacteria do.

The DNA molecules of the chloroplasts and mitochondria are circular and are associated with few proteins, like bacterial DNA, rather than linear and associated with histone proteins like most eukaryotic DNA.

Chloroplasts and mitochondria also have ribosomes, structures that translate the genetic material into proteins, that are more similar to bacterial ribosomes than they are to eukaryotic ribosomes. These ribosomes are even sensitive to some of the same antibiotics, such as chloramphenicol and streptomycin, that inhibit the function of bacterial ribosomes.

Endomembrane System

The internal membranes of eukaryotic cells are dynamic, constantly changing structures. The concept of the endomembrane system describes all internal cytoplasmic membranes, with the exception of mitochondrial and plant plastid

membranes, as a single continuum.

In this model, the ER, generally the largest membrane system of eukaryotic cells, is the initial source of most other membranes. The ER is a network of interconnected, closed, membrane-bound vesicles that is contiguous with the nuclear envelope.

Vesicles from the ER carry proteins from the ER to the Golgi complex, fusing with its membranes. The Golgi complex can be described as a series of flattened membrane sacs, like a stack of hollow pancakes.

The side closest to the nucleus receives vesicles from the ER, and the proteins inside these vesicles are processed and modified as they pass through the Golgi complex. Eventually, membrane vesicles containing the modified proteins will bud from the opposite surfaces of the Golgi complex and fuse with the cell membrane or the membranes of other organelles.

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