

National Aeronautics and
Space Administration



EXPLORE SCIENCE

Lori S. Glaze, Ph.D., NASA Planetary
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Science Associate Director for Flight
Programs

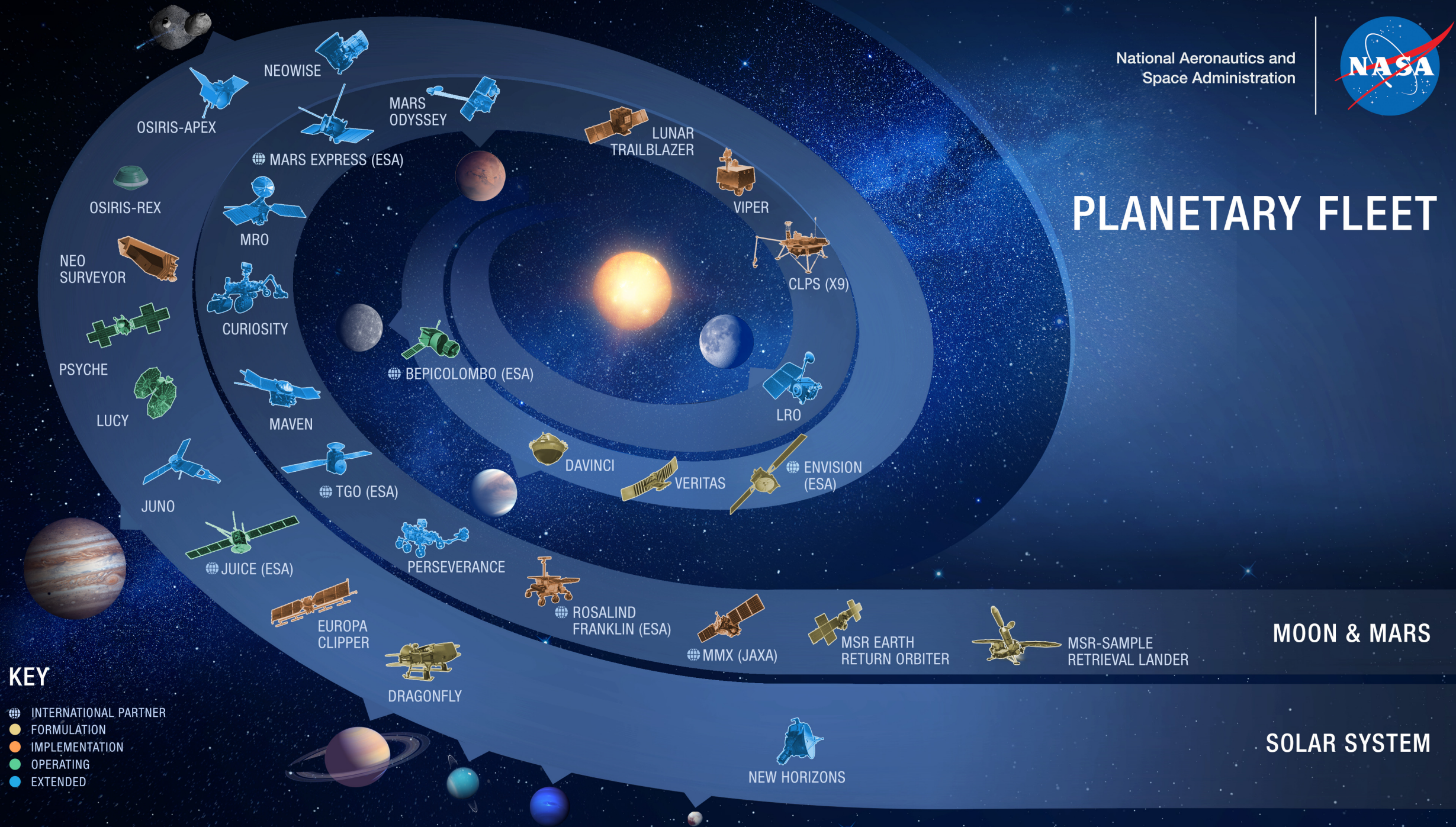
PAC

November 13, 2023





PLANETARY FLEET



KEY

- INTERNATIONAL PARTNER
- FORMULATION
- IMPLEMENTATION
- OPERATING
- EXTENDED

MOON & MARS

SOLAR SYSTEM

PSD Personnel Updates



Charles Webb
PSD Associate
Director, Flight
Programs (Acting)



*Delia Santiago-
Materese*
PSD Director of
Research Programs
(Acting)



David Grinspoon
Senior Scientist for
Astrobiology
Strategy



*Kathleen Vander
Kaaden*
PSD Deputy
Director of
Research Programs
(Acting)



