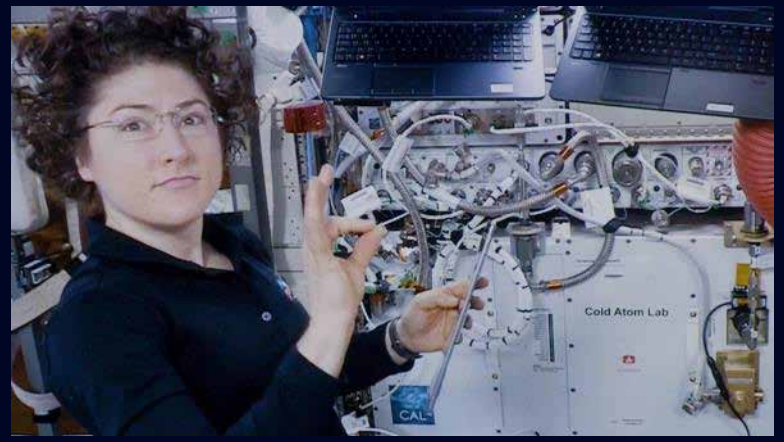
National Aeronautics and Space Administration

Biological and Physical Sciences Program Status

Craig Kundrot
Director
Biological and Physical Sciences Division

BPS Vision



Example of Physical Sciences research: Studying quantum gasses

Example of Space Biology research: Growing plants in space

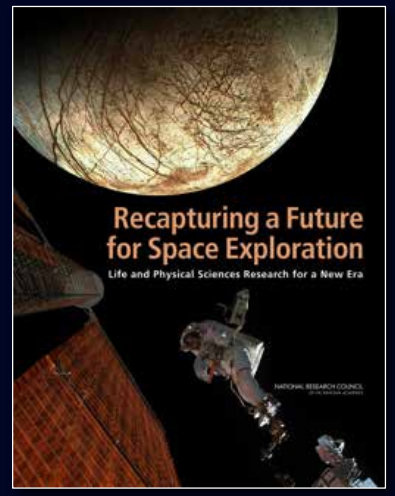
We use spaceflight environments to study biological and physical systems.

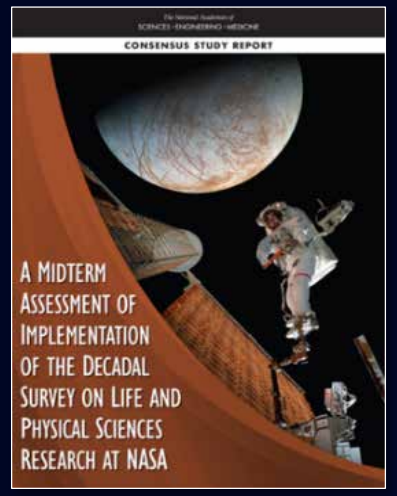
Examining phenomena under extreme conditions can help us better understand how they function.

This can contribute to significant scientific and technological advancements that

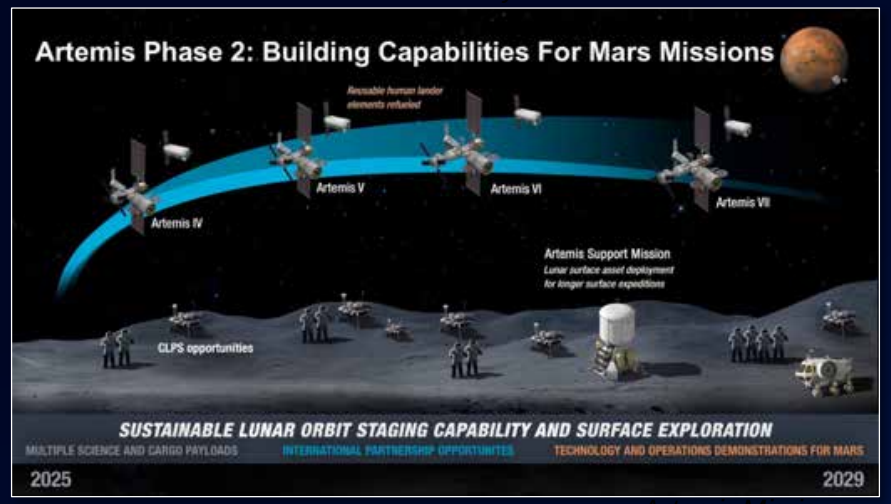
- make fundamental advances in science,
- enable space exploration, and
- benefit life on Earth.

