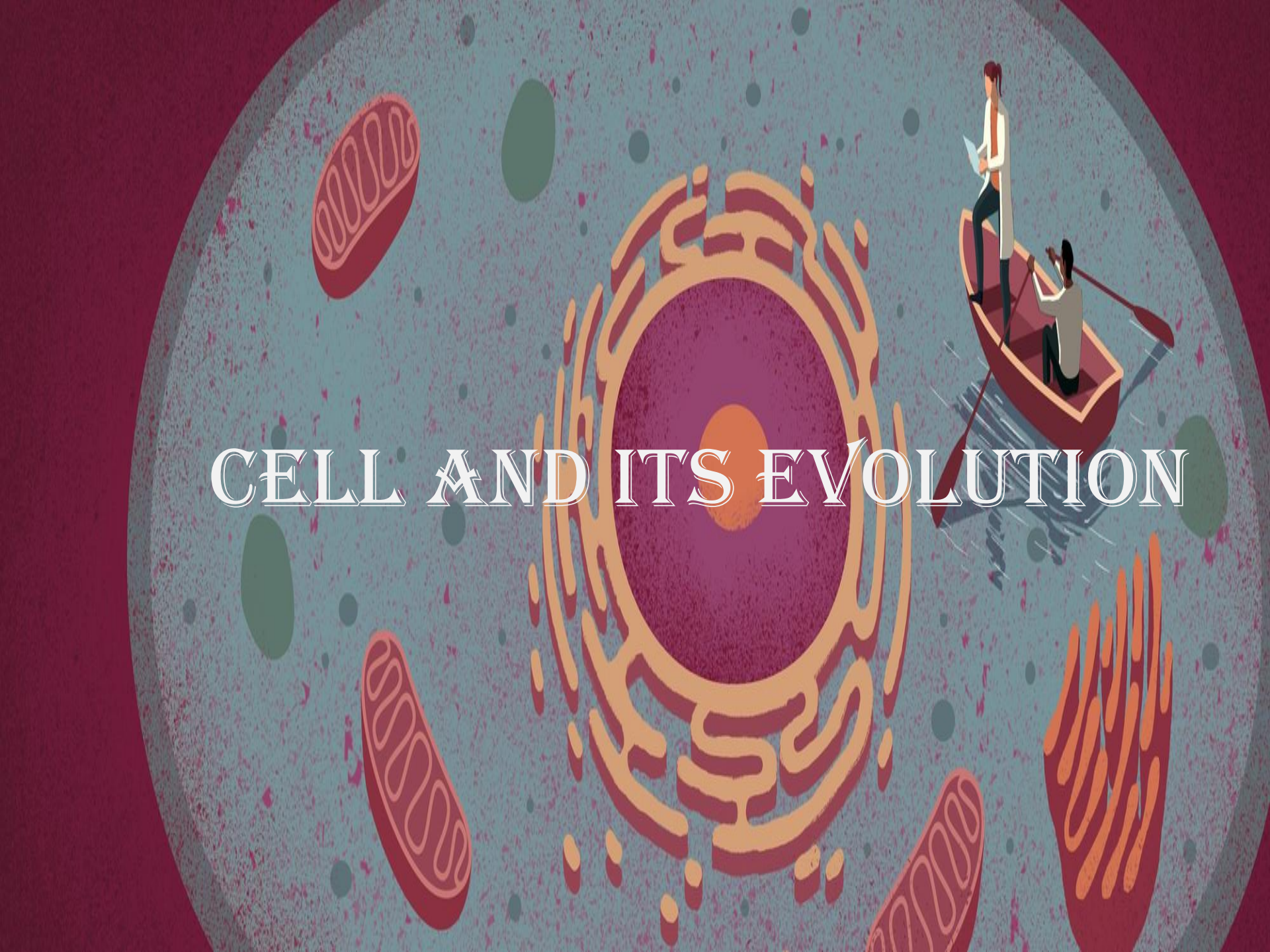
CELL AND ITS EVOLUTION

INTRODUCTORY BIOCHEMISTRY

Chapter: 3
Cell and Its Evolution
Lecture - 9

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Peroxisomes

They are membrane-bound spherical bodies of 0.2 to 1.5 μm in diameter found in all eukaryotic organisms including both plants and animal cells. These are made of a phospholipid bilayer with many membrane-bound proteins.. They are found floating freely in the cytoplasm in close association of ER, mitochondria or chloroplast within the cell.

