NATIONAL ACADEMIES Sciences Engineering Medicine

Committee on Astrobiology and Planetary Science Report to the Space Studies Board

A Personal View by

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CAPS CoChairs

SPACE STUDIES BOARD SPRING MEETING 2024

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* Planetary decadal survey member
** Astrobiology Strategy for the Search for Life in the Universe member

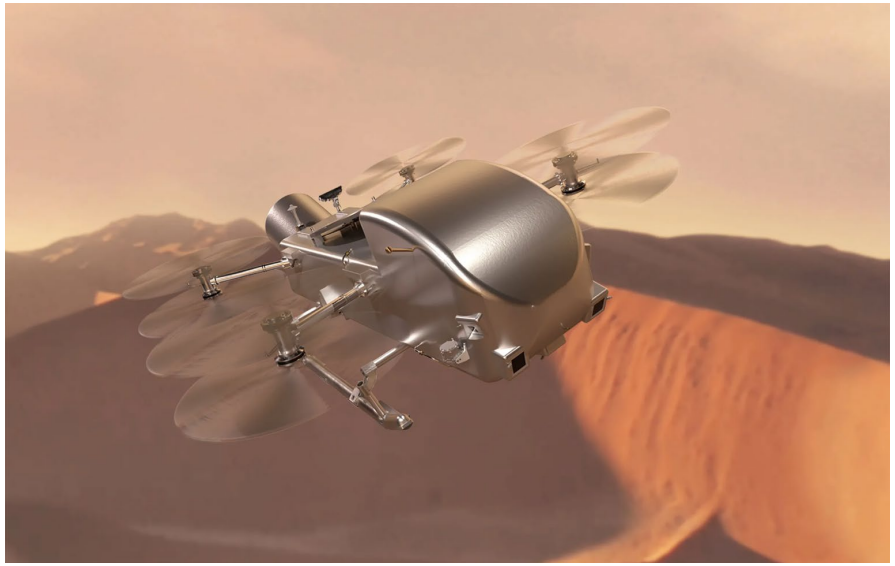
The Year for CAPS

- Fall Meeting October 2023
  - Discussion of MSR IRB report and responses from the community
  - Planetary Defense after DART
- January 2024
  - Assigned Task: “Proposed Science Themes for NASA’s Fifth New Frontiers Mission”
  - Commenced online closed and open sessions.
- Spring Meeting March 2024, SSW
  - CAA-CAPS Joint Session on Lunar Science and Integrated Lunar Strategy
- Celebrated successful Psyche launch Oct 13, 2023. OSIRIS-Rex return of Bennu samples Sept. 24, 2023. Europa Clipper on track for launch Oct 2024.

NASA’s Psyche spacecraft, atop a SpaceX Falcon Heavy rocket, lifts off from Kennedy Space Center’s historic Launch Complex 39A in Florida at 10:19 a.m. EDT on Friday, Oct. 13, 2023. Riding with Psyche is a pioneering technology demonstration – NASA’s Deep Space Optical Communications (DSOC) experiment – which will be the first test of laser communications beyond the Moon. *Photo credit: NASA/Kim Shiflett*

Astrobiology/Planetary Science Updates

- FY24 minibus and FY25 President's Budget Request supports Dragonfly, NEO Surveyor, LDEP, VIPER, ongoing/extended operations of 5 missions at Mars, New Horizons extended mission.
- Mars Sample Return slowdown after IRB report. FY24 omnibus funds ≥$300M, allows up to PBR of $949.3M
- VERITAS mission restored with 2031 launch date. DAVINCI mission delayed to same launch window.
- New start for Uranus Flagship delayed.
- New Frontiers 5, Discovery 20 and SIMPLEX AOs expected to be released no earlier than 2026.



Artist's concept of Dragonfly soaring over the dunes of Saturn's moon Titan.
Credit: NASA/Johns Hopkins APL/Steve Gribben

New Frontiers Overview & Timeline

The New Frontiers program was established in 2003. NF is meant to support medium-sized, PI-led missions that bridge Flagship missions and the Discovery program at a launch cadence of ~60 months.

