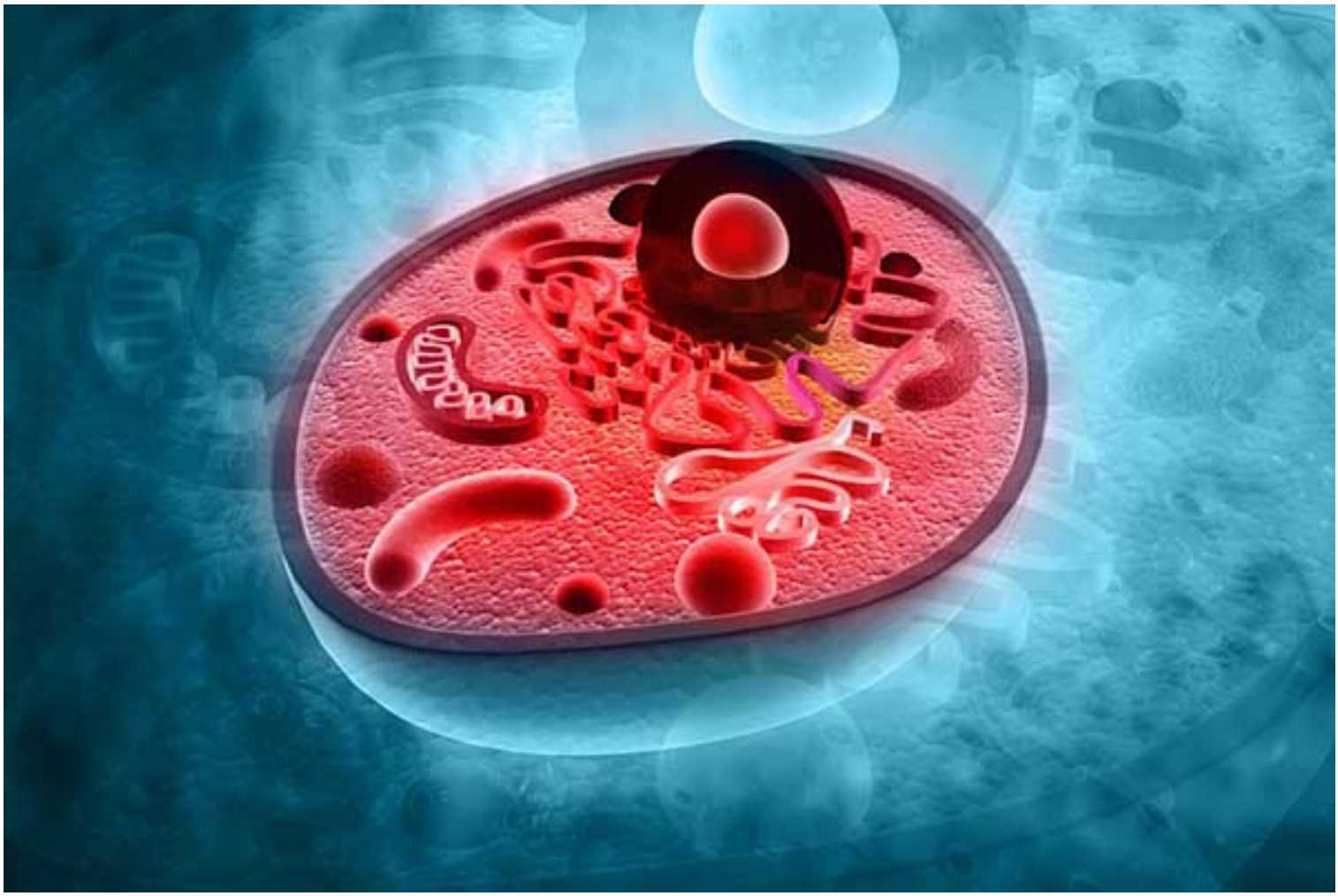
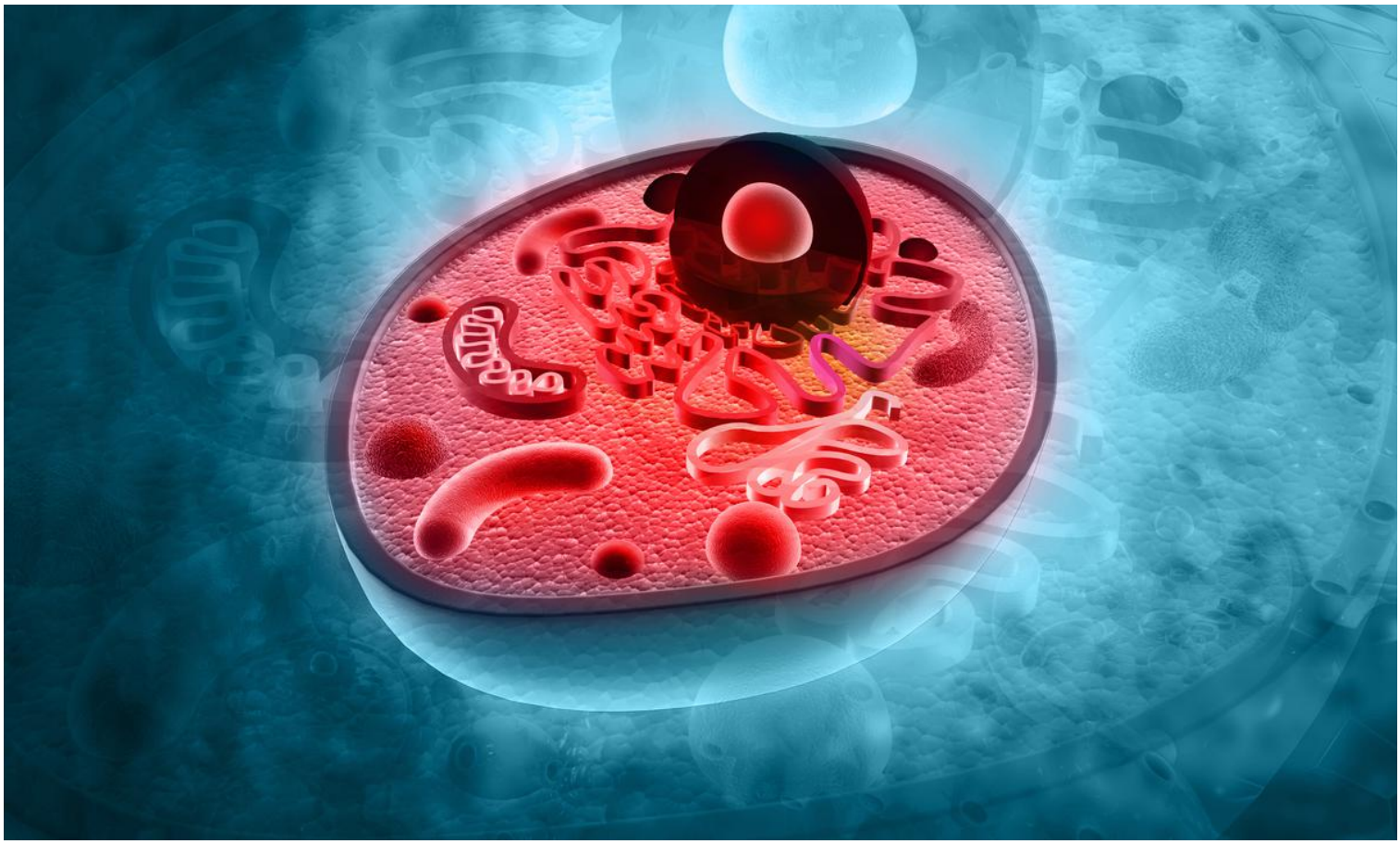
How mitochondria adapted to living within cells