•They exist either in the form of a network of interconnected tubules called peroxisome reticulum or as individual microperoxisomes. They are variable in size and shape according to the cell and usually circular in cross-section.

Functions of Peroxisomes

Hydrogen Peroxide Metabolism:

Enzymes present in the peroxisomes both lead to the production and elimination of H_2O_2 which is a reactive oxygen species.

Fatty acid oxidation:

Oxidation of fatty acids, in animal cells, occurs in both peroxisomes and mitochondria, but in yeasts and plants, only limited to peroxisomes.

Oxidation is accompanied by the production of H_2O_2 which is decomposed by catalase enzyme. This provides a major source of metabolic energy

Peroxisomes

Lipid biosynthesis

Synthesis of cholesterol occurs in both ER and peroxisomes. Peroxisomes contain enzymes to synthesize plasmalogens, a family of phospholipids which are important membrane components of tissues of the heart and brain.

Germination of seeds

Peroxisomes in seeds responsible for the conversion of stored fatty acids to carbohydrates, critical to providing energy and raw materials for the growth of germinating plants.

Photorespiration

Peroxisomes in leaves particularly in the green ones carry out the photorespiration process along with chloroplasts

Peroxisomes

Degradation of purines

Carry out the catabolism of purines, polyamines and amino acids especially by uric acid oxidase

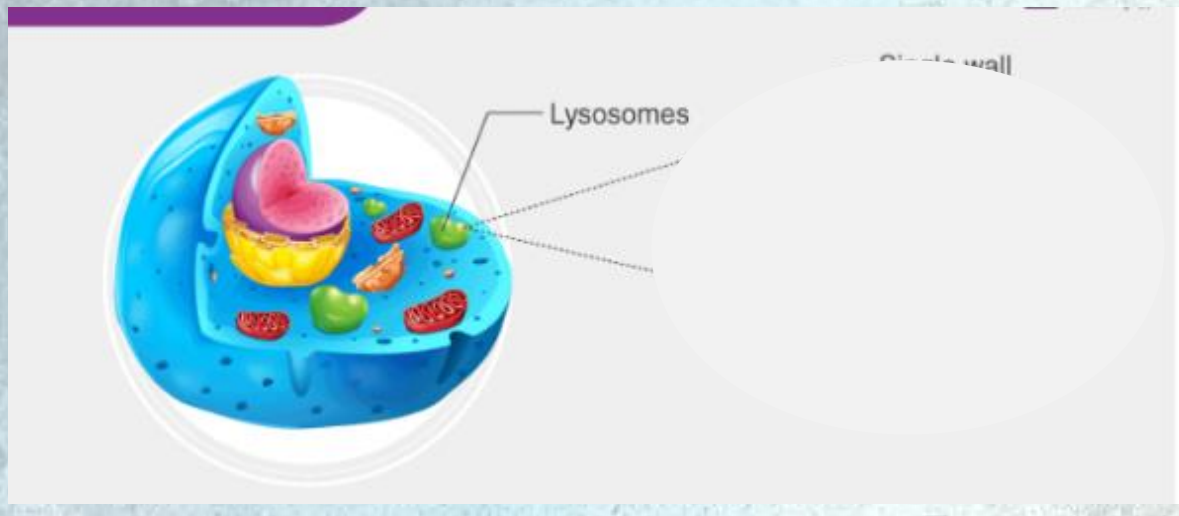
Bioluminescence

Luciferase enzyme found in the peroxisomes of fireflies help in bioluminescence and thus aid the flies in finding a mate or its meal.

Glyoxysomes are specialized types of plant peroxisomes containing glyoxylate cycle enzymes, which participate in the conversion of lipids to sugar during the early stages of germination in oilseeds.

Lysosome

A lysosome is a membrane-enclosed organelle inside the cell, which contains enzymes for the degradation of biological polymers like proteins, polysaccharides, lipids and nucleic acids.



Due to their peculiar function, they are also known as the "*suicide bags*" of the cell.

Lysosomes are comparatively large in size; the size varies from 0.1-1.2 µm depending on the materials taken up for the digestion.

They are composed of membrane proteins and lysosomal lumen enzymes. Lysosomal lumen contains about 50 different digestive enzymes, which are produced in the rough endoplasmic reticulum and exported into the Golgi apparatus. Small vesicles, containing the enzymes released from the Golgi, are later fused to form a large vesicle.