NF-1	New Horizons*	*2006 - present*
NF-2	Juno	*2011 - present*
NF-3	OSIRIS-REx	*2016 - present*
NF-4	Dragonfly	*Launch NET 2028*

**New Horizons was grandfathered into the program as the first mission target.*

New Frontiers 5 and OWL Timeline

Dec 2016	*NF 4 AO released*	Dragonfly selected June 2019
May 2020	*OWL commissioned*	NF-5 missions not in scope or in panel design; last reviewed in V&V (2011)
June 2021	*Discovery Mission Selection*	VERITAS and DAVINCI missions to Venus
April 2022	*OWL released*	OWL lists targets for NF-6 and NF-7, expected during OWL decade 2023 - 2032
Jan 2023	*Draft NF-5 AO released*	OWL members expected NF-5 AO out before OWL released
Aug 2023	*NF-5 AO delayed NET (Fall) 2026*	Earliest selection 2029; LRD likely Fall 2033 – Fall 2036

New Task: Proposed Science Themes for NASA's Fifth New Frontiers Mission

- *Has scientific understanding or external factors, such as programmatic developments or technological advances, significantly changed since the New Frontiers 5 (NF-5) mission themes or New Frontiers 6 (NF-6) mission themes were evaluated by the most recent planetary science and astrobiology decadal survey, Origins, Worlds, and Life (OWL)?*
- *Has scientific understanding or external factors, such as programmatic developments or technological advances, been sufficiently substantial since OWL to warrant reconsidering or removing any of these mission themes?*
- *Given that NASA anticipates the next New Frontiers Announcement of Opportunity (AO) will be released no earlier than 2026, should NASA use the mission themes provided in the draft NF-5 AO (released 1 September 2023), the NF-6 mission themes as provided in OWL, or a hybrid of the these?*

Proposed Science Themes for NASA's Fifth New Frontiers Mission

NF5 2023 Draft AO	NF5 (OWL)
	Centaur Orbiter and Lander (CORAL)
	Ceres Sample Return
Comet Surface Sample Return (CSSR)	Comet Surface Sample Return (CSSR)
Ocean Worlds (only Enceladus)	Enceladus Multiple Flyby (EMF)
Io Observer	Io Observer
Lunar Geophysical Network (LGN)	Lunar Geophysical Network (LGN)
Lunar South Pole-Aitken Basin (SPA) Sample Return	~~Lunar South Pole-Aitken Basin (SPA) Sample Return~~ → OWL moved to LDEP
Saturn Probe	Saturn Probe
	Titan Orbiter
	Venus In-Situ Explorer

Task Meetings and Schedule

January 2024	Task Initiated
Jan 23	Closed Meeting
Feb 13	Open Session, Discussion with Lori Glaze and Curt Neibur
Feb 20	Open Session, Discussion with Robin Canup and Phil Christensen, Decadal Survey Chairs
March 5	Closed Meeting
March 19-22	Closed Meeting during Space Science Week
April 18	Closed Meeting
May 20	Open Session, Presentations and Discussion with chairs of relevant AGs: SBAG, LEAG, VEXAG, OPAG.
Early September	Estimated Delivery of Report

