Lori S. Glaze, Ph.D.
NASA Planetary Science Division Director

Planetary Science Advisory Committee (PAC) Virtual Meeting

February 15, 2022

New(er) PSD Team Members

Tiffany Morgan
MEP Deputy Director

Doris Daou
Program Scientist

Delia Santiago-Materese
Program Scientist

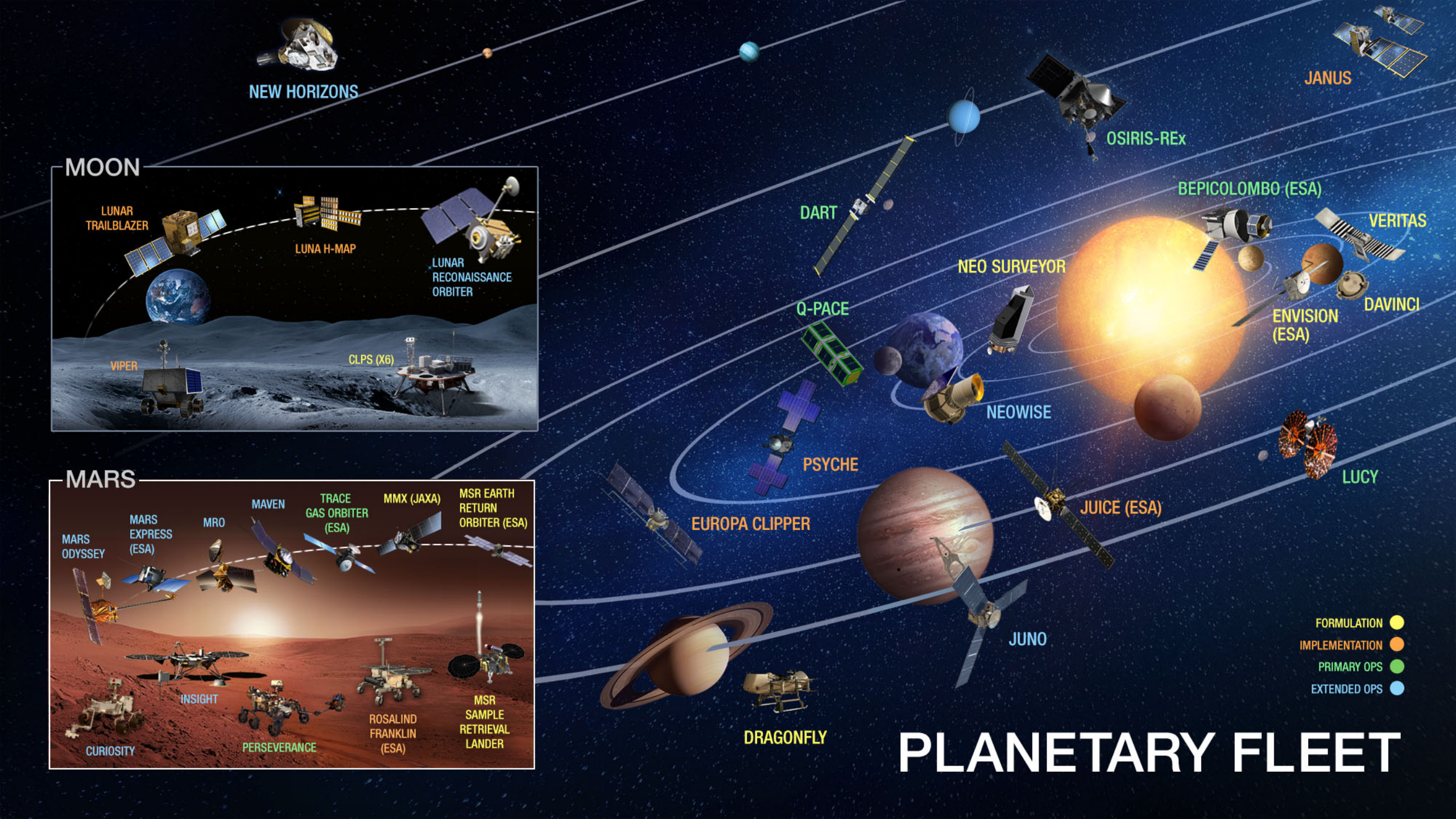
Nicolle Zellner
Program Scientist (IPA)

Kathleen Vander Kaaden
Program Scientist

Stacey Cunningham
Project Support Specialist

Erin Morton
Senior Communications Specialist

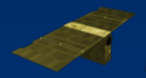
Tahira Allen
Digital Communications Specialist


NEW HORIZONS
MOON
LUNAR TRAILBLAZER
LUNA H-MAP
LUNAR RECONAISSANCE ORBITER
VIPER
CLPS (X6)
MARS
MARS ODYSSEY
MARS EXPRESS (ESA)
MRO
MAVEN
TRACE GAS ORBITER (ESA)
MMX (JAXA)
MSR EARTH RETURN ORBITER (ESA)
INSIGHT
CURIOSITY
PERSEVERANCE
ROSALIND FRANKLIN (ESA)
MSR SAMPLE RETRIEVAL LANDER
JANUS
OSIRIS-REx
DART
BEPICOLOMBO (ESA)
VERITAS
NEO SURVEYOR
Q-PACE
ENVISION (ESA)
DAVINCI
NEOWISE
PSYCHE
LUCY
EUROPA CLIPPER
JUICE (ESA)
JUNO
DRAGONFLY
FORMULATION
IMPLEMENTATION
PRIMARY OPS
EXTENDED OPS
PLANETARY FLEET

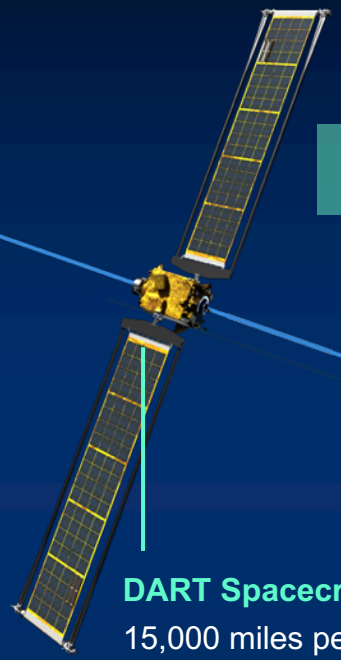
DART
Double Asteroid Redirection Test

Vandenberg Space Force Base
Nov 24, 2021

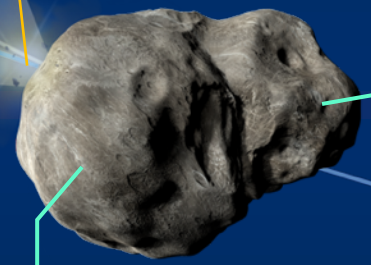
IMPACT: Sep 26, 2022



LICIACube
(Light Italian Cubesat for Imaging of Asteroids)
Italian Space Agency contribution