Lindsay Hays
Program Scientist
for Astrobiology

Mission Updates



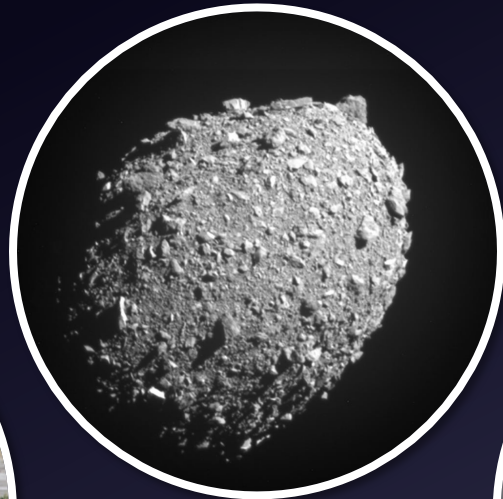
Asteroid Autumn



OSIRIS-APEX start
September 24



OSIRIS-REx Sample Return
September 24



DART Impact
1-yr Anniversary
September 26

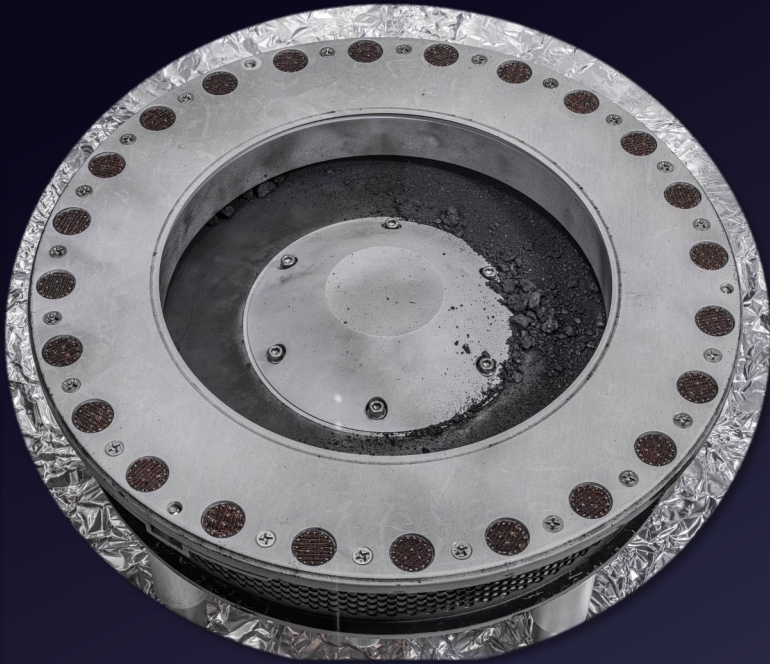


Psyche Launch
October 13



1st Lucy Asteroid
Flyby
November 1

OSIRIS-REx





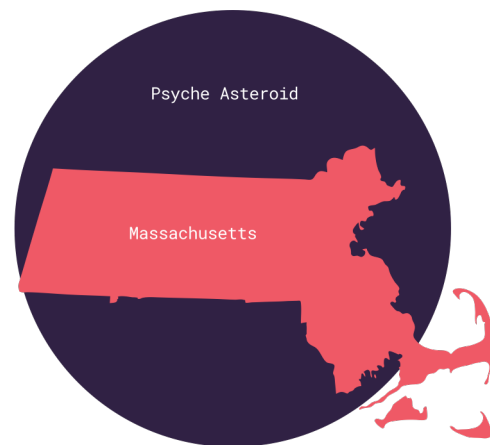
Psyche

Timeline

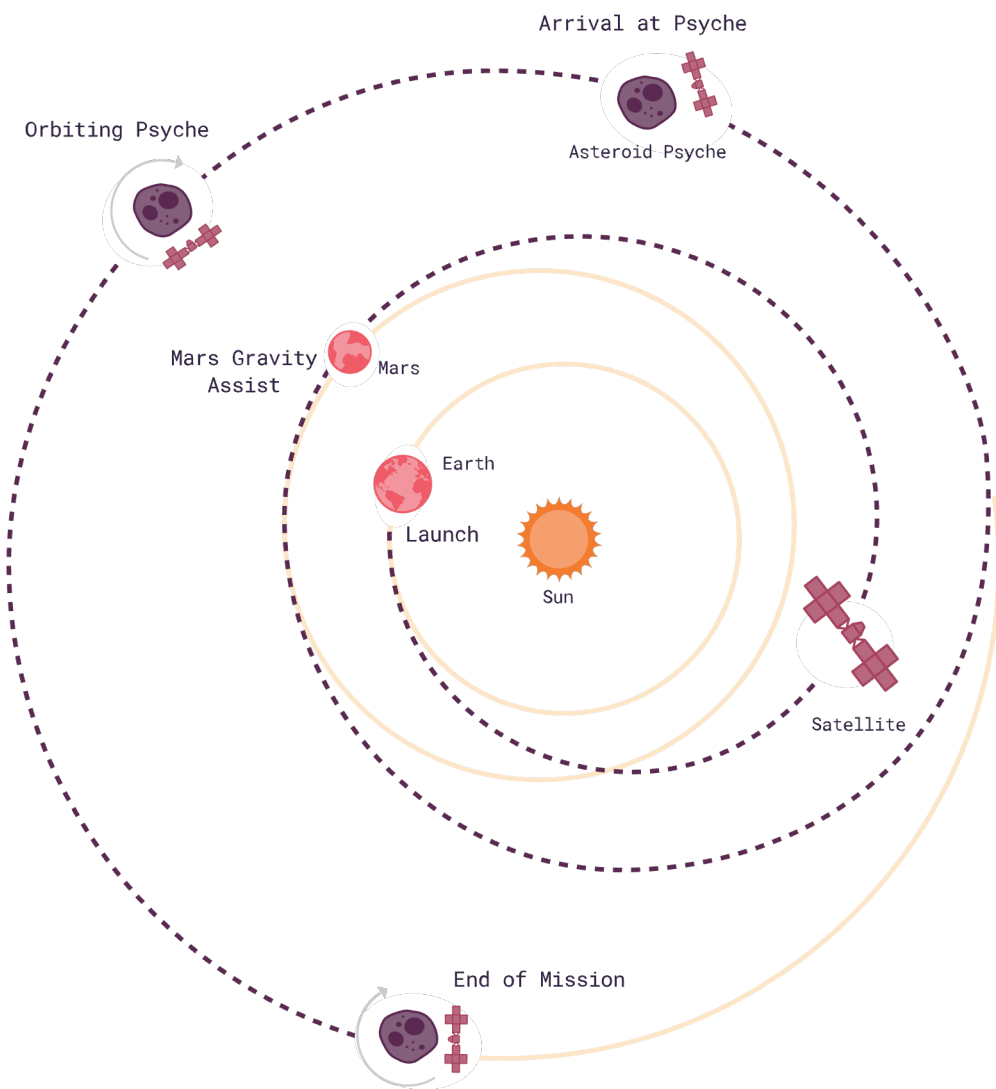
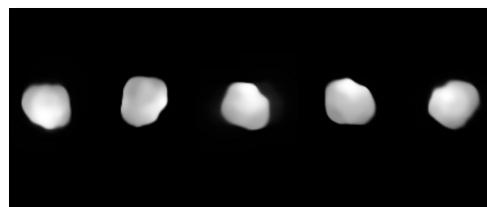
- Launched: October 13, 2023
- Mars flyby: March–May 2026
- Psyche Orbit Insertion: August 2029
 - Orbital mission: ~26 months

Payload

- **Gamma-Ray and Neutron Spectrometer** (Johns Hopkins University Applied Physics Laboratory & Lawrence Livermore National Laboratory)
- **MultiSpectral Imager** (Malin Space Science Systems)
- **Magnetometer** (MIT)



← 140 miles →

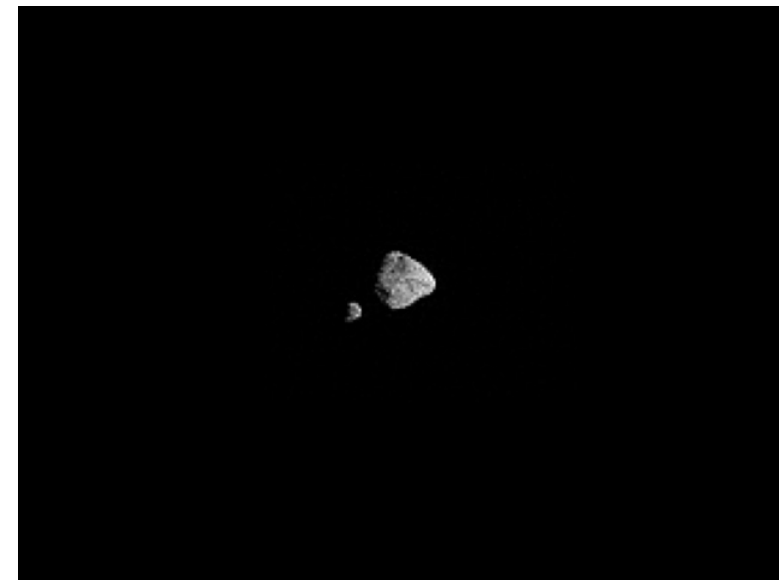
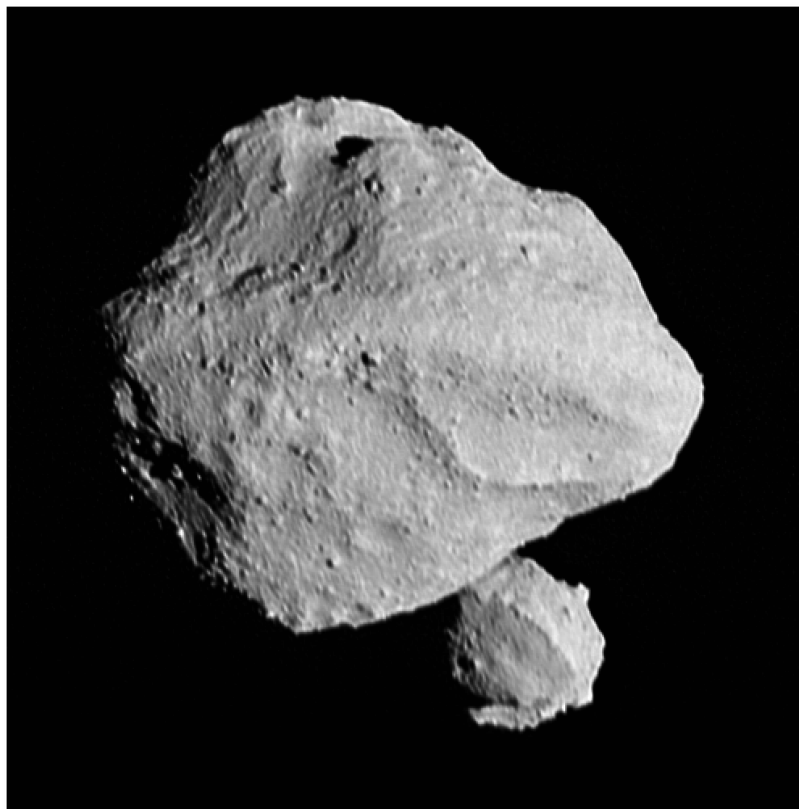




Lucy

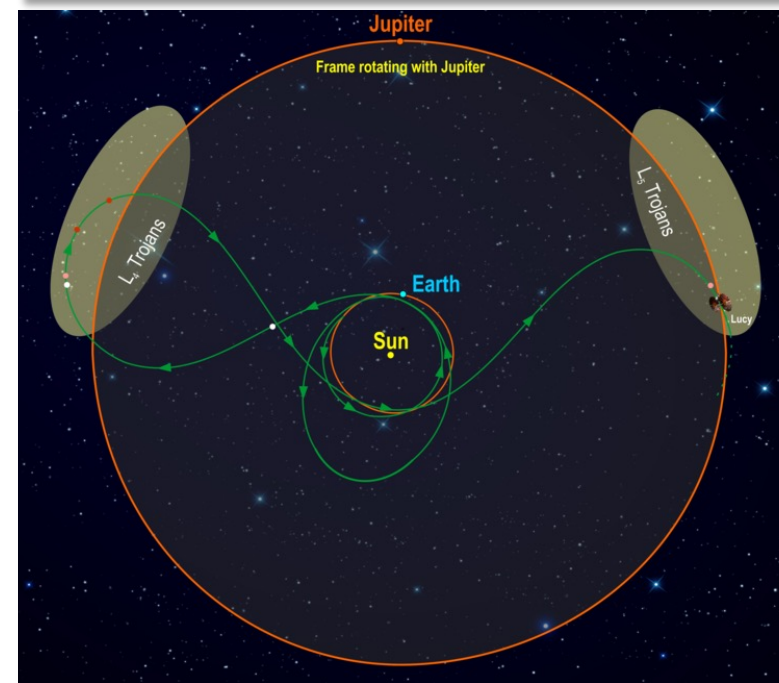
Dinkinesh Flyby (November 1)

- In-flight test of spacecraft and autonomous terminal tracking system
- First L'LORRI images revealed a close binary system
- Preliminary analysis: larger body is ~0.5 miles at its widest and the smaller is ~0.15 miles across



Coming Up

- December 2024: second Earth gravity assist
- April 2025: Donaldjohanson (main belt asteroid) flyby
- August 2027: First trojan asteroid flyby (Eurybates)

