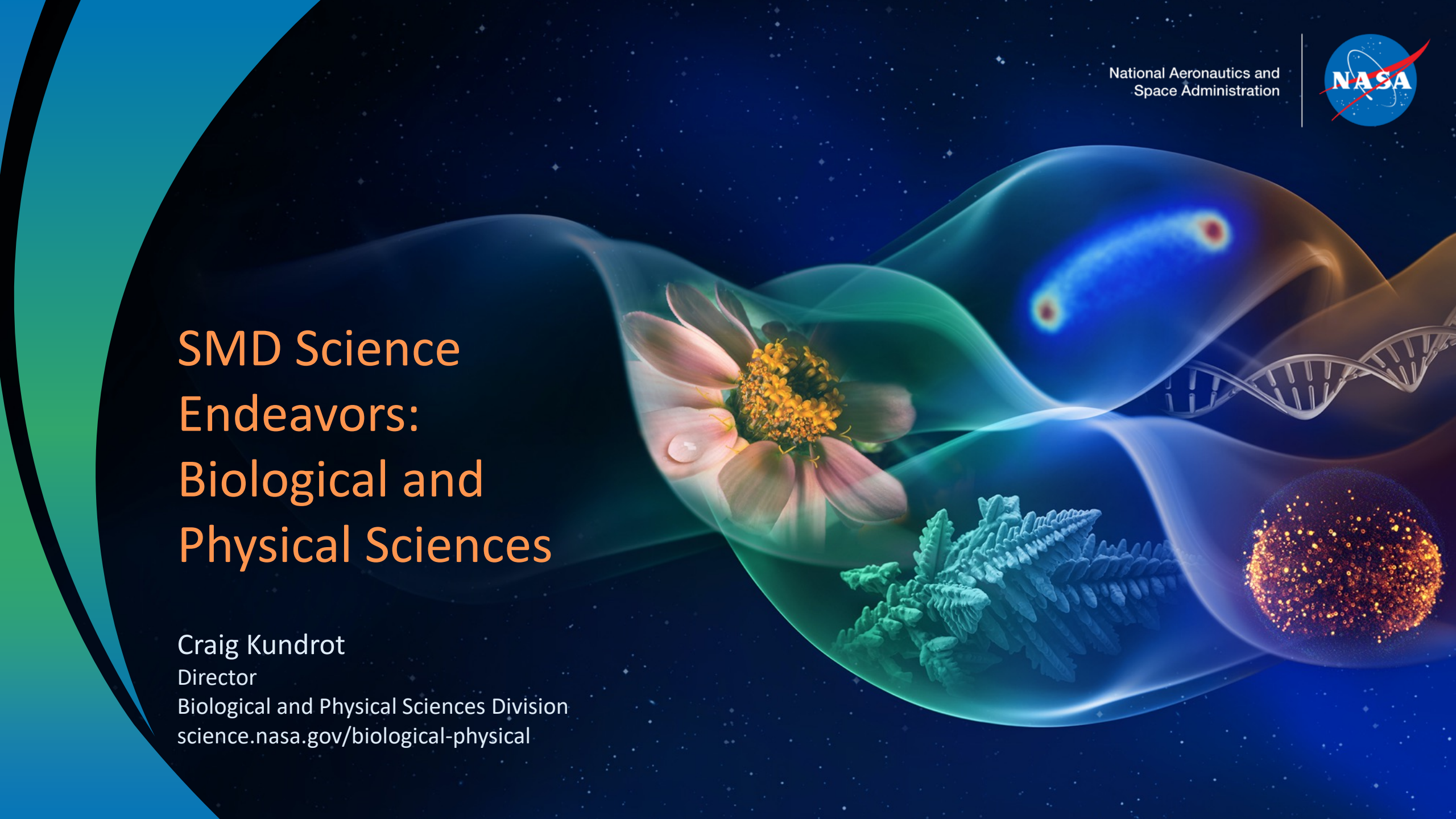
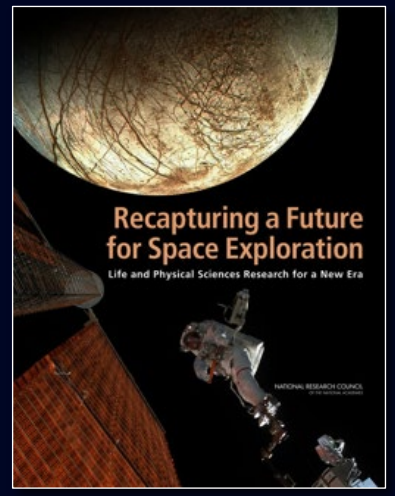
National Aeronautics and Space Administration