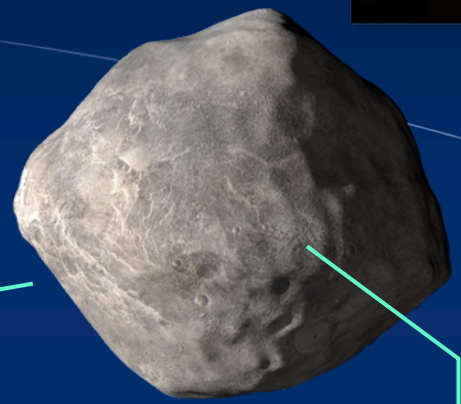


DART Spacecraft
15,000 miles per hour



Dimorphos
160 meters
11.92-hour orbital period

1,180-meter separation between centers

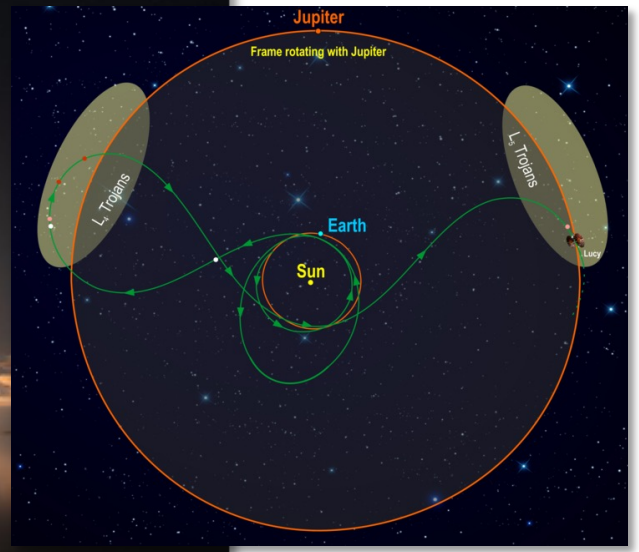


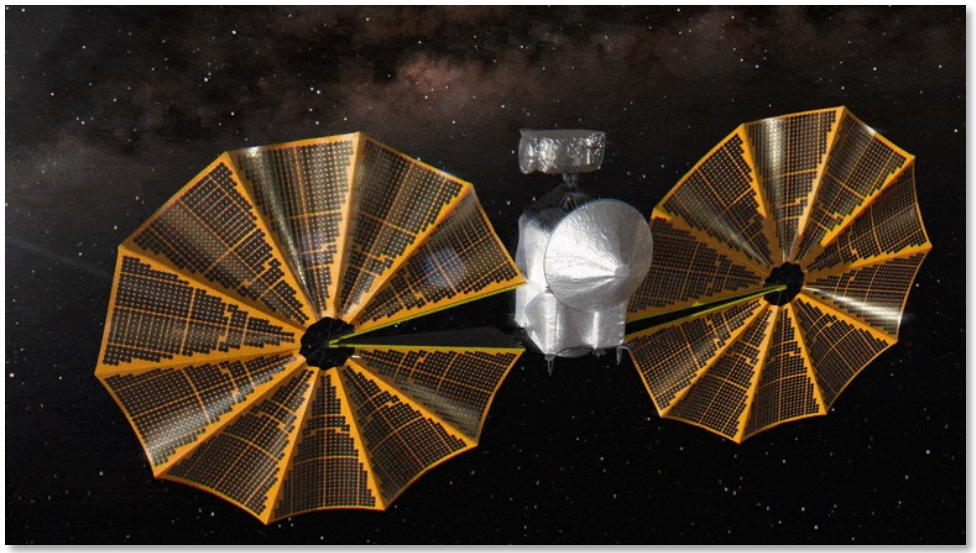
Didymos
780 meters

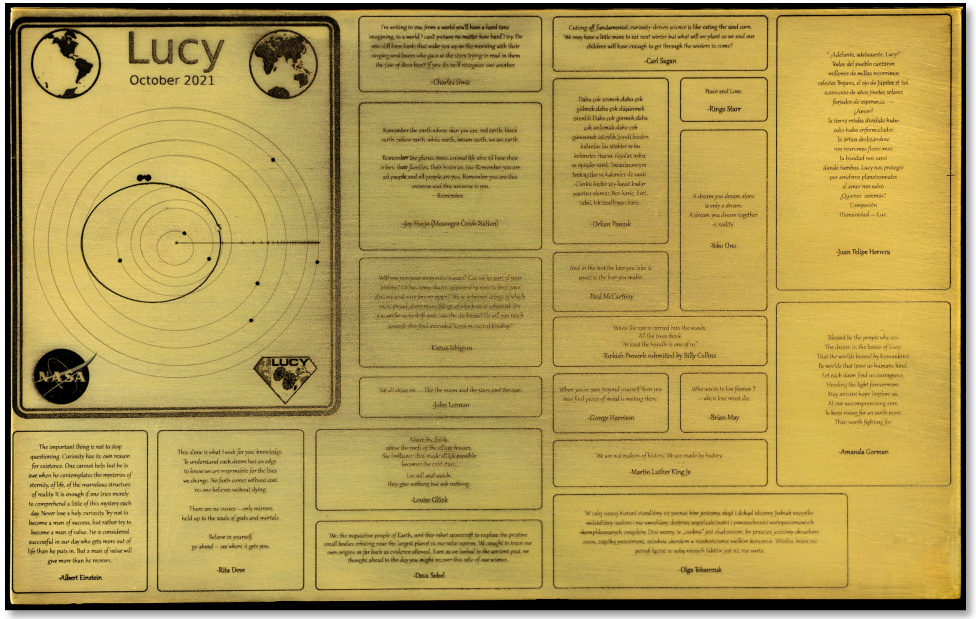
Earth-Based Observations
6.8 million miles (0.07 AU) from Earth at DART impact

Lucy

Lucy launch, Cape Canaveral, Oct 16, 2021

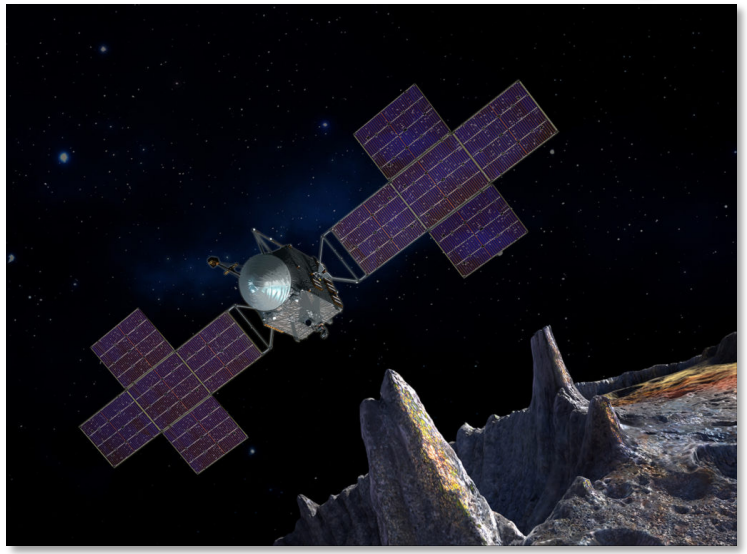






Psyche

- Despite some COVID challenges, making good progress toward 2022 launch
- Installation of spacecraft components nearly complete; environmental testing underway
- Pre-Ship Review (PSR) will be mid-April and spacecraft delivery to launch site early May
- Science team has almost completed a Psyche Spacecraft Overview special paper collection
- **Janus** (SIMPLEx-2) will launch with Psyche as a rideshare



Above: *Psyche in EMI/EMC tent*
Right: *Psyche being moved 'up the hill' to TVAC testing*

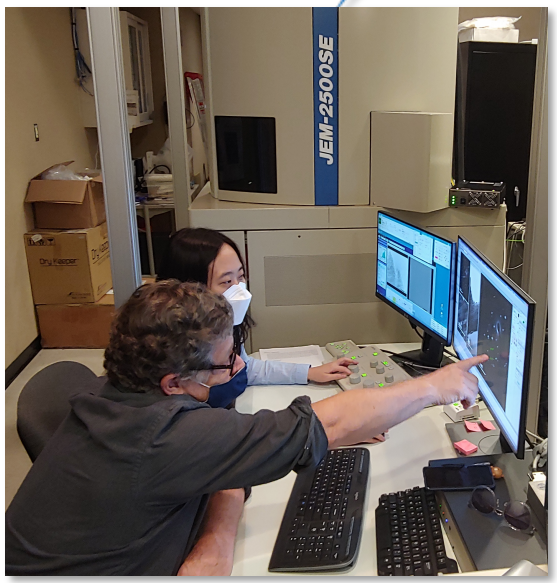
OSIRIS-REx and Hayabusa-2

OSIRIS-REx:

