



National Aeronautics and  
Space Administration

# BPS Update: CBPSS

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Biological & Physical Sciences





# Know before we go.

Science that enables exploration.

Exploration that enables science.

- Uncover **critical scientific insights** needed for NASA's deep space missions.
- Leverage unique conditions in space to **conduct research impossible to do on Earth.**
- Optimize mission investments by **advancing science and technology.**



# AVATAR (1 of 2)

## A Virtual Astronaut Tissue Analog Response

### Organ-on-a-chip devices to fly aboard Artemis II.

- Small devices the size of a USB thumb drive containing with real human cells.
- Mimic how organs function — breathe like a lung, beat like a heart, or process like a liver.

### Help ensure crew health on Mars mission.

- Study – and predict – the effects of increased radiation and microgravity on individual crew health.
- Contain bone marrow cells developed from crew samples.
- Fly with crew in the Orion capsule in automated hardware.
- Compare flight samples to ones taken from crew pre- and post-mission.



# AVATAR (2 of 2)

## Paving the way for personalized medicine.

- Identify potential risks to individual crew health before Moon, Mars missions.
- Enable clinicians to tailor medical plans to individual patients, advance treatments.

## A partnership between government and industry.

- NASA's BPS and Human Research Program
- Biomedical Advanced Research and Development Authority
- National Center for Advancing Translational Sciences
- Space Tango
- Emulate, Inc.





# International Year of Quantum

Events in 2025 where BPS will promote NASA's work in Quantum:

**January 12-16**

**American  
Astronomical  
Society**



**March 15**

**Quantum Jubilee**

Jason Williams (CAL), Paul Kwiat (SEAQUE) presenting



**March 16-21**

**American Physical  
Society Global  
Physics Summit**

Anaheim, CA



**April 2025**

**Space Symposium**

Commemoration Signing of BECCAL partnership with DLR and Nicky Fox



**April 14**

**World Quantum Day**

Celebrating 100 years of quantum mechanics



**April 21**

**Atomic Clock  
Ensemble in  
Space  
(ACES)**

Launch on SpaceX-32



**June 16-20**

**APS Division of  
Atomic, Molecular  
and Optical Physics  
Meeting**

Portland, OR



**September 2025**

**Direct Detection of Dark  
Energy in the Einstein  
Elevator (D3E3)**

Bremen Drop in Tow  
in Germany (DLF)



**Fall 2025**

**Next version of CAL  
SM-3X is launching**

More Details TBA



# 2025 Launches to Date

- **Space Crops:**

- Determining How Chromosome Ends and Specialized Protein Affect Plant Resilience (SpX-32)
  - APEX-12 (Advanced Plant Experiments in Space-12)
  - Dr. Shippen, Texas A&M University
- Growing Wasabi mustard greens, Red Russian Kale, and Dragoon Lettuce in Veggie facility (Crew 11)
  - VEG-03 MNO
  - Gioia Massa, NASA KSC

- **Quantum Leaps:**

- 'Second guessing' Time in Space (SpX-32)
  - ACES (Atomic Clock Ensemble in Space)
  - Dr. Cristophe Salomon, ENS, Paris, France
  - Partnership between ESA and NASA

- **Precision Health:**

- Examining how microgravity affects bone-forming and bone-degrading cells (SpX-33)
  - MABL-B (Microgravity Associated Bone Loss-B)
  - Dr. Abba Zubair, Mayo Clinic

- **Foundations**

- Understand the effects of a non-condensable atmosphere on preventing cryo propellant boil-off (NG-23)
  - ZBOT-NC (Zero Boil-Off Tank Noncondensables)
  - Dr. Mohammad Kassemi, Case Western Reserve University



# Upcoming Launches\*

- NG-24 – NET April 2026
- Artemis II – NLT April 2026
- SpX-34 – NET June 2026
- TechLeaps winners' parabolic flights – Summer 2026

\*Subject to change





# Solicitations

- **ROSES 2024 solicited proposals for**
  - **Space Crops:** Plant research addressing KSQs related to the decadal-recommended BLISS campaign
  - **Precision Health:** Model studies relating to biological aging, age-associated diseases, and genetic diversity
  - **Foundations:** Fundamental physics research on fluids, fire systems and combustion, soft matter, materials
  - **Quantum Leaps:** Concepts for future space experiments in fundamental physics, with an emphasis on quantum science and atomic physics
- **Panels are reviewing Step 2 proposals**
- **Awards anticipated Fall 2025**





# SpaceApps Challenge

## “Build a Space Biology Knowledge Engine”

- NASA has accumulated extensive data of biology experiments in space - **crucial for missions to the Moon and Mars.**
- Essential for users to locate information specific to their interests in an **accessible and user-friendly** platform.
- Challenge focuses on developing a dynamic dashboard using **AI, knowledge graphs, or other tools** to summarize NASA bioscience publications.