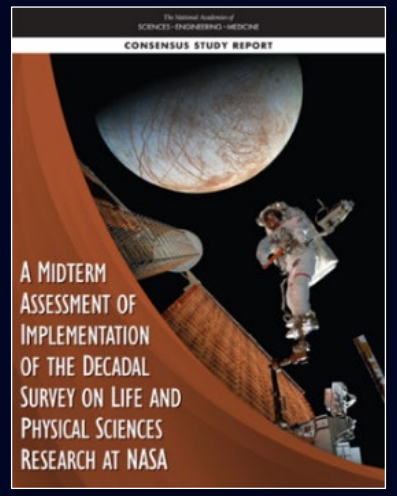


SMD Science Endeavors: Biological and Physical Sciences

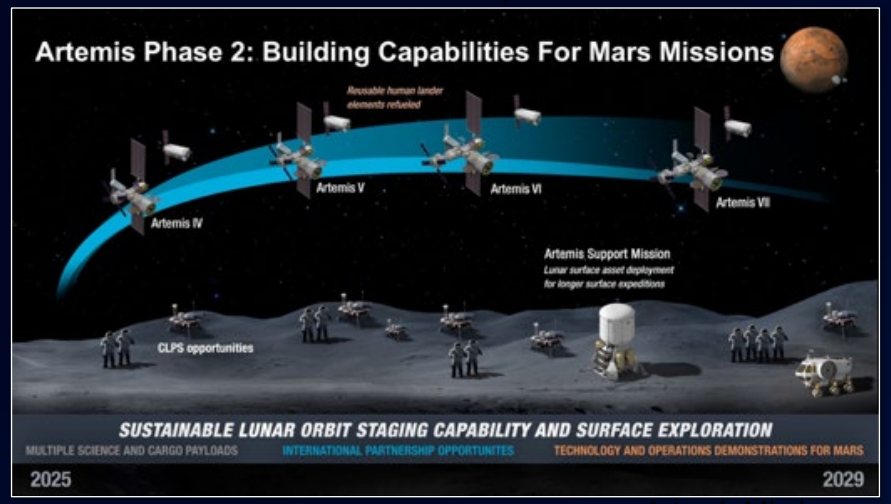
Craig Kundrot
Director
Biological and Physical Sciences Division
science.nasa.gov/biological-physical

