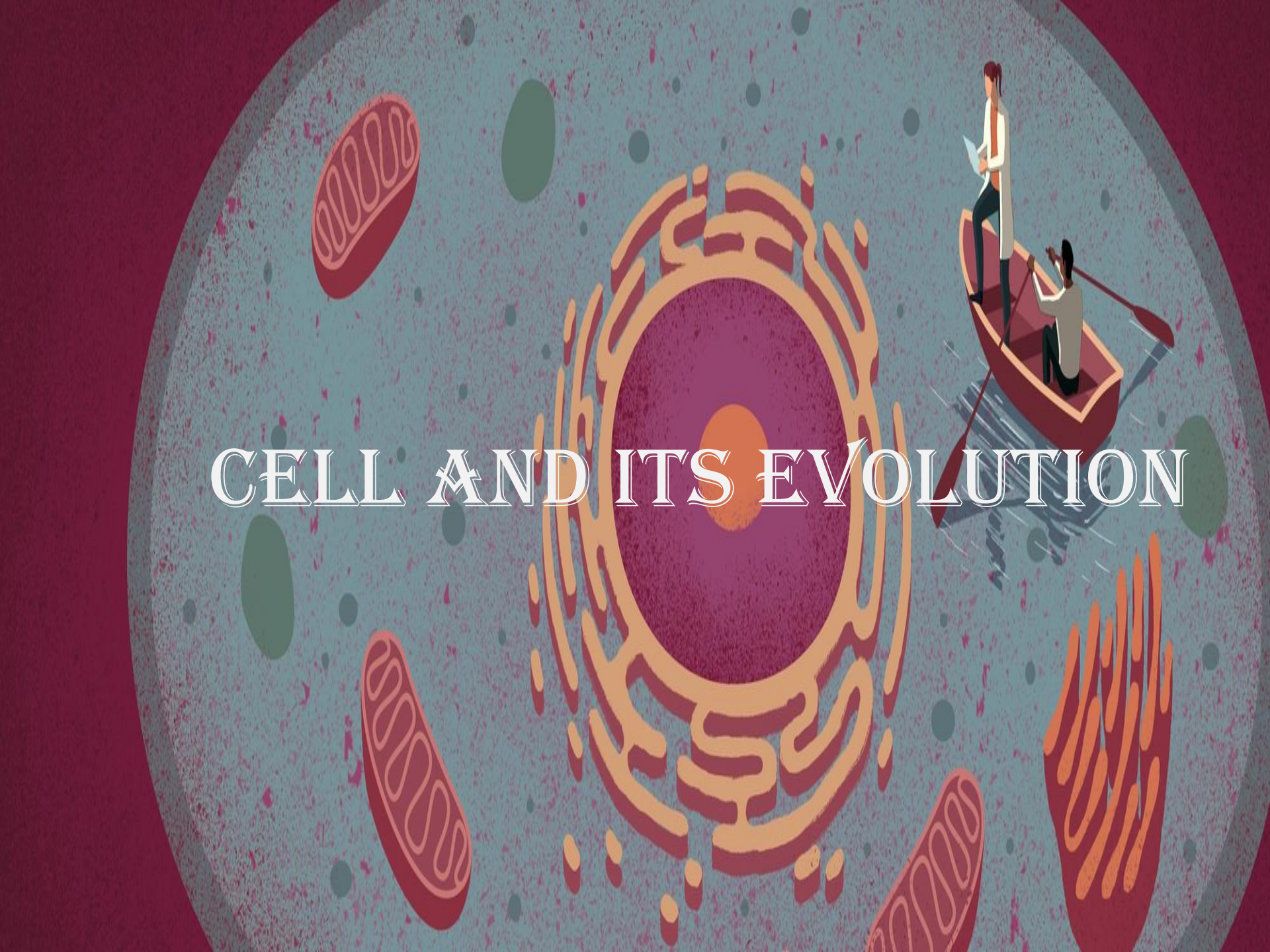

CELL AND ITS EVOLUTION

INTRODUCTORY BIOCHEMISTRY

Chapter: 3
Cell and Its Evolution
Lecture - 7

Fahmida Akter Lia
Department of Biochemistry
National Institute of Science and Technology

CYTOPLASM

Cytoplasm consists of all of the contents outside of the nucleus and enclosed within the cell membrane of a cell. It is clear in color and has a gel-like appearance.