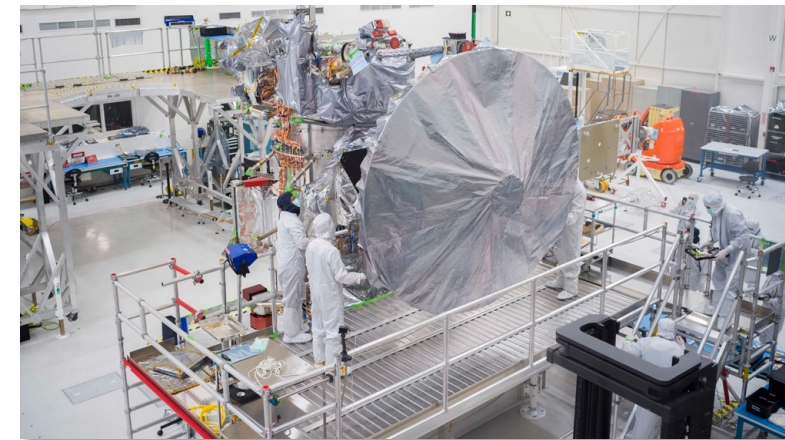


Europa Clipper

- ATLO is continuing: [live feed from High Bay](#)
- Message in a Bottle campaign – send your name to Europa – **before December 31**: go.nasa.gov/MessageInABottle
- All 10 instruments have been delivered and installed on spacecraft!
- Spacecraft is largely complete (with exception of solar arrays, which will be installed at KSC)
- Environmental testing of entire spacecraft began in November
- Target launch: October 2024
- Jupiter Orbit Insertion: April 2030



Message in a bottle campaign



Installation of 10-ft high-gain antenna

Dragonfly

- Preliminary design and technology maturation are complete
 - Successfully passed all technical requirements for mission PDR in March 2023
- APMC happening this fall



Mars2020



Perseverance and Ingenuity, as of November 6

- Rover has traveled >22 km
- Ingenuity: completed 64 flights

Samples collected to date (26 of 43 tubes)

- 14 paired rock core samples:
 - 8 during Crater Floor Campaign
 - 6 during Delta Front Campaign
- Single samples:
 - 1 during Crater Floor Campaign
 - 5 during Upper Fan & Margin Unit Campaign
- 2 regolith samples
- 1 atmospheric sample
- 3 witness blank samples

Samples cached at Three Forks

- 10 tubes
 - 7 rock cores (4 igneous, 3 sedimentary)
 - 1 regolith sample
 - 1 atmospheric sample
 - 1 witness blank sample



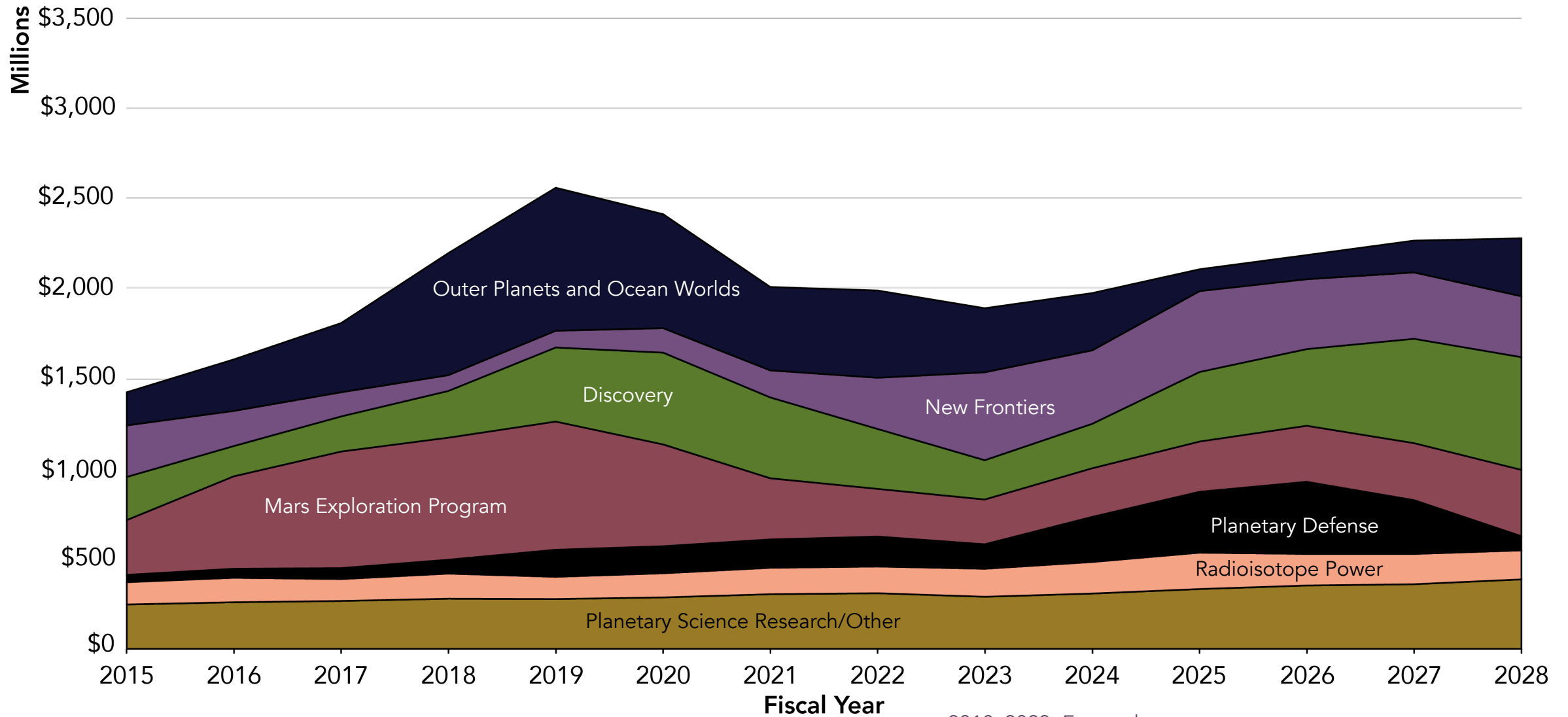
Full sample information available:

<https://mars.nasa.gov/mars-rock-samples/>

Budget Challenges



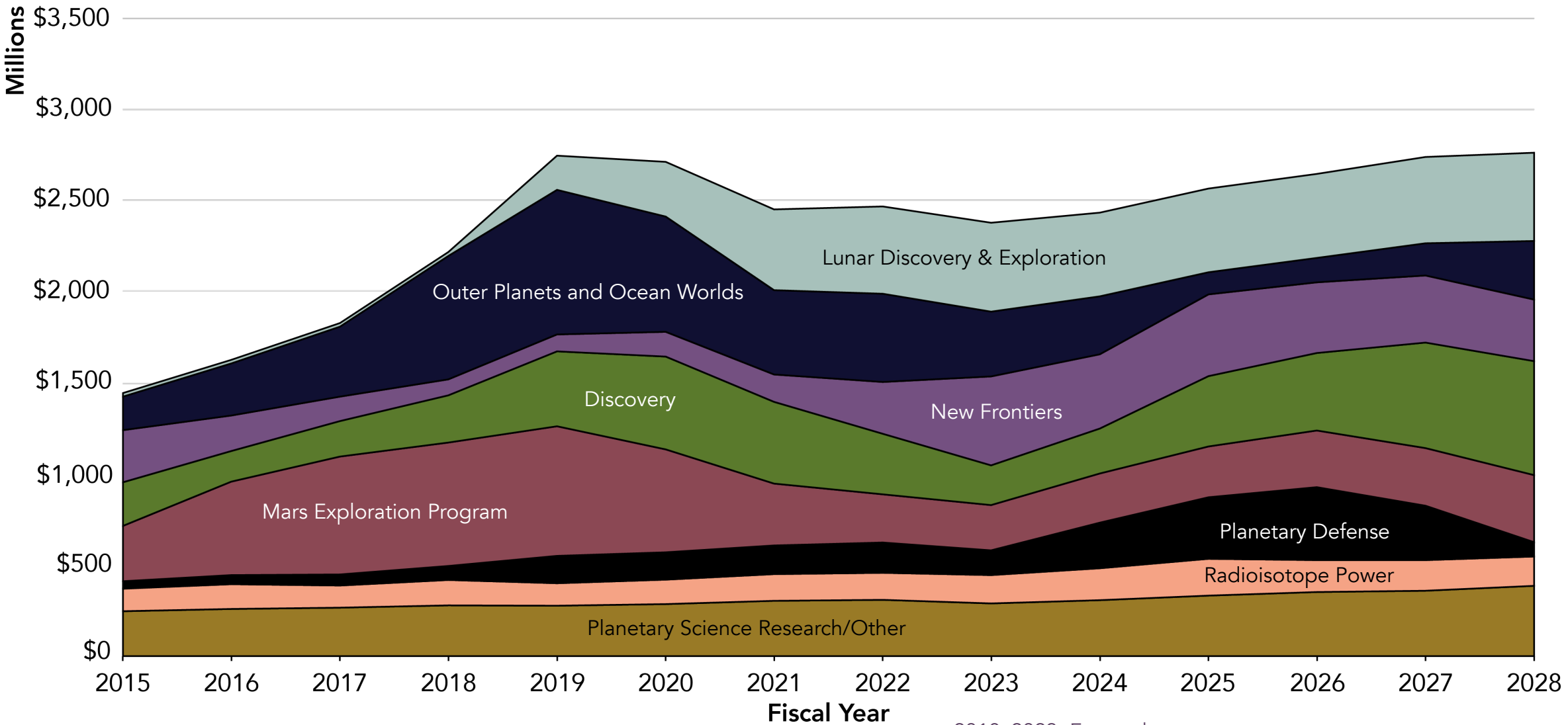
PSD Budget 2015–2028



2018–2023: Enacted

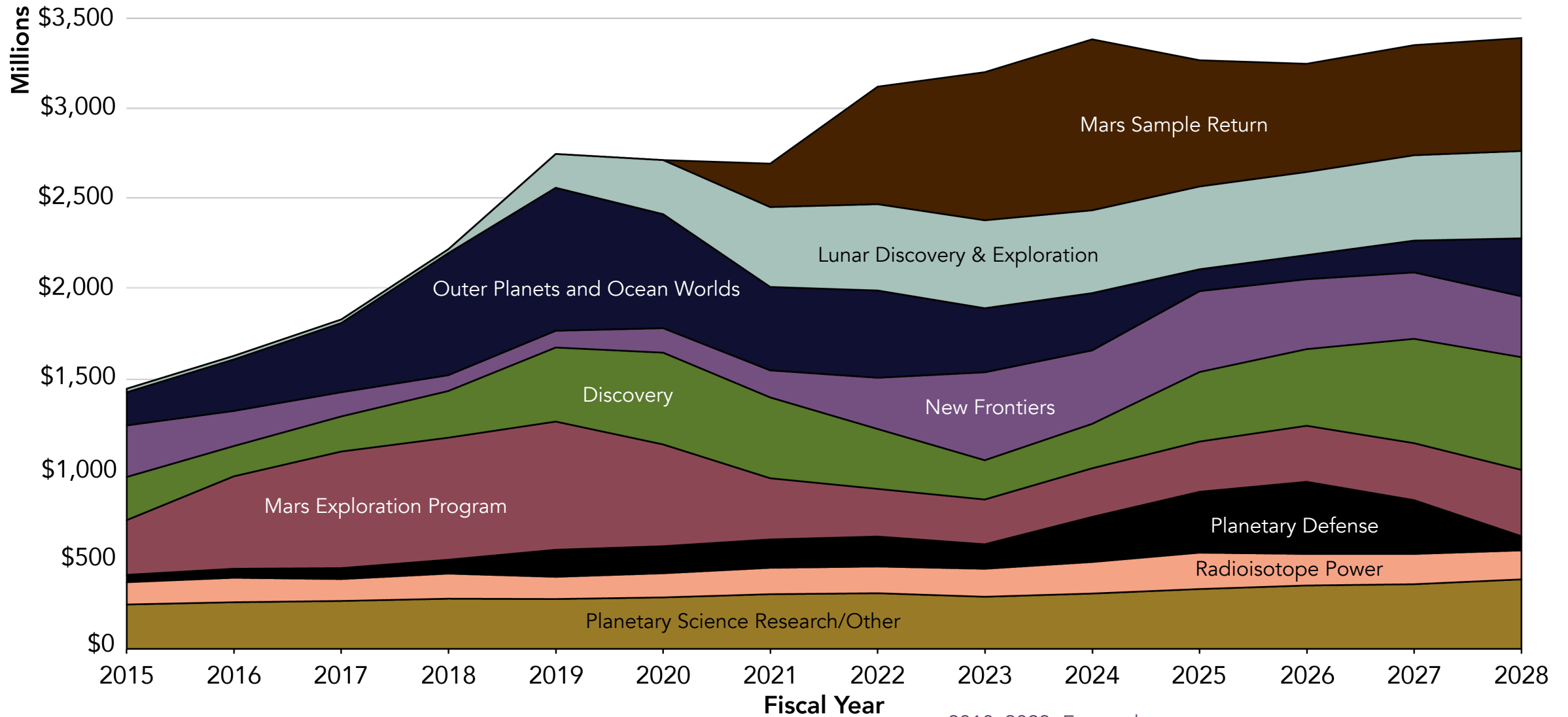
2024–2028: From President's Budget Request (PBR)

PSD Budget 2015–2028



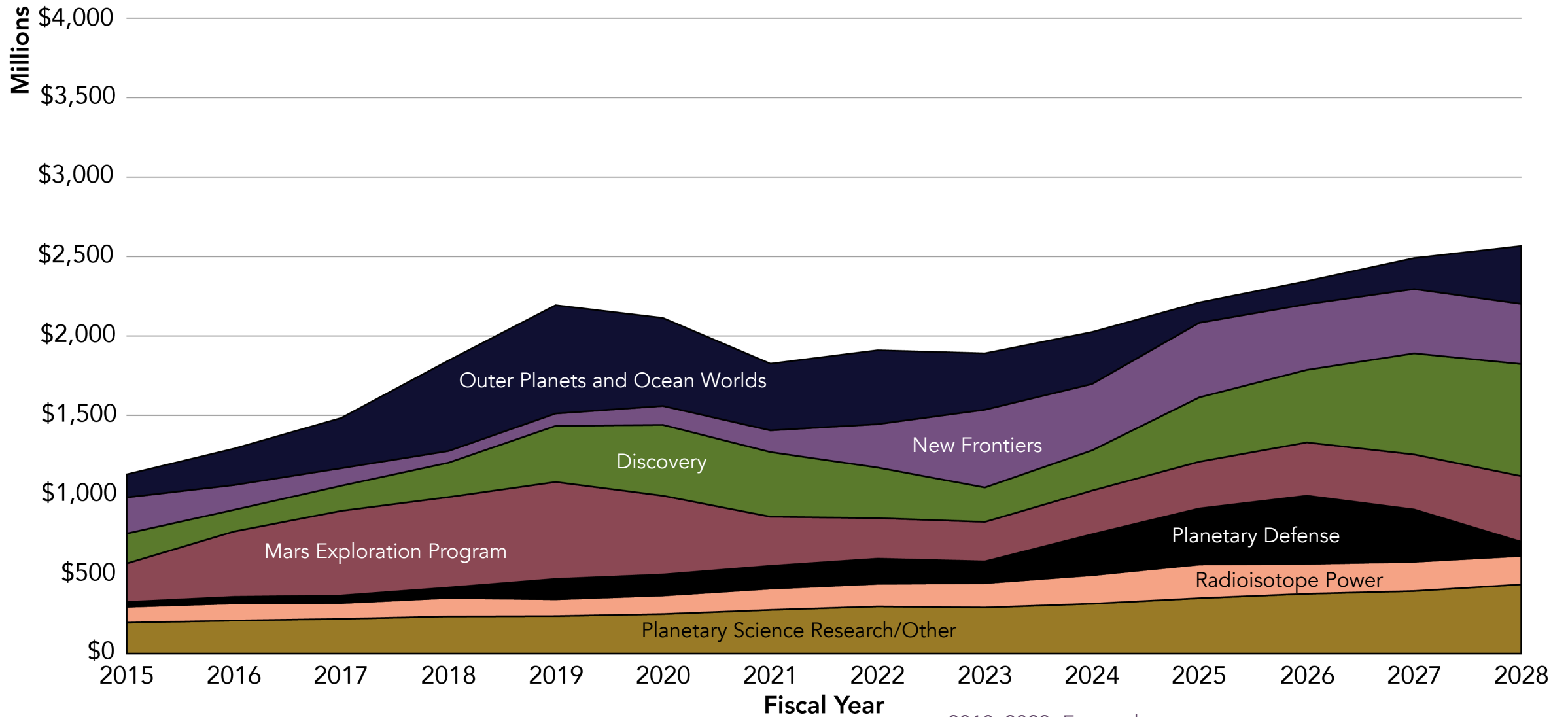
2018–2023: Enacted
 2024–2028: From President’s Budget Request (PBR)

PSD Budget 2015–2028



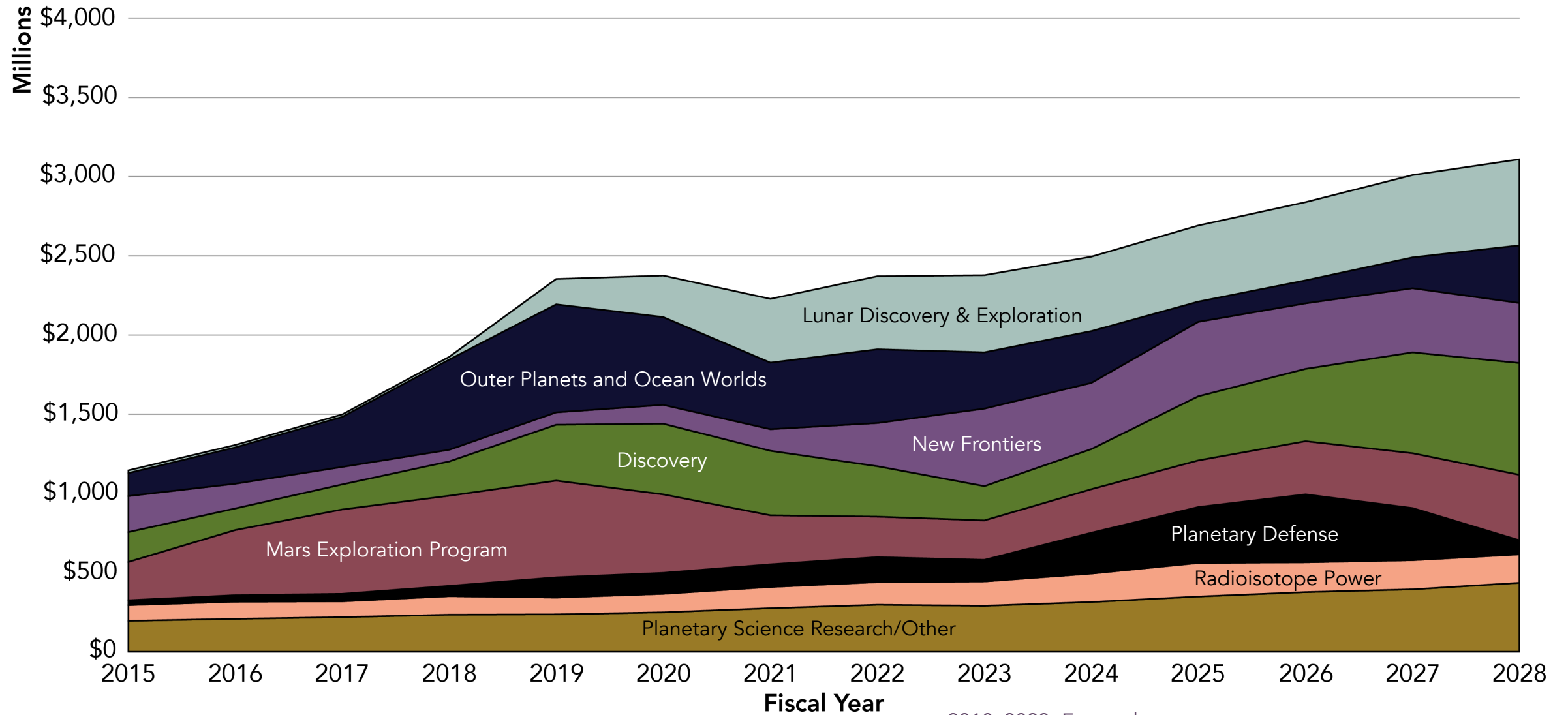
2018–2023: Enacted
 2024–2028: From President’s Budget Request (PBR)