Lysosome

Function of Lysosome

The hydrolytic enzymes in the lysosomes break down materials like biomolecules, exhausted organelles and other unwanted materials in the cytoplasm by engulfing them into the lysosome. Lysosomes are formed during endocytosis, engulfing materials from the outside of the cell. The lysosome is considered to act as the cells' waste disposal system.

In addition to unwanted polymer degradation, lysosomes exhibit some other functions.
They fuse with other organelles to digest cellular debris or large structures in the process called autophagy.

Moreover, lysosomes along with phagosomes are capable of clearing out the damaged structures including bacteria and viruses by a process called phagocytosis.

Besides degradation, lysosomes are involved in secretion, cell signaling, plasma membrane repair, and energy metabolism.

LYSOSOME VERSUS PEROXISOME

LYSOSOME	PEROXISOME
Lysosomes break down biological polymers like proteins and polysaccharides	Peroxisomes oxidize organic compounds, breaking down metabolic hydrogen peroxides
Consists of degradative enzymes	Consist of oxidative enzymes
Responsible for the digestion in the cell	Responsible for the protection of the cell against metabolic hydrogen peroxide

Found in animals	Found in all eukaryotes
Derived from either Golgi apparatus or endoplasmic reticulum	Derived from the endoplasmic reticulum and are capable of replicating by themselves
Comparatively large in size	Comparatively small
Involved in endocytosis, autophagy, and phagocytosis	Involved in biosynthesis of lipids and photorespiration
Degradative reactions do not generate energy	Oxidative reactions in peroxisomes generate ATP energy

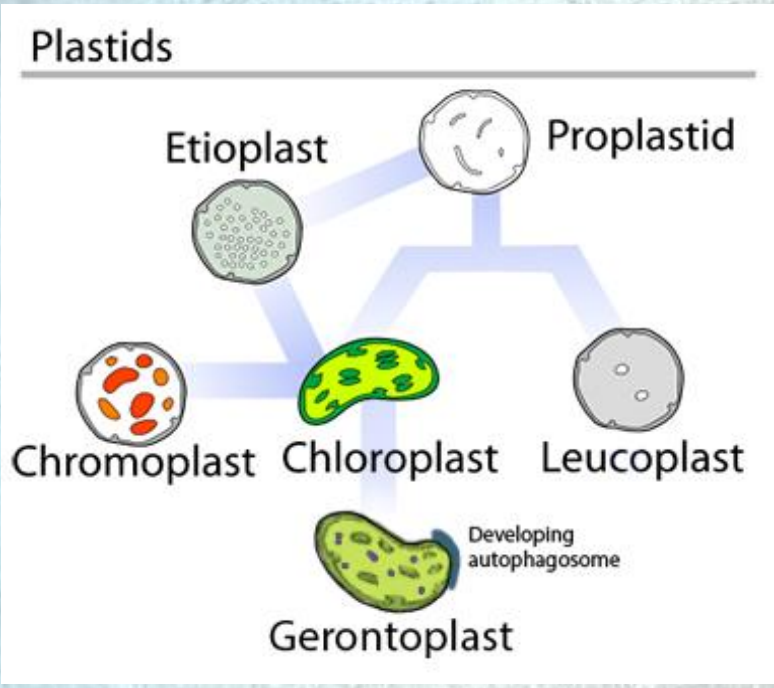
Plastids

Plastids are a class of small organelles that contain pigment or food and are found in the cytoplasm of cells. They have a double membrane and their own DNA and ribosomes, similar to mitochondria in animal cells. They can be found all over in plants and other photosynthetic organisms.

Types of Plastids

In order for plastids to accomplish all the food production and storage that the plant needs, there need to be multiple types of them. All plastids begin as progenitor proplastids that come from the meristem and later differentiate into the other types.

Some develop into etioplasts if the plant begins development in darkness. These are not fully mature and cannot participate in photosynthesis, but they are a distinct stage between proplastids and mature plastids.



Plastids

The four major types of plastids are:

- Chloroplasts are green and serve as the sites for photosynthesis in the cells.
- Highly pigmented plastids called chromoplasts - give plants the colors they use to attract pollinators.
- When the plant stops using photosynthesis in the leaves (like in the fall), the chloroplasts develop into gerontoplasts.
- Non-pigmented plastids used for storing starches, lipids, and proteins are called leucoplasts.