- Arrives back at Earth September 2023
- ROSES-21 C.30 **OSIRIS-REx Sample Analysis Participating Scientist Program** (Dual Anonymous Peer Review): Step-1 proposals due February 28 (Step-2 proposals due April 25)

Hayabusa-2:

- NASA allocation of Hayabusa-2 samples delivered to JSC in early December
- Proposals to study JAXA-catalogued Hayabusa-2 samples can be submitted to LARS from February 13, 2022
- Expect JAXA sample availability to be announced this winter, for allocation in early summer 2022
- Catalog of U.S. sample share (10% / 0.5 g) will be posted by late spring 2022 and opened to loan requests

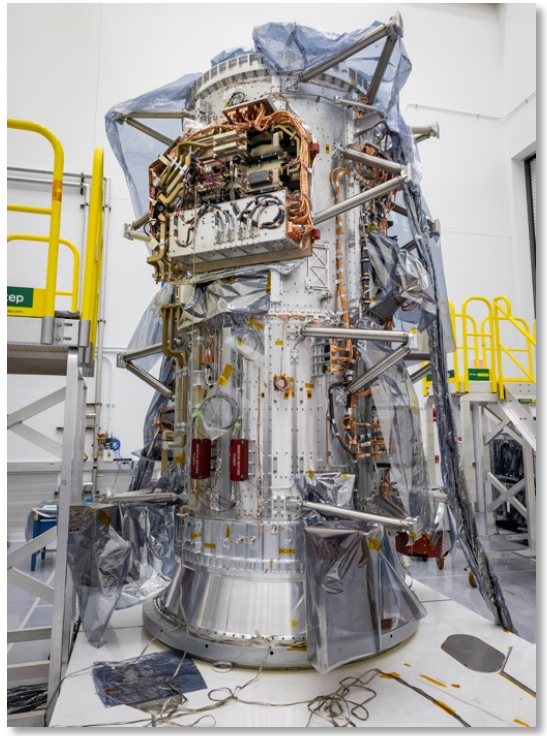


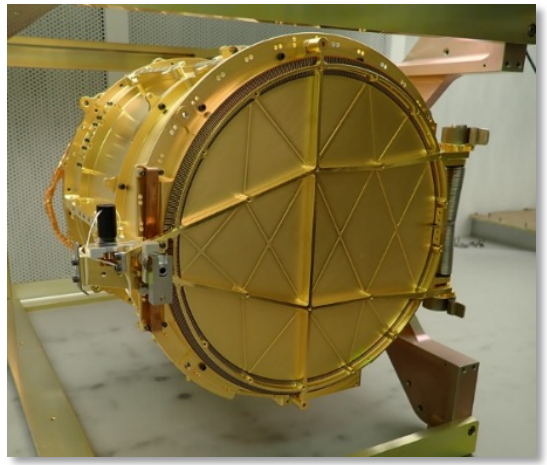
Left: Hayabusa-2 NASA Participating Scientists analyzing a Ryugu grain in the laboratory

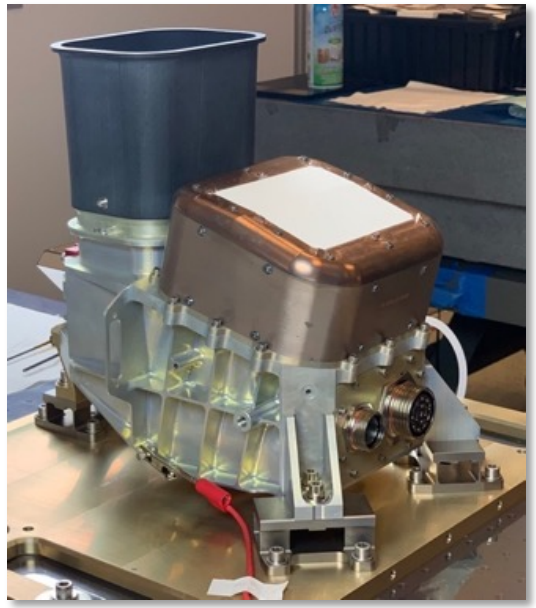
Bottom: Hayabusa-2 sample container

Europa Clipper

- Recent accomplishments:
  - EIS (Europa Imaging System) achieved flight wide-angle camera (WAC) sensor head ‘first light’
  - E-THEMIS (Europa Thermal Imaging System) completed flight sensor assembly vibration testing
- KDP-D DPMC completed February 2022
  - Now preparing for APMC
- On track for ATLO starting in March 2022
- Science team meeting scheduled for March 29–31, 2022
- Areas of concern:
  - Instrument delivery schedules for ATLO
  - Avionics delivery schedule due to COVID-related and development issues
  - Solar array delivery due to COVID and manufacturing quality issues/delays







Top right: *Flight RF panel*
Top left: *FM propulsion module with RF module installed*
Lower right: *E-THEMIS FM integrated sensor assembly*
Lower left: *Surface Dust Analyzer (SUDA) FM sensor assembly*

Dragonfly

Mission Plan

- Launch June 2027; arrive at Titan by 2034
- More than 3 years of exploration, traversing up to ~180 km with 20+ unique landing sites

Status

- Preparing for Mission PDR in October 2022
- Focus on preliminary design, technology maturation, and hardware testing
- Receipt and preparation of Titan chamber
- Production of PICA-D heat shield material has begun
- Preparing for test in LaRC Transonic Dynamics Tunnel this spring
- International agreement with CNES signed, DLR and JAXA agreements in progress

Dragonfly testbed flights. Credit: JHUAPL (Video)

Titan chamber arriving at APL

Mars Exploration Program

Mars Exploration Status Highlights

- **Perseverance** sample cache now eight samples (1 witness, 1 atmospheric, 6 cores)
  - Bit exchange fault occurred after coring Pauls target from Issole
  - Debris cleared from bit carousel and Pauls sample tube emptied before collecting Malay sample
- **Ingenuity** helicopter successfully performed 19 flights to date

Left Navcam image of Issole showing the triple tailing mounds at Robine, Pauls and Malay. Credits: NASA/JPL-Caltech/MSSS

- **International Mars Ice Mapper** Measurement Definition Team meetings underway; final report expected April 2022
- First Joint Steering Group (JSG) between MEP and MSR Program held in Jan 2022
- Large Martian Dust storm in the new year impacted operations
  - Ingenuity 1st flight of 2022 delayed
  - **InSight** entered (and exited) safe mode due to decreased power from dust