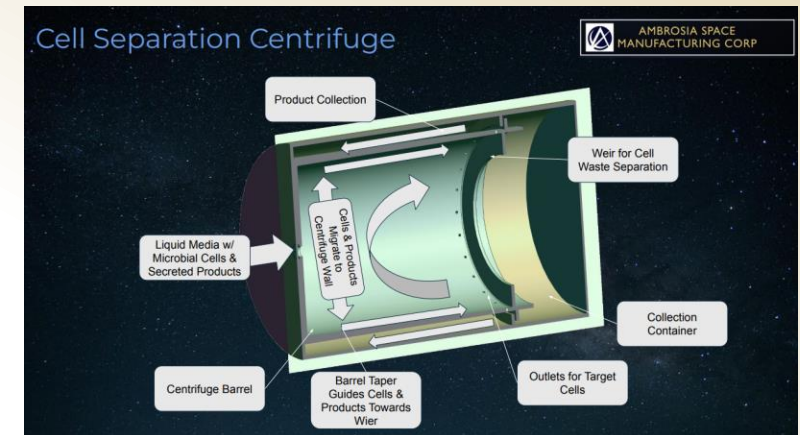


Hackathon: October 4-5, 2025

# TechLeaps Challenge – BPS Winners

## Ambrosia Space: Food & Nutrition for Mars and Sustained Lunar

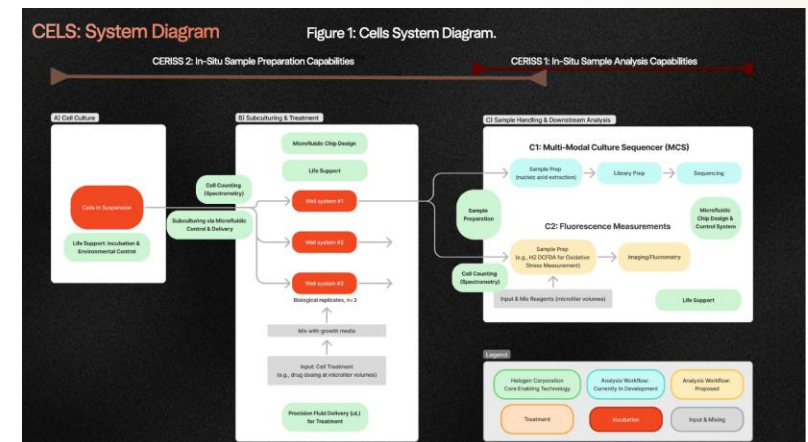
- Cell separation centrifuge for nutrient production for crewed missions.
- Building scalable in-space biomanufacturing systems for large-scale protein and nutrient manufacturing for long-duration human spaceflight.
- Provide capability to process large volumes of liquid-based cell culture efficiently in reduced and micro-gravity environments.



*Ambrosia Space*

## Helogen: Addressing In-situ Sample Preparation

- Cellular Experiment Laboratory System (CELS) technology - an autonomous biological payload developed to enable sample handling and preparation for in-orbit analysis.
- Focuses on ensuring high-quality biological experimentation comparable with state-of-the-art ground-based research.
- Designed for use in suborbital, hosted orbital, CLDs, CLPS.