By IASToppers | 2022-03-28 17:25:00



How mitochondria adapted to living within cells

An organism that has been around from 2 billion years ago has given biologists from Centre for Cellular and Molecular Biology, Hyderabad (CCMB), a clue as to how mitochondria became an inseparable part of animal and plant cells.



[Ref-The Hindu]

Highlights of research

- Researchers observed the unexpected biochemistry of **eukaryotic D-aminoacyl-tRNA deacylase (DTD)** that could be explained based on endosymbiotic origin of complex eukaryotic cell organelles**.**
    - **Endosymbiosis** is an intense form of symbiosis when one of the organisms is captured and internalized by the other.
- They found that a prokaryotic organism (without a nucleus) called **archaea** captured a bacterial cell some million year ago.
    - **Archaea** is any of a group of **single-celled prokaryotic organisms** that have distinct **molecular characteristics** separating them from bacteria as well as **from eukaryotes**.
- They also studied an ancient organism known as **'Jakobid'**.
    - It has been present since before animals and fungi branched off from plants and algae in the process of evolution.
- The researchers show that changes, in a **protein (DTD) and a tRNA** (carrying an amino acid glycine for protein synthesis) are crucial for the successful emergence of mitochondria.
- The other change identified by the researchers is that **mitochondrial tRNA (Gly) has changed its critical nucleotide base from U73 to A73**.

