The National Academies of SCIENCES ENGINEERING MEDICINE

Preparing for the Next Planetary Science Decadal Survey

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Space Studies Board

Mars Exploration Program Analysis Group
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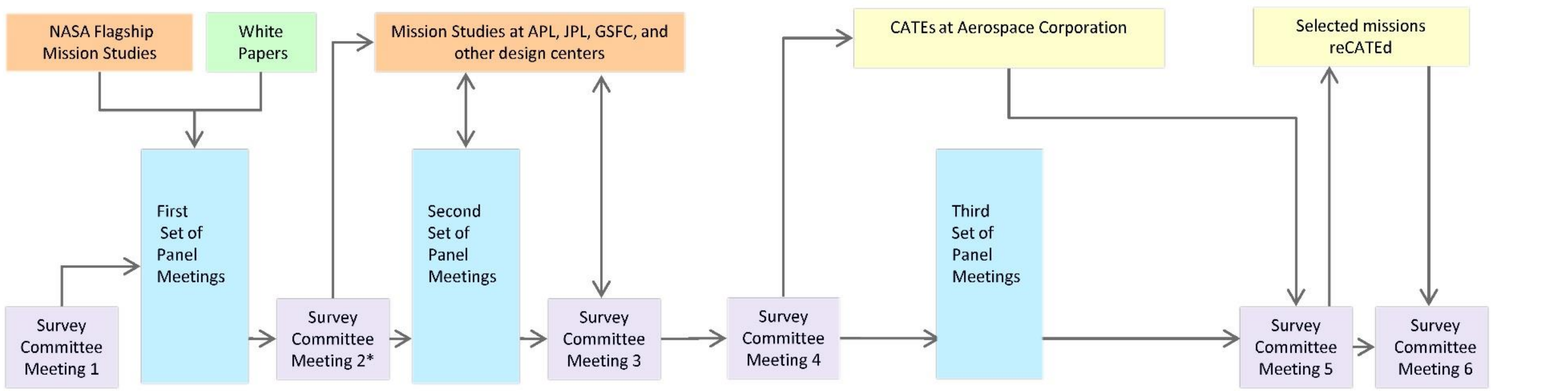
Schedule of the Next Decadal Survey

10-12/9/2019	Organizing meeting for 3rd planetary decadal survey
1/2020	Statement of task finalized and survey initiated
3/2020	Chair selected and announced at LPSC
6-7/2020	Survey committee and panel meetings begin
10/2021	First complete draft of survey report assembled
3/2022	Survey report released at LPSC



July 2009	August 2009	September 2009	October 2009	November 2009	December 2009	January 2010	February 2010	March 2010	April 2010	May 2010	June 2010	July 2010	August 2010	September 2010
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Months														

Panels formulate science goals and begin to define potential mission concepts based on prior NASA-planning activities and community white papers. Advocates for key mission concepts and other activities are invited to make presentations at panel meetings.

Panels nominate most promising mission concepts for technical studies at design centers. Panel-appointed “science champions “ work with their design team to ensure fidelity to the science goals of each mission concept. In some cases, rapid mission architecture studies are followed by more detailed point-design studies.

Mission design reports inform panels as to the technical realism and likely cost of the initial list of priority mission concepts. Panels down-select missions and report back to survey committee.

Panel-nominated mission concepts are assessed by the survey committee, and most, if not all, were forwarded to Aerospace Corporation for independent cost and technical evaluation (CATE). When in doubt, the survey committee deferred to the panels as to the relative priorities within the respective panels areas of responsibility.

Results of Aerospace Corporation’s CATEs are briefed to the survey committee, and the CATE reports are forwarded to their respective nominating panels. In two cases, CATEd missions were descoped by their nominating panel and re-CATEd. The survey committee determined the relative priorities between the panel-nominated missions.

Recently Completed Studies

- Decadal Surveys: Lessons Learned and Best Practices (completed 2015)
- Achieving Science Goals with CubeSats (completed 2016)
- NASA Science Mission Extensions: (completed 2016)
- Review of SMD/PSD Reorganized R&A Programs (completed 2017)
- Large Strategic NASA Science Missions (completed 2017)
- CAPS Short Report: Getting Ready for the Next Planetary Decadal (completed 2017)

Ongoing and Future Studies

- Planetary Protection Policy Development Process Review (Summer, 2018)
- CAPS Short Report: Review of the Planetary Science Aspects of the Administration's Lunar Science and Exploration Initiative (Summer, 2018)
- Planetary Science Decadal Midterm Review (Summer, 2018)
- Exoplanet Exploration Strategy (Summer, 2018)
- Astrobiology Strategy for Search for Life (Summer, 2018)
- Review of Extraterrestrial Sample Analysis Facilities (Autumn, 2018)
- CAPS Short Report: The Role of Commercial Ventures in Addressing Lunar Science and Exploration Objectives (Autumn, 2018)
- Martian Moons Planetary Protection (Winter, 2018)

