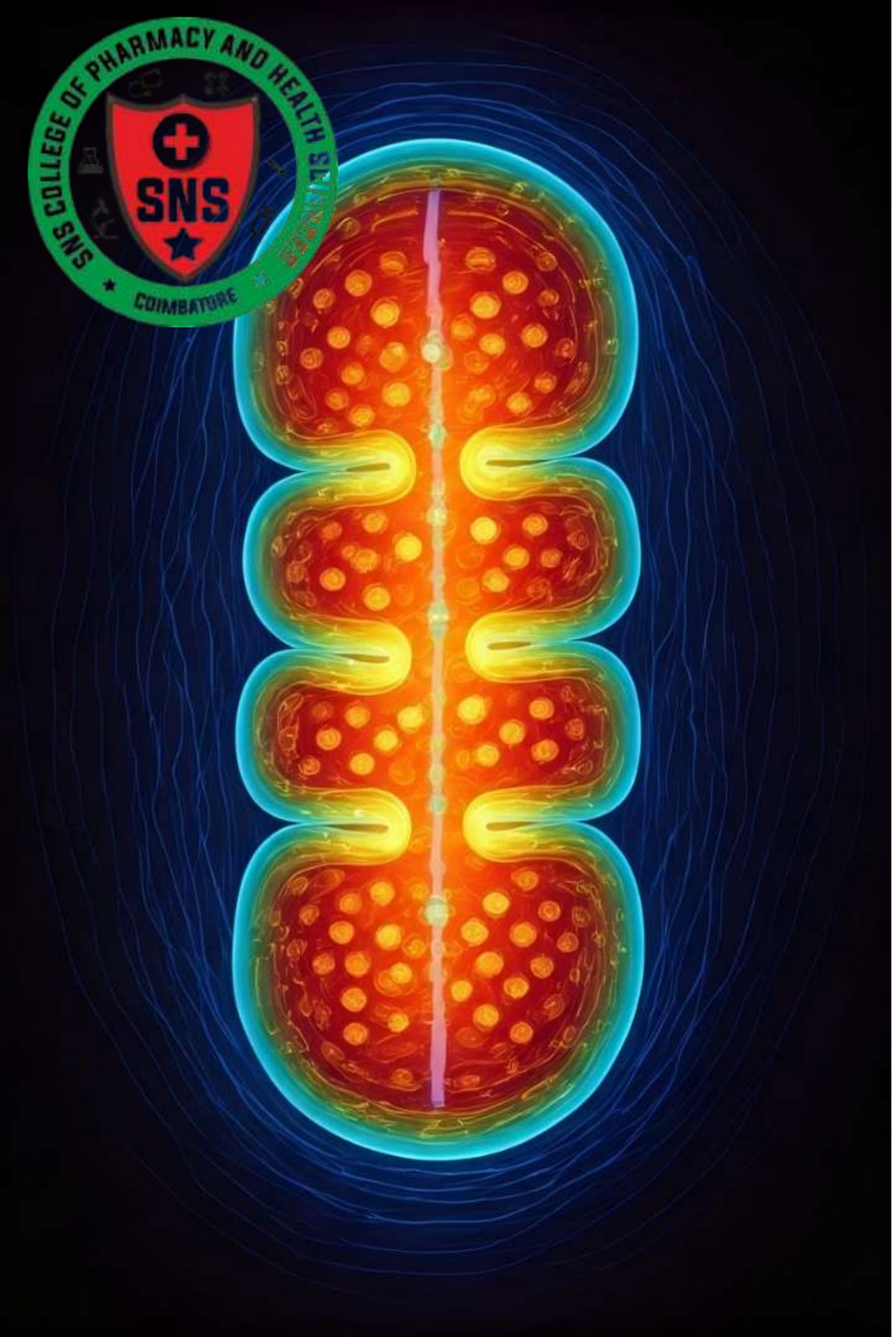


Oxidative Phosphorylation: Powering Life

This process is the main ATP source in aerobic organisms. It converts nutrient energy efficiently.