BPS Mission





Decadal Survey



Artemis Missions

Pioneer Scientific Discovery

- Proactively seek out new ways to expand fundamental scientific knowledge
- Provide expertise and support to others seeking to utilize space

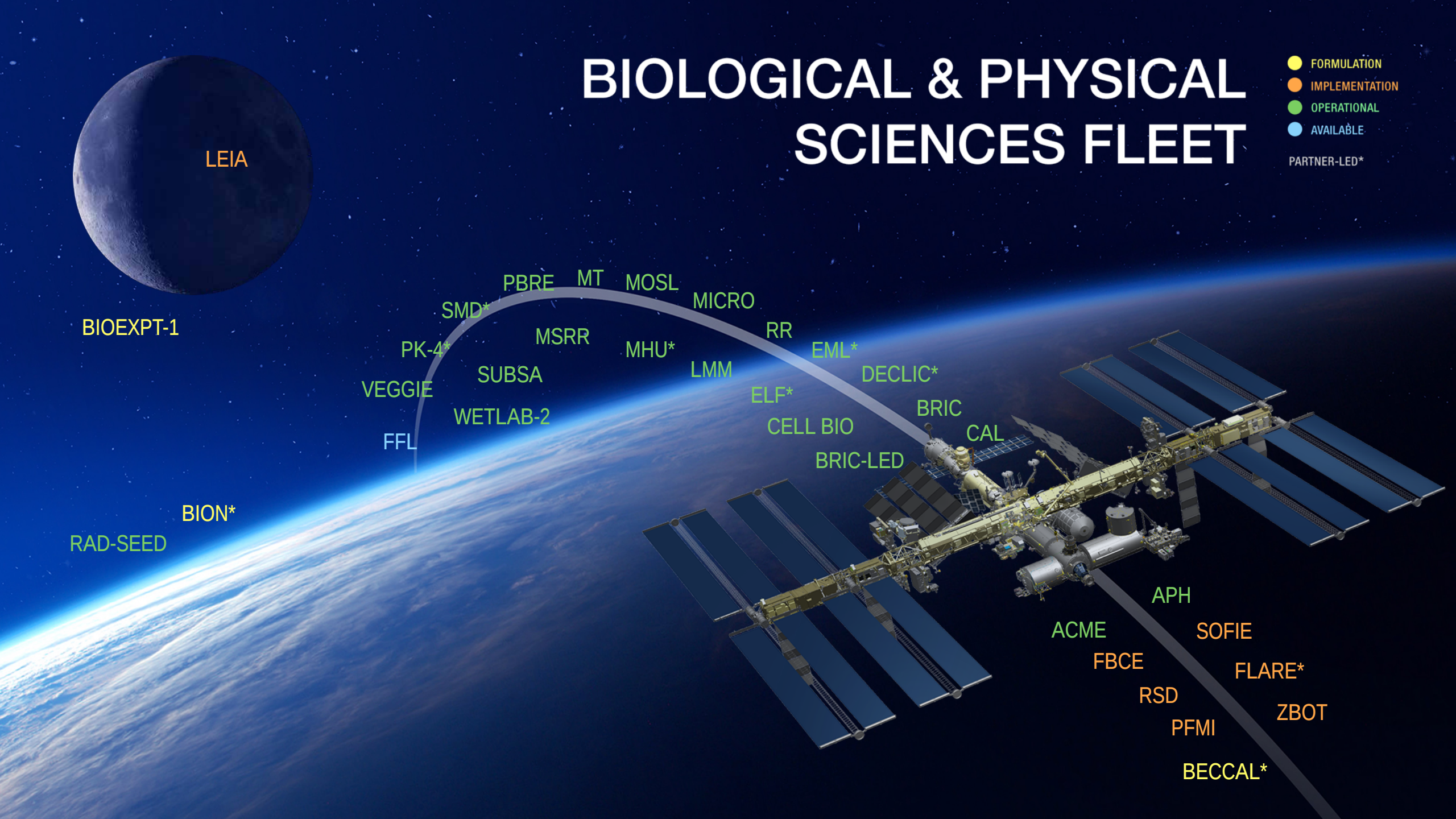
Enable Exploration

- Anticipate and investigate critical areas for scientific knowledge and technology development
- Deliver results to other NASA organizations and industry