PSD Budget 2015–2028 (inflation-adjusted to FY23)



2018–2023: Enacted
2024–2028: From President's Budget Request (PBR)

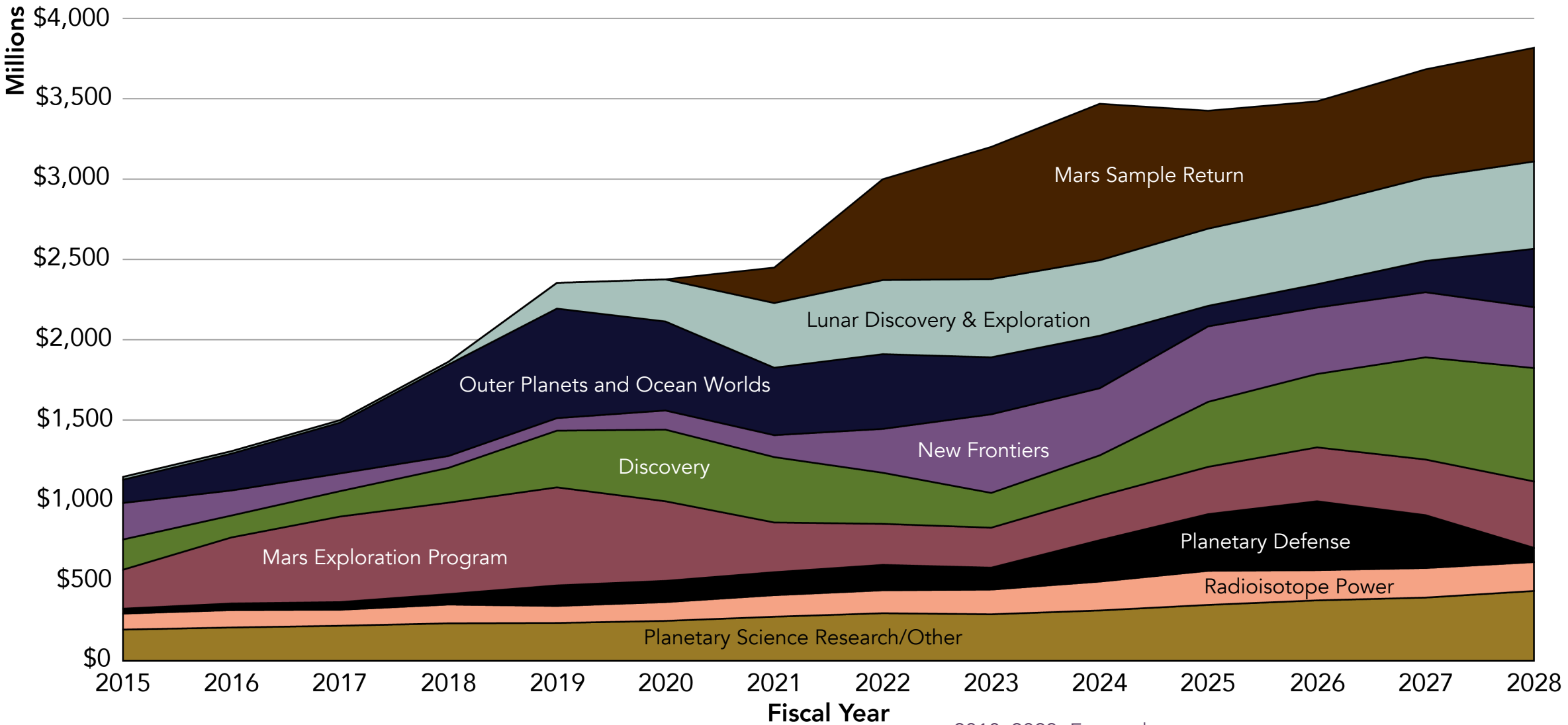
PSD Budget 2015–2028 (inflation-adjusted to FY23)



2018–2023: Enacted

2024–2028: From President's Budget Request (PBR)

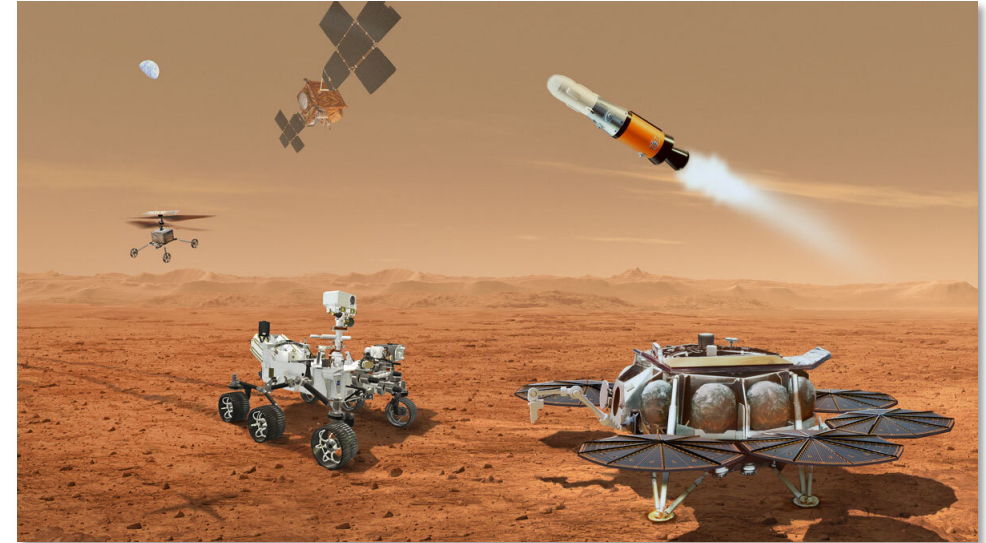
PSD Budget 2015–2028 (inflation-adjusted to FY23)



2018–2023: Enacted
2024–2028: From President’s Budget Request (PBR)