More than 90% of the human body's ATP is produced this way.

by SRI VIKRAM S

The Electron Transport Chain (ETC)

Complex I

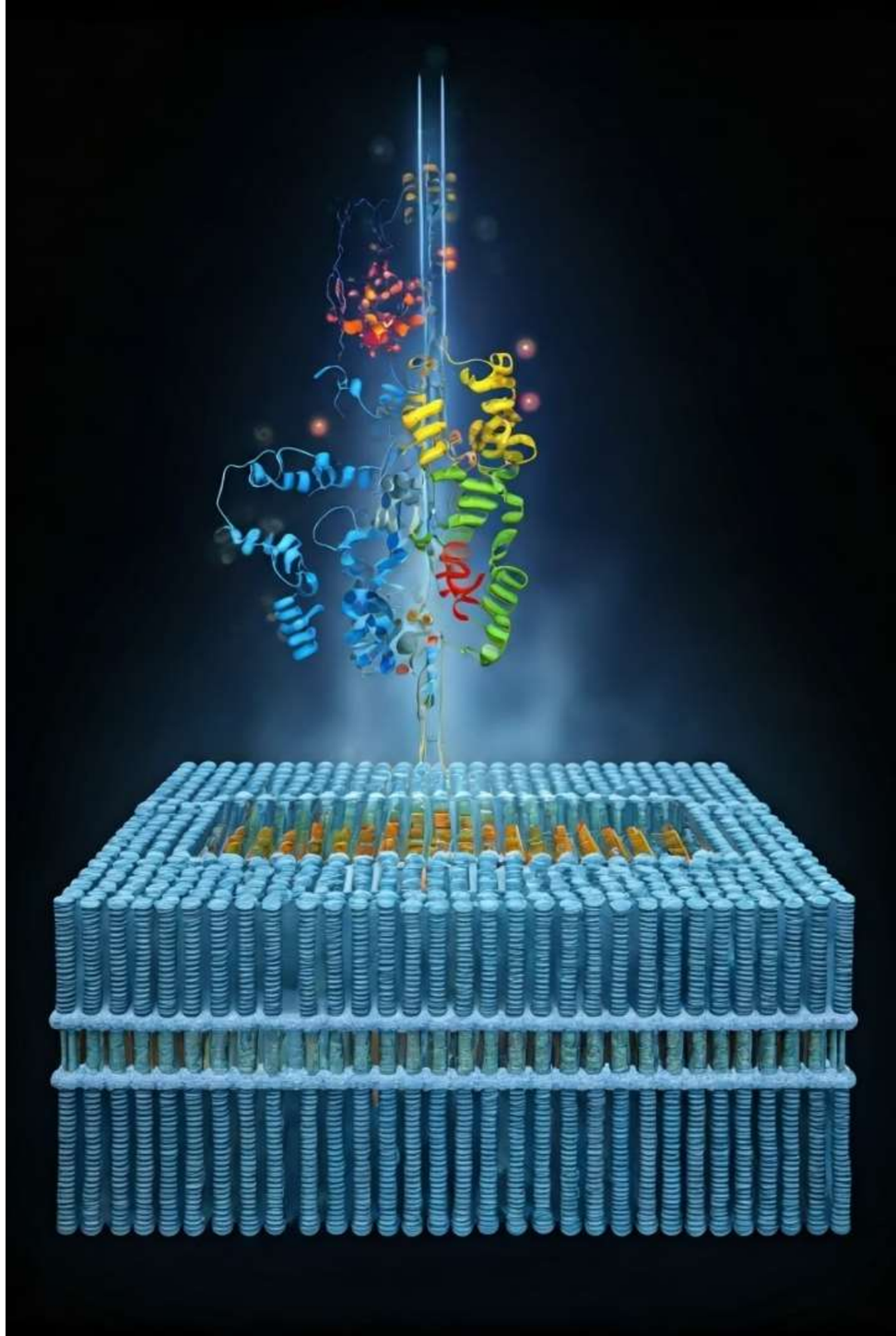
Transfers electrons from NADH to Coenzyme Q (CoQ).

Complex II

Transfers electrons from succinate to CoQ.

Complex III & IV

Move electrons to cytochrome c and then to oxygen forming water.