BPS Mission





Decadal Survey



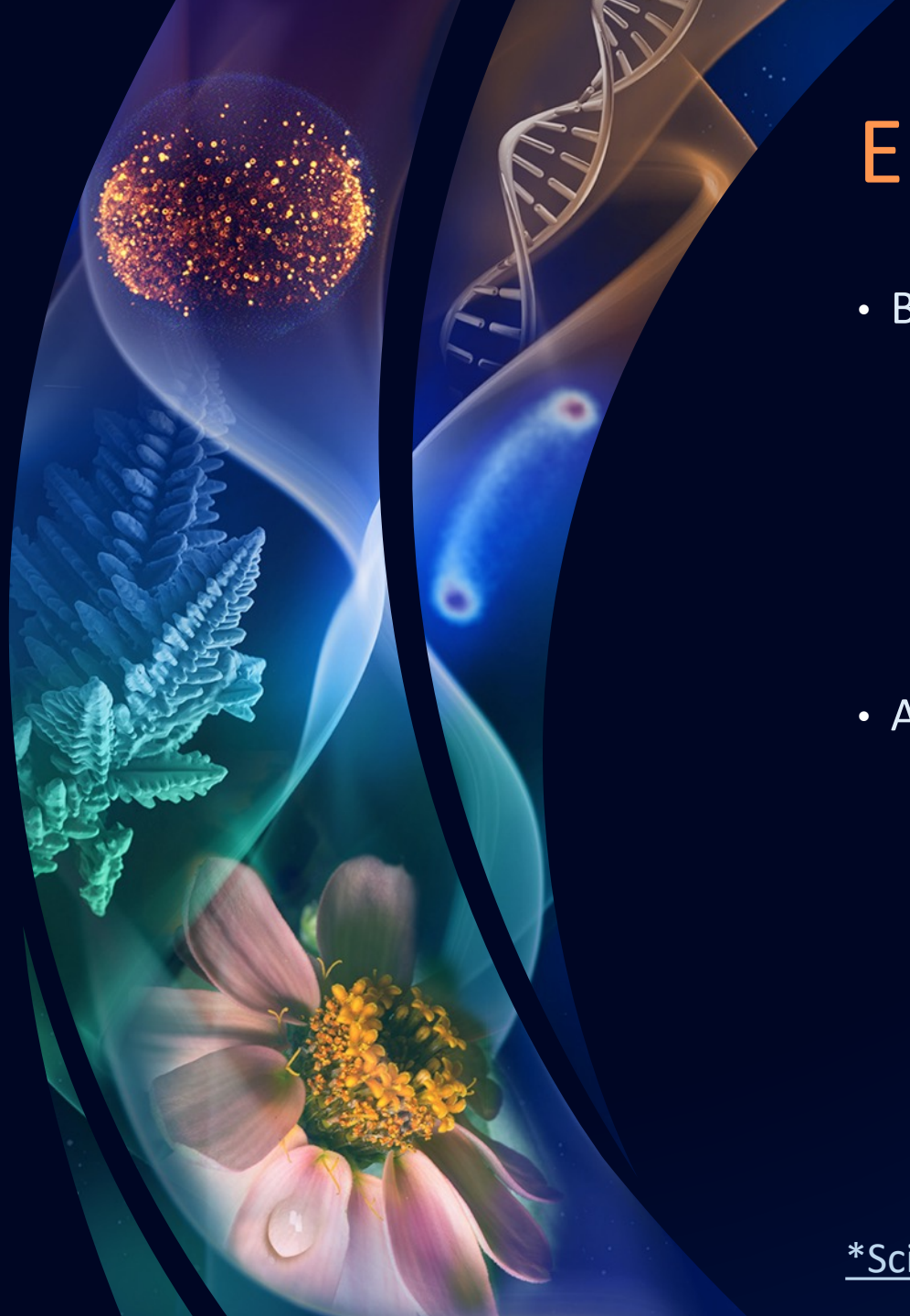
Artemis Missions

Pioneer Scientific Discovery

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

Enable Sustainable Exploration

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



Emphases for BPS in SMD

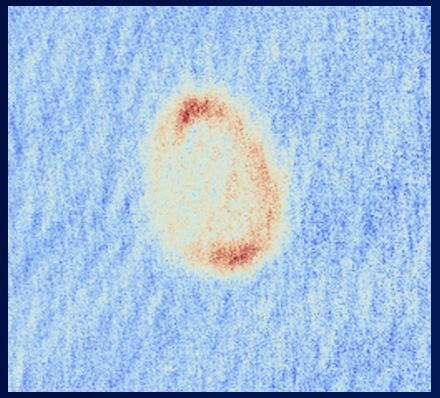
- BPS very well aligned with SMD Science Plan*
  - Priority 1: Exploration and Scientific Discovery
  - Priority 2: Innovation
  - Priority 3: Interconnectivity and Partnerships
  - Priority 4: Inspiration