MEP Look-Ahead

2022 Budget

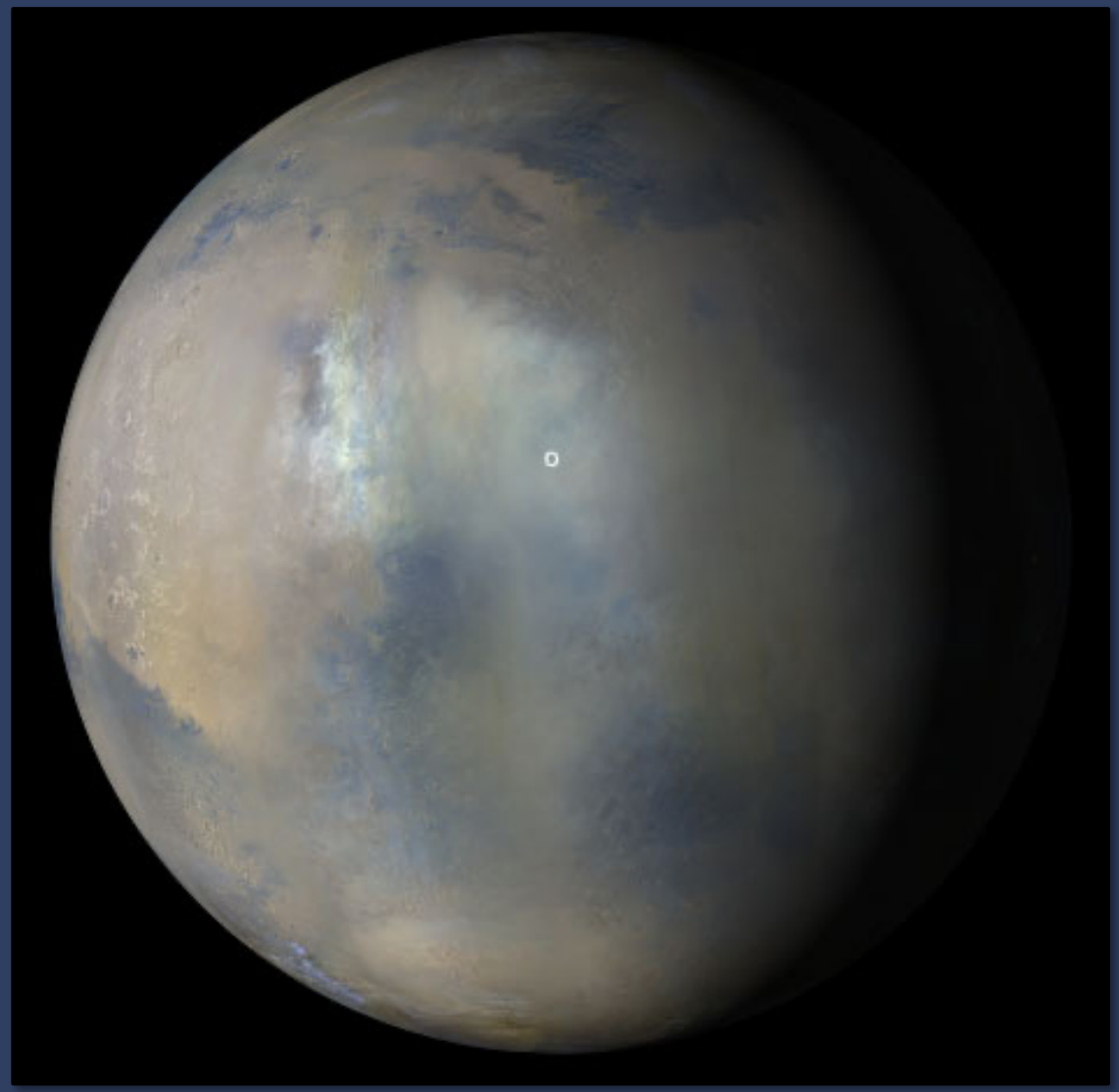
- All MEP missions, including Ingenuity, are budgeted through the end of the fiscal year

Strategic Planning

- Creating framework for Strategic Plan in preparation for the decadal
  - MEP off-site held at JPL in Dec 2021 to kick-off the effort

Events

- Low-Cost Science Mission Concepts for Mars Exploration Workshop rescheduled to Mar 29–31, 2022 in Pasadena
- Science Objectives for Human Exploration of Mars Workshop May 4–6, 2022 in Denver



Multiple images from MRO's Mars Color Imager (MARCI) generated this view of a regional dust storm obscuring Syrtis Major and Jezero Crater (white circle). Credit: NASA/JPL-Caltech/MSSS.

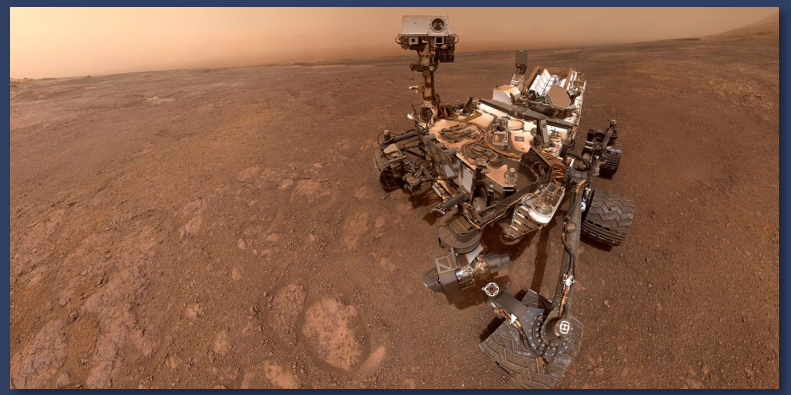
Mars Science Updates

- Current MRO dust storm monitoring revealed level of dust activity in November timeframe not seen since 2008; provided early warning of InSight power challenge
- **MAVEN** continues detecting coronal mass ejections and high radiation streams that precede major solar storms - help improve models for predicting Mars solar activity
- Selections complete for MSL Participating Scientist Program: 25 proposals selected

Curious Carbon Measurements on Mars

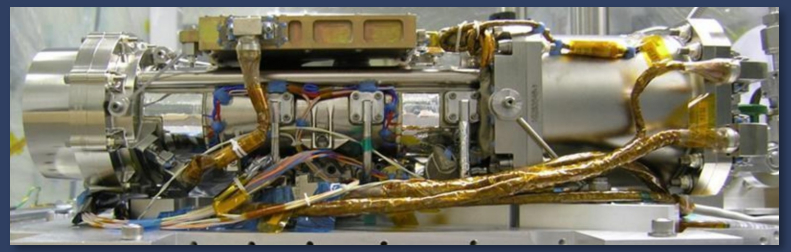
Chris House (Penn State U.), Greg Wong (Penn State U.), Chris Webster (JPL), Greg Flesch (JPL) , Heather Franz (NASA/Goddard), Jen Stern (NASA/Goddard), Alex Pavlov (NASA/Goddard), Sushil Atreya (U. MI), Jen Eigenbrode (NASA/Goddard), Alexis Gilbert (Tokyo Inst. Tech.), Amy Hofmann (JPL), Maëva Millan (NASA/Goddard), Andrew Steele (Carnegie Inst. Tech., Danny Glavin (NASA/Goddard), Charles Malespin (NASA/Goddard), Paul R. Mahaffy (NASA/Goddard)

- A signature of biological activity on early Earth is a reduced heavy:light ratio of C, preserved in rocks formed by microbial activity
  - A similar signature has been found from analyses of SAM isotope data, i.e., of gas released from heated samples of >3 Ga rocks in Gale crater
- However, to confidently conclude there was microbial life on early Mars requires additional supporting evidence, such as:
  - An abundance of complex molecules produced by life
  - Evidence of microbial mats
- Without such evidence, the team put forward other hypotheses that do not require biology for the observation, including:
  - Photochemical reactions in the early Mars atmosphere
  - Delivery of material from space as the solar system passed through a giant molecular cloud



Top: *Curiosity rover selfie taken at drill site Rock Hall in January 2019*

Bottom: *The Tunable Laser Spectrometer in the SAM instrument produced the carbon isotope data from methane gas released from heated samples*



House, C. H. et al., (2022), *Depleted carbon isotope compositions observed at Gale crater, Mars, PNAS 119(3), 2022.*

Science Nuggets Reminder!

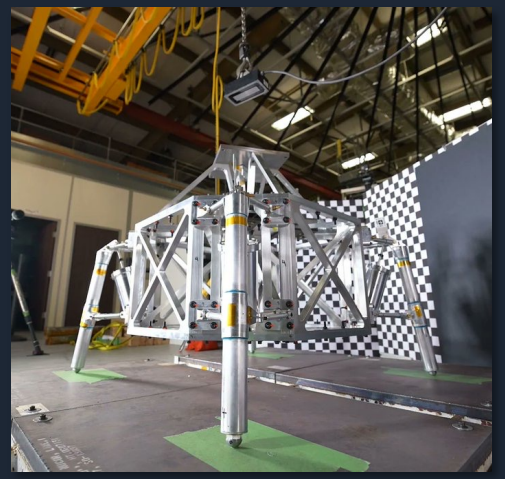
- Planetary Science Nuggets are slides provided to PSD by members of the scientific community to highlight important science results or mission activities
- A subset of these submissions are selected by PSD to be presented to SMD leadership, and potentially, NASA leadership, OSTP, and the White House
- All science nuggets, for any program in PSD, should be sent to Kathleen Vander Kaaden (kathleen.e.vanderkaaden@nasa.gov)
- Past nugget examples: https://www.lpi.usra.edu/nuggets

We're excited to hear about all the amazing science being conducted in our community! All science nuggets are appreciated and reviewed by members of our HQ team.