Chemiosmosis: The Proton Gradient

Proton Pumping

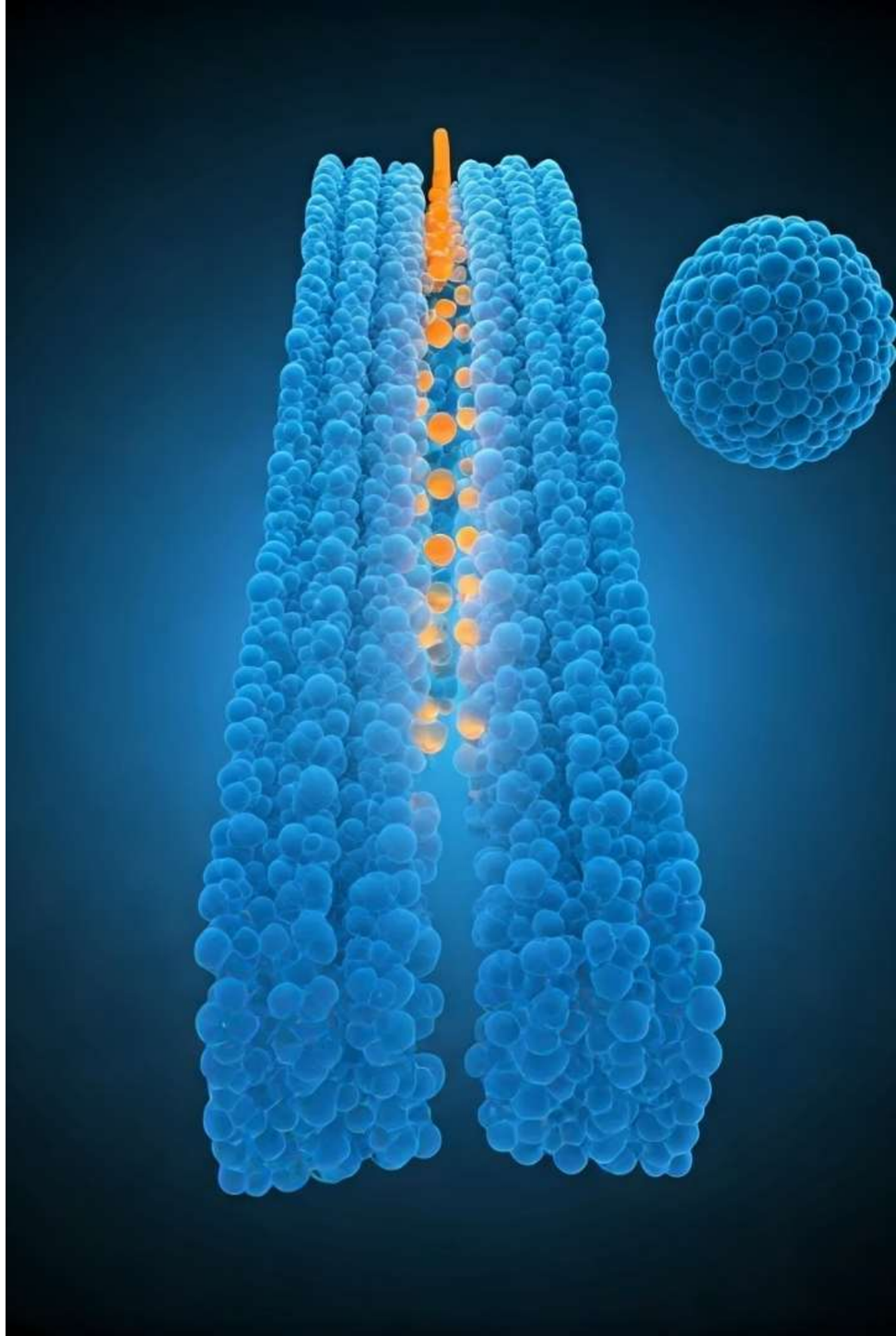
Creates an electrochemical gradient called proton-motive force.

Acidic Intermembrane Space

Lower pH stores potential energy for ATP synthesis.

Theory

Peter Mitchell received Nobel Prize for this chemiosmotic concept.