Mars Sample Return

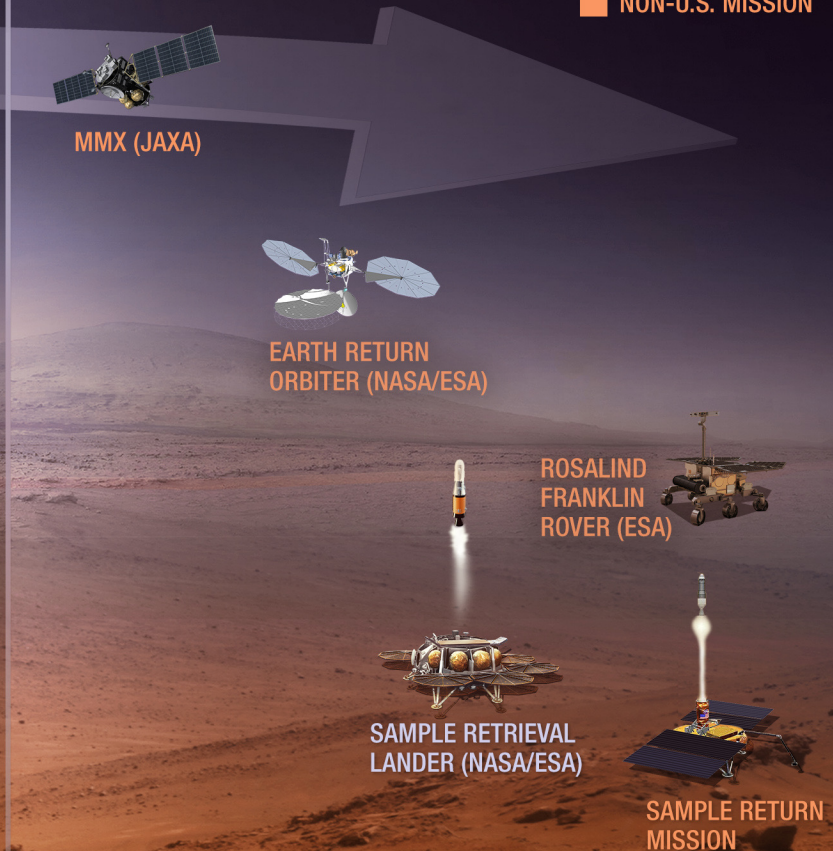
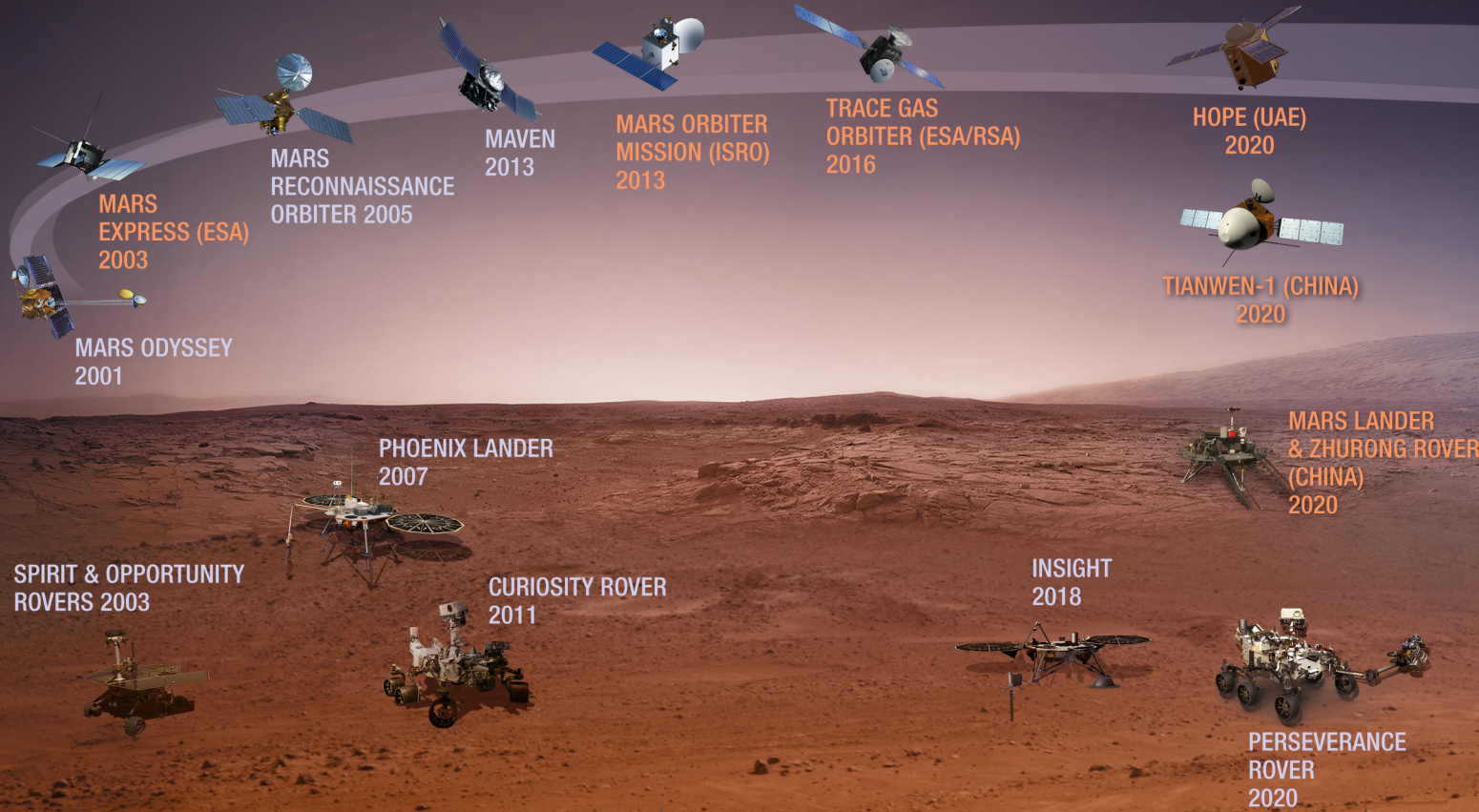
- Independent Review Board established May 2023 to evaluate technical, cost, and schedule plans prior to mission confirmation
 - Report published online:
<https://www.nasa.gov/wp-content/uploads/2023/09/mars-sample-return-independent-review-board-report.pdf>
- Team, led by Sandra Connelly (Deputy Associate Administrator for Science), will review report and make recommendations by Q2 of FY2024
- Plans to confirm official mission cost and schedule will be delayed until completion of the review



2001-2022

2024 AND BEYOND

U.S. MISSION
NON-U.S. MISSION



Follow the Water

Explore Habitability

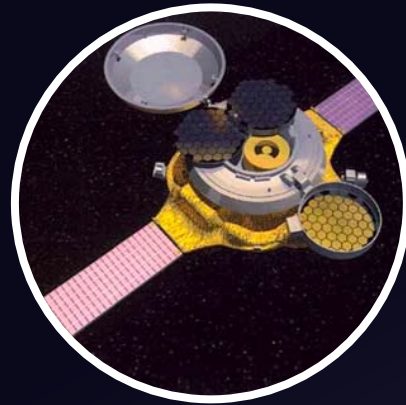
Seek Signs of Life

Prepare for Future Human Explorers

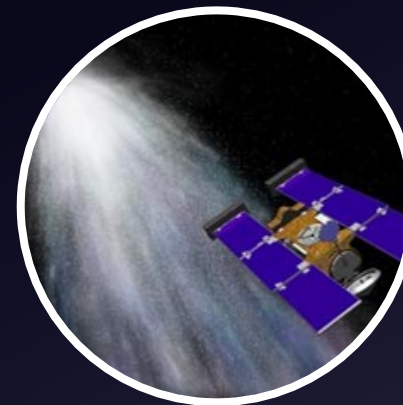
Sample Return: Multigenerational Gifts



Apollo: Lunar
Sample Return
Returned 1969–1972



Genesis: Solar wind
Sample Return
Landed 2004



Stardust: Comet
Sample Return
Landed 2006



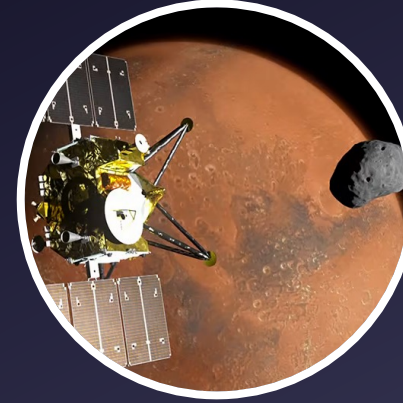
Hayabusa & Hayabusa2 (JAXA):
Asteroid Sample Returns
Landed 2010 & 2020



OSIRIS-REx: Asteroid
Sample Return
Landed 2023



Artemis III+: Lunar
Sample Returns
Landing 2025 and beyond



MMX (JAXA): Phobos
Sample Return
Landing 2029



Mars Sample Return
Landing TBD

New Horizons



- SMD multi-panel review of New Horizons was held in 2022, led by Planetary Science Mission Senior Review (PSMSR) process
 - Demonstrated excellent science value that New Horizons could bring as a heliophysics mission
- Updated plan for exploration of the outer solar system with New Horizons:
 - Beginning in FY25: spacecraft will focus on gathering unique heliophysics data during a low-activity mode of operations
 - Possibility for spacecraft to be used for a future close flyby of any newly discovered, reachable Kuiper Belt object
 - Extended operations will continue until spacecraft exists Kuiper Belt (expected 2028 through 2029)
- New extended mission will be primarily funded by PSD
 - Jointly managed by HPD and PSD
 - Mission's budget needs and impact on PSD portfolio will be assessed during annual budget process this spring

A young girl with long dark hair, wearing a dress with the American flag pattern, is looking down at a glowing, translucent orb held in a glass. The background is a dark, starry night sky with a soft glow on the horizon. The image is framed by a white, curved border.

Future Mission AOs

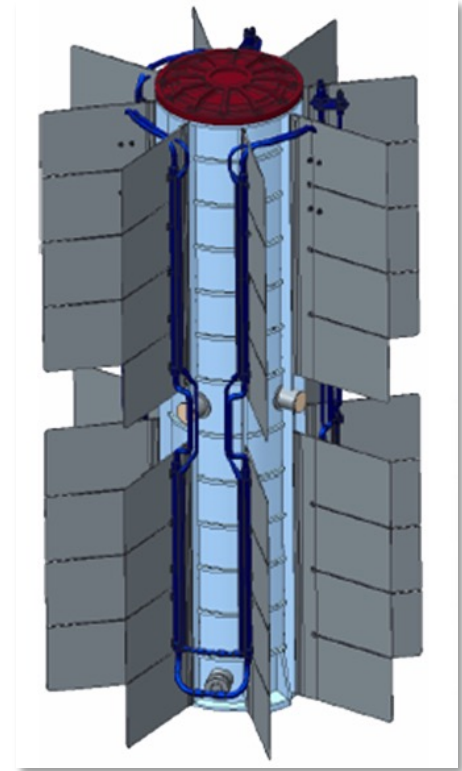
- Next New Frontiers (NF) AO final release will be no earlier than 2026
 - NF5 Community Announcement released in August provides more details
 - If the delay is significant NASA will ask CAPS to discuss mission theme recommendations (considering lists for NF5 and NF6)
- Unlikely to be solicitations for Discovery or SIMPLEx in the next two years