Mars Sample Return

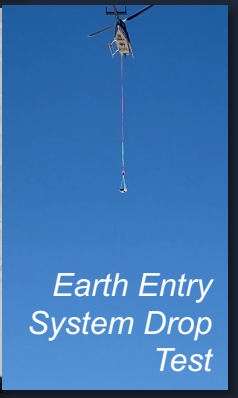
Mars Sample Return Highlights

- MSR is working to complete Phase A activities, including technical and programmatic trades recommended by the Independent Review Board prior to Phase A
- Multiple long-lead procurements have been awarded
  - Mars Ascent Vehicle Integrated System (MAVIS) contract award to Lockheed Martin
- Technology and engineering developments continue with progress on several prototypes (see images on right)
- The Program System Requirements Review is scheduled for April 2022 with KDP-B following in early Summer 2022



Landing legs

MAV VECTOR launch system



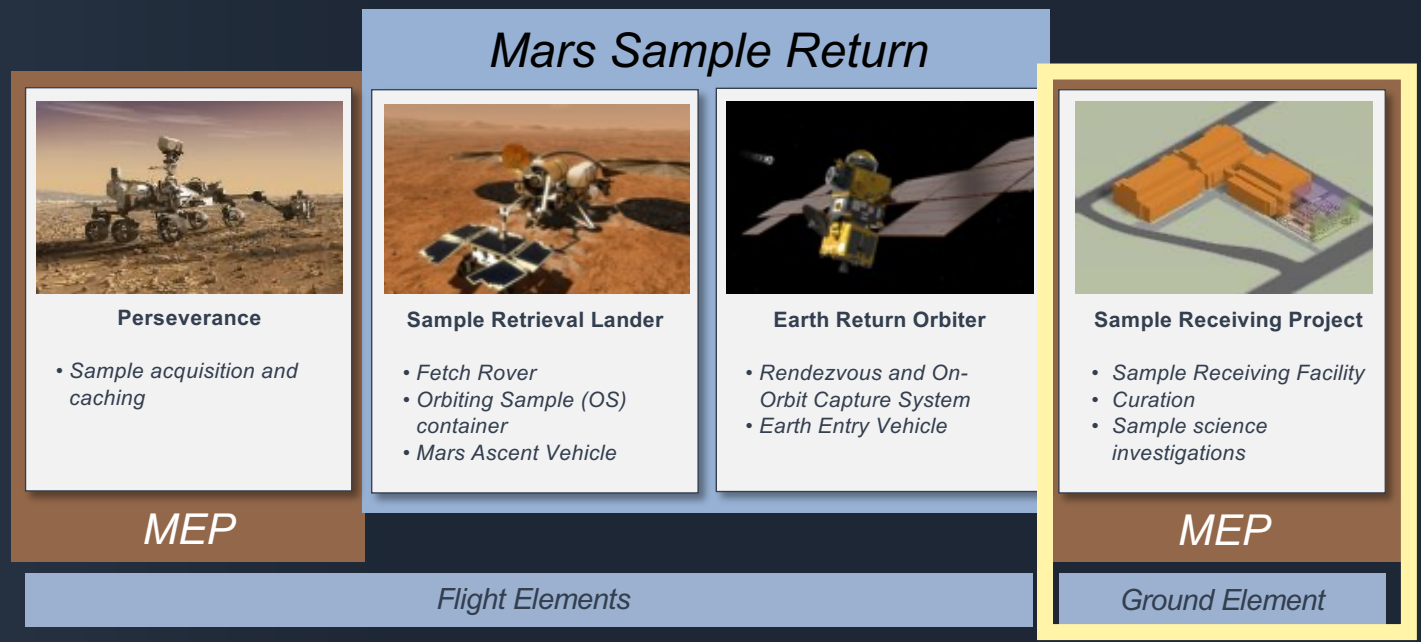
Earth Entry System Drop Test

Mars Sample Return Campaign

- Perseverance science team published first scientific findings since landing in *Science*, Oct 2021 – confirm and enhance the scientific potential of the collected Samples from Jezero Crater
  - several more papers have been submitted
- MSR Science Planning Group-2 report accepted for publication in *Astrobiology*
- Joint MSR Operational Scenarios Definition Team (MOSDT) Report completed
- MSR Campaign Science MOU with ESA in formulation

Sample Receiving Project (SRP)

- Objective: safely secure the samples upon return to Earth and release the samples to the science community as quickly as possible
- JSC will select a Project Manager to lead the SRP effort
- High-level plan and schedule for SRP development will be completed in FY23
- Sample receiving facility progress:
  - Astromaterials Acquisition and Curation Office RFI/Sources Sought, released in Sept 2021
  - RFP release to select vendors expected in spring 2022




ESSIO

ESSIO Highlights

- NASA's 2021 *International Observe the Moon Night* events hosted 500k worldwide; Moon enthusiasts from all 7 continents participated in the celebration of learning and cultural connections
- Payloads and Research Investigations on the Surface of the Moon (PRISM) 1:
  - Task order CP-11 awarded to Intuitive Machines in Nov 2021
    - Will deliver Lunar Vertex and STMD's CADRE to Reiner Gamma (lunar swirl) in 2024 on NOVA-C lander
  - CP-11 International payloads: ESA's MoonLIGHT Pointing Actuator (MPAc) and KASI's Lunar Space Environment Monitor (LUSEM)
- PRISM 2:
  - Step-2 proposals received Dec 20, 2021; selections to be made in summer 2022 for flights to the Moon starting late 2025
- Upcoming Lunar Surface Science Workshops (LSSWs):
  - Heliophysics Applications Enabling and Enabled by Human Exploration of the Lunar Surface: **February 17, 2022**
  - Updates from HQ/Artemis: May (TBD)
  - ISRU: June (TBD)

All LSSW reports and archived talks:
https://lunarscience.arc.nasa.gov/lssw

Observe the Moon Night: 122 participating countries

NASA payloads NIRVSS and NSS integrated onto Astrobotic's Peregrine Mission-1 lander


