National Aeronautics and Space Administration

NASA BIOLOGICAL AND PHYSICAL SCIENCES (BPS) DIVISION

Decadal Science Road Map

Sunsetting & Emerging Science: CBPSS Community Input

NASA invites community input on Sunsetting & Emerging Science topics until Oct 17, 2025

Instructions for Providing Input

- NASA BPS invites community input on Sunsetting & Emerging Science topics until Oct 17, 2025
  - Provide input using the templates at the end of this deck
  - Send completed templates (or written feedback in same categories) to: hq-bps-road-map@mail.nasa.gov
  - NASA will review community inputs in October and November, 2025
- Download the interactive BPS Decadal Science Road Map for reference
  - https://science.nasa.gov/biological-physical/goals/
  - https://assets.science.nasa.gov/content/dam/science/bps/bps-general/goals/BPS%20Decadal%20Road%20Map.pdf

Definitions

Sunsetting

- What science are you involved in that we know enough about and could be sunsetted?
- What have we learned and where do we take it next?

Emerging Science

- What emerging science are you involved with that will play a role in the future of space exploration?
- What is the future of the science?
- With ISS ending, what could we do elsewhere?
  - E.g., ground-based, CLDs, other space destinations, free-flyers, small sats, rideshares

Key Science Questions (KSQs) from the Decadal Survey

KSQ 01	How does the space environment influence biological mechanisms required for organisms to survive the transitions to and from space, and thrive while off Earth?
KSQ 02	How do genetic diversity and life history influence physiological adaptation to the space environment?
KSQ 03	How does the space environment alter interactions between organisms?
KSQ 04	What are the important multi generational effects of the space environment on growth, development, and reproduction?
KSQ 05	What principles guide the integration of biological and abiotic systems to create sustainable and functional extraterrestrial habitats?
KSQ 06	What principles enable identification, extraction, processing, and use of materials found in extraterrestrial environments to enable long-term, sustained human and robotic space exploration?
KSQ 07	What are the relevant chemical and physical properties and phenomena that govern the behavior of fluids in space environments?
KSQ 08	What are the mechanisms by which organisms sense and respond to physical properties of surroundings and to applied mechanical forces, including gravitational force?
KSQ 09	What are the fundamental principles that organize the structure and functionality of materials, including but not limited to soft and active matter?
KSQ 10	What are the fundamental laws that govern the behavior of systems that are far from equilibrium?
KSQ 11	What new physics, including particle physics, general relativity, and quantum mechanics, can be discovered with experiments that can only be carried out in space?

From the National Academies of Sciences, Engineering, and Medicine's *Thriving in Space: Ensuring the Future of Biological and Physical Sciences Research: A Decadal Survey for 2023-2032*

BPS Decadal Science Goals

- Thriving in Space: Revolutionary research in extraordinary places

Precision Health

Leveraging space to unlock the secrets of aging and disease

Space Crops

Boldly growing where no one has grown before

Quantum Leaps

Unraveling mysteries of the universe

Foundations

Revealing the novel behaviors of fluids, fire, and materials in space

Space Labs

Advancing research in space, on any platform, anywhere

BPS Road Map FY25 Framework

BPS Program	Exploration Science				
Key Science Questions Addressed	1,2,3,4,5,8	1,2,3,4,5,8	9,10,11	5,6,7,8,9,10	ALL
Goal	Precision Health	Space Crops	Quantum Leaps	Foundations	Space Labs
Theme	▸ Organ-on-a-Chip	▸ Growth Medium	▸ Cold Atoms/Atom Interferometry	▸ Fluids & Thermal Management	▸ Commercially Enabled Rapid Space Science (CERISS)
	▸ Aging & Disease	▸ Crop Cultivars	▸ Quantum Entanglement	▸ Fire Safety	▸ Low Earth Orbit (LEO)
	▸ Synthetic Biology	▸ Space Farming	▸ Deep Space Laser Ranging*	▸ Recycling & Sustainability*	▸ Moon
	▸ Acclimation & Adaptation	▸ Bioregenerative Life Support Systems	▸ Precision Clocks	▸ Building Blocks for ISRU	▸ Mars*
					▸ Interplanetary Space*

*Themes marked with an asterisk will link to funded projects in future

Sunsetting and Emerging Science

Goal	Sunsetting	Timeframe	Emerging Science	Space Labs (CERISS, LEO, Moon, Mars, Interplanetary Space)
Precision Health	▸ Research on individual systems	▸ 1-5 years	▸ Systems biology ▸ Integrated physiological systems	▸ LEO ▸ Partial gravity ▸ Interplanetary space
Space Crops	▸ Gene expression in whole plants (transcriptomics) studies in 1g & ISS microgravity	▸ 1 year	▸ Cell-type specific 'omics' in space environments ▸ Genes relevant for Earth-to-Space transitions	▸ Partial gravity ▸ Suborbital flights
Quantum Leaps	▸ Cold Atom Lab (CAL)	▸ 5 years	▸ Bose-Einstein Condensate and Cold Atom Lab (BECCAL)	▸ LEO
Foundations	▸ ISS Combustion Integrated Rack	▸ 1-3 years	▸ Flammability of Materials on the Moon (FM2)	▸ Partial gravity

The NASA BPS Director presented these examples to the Committee on Biological and Physical Sciences in Space on April 2, 2025

Sunsetting and Emerging Science

Precision Health

Sunsetting	Timeframe	Emerging Science	Space Labs (CERISS, LEO, Moon, Mars, Interplanetary Space)
Text goes here	Text goes here	Text goes here	Text goes here

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Sunsetting and Emerging Science

Space Crops

Sunsetting	Timeframe	Emerging Science	Space Labs (CERISS, LEO, Moon, Mars, Interplanetary Space)
Text goes here	Text goes here	Text goes here	Text goes here

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Sunsetting and Emerging Science

Quantum Leaps

Sunsetting	Timeframe	Emerging Science	Space Labs (CERISS, LEO, Moon, Mars, Interplanetary Space)
Text goes here	Text goes here	Text goes here	Text goes here

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Sunsetting and Emerging Science

Foundations

Sunsetting	Timeframe	Emerging Science	Space Labs (CERISS, LEO, Moon, Mars, Interplanetary Space)
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