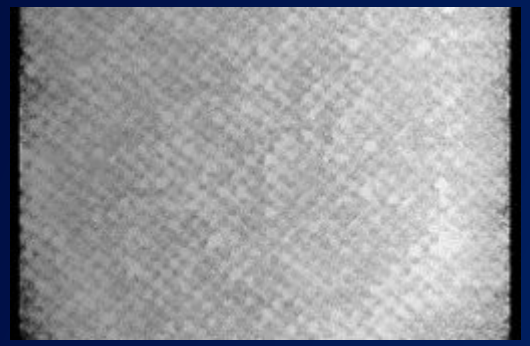
- Areas of increased emphasis for BPS in SMD
  - Transformative science
  - Inclusion, Diversity, Equity, Accessibility (IDEA)
  - Commercial spaceflight
  - Broad communication
    - @NASASpaceSci

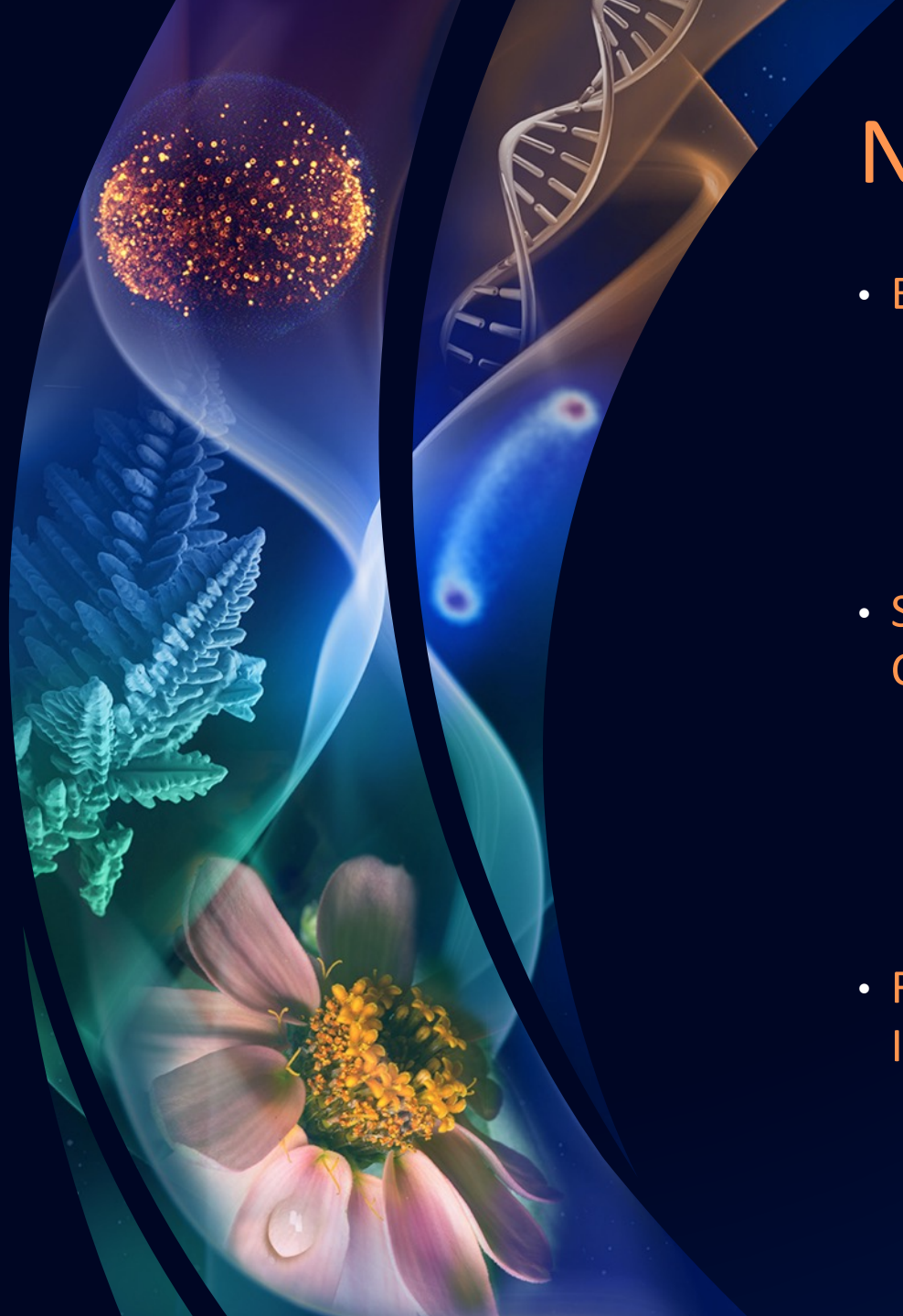
*Science 2020-2024: A Vision for Scientific Excellence