ATP Synthase: Harnessing the Gradient

F0 Subunit

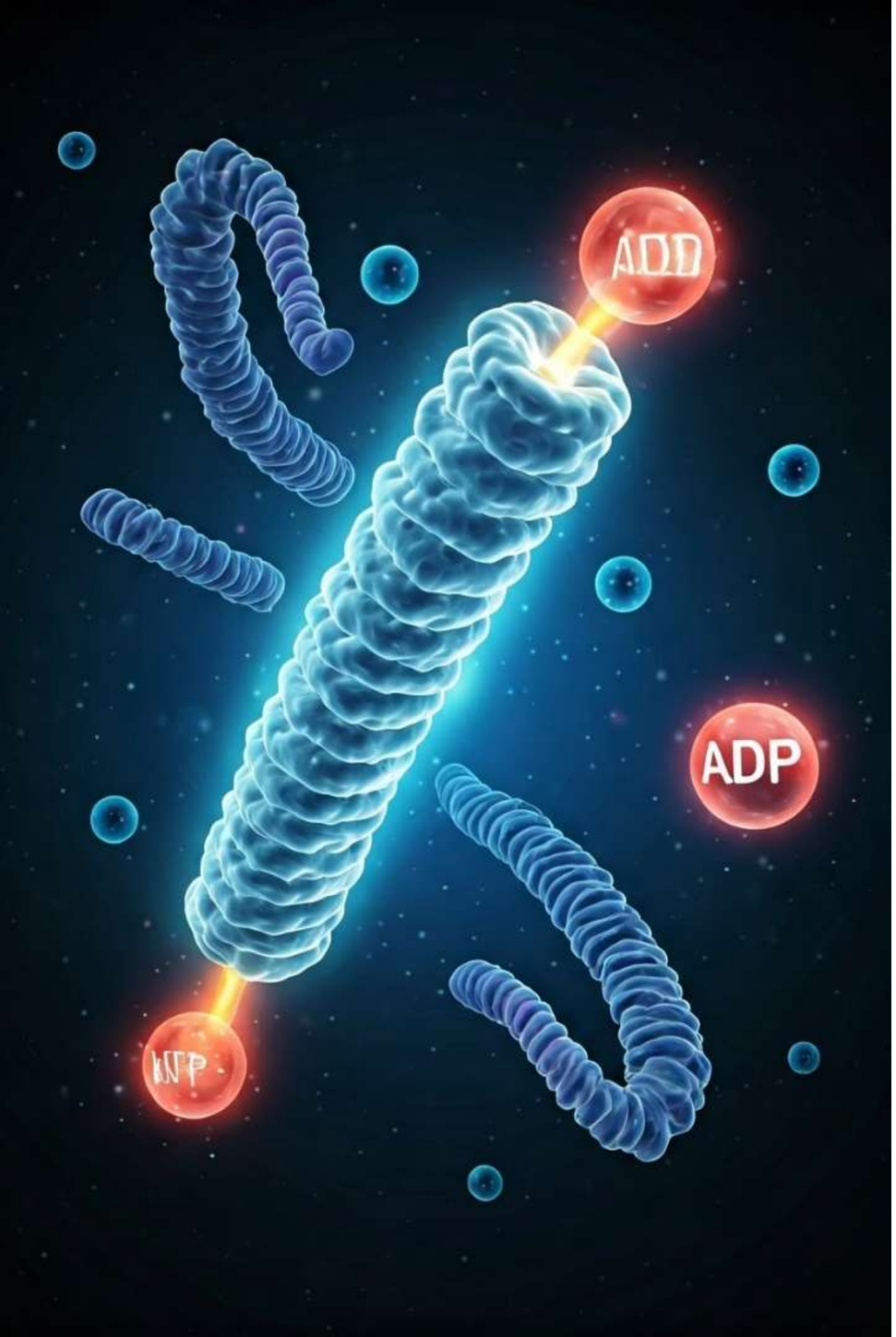
Forms a proton channel in the membrane, rotates with proton flow.

F1 Subunit

Contains catalytic sites where ATP is synthesized from ADP and phosphate.

Result

One full rotation produces about 3 ATP molecules.