BIOLOGICAL & PHYSICAL SCIENCES FLEET

- FORMULATION
- IMPLEMENTATION
- OPERATIONAL
- AVAILABLE

PARTNER-LED*



BPS over the Next 10 Years

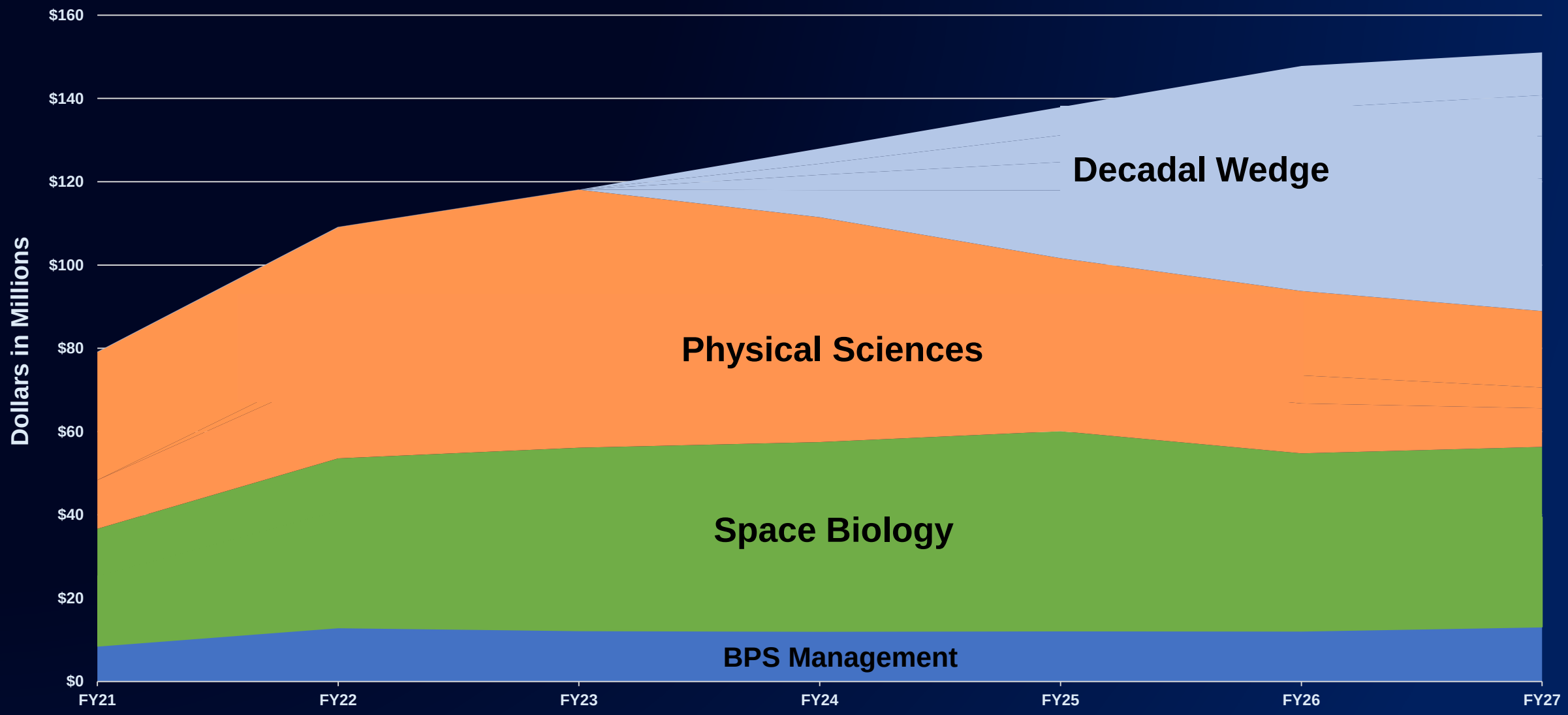
- Pioneer transformative science at the frontiers of biology and physical sciences in space
  - Frontiers: Conceptual and Physical
    - Areas where BPS can uniquely
      - Advance scientific knowledge
      - Meet the needs of exploration missions
      - Provide terrestrial benefits
    - Locations include
      - Commercial and governmental ground-based; commercial sub-orbital
      - Commercial Low Earth Orbit
      - Lunar orbit (Gateway)
      - Lunar surface (Commercial Lunar Payload Services, Human Landing System)
      - Mars transit vehicle
  - Pioneer
    - BPS first or among first at a frontier
    - Other organizations (government, commercial, academic, international) may follow
    - BPS collaborates with other organizations in all phases
      - First tests of feasibility and value assessment
      - Refining methods and re-assessing value
      - Sustained research and returning value