Prokaryotic cells, such as bacteria and archaeans, do not have a membrane-bound nucleus. In these cells, the cytoplasm consists of all of the contents of the cell inside the plasma membrane.

The cytoplasm consists of two main components.
They are the cytosol and organelles

Cytosol: The cytosol is the semi-fluid component or liquid medium of a cell's cytoplasm. It contains cytoplasmic inclusions.

Cytoplasmic inclusions are particles that are temporarily suspended in the cytoplasm. For example - proteins, enzymes, RNA molecules that encode them , amino acids and nucleotides, hundreds of small organic molecules called metabolites like glycogen (glucose storage molecule) and lipids, coenzymes and inorganic ions such as K^+, Na^+,Mg^+ etc., Melanin found in skin etc.

CYTOPLASM

•**Organelles:** Organelles are tiny cellular structures that perform specific functions within a cell.

Examples of organelle include - mitochondria, ribosomes,nucleus, lysosomes, chloroplasts, endoplasmic reticulum, and Golgi apparatus.

Also located within the cytoplasm is the cytoskeleton, a network of fibers that help the cell maintain its shape and provide support for organelles.

Cytoplasm Functions

•The cytoplasm functions to support and suspend organelles and cellular molecules.

•Many cellular processes also occur in the cytoplasm, such as protein synthesis, the first stage of cellular respiration (known as glycolysis), mitosis, and meiosis.

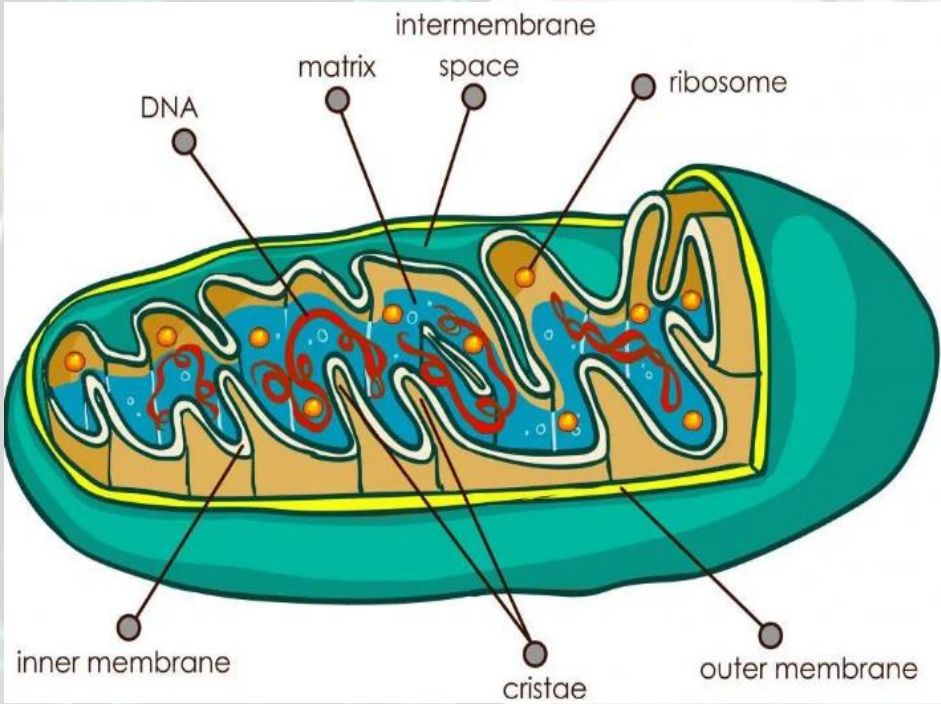
•The cytoplasm helps to move materials, such as hormones, around the cell and also dissolves cellular waste.

MITOCHONDRIA

Mitochondria are small, often between 0.75 and 3 micrometers and are not visible under the microscope unless they are stained.

- have two membranes, an outer one and an inner one. Each membrane has different functions.

Mitochondria are split into different compartments or regions, each of which carries out distinct roles.



Outer membrane: Small molecules can pass freely through the outer membrane. This outer portion includes proteins called porins, which form channels that allow proteins to cross. The outer membrane also hosts a number of enzymes with a wide variety of functions.