Regulation of Oxidative Phosphorylation

1 **ATP Levels**

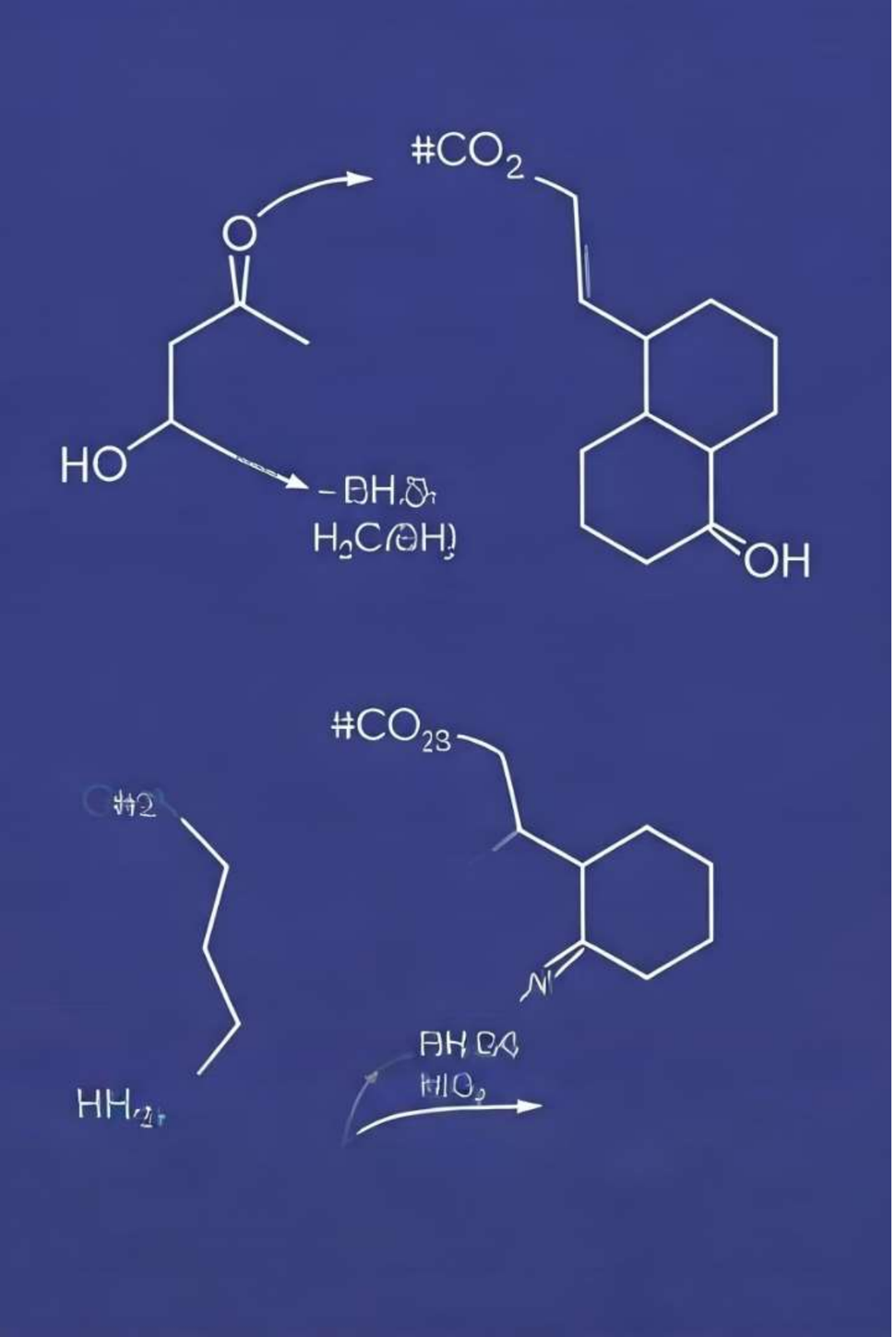
High ATP slows down the electron transport chain and ATP synthase.

2 **ADP Levels**

ADP presence stimulates activity, increasing ATP production.

3 **Efficiency**

Respiratory Control Ratio measures coupling efficiency between respiration and phosphorylation.



Substrate-Level Phosphorylation

Direct Phosphate Transfer

Transfers phosphate group directly to ADP, forming ATP without proton gradient.

Location

Occurs in cytoplasm during glycolysis and mitochondrial matrix in citric acid cycle.

Examples

- 1,3-bisphosphoglycerate to 3-phosphoglycerate
- Succinyl-CoA to succinate

Comparing Phosphorylation Types

Oxidative Phosphorylation

Yields far more ATP; happens in mitochondrial inner membrane.

Substrate-Level Phosphorylation

Produces less ATP; takes place in cytoplasm and mitochondrial matrix.

Summary & Key Takeaways

1

Primary ATP Source

Oxidative phosphorylation generates most cellular ATP.

2

Gradient Creation

ETC drives proton gradient for energy storage.

3

ATP Synthase Role

Uses gradient to synthesize ATP efficiently.

4

Substrate-Level Phosphorylation

Offers smaller but essential ATP supply during metabolism.