BPS Strategy

- Focus on transformative research
  - Recommended by the 2011 Decadal Survey
  - Likely to be recommended by the 2023 Decadal Survey
- Include large research activities
  - Keystone Capabilities/Missions
  - Research Campaigns
- Use NASA and non-NASA capabilities, especially commercial
- Balance flight-based research program with strong ground-based research program

- Near-term: Focus on transformative areas
  - Bolster three areas likely to be recommended by the 2023 Decadal Survey
    1. Quantum Science (Cold matter)
    2. Thriving in Deep Space (TIDES) (Animal/Human, Plant)
    3. Soft Matter (Far-from-equilibrium processes; unique assemblies)
  - Pause other areas until 2023 Decadal Survey received
    - Complete funding existing grants; Defer or descope future solicitations; Pause early-stage flight projects
- Long-term: Implement 2023 Decadal Survey priorities

BPS Budget Plan Based on President's Budget Request FY22



BPS Platforms for Research

*Future Platforms


CubeSat


International Space Station


Free Flyers (BION)


*Lunar Gateway


*Commercial Lunar Lander Services


Drop Tower


Parabolic Flight


Sounding Rocket
Sub-orbital Vehicle


Electrostatic Levitator


*Human Landing System


Rodent Unloading


Centrifuge


Balloon Flight


NASA Space Radiation Lab


NASA Isolation Chamber


NSF Polar Station


Russian Isolation Chamber


Gravity Vector Averaging


Physical Sciences
Informatics


GeneLab

BPS Will Use Multiple Spaceflight Platforms

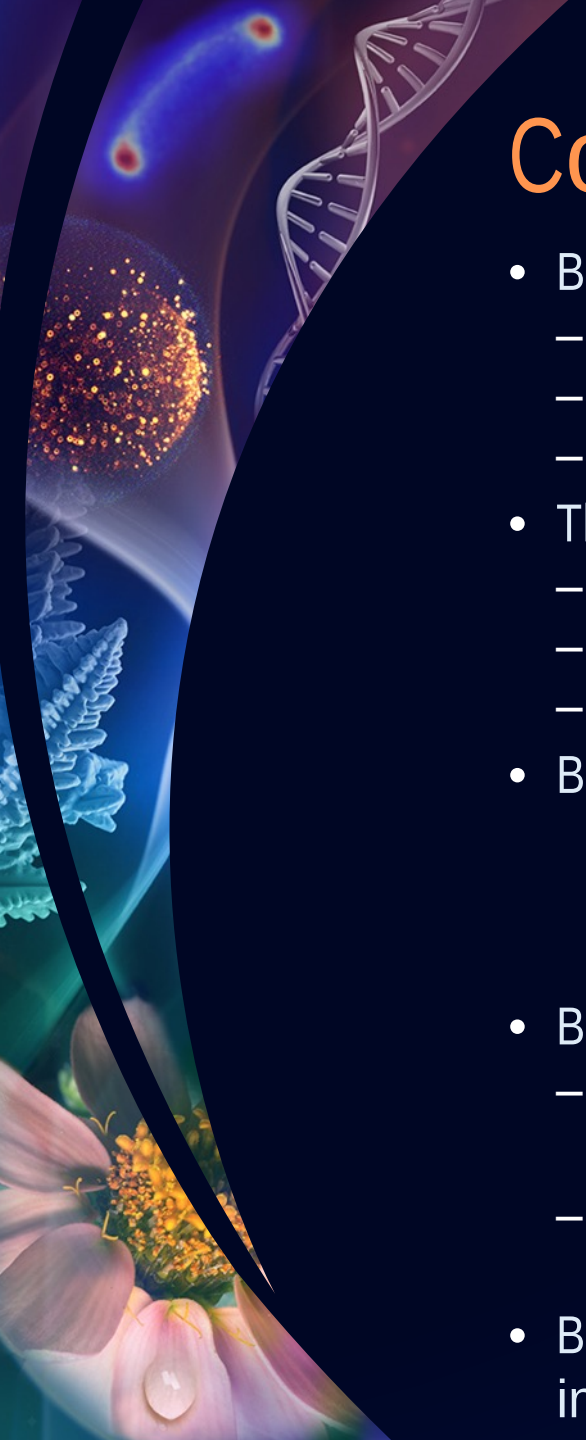
- The Decadal Survey priorities will dictate the choice of platform and environment
- Experiments or applications may be conducted in several spaceflight environments
  - Ground-based, sub-orbital, low Earth orbit (LEO), deep space, lunar orbit, lunar surface, Martian orbit, Martian surface
  - Commercial and governmental