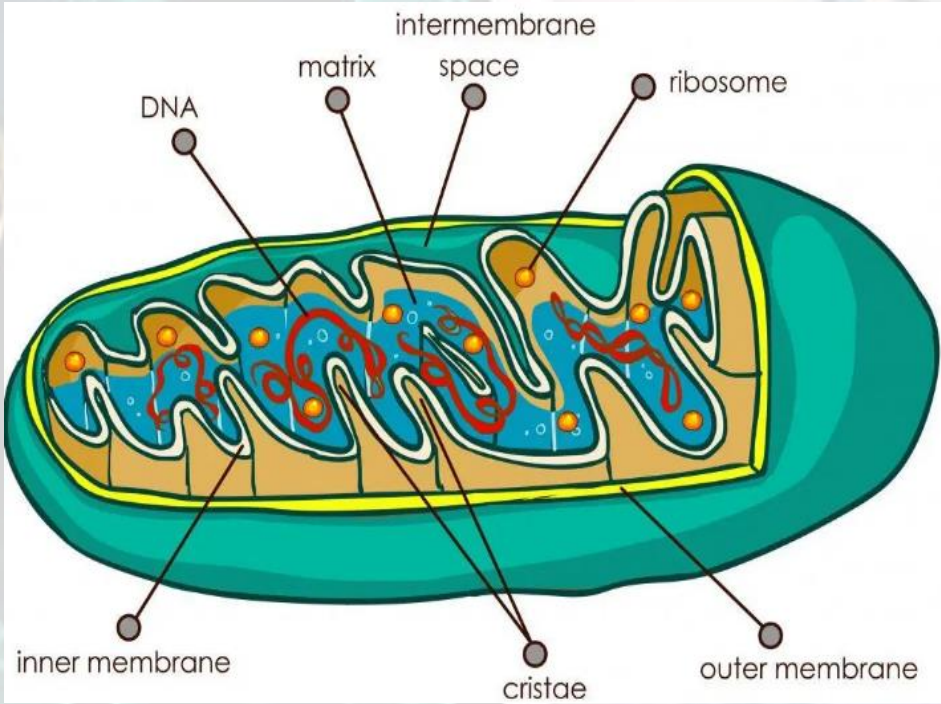
Inner membrane: This membrane holds proteins that have several roles. Because there are no porins in the inner membrane, it is impermeable to most molecules. Molecules can only cross the inner membrane in special membrane transporters. The inner membrane is where most ATP is created.

MITOCHONDRIA

Intermembrane space: This is the area between the inner and outer membranes.

Cristae: These are the folds of the inner membrane. They increase the surface area of the membrane, therefore increasing the space available for chemical reactions.

Matrix: This is the space within the inner membrane. Containing hundreds of enzymes, it is important in the production of ATP. Mitochondrial DNA is housed here.



Mitochondrial DNA

Although most of our DNA is kept in the nucleus of each cell, mitochondria have their own set of DNA. Interestingly, mitochondrial DNA (mtDNA) is more similar to bacterial DNA.

The mtDNA holds the instructions for a number of proteins and other cellular support equipment across 37 genes.

The human genome stored in the nuclei of our cells contains around 3.3 billion base pairs, whereas mtDNA consists of less than 17,000 genes.

MITOCHONDRIA

Different cell types have different numbers of mitochondria. For instance, mature red blood cells have none at all, whereas liver cells can have more than 2,000. Cells with a high demand for energy tend to have greater numbers of mitochondria. Around 40 percent of the cytoplasm in heart muscle cells is taken up by mitochondria

During reproduction, half of a child's DNA comes from their father and half from their mother. However, the child always receives their mtDNA from their mother. Because of this, mtDNA has proven very useful for tracing genetic lines.
For instance, mtDNA analyses have concluded that humans may have originated in Africa relatively recently, around 200,000 years ago, descended from a common ancestor, known as mitochondrial Eve.

MITOCHONDRIA

What do mitochondria do?

Although the best-known role of mitochondria is energy production, they carry out other important tasks as well.

Producing energy

Most ATP is produced in mitochondria through a series of reactions, known as the citric acid cycle or the Krebs cycle. Energy production mostly takes place on the folds or cristae of the inner membrane.

Cell death

Cell death, also called apoptosis, is an essential part of life. Mitochondria help decide which cells are destroyed.
Mitochondria release cytochrome C, which activates caspase, one of the chief enzymes involved in destroying cells during apoptosis.

Storing calcium

Mitochondria play a part in this by quickly absorbing calcium ions and holding them until they are needed.

Heat production

During a process called proton leak, mitochondria can generate heat. This is known as non-shivering thermogenesis.