Highlights from Recent Endeavors

- Quantum Science
  - Bose-Einstein Condensates created in “bubble” geometry; 1 mm diameter
  - Explores phenomena when atoms meet themselves on the surface of a bubble
- Soft Matter
  - Phase diagram study produces near perfect FCC crystal of 1.3 µm spheres (27 mm x 1.5 mm x 0.15 mm)
  - Improved modelling supports development of photonics, additive manufacturing, etc.
- Thriving in Deep Space
  - Surprising growth patterns for plants with reduced lignin, a structural molecule
  - Identifies fundamental lack of understanding, difficulty in optimizing plants for sustainable exploration







Near Term Endeavors

- Bio-Expt-1 aboard the Artemis I mission
  - – First biological experiments to be conducted beyond the Van Allen Belts since the Apollo missions
  - – Analyze the impacts of deep-space radiation and microgravity on seeds, yeast, fungus, and algae
- Solid Fuel Ignition and Extinction (SoFIE) investigations in the Combustion Integrated Rack aboard the ISS
  - – Starting multi-year series of five investigations follows years of investigations of liquid and gaseous fuels
  - – First investigation, Growth and Extinction Limit, studies flame growth, decay, and extinction
- Flow Boiling and Condensation Experiment in the Fluids Integration Rack aboard the ISS
  - – Starting multi-year pair of investigation (BPS; NSF/ISSNL)
  - – Provides data to test and validate numerical models used to design new thermal management systems

BPS Budget Strategy

- Near-term: Focus on transformative areas
  - Bolster two areas likely to be recommended by the 2023 Decadal Survey
    1. Quantum Science (Cold matter)
    2. Thriving in Deep Space (TIDES) (Animal/Human, Plant)
  - Pause other areas until 2023 Decadal Survey received
    - Complete funding of existing grants; defer or descope future solicitations
    - Pause early-stage flight projects
  - Refine content given FY22 Appropriations ($82.5M, up from $79.1M FY 21)

- Long-term: Implement 2023 Decadal Survey priorities

The Next Decadal Survey for BPS (2023-2032)

- Recommendations for a decade of transformative science at the frontiers of biological and physical sciences research in space
  - Uniquely advance scientific knowledge,
  - Meet the needs of human and robotic exploration missions, and/or
  - Provide terrestrial benefits
- Recommendations for implementing the transformative science goals and objectives
  - Research activities
  - Associated facilities and platforms ("Keystone Capabilities/Missions")
  - Research Campaigns
- Recommendations organized into broad cost categories
  - Example: New Worlds, New Horizons in Astronomy and Astrophysics (2010)
    - Table ES.4 "$100M to $200M", "$60M to $200M"
- Release scheduled summer 2023

The transformative science conducted through Keystone Capabilities and Research Campaigns will be the building blocks of BPS's scientific program for the next decade

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
      - ISS; Commercial Low Earth Orbit Destinations
      - Lunar orbit (Gateway)
      - Lunar surface (Commercial Lunar Payload Services, Human Landing System)
      - Mars transit vehicle prototype
  - Pioneer
    - BPS first or among first at a frontier
      - Other organizations (government, commercial, academic, international) may join or follow
    - BPS collaborates in all phases
      - First tests of feasibility
      - Refining research
      - Sustained research

Thank you,
Sandra Graham!