Planetary Defense

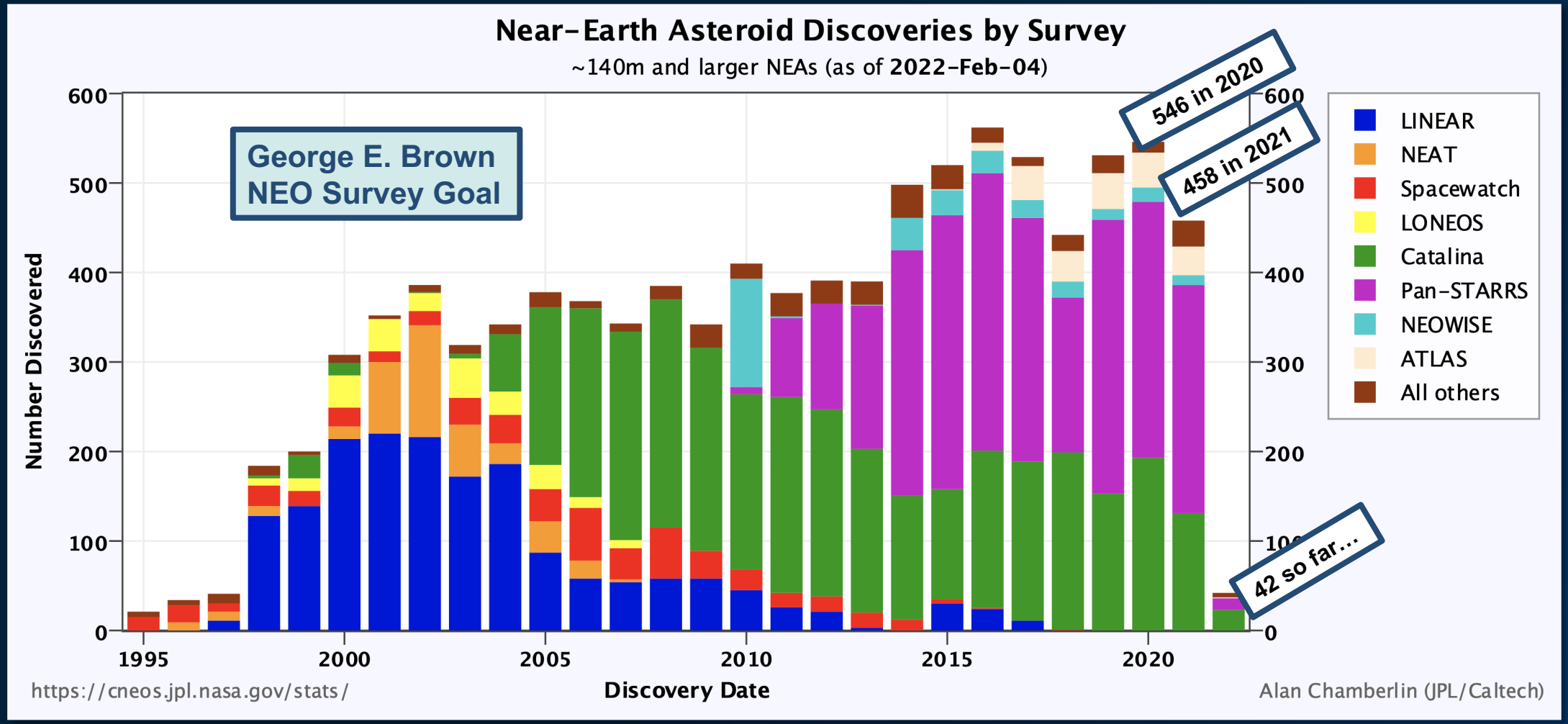
NASA-funded Near-Earth Object Survey (Discovery) Telescopes

NEOWISE

Two new ATLAS telescopes are now in operation in Chile and South Africa

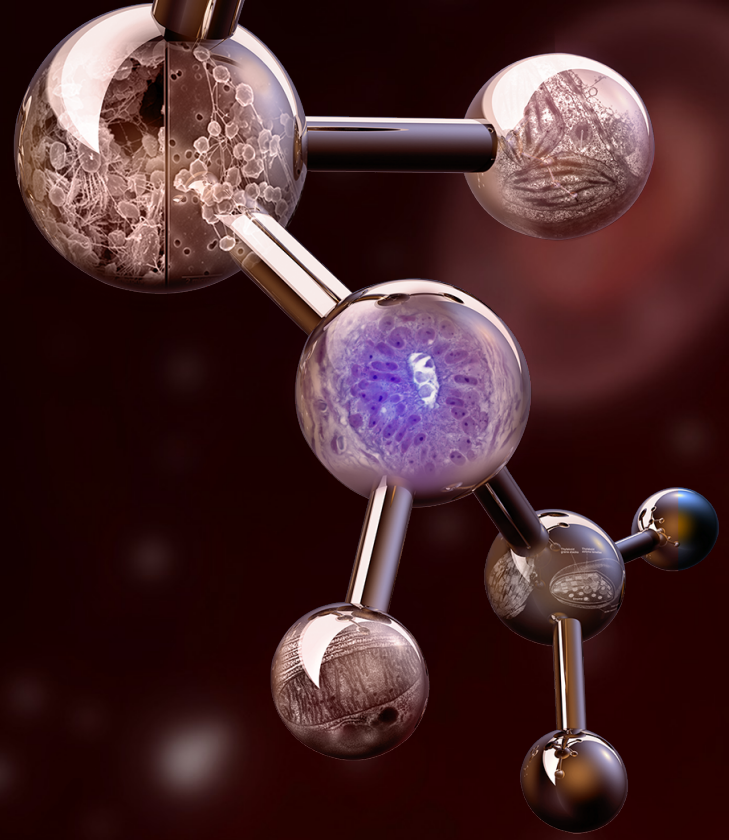
https://www.nasa.gov/feature/nasa-asteroid-tracking-system-now-capable-of-full-sky-search

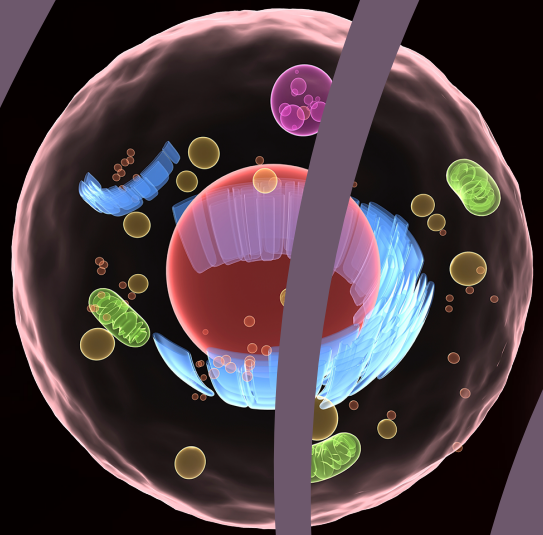
NEAs 140 Meters and Larger



nasa.gov/planetarydefense

Astrobiology





Standards of Evidence

- NfoLD and NExSS Research Coordination Networks (RCNs) hosted a joint virtual workshop on biosignature standards of evidence and reporting protocols in July 2021

  Current draft of workshop white paper report: https://www.nfold.org/soe-report-in-progress

- In January 2022, NASEM convened the Committee on Astrobiology and Planetary Sciences (CAPS) to conduct an independent review of the white paper and issue a short report, to address several questions:
  - *Does the white paper include a clear and transparent description of the process?*
  - *Does the report accurately reflect the scientific literature? Are there any crucial content areas detrimentally underrepresented in the report?*
  - *Are the assumptions valid and reasonable?*
  - *Are the conclusions valid and supported?*
  - *Are there potential limitations or data gaps that would substantially impact the conclusions?*

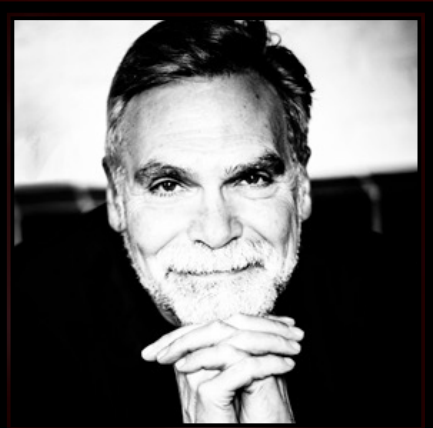
Early Cells to Multicellularity (ECM) RCN

- Last of five original RCNs to be proposed
- ECM RCN co-leads have been identified and are standing up the RCN:
  - Developing charter and website, coordinating with other related RCNs, and preparing activities, including a launch, at AbSciCon.
- Steering Group will be comprised of NASA-funded PIs, to be invited in coming weeks
- NASA Point of Contact: Becky McCauley Rench (rebecca.l.mccauleyrench@nasa.gov)

Ariel Anbar (ASU)

Mary Droser (UCR)

Betül Kaçar (University of Wisconsin)



Frank Rosenzweig (Georgia Tech)


Community

Contributions to Partner-Led Missions

- ESA recently released their call for M6 proposals (Letters of Intent due in February)
- Reminder of the new SMD process for considering U.S. contributions:
  - Step 1: An idea is brought to SMD's attention
  - Step 2: SMD should ensure it has adequate information to consider the idea
  - Step 3: SMD should consider the idea
  - Step 4: Discuss path forward with the SMD AA
  - Step 5: Give a preliminary response to the international partner
  - Step 6: Conduct a joint study
  - Step 7: Select the U.S. provider for the NASA contribution
- If you are talking with collaborators on an M6 proposal, please let PSD (Lori Glaze; lori.s.glaze@nasa.gov) know