Other Updates



Radioisotope Power Systems

- Department of Energy's current heat source plutonium oxide constant rate production plan supports:
 - **Dragonfly**: one multi-mission radioisotope thermoelectric generator (MMRTG)
 - **Rosalind Franklin**: up to 40 light weight radioisotope heating units (LWRHUs)
 - **New Frontiers 5**: two MMRTGs and up to 20 LWRHUs
- Current rate supports one MMRTG every three years or one Next-Gen RTG every six years
- RPS Program is also currently evaluating potential needs for New Frontiers 5 and a Uranus flagship – funding availability and planned launch dates influence the rate of RPS fuel and system development
- Some MSR architectures being considered by MSR IRB Response Team (MIRT) require an MMRTG – RPS team is supporting trade studies etc



The number of nuclear-powered NASA missions is driven by selection/development of missions (and associated budgets) rather than the fuel demand/supply

Cross-Disciplinary Deep Space Radar Needs Study Report

- New report conducted by Aerospace Corporation on behalf of NASA and NSF: <https://www.nasa.gov/wp-content/uploads/2023/10/atr-2023-01267.pdf>
- Aim: determine a comprehensive list of common deep-space radar needs for NASA, NSF, and other US government agencies to:
 - Identify gaps in current and planned radar capabilities to meet agency needs
 - Provide potential reference architectures that could improve current/planned capabilities
- Major findings:
 - Significant gaps in capabilities and capacities of current deep-space radar facilities
 - Identification of overlapping needs between many missions and stakeholders



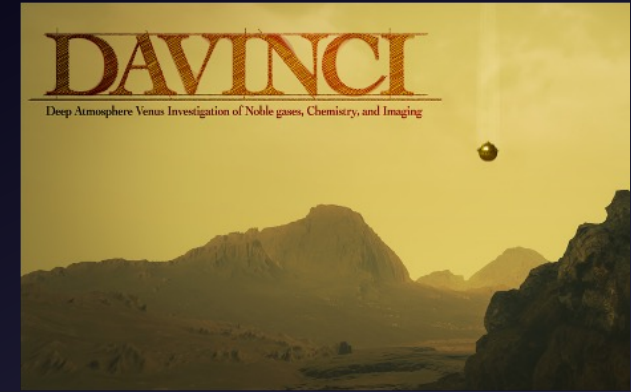
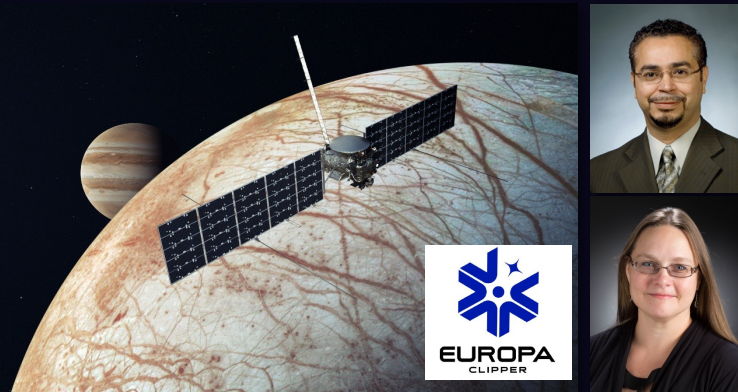
Green Bank Telescope



Research Programs

- Support for Planetary Science with Samples Cooperative Agreement Notice (CAN) – award made to USRA (LPI)
- Acquisition process for future LPSC and AG meeting support to start soon – desired award date is March 2025
- Proposal submission rates continue to be below historical numbers
 - Some evidence for the start of an uptick
- No Due Date (NoDD) programs – evaluation is underway
- New [SMD Scientific Information Policy \(SPD-41a\)](#) sets requirements for how SMD-funded scientific information must be shared
 - [SMD Open Science Guidelines](#)
 - [PSD supplement](#) to SPD-41a now available – feedback welcome
- **Here to Observe (H2O) Program** solicitation released in ROSES-23 (C.24)
 - Solicits proposals from non-R1 institutions for undergraduate students to observe PSD mission meetings/activities, alongside mentors and peers
 - Proposals may be submitted at any time (no due date)

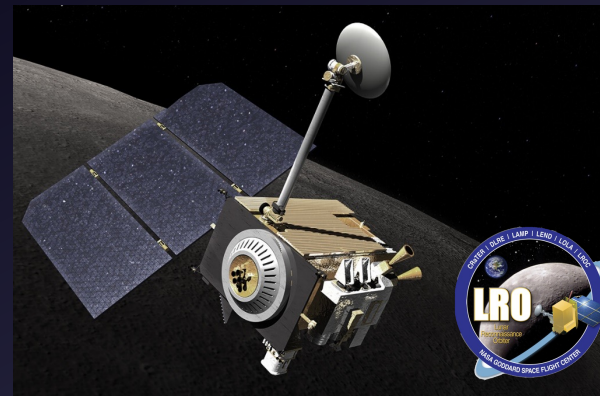
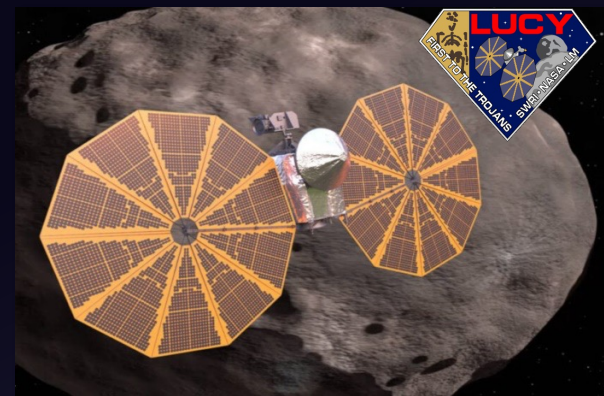
Here to Observe (H2O) Program – New Partners!



Ohio & Puerto Rico Space Grant Consortia
 Robert Romero (Ohio Aerospace Institute)
 Prof. Gerardo Morell (U. of Puerto Rico)
 Dr. Rachel Klima (Europa Clipper Mission Liaison)

Kingsborough Community College
 Prof. Steven Jaret (KBCC)
 Dr. Alexandra Pontefract (Dragonfly Mission Liaison)

New Mexico State University
 Prof. Nancy Chanover (NMSU)
 Dr. Erika Kohler (DAVINCI Mission Liaison)



Univ. of Arkansas at Pine Bluff
 Prof. Miah Adel (UAPB)
 Dr. Katherine Kretke (Lucy Mission Liaison)

New Mexico Institute of Mining & Technology
 Prof. Raúl Morales-Juberías (NMT)
 John Van Eepoel (LRO Mission Liaison)



Virginia State University
 Prof. Dawit Haile (VSU)
 Dr. Ashwin Vasavada (Curiosity Mission Liaison)



Meeting New Mexico State H2O students and faculty at VEXAG, Albuquerque, October 2023



Meeting Ohio and Puerto Rico Space Grant Consortia H2O students at Europa Clipper PSG, San Juan, November 2023



VSU H2O students visit NASA Wallops, April 2023

Inspiring Clipper: Opportunities for Next-generation Scientists (ICONS)

Undergraduate internship program – to develop and sustain a diverse and inclusive Europa science community, who will eventually lead the Europa Clipper extended mission

- Paid 10-week program – opportunity to conduct original scientific research
- In-person/virtual/hybrid options available
- First program: June 3 to August 9, 2024
- Student applications due February 2, 2024



Full details:



Decadal Survey Progress



Maintaining Balance

Decadal survey lays out:

- **Level program** (assuming 2% annual increase)
- **Recommended program** (additional 17.5% budget increase)
- **Budgetary Decision Rules** (should program budget be reduced below level program)

Reductions beyond Decadal Survey rules may be required if anticipated budgets are realized – following this strategy:

- Consider the Decadal budgetary decision rules and suggested descopes carefully
 - Does little to offset funding needs in very near term
- Postpone new initiatives (Uranus Orbiter & Probe; other competed mission programs) – **biggest lever**
- Prioritize missions in development (with Agency commitment to cost and schedule), in order of launch date
- Protect R&A budget
- Minimize disruption to international partnerships
- Try to maintain balance between operating missions and those in development
- Try to maintain balance between competed and directed missions

Other Decadal Survey Progress

Integrated Lunar Science Strategy

- PSD/ESSIO work continuing
- Release of draft document for community comment: Fall 2023

Future Mars Science Plan

- Draft is in circulation with the community

Technology Development plan

- PESTO team working to create a new PSD Technology plan
- Plan will be responsive to OWL recommendations and findings, as well as to NASA's Strategic and Science Plans

Astrobiology

- New Senior Scientist for Astrobiology Strategy now in role (David Grinspoon)

Coming Up in 2024



A Big Year for the Moon



First CLPS Landings
Starting January



Total Solar Eclipse
April 8



VIPER
Launching November



Lunar Trailblazer
Launching with IM-2



Findings



Finding 1: PSD Budget Prioritization (1/3)

Context: There is currently a high degree of uncertainty regarding federal government budgets in the coming years, leading to difficulties in developing plans and decisions through all levels of planetary/PSD work. Such concerns are compounded by recent increases in general mission costs, including the still evolving estimates for the Mars Sample Return (MSR) project, and questions about how such costs would be covered. Within potential future hard decisions about where to put funding, the Planetary Science and Astrobiology Decadal Survey and the community have both emphasized the importance of programmatic balance for science advancement, community engagement and experience, and opportunities for diverse and broad contributions. Such balance should be considered across missions of different sizes and with different target bodies/investigations, between competed and directed efforts, and between continued high science return from extended missions and development of new science investigations/incorporation of improved technologies.