BIOLOGICAL & PHYSICAL SCIENCES FLEET

- FORMULATION
- IMPLEMENTATION
- OPERATIONAL
- AVAILABLE

PARTNER-LED*

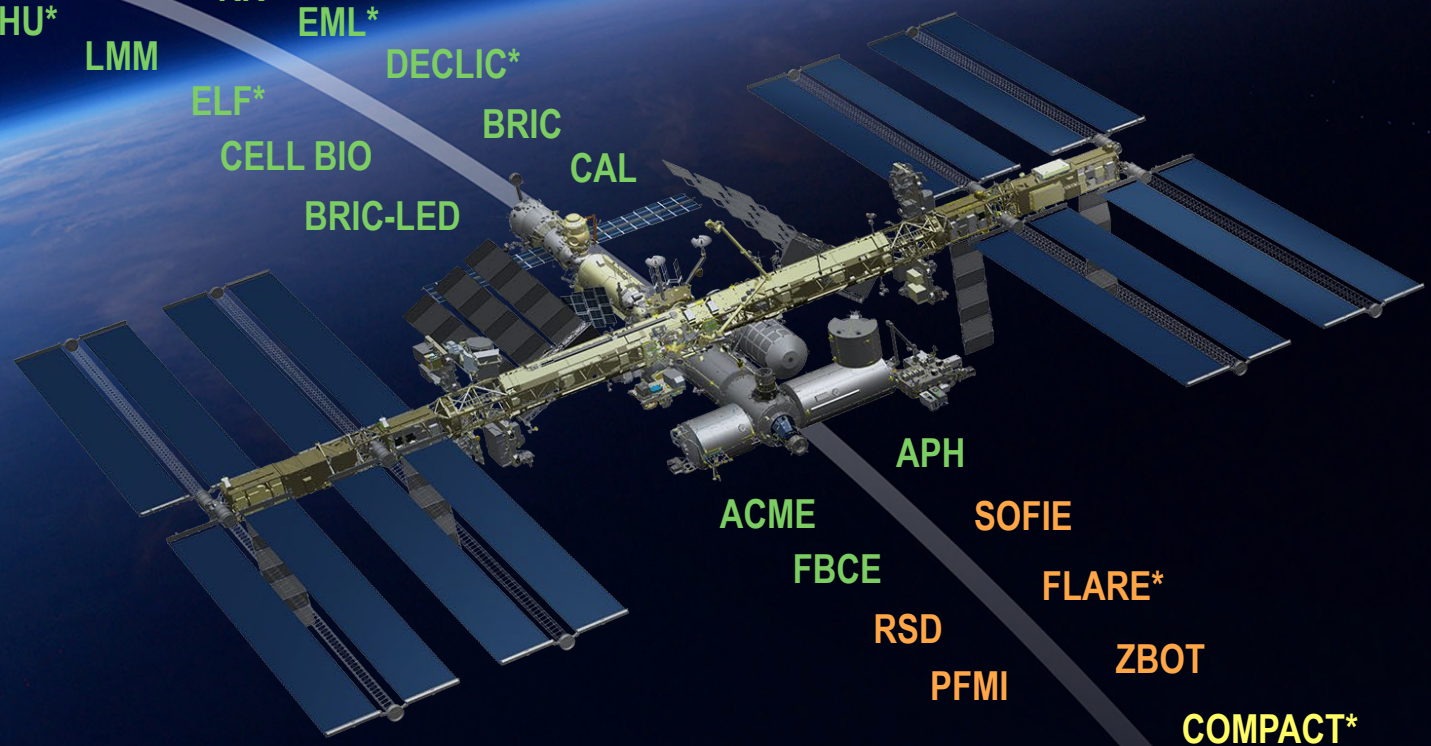
LEIA

BIOEXPT-1

PBRE
MT
MOSL
SMD*
MICRO
RR
PK-4*
MSRR
MHU*
EML*
SUBSA
LMM
DECLIC*
VEGGIE
ELF*
BRIC
WETLAB-2
CELL BIO
CAL
FFL
BRIC-LED

BION*

RAD-SEED



APH
ACME
SOFIE
FBCE
FLARE*
RSD
ZBOT
PFMI
COMPACT*
BECCAL*

Thank you