R&A Updates

Scientific Information Policy for the Science Mission Directorate (SPD-41)

- SMD has created SPD-41 based on recommendations from SMD's Strategy for Data Management and Computing for Groundbreaking Science 2019–2024 (also based on existing Government directives and NASA/SMD policies)
- Request for Information (RFI) on the Implementation and Changes to SPD-41 is open for community feedback on SPD-41: https://science.nasa.gov/researchers/science-data/science-information-policy
  - Slides and recording of SMD Townhall held on January 26, 2022 is available
- **Please read SPD-41 and provide comments by March 4, 2022**

Preparatory Investigations for Europa

- Draft language for new program element in ROSES-21 C.31 Preparatory Investigations for Europa is **open for public comment until March 18**: https://nspires.nasaprs.com/external/viewrepositorydocument/cmdocumentid=858604/solicitationId=%7B980E978F-03F4-3FE6-1D05-E79B4B93FCB9%7D/viewSolicitationDocument=1/C.31%20draftPSIE011922.pdf

Job Opportunity: Program Executives

- SMD will be releasing a USAJOBS announcement to fill multiple Program Executive positions across the directorate on **February 17**
  - A Direct Hire Authority announcement so **opportunity will only be open for 5 calendar days** (to February 22)
- Opportunity can be found by searching for **HQ-22-DE-11374045-JK**

PSD IDEA Team

New PSD IDEA team:

- Led by LaJuan Moore and Meagan Thompson
- A single group to coordinate all PSD IDEA initiatives to help:
  - Communicate to a variety of audiences what PSD IDEA initiatives are happening
  - Identify gaps and redundancies in activities
  - Exchange information with various entities: in PSD, SMD, and elsewhere at NASA
  - Monitor funding and evaluation of initiatives
  - Refine PSD's 'lanes of influence' and how best to work within them

Planetary Science and Astrobiology Decadal Survey 2023–2032

- Latest input from NASEM:
  - On track to deliver the report to NASA and NSF at the end of March/beginning of April
  - Public release will be middle of April
- Timeline for a response to the Decadal will be set by SMD and PSD
  - Initial PSD public response to the Decadal within 90 days
  - Full written response provided later (timing to be shared publicly in advance of Decadal release)

Response to November 2021 Findings

Finding 1: Funding for NASA Service Activities

Background: NASA's Planetary Science Division (PSD) relies on the science community to perform a variety of service activities in order to support its portfolio of missions and research & analysis programs. These service activities support NASA's strategic goals of equity, diversity, and inclusion by drawing on the full breadth of talent available in the community and ensuring inclusive opportunities for community contribution. The PAC appreciates that NASA has provided clarification that funding for PAC or other NASA advisory committee memberships is governed by FACA rules, and ROSES panel reviews are generally limited to honoraria. But other service activities that have the potential to be funded may include NASA studies such as mission definition teams, facility reviews, "state of the community" studies, or Assessment group steering committee leadership. Additionally, contracts or other pathways may exist for supporting studies of the planetary science workforce (see Rathbun et al., 2021).

Finding: The PAC recommends that NASA should itemize its service activities performed by the community and delineate the potential for compensation for each, along with estimated costs.

Response: Community service is a valuable part of the scientific ecosystem, and PSD recognizes that the volunteer model that has been used for decades has negative implications for inclusivity. We have attempted to, at least partially, address this in recent years with increases in reviewer honoraria and funding for AG chairs, but we continue to look at other options. PSD has created a table of community service activities, as requested by the PAC, and this will be presented and discussed as part of the R&A Update at this PAC meeting.

Finding 2: Data Analysis Programs

Background: As NASA's PSD undertakes new missions, the volume of data available in public archives and the number of investigations focused on analyzing that data have grown considerably. Mission-specific Data Analysis Programs (DAPs) have been instituted with dedicated funding to support these investigations, but the question was raised about how long those dedicated funds should be offered. A balance must be struck to support for studies using data from new missions with recognition that data from old missions can still yield new and significant science results.

Finding: The PAC finds that the PSD DAPs could be managed using several different options; consequently, the PAC requests that PSD should present information at a future meeting on the potential impacts of different programmatic strategies.

Response: We concur that although the current DAP structure is sound, there are several areas where this model may be improved. We will look at several different options for how DAPs could be managed, including both how to prioritize missions and the overall management structure. With the impending release of the Decadal Survey, however, this undertaking will likely to be deferred for now.

Finding 3: SIMPLEx, Discovery, New Frontiers schedule

Background: Concerns have been raised about the community having enough time to prepare strong and compelling proposals, especially with the closeness of the expected Discovery call in 2023 and the NF-5 call in 2024, and the uncertainty in the date of the next SIMPLEX call's release.

Finding: The PAC finds that finalizing call dates and releasing draft AOs as early as possible is beneficial for both NASA and the community responding to these opportunities.

Response: NASA understands that releasing upcoming draft AOs as early as possible is important, and endeavors to always do so. We note that the current schedule for upcoming AOs is listed on the NASA Science Office for Mission Assessments (SOMA) website: https://soma.larc.nasa.gov/. We hope to provided updated information after the President's proposed budget is released.

Finding 4: NASA EDIA Efforts

Background: The PAC appreciates the current efforts within NASA to improve diversity within the planetary science community, including efforts by the PSD R&A IDEA group and the SMD IDEA working group, and new programs like Mentoring 365, the SMD Bridge Program, and the Here to Observe (H2O) Pilot Program. These new programs have the potential to improve the diversity of the pool of planetary scientists entering the field. However, the PAC notes that (1) current efforts focus primarily on students and/or early career scientists and towards potential future increases in planetary science community diversity, (2) that current discussions of diversity usually only focus on cis-gendered diversity and exclude mention of disability communities, and (3) most determinations of diversity are not based on careful collection of selfreported demographics data. It is important for the PSD R&A IDEA group and others in PSD working on EDIA progress to look for ways to broaden efforts beyond and/or early career scientists and beyond cis-gender and ableist considerations.

Finding: The PAC requests that PSD provide regular updates on ongoing programs and should in particular provide an evaluation of the results of the H2O Pilot Program. The PAC requests regular updates on NASA SMD efforts to improve inclusion and equity within the present planetary science community, focused on mid-career scientists. In addition, PSD should work with NASA's Office of Diversity and Equal Opportunity to pursue demographic data collection efforts in order to enable assessments of inclusivity and diversity, including a broader range of underrepresented identities, and assessment of progress in the future.

Response: PSD has recently formed an IDEA team that is focused on working with PSD, PSD leadership, and the SMD IDEA Working Group on their diversity initiatives. Moving forward, the PSD IDEA team will report to PSD management on a regular basis, and at future PAC meetings. The H2O Program is still within the pilot year so PSD will report on the pilot outcomes and future program plans at an upcoming PAC meeting. In addition, the PSD IDEA team has begun to work with OMB, rather than the NASA Office of Diversity and Equal Opportunity issue, in relation to demographic data collection. As more information is provided to us, the data will be provided to the PAC. The PSD IDEA team will also work with the Office of Diversity and Equal Opportunity on possible future IDEA opportunities.

Finding 5(a): Science-driven Leadership of Strategic SMD Missions

Background: NASA's mission is achieved through a mix of competed and directed strategic missions. Maximizing the science return of both is only achievable through strong scientific leadership, which provides the necessary expertise, and peer review to ensure that mission architecture, instrumentation, and operations are optimized properly. The PAC appreciates the formation and public identification of the Mars Ice Mapper (MIM) Measurement Definition Team (MDT) and learning about the development of the Artemis and CLPS programs.

Finding: (a) The PAC finds that NASA should ensure that the scope of the MIM MDT is clearly shared with the community, that the MDT's inputs should carry significant weight in the development of the MIM, and that the final report should be released to the community as quickly as possible.