*Helogen*

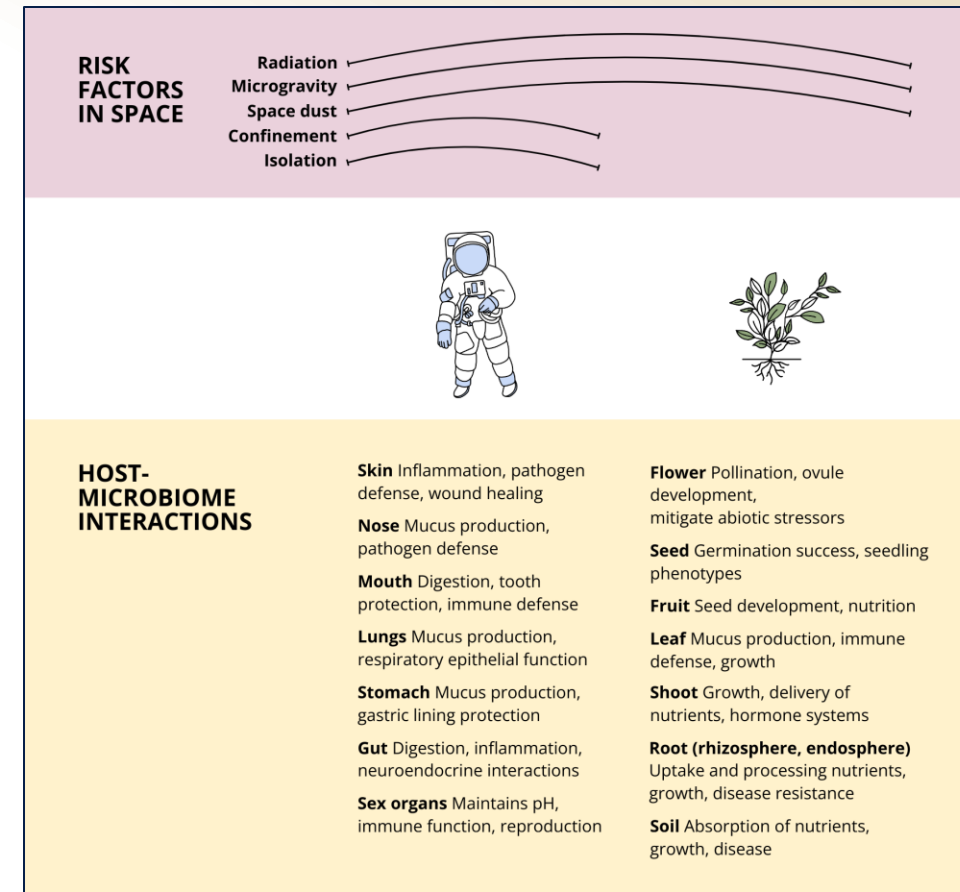


# Consortium: Establishing Networks for Durable & Resilient Systems BioS-ENDURES



Dr. Morgansen

- **PI:** Kristi Morgansen, PhD, University of Washington, WA
- Focus: Host-microbiome interactions (Human, plant and microbe)
- Three thrust areas:
  - Develop **biological monitoring capabilities** to monitor stress-induced by spaceflight.
  - Build models to **predict human, plant, and human-plant-microbe interactions and space biology stress**.
  - Validate and apply understanding of human-plant-microbe interactions to **enhance health in space**.

