# MICROALGAE EXPERIMENT: SUSTAINABLE NUTRITION IN SPACE

NEWS: India has announced its first-ever biological experiments aboard the International Space Station (ISS) to Study Sustainability of Human Life in Space.

- The initiative is part of the broader BioE3 Biotechnology Policy launched in 2024.
- This is a collaborative mission between ISRO, NASA, and the Department of Biotechnology (DBT) Ministry of Science and Technology of India.
- It will be conducted as part of the AXIOM-4 mission, with Group Captain Shubhanshu Shukla as the first Indian astronaut participating in space biology research aboard the ISS.

## WHAT'S IN THE NEWS?

#### Objective of the Experiment

- To investigate how microgravity and cosmic radiation in space affect the growth, metabolism, and viability of edible microalgae strains.
- The study focuses on evaluating their utility for supporting longduration human space missions.

#### Nutritional and Environmental Potential

- Microalgae are nutrient-dense organisms with rich protein content, essential amino acids, vitamins, and antioxidants.
- They also possess high photosynthetic efficiency, making them capable of generating oxygen and sequestering carbon dioxide—key components of closed-loop life support systems in space.
- 2. Expected Scientific Outcomes
  - Identification of the most resilient and productive algal species that can be used for food supply, oxygen generation, and CO<sub>2</sub> recycling in extraterrestrial environments.
  - Development of algal bioreactor models for long-term spaceflight applications.

Cyanobacteria Experiment: Waste Recycling and Superfood Applications

Organisms Under Study

• The experiment focuses on strains of cyanobacteria such as *Spirulina* and *Synechococcus*, which are known for their high protein content and rapid growth.

Experimental Design

- The cyanobacteria are cultured in two different nutrient mediums urea-based (representing human waste recycling) and nitratebased environments (conventional nutrient source).
- The goal is to compare growth dynamics and metabolic performance in microgravity under these conditions.

### Scientific and Practical Objectives

- Assess *Spirulina*'s potential as a reliable superfood source for astronauts due to its rich content of proteins, iron, and vitamins.
- Investigate the ability of cyanobacteria to recycle carbon and nitrogen from human metabolic waste, making them integral to sustainable, closed-loop life support systems on space habitats.

## Significance of the Space Biotechnology Experiments

Pioneering India's Space Life Sciences Capabilities

- These experiments mark India's first biological payloads aboard the International Space Station (ISS), representing a major step toward developing space-compatible biotechnologies.
- The outcomes support future long-term missions by enabling selfreliant systems for food production, oxygen generation, and waste recycling.

Supporting Sustainable Space Missions

- These biological systems reduce the dependency on Earth-based resupply missions by enabling in-situ resource utilization (ISRU).
- They lay the foundation for human survival on the Moon, Mars, or deep-space missions by ensuring food security and atmospheric balance in isolated habitats.

Alignment with India's BioE3 Policy Vision

- The experiments are aligned with India's BioE3 vision, which promotes:
  - Environmentally sustainable biomanufacturing
  - Development of smart proteins and carbon-negative technologies
  - Advancements in precision therapeutics and space-oriented bioengineering

### Promoting High-Performance Biotechnologies

 The research is designed to contribute to advanced synthetic biology, metabolic engineering, and life systems engineering with cross-sectoral applications beyond space—including climate action and food security on Earth.

### Enhancing International Cooperation

Participation in AXIOM-4 ISS Mission

 India's involvement in the AXIOM-4 mission to the ISS signifies deepening cooperation with international space agencies, including NASA, AXIOM Space, and other global research partners.

Strengthening India's Global Position in Space Sciences

• These collaborative efforts place India at the forefront of space biology, aligning with its broader aspirations to lead in cutting-edge, sustainable science and technology domains.

Source: <u>https://timesofindia.indiatimes.com/india/in-a-first-india-to-conduct-</u> <u>experiments-aboard-iss-to-study-sustainability-of-life-in-</u> <u>space/articleshow/121192691.cms</u>