- A series of environments or platforms may be employed as stepping stones
  - Example: the progression of 1/6-g studies in drop tower -> parabolic flight -> sub-orbital flight -> ISS -> lunar surface vary in
    - Duration
    - Coriolis effect
    - Acceleration before and after the nominal experiment

Grow & Strengthen the Community
Improve Inclusion, Diversity, Equity & Accessibility (IDEA)

- **Reaching Students**
  - *GeneLab for High School (GL4HS)
  - Space Life Sciences Training Program (SLSTP)
  - *Program for Undergraduate Learning of Spaceflight Applications and Research (PULSAR)
  - *MSI Fellowship (Masters) and student internships managed by OSTEM
- **Supporting Early, Mid, and Late Career Investigators**
  - NASA Post-doc Program (NPP)
  - Spaceflight Technologies, Application, and Research (STAR)
  - Close coordination with Established Program to Stimulate Competitive Research (EPSCoR)
    - Rapid Response Research (R3) topic solicitation
    - Research Cooperative Agreement Notice (CAN) solicitation
    - ISS flight opportunity solicitation
- **Engaging General Public via Citizen Science and Science Activation Activities**
  - GeneLab: 4 Analysis Working Groups
  - New Physical Science Informatics (PSI) initiative to encourage open science
  - *Science at the Drop of a Hat (public opportunity to conduct their own drop tower testing)
  - *Growing Beyond Earth (GBE)
  - Scouts of America
  - Frontier Development Lab Challenge: “Space Medic: Causal Inference for Out-of-Distribution Generalization”

*Programs that include direct outreach to under-represented groups



Conclusion

- BPS seeks to tackle the most transformative research questions driven by
  - Advancing science
  - Enabling exploration
  - Benefiting life on Earth
- The 2023 Decadal Survey will
  - Identify the highest priority, most transformative research for BPS
  - Recommend an ambitious program to provide the transformative results
  - Provide the building blocks for the next decade of BPS research
- BPS is bolstering three areas likely to be recommended by the 2023 Decadal Survey
  - Quantum Science
  - Thriving in Deep Space (TIDES)
  - Soft Matter
- BPS will use, to the extent recommended by the 2023 Decadal Survey,
  - A broad range of spaceflight platforms
    - Commercial and governmental; Sub-orbital, orbital, lunar
  - Partnerships with other NASA organizations, other government agencies, international partners, and industry
- BPS will continue strengthening the community and improving accessibility, diversity, inclusion and equity in its programs

Deep Dive

Questions for the Committee

- **How can we improve our efforts to achieve these SMD Science Plan objectives?**
  - Drive innovation to capitalize on the rapid evolution of commercial capabilities.
  - Increase the diversity of thought and backgrounds represented across the entire SMD portfolio through a more inclusive environment.

Thank you!

Supplemental Information

Biological and Physical Sciences Division Leadership

Craig Kundrot
Division Director

Diane Malarik
Deputy Director

BPS Program Leadership

Space Biology

Mary Walsh*
Program Manager

Sharmila Bhattacharya
Program Scientist

Mamta Nagaraja*
Deputy Program Scientist

Anthony Hickey
Support Scientist

Physical Sciences

DeVon Griffin
Program Manager

Bradley Carpenter
Fundamental Physics Program Scientist

Fran Chiaramonte
Fundamental Physical Sciences Program Scientist

Exploration & Partnerships

Kevin Sato*
Program Scientist for Exploration

Lisa Carnell
Program Scientist for Translational Research

Doug Gruendel
Partnership Coordinator

*On detail