Mitochondria

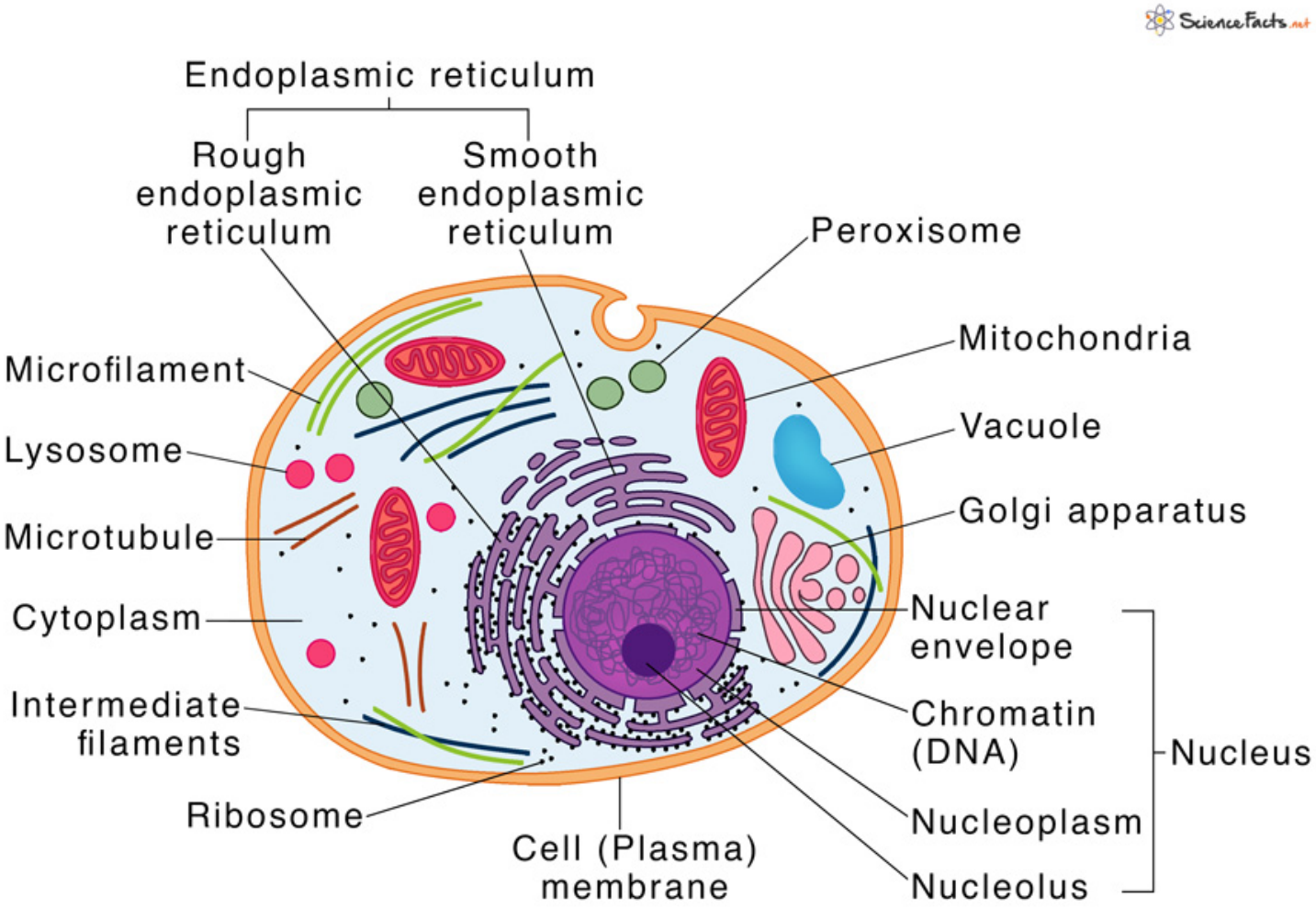
- It was **first discovered by Albert von Kolliker in 1857.**

- It is a **double-membrane-bound** organelle found in **most eukaryotic organisms.**
- It generates most of the **chemical energy needed to power the cell's biochemical reactions**.
- Chemical energy produced by the mitochondria is **stored in a small molecule called adenosine triphosphate (ATP).**
    - It is popularly known as the **"powerhouse of the cell".**
- Mitochondria contain their own **small chromosomes**.
- It is commonly between 0.75 and 3 ?m2 in the area but varies **considerably in size and structure**.
- Generally, mitochondria, and therefore mitochondrial DNA, are inherited **only from the mother.**
- Mitochondria have been implicated in several human disorders and conditions, such as **mitochondrial diseases, cardiac dysfunction, heart failure, and autism**.
- The number of mitochondria in a **cell can vary widely by organism, tissue, and cell type**.
    - A **mature red blood cell has no mitochondria**, whereas a liver cell can have more than 2000.
- There are five distinct parts to a mitochondrion:
    - The **outer** mitochondrial membrane.
    - The **intermembrane space** (the space between the outer and inner membranes).
    - The **inner mitochondrial membrane**.
    - The **cristae space** (formed by infoldings of the inner membrane).
    - The **matrix** (space within the inner membrane), is a fluid.

Eukaryotic cell

- It contains **membrane-bound organelles** such as a nucleus, mitochondria, and an endoplasmic reticulum.
- Organisms based on the eukaryotic cell **include protozoa, fungi, plants, and animals**.
- It **contains mitochondria** to create ATP molecules from glucose and chloroplasts to create glucose from sunlight.

Eukaryotic Cell



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