CAPS Observations of Overarching Challenges

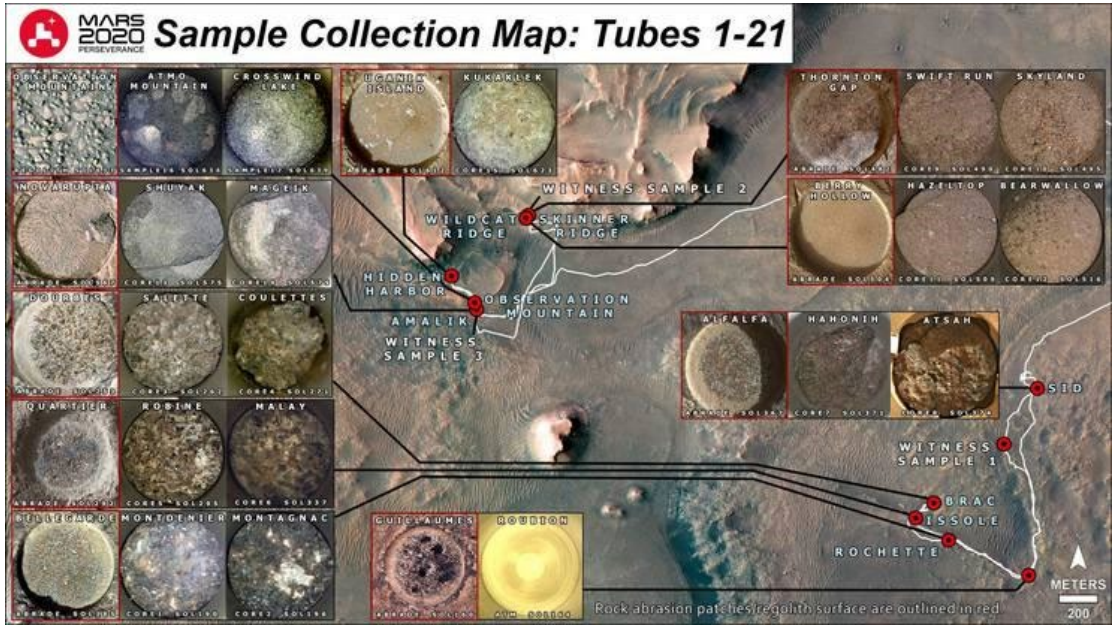
Mission Cadence

- The timelines and recommended cadence of solar system missions (Flagship, New Frontiers, Discovery, etc.) and their scientific and technological development conflict with the cadence of NASA's budget.
  - To meet budget challenges, missions are extending their timelines leading to mission delays and cost overruns, and greater costs overall. The inevitable impact on the mission portfolio makes it difficult to meet the goals of the Decadal.
  - Timely responses to IRB-style mission reviews, e.g., the NASA HQ response to MSR IRB-2, may lead to early mitigation to restore programmatic balance and budgetary challenges.
  - The long-term health of the Flagship, New Frontiers, and Discovery programs, as well as the mission workforce, is bolstered by a stable budget environment, predictable program cadance, and minimal budgetary deviations and delays of ongoing missions. Early intervention in selected and ongoing programs could mitigate downstream negative impacts on the portfolio.

CAPS Observations of Overarching Challenges

Mars Sample Return

- CAPS received reports from MSR Science program, IRB-2, and NASA HQ in Oct. 2023.
- IRB-2 findings played a role NASA's FY24 appropriation (reduction of ~$660M).
- The long-term impacts of workforce reductions warrant close attention.
- The MSR IRB 1 and IRB 2 reports offer valuable insights toward resolving challenges within the multi-mission Mars Sample Return Campaign.
- The OWL concluded that NASA should seek additional Congressional support for MSR in order to prioritize programmatic balance across the PSD mission portfolio. CAPS agrees that this approach is most likely to result in programmatic balance and realization of Decadal priorities