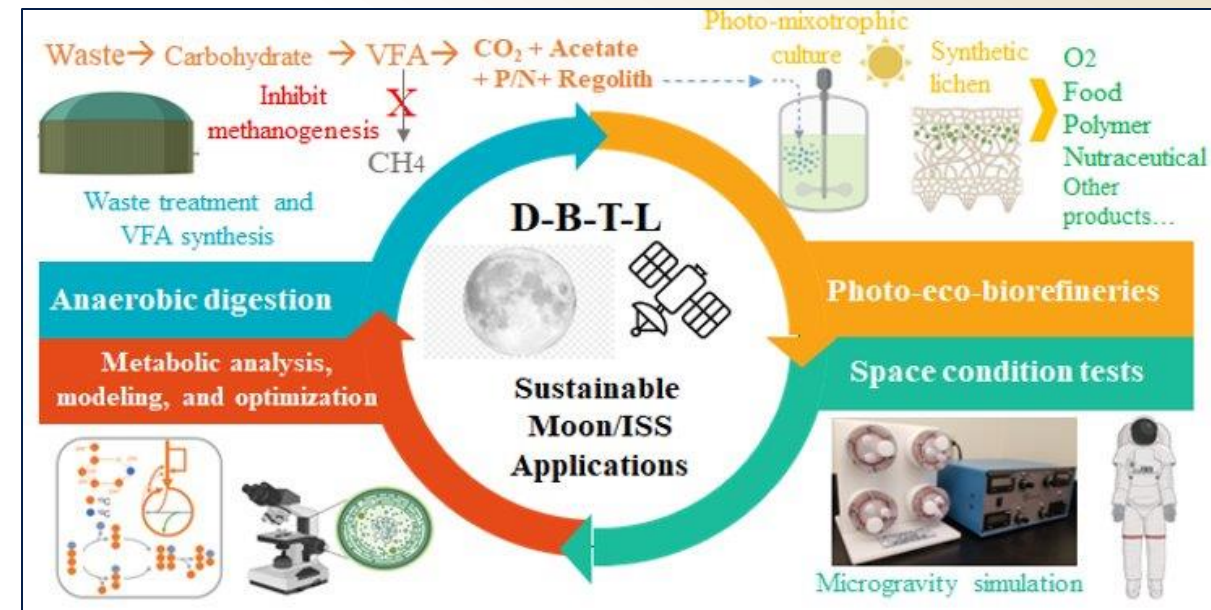


# Consortium: Anaerobic Digestion for Advanced Space Technology and Resource Acquisition (AD ASTRA)



Dr. Tang

- **PI:** Yinjie Tang, PhD, Washington University in St. Louis, MO
- **Focus:** Waste recycling and biomanufacturing (microbiology)
- Three thrust areas
  - Develop a **microbial anaerobic digestion (AD) process that converts human metabolic waste** into volatile fatty acids (VFAs) instead of methane.
  - **Engineer cyanobacteria** that uses AD-processed wastewater, acetate, and CO<sub>2</sub> to produce O<sub>2</sub>, protein-rich biomass as food/nutrient sources and biopolymers.
  - Determine how simulated microgravity and space environments **affects microbial AD and VFA production**.

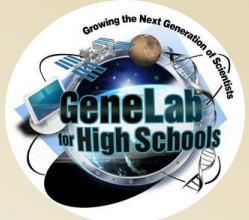


<https://sites.google.com/view/nasaadastra/home>



# BPS Workforce Development – Recent Highlights

- **GeneLab for High Schools (GL4HS) – Expansion a Success!**
  - Over 900 participants in this year's program, redeveloped for asynchronous participation
  - More than half of participants successfully completed the basic course
- **GeneLab for Universities (GL4U) Courses – On-Demand Model, Broad Reach**
  - Over 1900 enrollees between the two on-demand courses since late-2024 launch: 1) Intro & 2) RNAseq
  - Flexible, self-paced NASA open science training for college level educators and students
- **Space Life Sciences Training Program (SLSTP)**
  - For over 10 years, this annual program training has provided training to university students
  - *“This experience has **changed my life forever**. Being able to pursue one of my dreams working for NASA, has completely changed my career trajectory.” – SLSTP participant*
- **Spaceflight Technology, Applications & Research (STAR)**
  - Sixth annual cohort began Sept. 9, 2025 – trains PIs, senior research scientists, postdocs
  - Program supports entry to space bio, spaceflight research on NASA & commercial platforms
- **And More!**
  - Growing Beyond Earth (GBE) Program Kicks Off 2025-2026 School Year
  - Many 2025 summer interns across BPS-supported NASA centers



# 2025 Agency Honors Awards

- **Exceptional Scientific Achievement Medal:**  
Jason Williams, Cold Atom Lab
- **Exceptional Public Achievement Medal:**  
Kamal Oudrhiri, Cold Atom Lab
- **Silver Achievement Medal:** Kevin Sato
- **Silver Group Achievement Award:** MHU-8 Mission Team
- **Silver Group Achievement Award:** Great Lakes Science Center Exhibition Team
- **Silver Group Achievement Award:** BPS Booz Allen Hamilton Team

## Honor Awards Appreciation Program

- **Excellence in Collaboration Award:** Spaceflight Technologies, Applications and Research (STAR) Team





**Learn more:**





Mars

Moon

ARTEMIS III

FM<sup>2</sup>

ARTEMIS II

# BIOLOGICAL & PHYSICAL SCIENCES FLEET

● FORMULATION  
● IMPLEMENTATION  
● OPERATIONAL  
\*Partner-led

CAL  
ELF\*  
EML\*  
FBCE  
BRIC  
FLARE\*  
APEX  
SOFIE  
SEAQUE\*  
GEARS  
ACES\*  
VEGGIE  
MICRO  
ZBOT-NC  
MABL

International Space Station

BRIC-LED  
APEX-11

CBIOMES

VEG-06

MeF1

Space Algae 2

MVP-Plant-02

ODYSSEY