Finding: The PAC applauds PSD's transparency in laying out priorities and potential trades and endorses PSD's stated budget priorities, which are consistent with the OWL Budgetary Decisions Rules. These are, first, to protect/grow R&A to at least 10% of PSD budget (per the OWL Decadal recommendation); second, support ongoing and confirmed (Phase C) missions; third, support missions that have been selected and are currently in Phase B, including restarting VERITAS; then, after current firm commitments are addressed, new starts and AOs would be initiated.

Finding 1: PSD Budget Prioritization (2/3)

Recommendations:

- (a)** The PAC endorses the plan to increase the R&A budget to 10% of the PSD budget by FY28, as proposed in the FY24 President's Budget Request. The PAC recommends not delaying achievement of this Decadal Survey-recommended funding level beyond FY28 and, should increased funding be available, the PAC supports meeting this goal sooner.
- (b)** The PAC recommends that PSD adopt the OWL recommendations for MSR and future MEP missions, including cost limits. Specifically, the PAC (1) supports development and execution of a comprehensive architecture of missions, partnerships, and technology development to enable continued scientific discovery at Mars; and (2) recommends that PSD follow the guidance in the Decadal Survey regarding MSR cost management, of no more than 35% of the PSD budget and no greater than 20% beyond \$5.37B. For the second item, the PAC requests that regular reports on the MSR project status continue to be provided to them and the community, including results of the current Independent Review Board (IRB) for MSR, and to hear about specific mechanisms planned for MSR cost management.
- (c)** Until the budget is available for a new large mission start, the PAC recommends early study funds, budget permitting, for the Uranus Orbiter and Probe and Lunar Endurance Rover so as to keep these Decadal-prioritized concepts maturing.
- (d)** The PAC supports the funding of extended missions at levels recommended by Senior Review evaluations.

Finding 1: PSD Budget Prioritization (3/3)

Response: PSD appreciates the PAC's endorsement of the priorities that are being used to make difficult funding decisions within the anticipated highly constrained budgets. With regards to the specific recommendations:

- (a)** PSD is working to preserve the R&A budget and meet the Decadal-Survey-recommended 10% of the PSD budget by FY28, as proposed in the FY24 President's Budget Request, or sooner if possible.
- (b)** The recent MSR IRB indicated a high likelihood that the cost of MSR will exceed 20% beyond \$5.37B, even in scenarios that consider different, less-complex, architectures. PSD, along with the MSR Program and SMD, however, believe that the Decadal-Survey guidance to not exceed 35% of the PSD budget in any given program year can assure completion of the high-priority MSR goals, while maintaining balance within the PSD program. This meeting includes updates on the MSR IRB and the SMD response plans.
- (c)** PSD concurs with the PAC recommendation, budget permitting, to support the Uranus Orbiter and Probe and Lunar Endurance Rover. Although, at this time, the FY24 budget uncertainty remains very high, PSD has supported multiple Uranus workshops and LDEP has begun studies of technologies of the Endurance-A Rover mission concept.
- (d)** At this time, FY24 budget uncertainty remains very high. PSD concurs that funding of extended missions should be supported, if at all possible, after meeting the highest-priority Division needs.

Finding 2: Broadened R&A Program Scope

Context: PSD has proposed an R&A program, including three new elements starting in FY25, that aim to not only increase total budget but use additional funds to broaden participation in planetary science and create a more diverse and inclusive planetary science community. The new proposed program elements include funding for (1) mission concept studies, (2) a named postdoctoral fellowship program (i.e., not tied to an institution), and (3) studies to explore approaches to improving and broadening participation in planetary science with eventual embedding of these approaches through all PSD programs.

Finding: The PAC agrees with the proposed R&A program's overall aims and scope and endorses the addition of the three notional new elements, pending future budgets enabling their addition.

Response: PSD appreciates the PAC's endorsement of these three newly proposed elements. PSD plans to initiate proposed program element (3) above in FY24: studies to explore approaches to improving and broadening participation in planetary science. This will be conducted in collaboration with NSF: Ideas Lab will be held with the goal of initiating projects that will lead to full proposals for future concept studies for a broadening participation in planetary science program. The new proposed elements for (1) mission concept studies and (2) a named postdoctoral fellowship program are delayed until the PSD budget can support these initiatives.

Finding 3: “Ethics in Fieldwork” Policy

Context: The PSD Astrobiology Program and ROSES, working with indigenous scientists and groups, have generated a detailed set of guidance and resources for the community to raise awareness of ethical responsibilities and related legal requirements for fieldwork. Such awareness, and related policies, are important within fieldwork and work with samples as the value of the site/materials for societal communities and future researchers/visitors should be considered in addition to value for their immediate science investigation. Intentional respect towards the lands, waters, and skies of a study area, along with any people invested in that area, will broaden and improve fieldwork planning and protect the potential for future viewing and research within a site/with a sample. Furthermore, such ethical behaviors will contribute towards fostering a more inclusive science community and culture.

Finding: The PAC strongly supports development of this new fieldwork policy, based on the generation of authentic partnerships with indigenous communities and valuation of indigenous cultures and science, that would complement policies to increase safety within fieldwork and environmental protection of study sites. The PAC encourages continued dissemination of related resources and guidance to the planetary science community, in particular to those involved with fieldwork and terrestrial or planetary sample collection and analysis.

Response: In C.1, Planetary Sciences Research Program Overview for ROSES-24, the “3.14 Fieldwork” section will be expanded to include additional information about how to respond to the requirement for a description of fieldwork and a “code of conduct”, as well as a detailed description for the motivation behind this requirement and a list of resources for proposers. To allow proposers to respond appropriately to this requirement, additional space will be provided in the proposal framework. A guide for reviewers will also be created to make sure that these sections in proposals are reviewed fairly and equally. We expect to make further improvements in future ROSES years. We thank the PAC for their support of these efforts.

Finding 4: Inclusion Plan Requirements in ROSES

Context/Finding: The PAC recognizes and appreciates the recent improvements in the definition and standardization of the inclusion plan (IP) requirement for the ROSES program and the scope of information shared with the community. The PAC supports the aim of the requirement that proposers must generate an inclusion plan and agrees with (1) the requirement being flexible so as to enable an IP to be tailored to a specific team/project/institution and (2) the IP's quality not currently being a basis for award selection.

Recommendations: The PAC recommends that the resource website and requirement description/guidance continue to evolve so as to further clarify to the community what is needed. In particular, future sharing of the rubric to be used by the reviewers of inclusion plans will provide useful guidance to proposers. The PAC also recommends communicating to the community that IP requirements in ROSES may be different from IP (or Diversity and Inclusion Plan) requirements in other NASA programs.

Response: NASA thanks the PAC for their recommendation and their continued support for Inclusion Plans. New resources will continue to be added to the Inclusion Plan Resources page (<https://science.nasa.gov/researchers/inclusion/>) as they are identified and when community members share them with us. The standardized language in ROSES for the Inclusion Plan is updated yearly based on feedback from the community and our reviewers. This language includes a statement that inclusion is separate and distinct from diversity, and that we are not requiring a diversity plan. Solicitations that are outside of ROSES (e.g., SSERVI CANs or AOs) may have different requirements than those for ROSES program elements. Once complete, the rubric will be included in the ROSES 2024 Summary of Solicitation and will be posted to the resources webpage.

Finding 5: Psyche IRB Follow-up with Institutional Assessment

Context/Finding: The PAC expresses our appreciation for the transparency and insights provided by JPL and PSD leadership in addressing the issues identified in the Psyche Independent Review Board (IRB) findings. JPL's proactive attitude of taking interim steps to mitigate remaining concerns with the Standing Review Board (SRB) review process, while NASA leadership assesses the SRB review process, is laudable. Similar proactive interim steps are desirable at other NASA Centers.

Recommendation: With important upcoming reviews for major missions, the PAC requests an update on the status of the Agency's internal reviews of the SRB review process and the Agency's response to the IRB recommendations.

Response: NASA's Chief Program Management Office (CPMO) is leading an Agency-wide initiative to strengthen the Independent Assessments (IA), which include SRBs/IRBs. CPMO aims to improve cross-organizational collaboration, share best practices and lessons learned, and identify forward work for IA improvement in collaboration with the mission directorates (MDs). CPMO led a data collection effort earlier this year, gathering feedback on NASA's IA process through an IA Community Survey (283 responses, 37 respondents) and IA Stakeholder Survey (466 responses, 87 respondents). These results were presented at the Mission Directorate (MD) Independent Assessment (IA) Forum in August 2023. As an outcome, CPMO identified 13 key takeaways across 9 categories, 16 challenges to the IA process, 13 ideas for action, and 8 focus areas for future work. The findings emphasized the importance of improving mechanisms used to provide SRB feedback to increase accountability and increasing SRB training opportunities, along with recommended improvements to SRB procedures to increase standardization and documentation. Some of these recommended improvements include broadening SRB Communities of Practice to promote open dialogue, developing metrics to measure SRB effectiveness, establishing SRB and project check-ins between reviews, developing meaningful SATERN training for SRB members, and standardizing procedures, techniques and templates across the Agency. Additional information related to this finding and recommendation will be presented during SMD/DAAP's PAC presentation.

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