CAPS Observations of Overarching Challenges

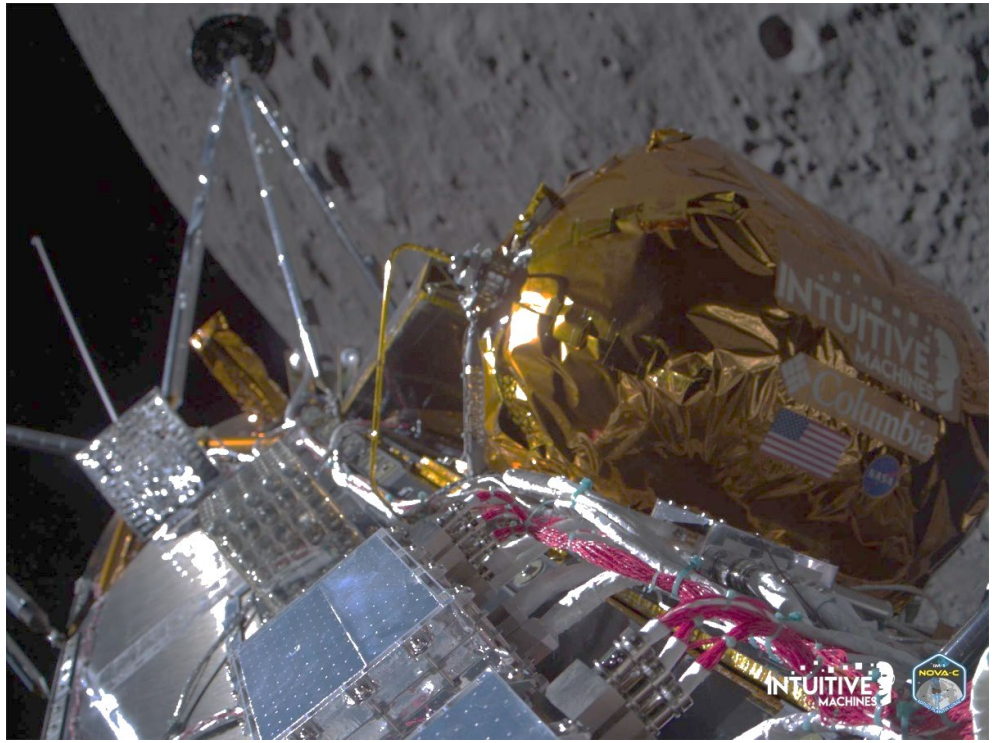
New Frontiers Program

- The intimate relationship between cadence and cost caps within the NF program make it particularly vulnerable to budgetary challenges.
- A consequence of the maintenance of NF concepts is that the list continues to grow. The VEXAG chair noted we have ~50 years of NF on the current portfolio at nominal decadal cadence.
- NF must balance the fact there are three flight centers and consider opportunistic science and launch windows and new technologies. For those targets carried over between Decadal surveys, updated science objectives and cost estimates could better inform community input. Amendments to the program AO (e.g., Step 1 concept proposals) might have a positive impact for decadal science objectives, workforce maintenance, and flight center efficiency.

CAPS Observations of Overarching Challenges

Lunar Exploration

- The shared management of LDEP between ESSIO and PSD has the potential to complicate the paths to achievement of the Decadal lunar science goals.
- Artemis and CLPS - human exploration and commercial flight programs can expand lunar exploration but cannot independently completely accomplish the decadal lunar science goals.



Nova-C lander entered lunar orbit Feb. 21, 2024 on the IM-1 mission.
Credit: Intuitive Machines

Backup Slides

Recap of CAPS October 24-26th Meeting

- Update from the NASA Planetary Science Division and NASA Astrobiology Program.
- Update on NEO Surveyor and Planetary Defense Spacecraft concepts.
- Europa Clipper Status report.
- Update on VIPER mission and Endurance-A mission concept.
- Discussion of NASA Science Activation Program.
- Science talks on life on early Earth and application to the search for life on exo – Earths.

NASA's largest planetary mission spacecraft, Europa Clipper, arrives at the Payload Hazardous Servicing Facility at the agency's Kennedy Space Center in Florida on May 23. *Credit: NASA/Isaac Watson*

Recap of CAPS March 18-22nd Meeting

- Update from the NASA Planetary Science Division and NASA Astrobiology Program.
- Update on ESA Mars Sample Return Science.
- CAA-CAPS Joint Session on Lunar Science
  - Peregrine and Odysseus CLPS updates
  - VIPER updates
- Discussion of DAVINCI mission to Venus.
- Discussion of OSIRIS-Rex Astromaterials Curation and Research
- Time allotted in closed session to discuss current task.

Carbon-rich sample of asteroid Bennu collected by the OSIRIS-REx spacecraft. *Credit: NASA*

Astrobiology/Planetary Science Updates

- New program leadership and management structure
- Strategic Planning
  - Focusing on cross-divisional and cross-directive initiatives, as well as interagency collaborations
- RCN Updates
- Astrobiology Strategy 2025
- Astrobiology Mission Ideation Factory
  - Phase 1: 32 EC participants developed 6 mission ideas; Phase 2 coming soon
- Biosignatures Ideas Lab – February 2024
  - 150 applicants, 30 participants, 5 mentors
- Standards of Evidence Workshop followup: *"Communicating Discoveries in the Search for Life"*