Response (a): An overview and status report for the MIM MDT was presented publicly at the MEPAG meeting on February 2, 2022. In summary:

- The following is the scope of the MDT:
  - **Task 1: Core Reconnaissance Mission**
    - Provide detailed measurement requirements traceable to mission reconnaissance goal/objectives for anchor radar payload
    - If radar payload is not uniquely capable of satisfying the reconnaissance objectives, identify measurements that are required and propose additional payload(s) **to meet the requirements**
  - **Task 2: Potential Mission Augmentation Options to Maximize Return on Investment**
    - Define additional recon and science objectives that could be met with reference payload
    - Assess and prioritize technical and scientific options for augmenting the core mission
    - Feasibility assessment of supplemental payload(s) and/or modest modifications to recon payload(s)
  - **Task 3: Concept of Operations**
    - Prepare a model operational concept based on findings from Tasks 1 and 2
- The use of the MDT findings for the I-MIM project development will be up to the partnering agencies
- The MDT Final Report is expected in April 2022 and will be shared with the MEPAG community

Finding 5(b): Science-driven Leadership of Strategic SMD Missions

Background: NASA's mission is achieved through a mix of competed and directed strategic missions. Maximizing the science return of both is only achievable through strong scientific leadership, which provides the necessary expertise, and peer review to ensure that mission architecture, instrumentation, and operations are optimized properly. The PAC appreciates the formation and public identification of the Mars Ice Mapper (MIM) Measurement Definition Team (MDT) and learning about the development of the Artemis and CLPS programs.

Finding: (b) The PAC finds that NASA should develop a broad lunar science and exploration strategy with a clear set of scientific priorities and a scientific leadership structure with the authority to generate the science requirements for NASA's Artemis and CLPS programs. The lunar science leadership should be charged with driving a strategy for selecting CLPS science objectives, landing sites, and instrumentation.

Response (b): The Lunar Discovery and Exploration Program (LDEP) within the Exploration Science Strategy and Integration Office (ESSIO) is responsible for setting the overall Agency science strategy for Artemis and CLPS. These strategies are largely informed by current community documents (e.g., SCEM and LEAG reports, Decadal) with further community input and refinement of requirements achieved through the 14 (to date) dedicated Lunar Surface Science Workshops (LSSWs). ESSIO Program Scientists work closely with the other mission directorates (MDs) to ensure science is integrated at every step of architecture development and requirements definition that ultimately get codified within the ESDMD/SOMD reference documents that guide architecture formation. Additionally, ESSIO co-chairs several intra- and inter-MD working groups that govern science utilization. For CLPS, ESSIO is working to address high-priority science objectives as outlined in various community documents, while at the same time also encouraging evolution of the CLPS vendors' technical capabilities at an appropriate cadence that enables more high-impact, priority science to be accomplished. Instrumentation for CLPS and Artemis will continue to be competitively selected based on high-priority science investigations and lunar exploration targets coupled with appropriate programmatic factors that continue to grow the lunar economy and commercial capabilities.

Finding 6: Software/Data Management (1/2)

Background: The PAC appreciates efforts to improve accessibility to data and software. However, the new software and data management policies may have unintended consequences in that the burden of supporting the new software and data management will be placed on the community (from individual PIs to mission teams) without additional support provided for that work. The PAC notes that public comments on draft policy SPD41 are actively being solicited by NASA.

Finding: The PAC finds that NASA should carefully consider concerns expressed by the community so that the final policy is clear with respect to format, documentation, and maintenance of these archived products and avoids new burdens unless additional appropriate financial support can be made available. Legal implications of software licenses and liabilities should be clearly explained, and efforts should be made to minimize the burden on new proposers, those from groups that are underrepresented in planetary science, and those with less institutional support. The PAC recommends that NASA encourage all community Analysis/Assessment Groups (AGs) to include a data/software management representative in their steering committees, so that such a person can work with NASA and MAPSIT to be aware of resources, policies, and leading practices to better support their respective communities.

Response: SPD-41 is a consolidation of existing federal laws and policies and existing NASA policies. While these requirements are not new, SMD recognizes that they may be new to the community. As such, SMD's position is that SPD-41 is a forward-looking policy with an expectation that future awards will be compliant with SPD-41 and that PIs should budget appropriately for these costs. Current missions and grants are encouraged to adopt SPD-41 to the extent possible within current resources, or as directed by Program Officers for scientifically useful information. SMD also expects there will be different tiers of compliance, for example, the expectations for missions are different than for researchers. SMD encourages reference to the current policy FAQ page: https://science.nasa.gov/researchers/science-data/science-information-policy_faq

The RFI for SPD-41 that is currently open is meant for collecting detailed feedback from the community on: (i) any unintended consequences and burdens on the community resulting from SPD-41 and the proposed updates; and (ii) what support, services, training, funding, or further guidance are needed by the community for the successful implementation of SPD-41 and the proposed updates. **The community should use the RFI to communicate their concerns and suggestions.** SMD intends to carefully consider all responses to the RFI, issue clear policies, minimize burdens on the community, and provide support needed to comply with any existing or new requirements. The proposed updates to SPD-41 also provide a process for variances where the policy may cause undue burden; while variances are expected to be rare, the process was included to support inclusive practices or technical difficulties.

Finding 6: Software/Data Management (2/2)

Response (continued): The Open Source Science Initiative ($20 Million per year in cross-divisional support) has been established to help support the implementation of Open Science including SPD-41. This includes Transform to Open Science, a 5-year program, focused on training the community in open science practices like scientific software development.

Some additional notes on software:

- For researchers, the statements about software in SPD-41 use "should" statements rather than "shall" statements indicating they are not a requirement at this time (i.e., in ROSES-22).
- There is no expectation or requirement for maintenance or user support for software in SPD-41 outside of what is funded as part of a proposal.
- Software is an increasingly important aspect of scientific research. The proposed updates to SPD-41 bring NASA science in line with current best practices for open science to ensure reproducibility while also beginning to reward software development as part of the scientific process, along with publications.
- The proposed updates to SPD-41 would require all scientifically useful software to be made publicly available. The expected level of documentation and maintenance for software would be part of the DMP and reflect the type of software and the importance of the software to the reproducibility of the science. For example, single-use software can simply be added as supplemental material with publications or placed on GitHub. While more substantial software (that is not exempted) would have additional requirements (open source / permissive license, persistent identifier to be citable, guidelines for making contributions) that are standard practices in the the open science community and training can be provided and any additional needed support would be expected to be included in the proposed budget.

Finding 7: Sharing of Lunar Samples with China

Background: Given the extreme rarity of lunar samples, the PAC notes that there is great scientific value in ability for the international community to share such samples. The PAC notes that exception to the Wolf Amendment that currently prohibits NASA's use of appropriated funds for bilateral cooperation with China may be possible if NASA certifies to Congress that the activity does not pose a risk of tech/data/info transfer to China with national security or economic security implications, and does not involve knowing interactions with officials determined to have direct involvement with human rights violations.

Finding: The PAC finds that NASA should explore paths to enable sharing of lunar samples between China and the US given the recent success of the Chang'E-5 sample return mission and the upcoming CLPS and Artemis missions.

Response: NASA recognizes the scientific benefit of reciprocal access to and open data from lunar samples and continuously works to explore opportunities to advance science as a whole, consistent with law and policy. We will continue to keep you apprised as we proceed.

Finding 8: NASA Request for Additional R&A Support

Background: Given the broad congressional support for Planetary Science Division missions such as Mars Sample Return and Europa Clipper, the overall PSD budget has grown rapidly. However, while the R&A budget has grown significantly as well, it has not kept pace with the overall budget or with the volume of data and samples available.

Finding: The PAC recommends that PSD continue to work through the budget process to increase the overall funding for R&A programs.

Response: Ensuring a robust and sustained funding line for R&A programs remains a high priority for PSD; we agree that an increase to the budget for R&A programs is necessary and we will be working towards that end through the annual PPBE process.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