Thank You

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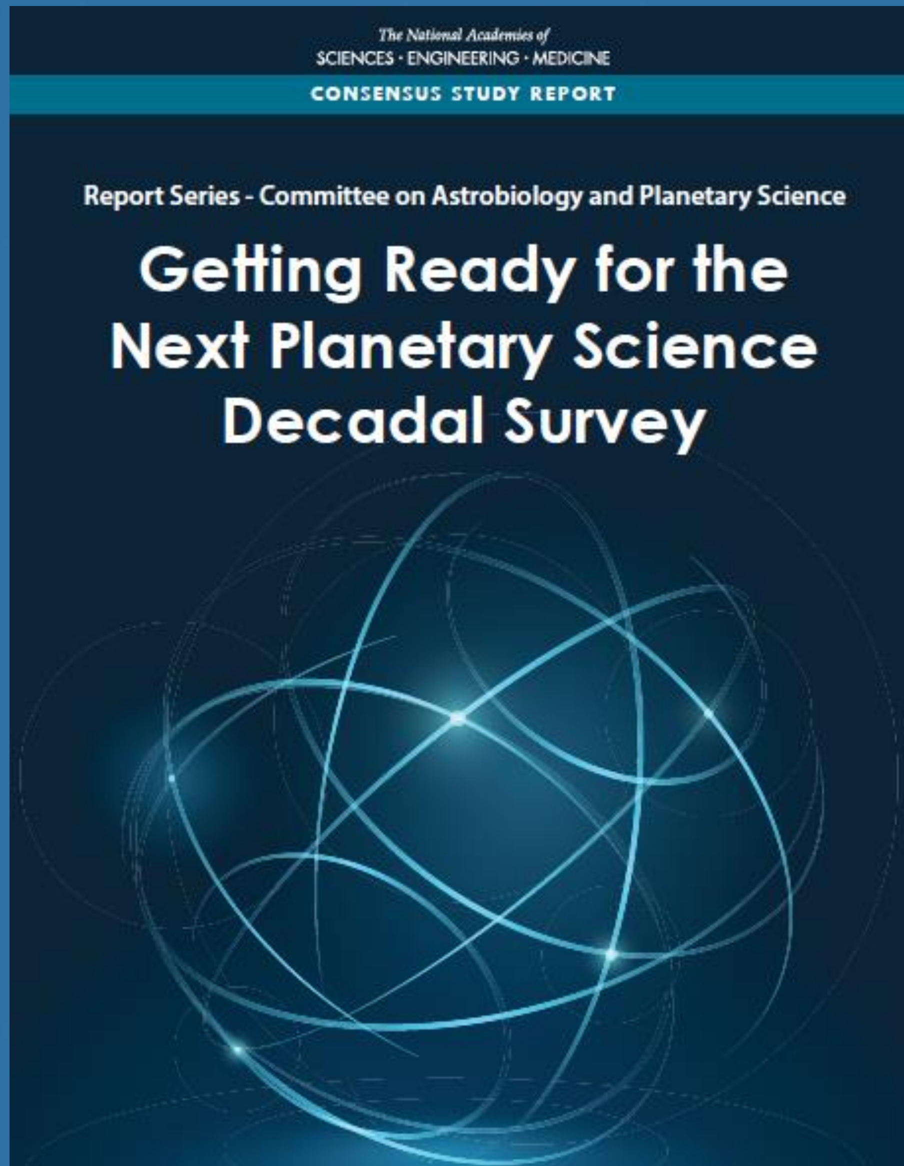
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CONSENSUS STUDY REPORT
Report Series - Committee on Astrobiology and Planetary Science
Getting Ready for the Next Planetary Science Decadal Survey

TABLE 2 Priority Areas That Are Candidates for Large- or Medium-Class Mission Studies (Unprioritized)

Area To Be Studied	Notes
Venus exploration missions	Additional concepts beyond the Venera-D orbiter and lander concept referenced in Table 1
Lunar science missions	Understanding interior processes and polar volatiles
Mars sample-return next-step missions	Mission elements beyond Mars 2020 (e.g., Mars ascent vehicle, sample containment, and Earth return) necessary for the second and third phases of a Mars sample-return campaign
Mars medium-class missions	Multiple mobile explorers, polar explorers, and life-detection investigations, responsive to new discoveries (e.g., the diversity of intact stratigraphies from ancient environments, the detail of the polar record, and the modernity of some liquid water-related deposits)
Dwarf planet missions	Large- and medium-class mission concepts designed to exploit recent discoveries concerning Ceres and Pluto (and the Pluto-like world, Triton)
Io science	Reexamine the science and technology case for a dedicated mission to determine internal structure and mechanisms driving Io's extreme volcanism
Saturn system missions	Affordable, large strategic missions that visit multiple targets and/or contain multiple elements are now feasible and are worthy of additional consideration
Dedicated space telescope for solar system science	Consider scientific return of a space telescope designed to monitor dynamic phenomena on planetary bodies

MARS MEDIUM-CLASS CANDIDATES

Studies conducted by Mars rovers and orbiters since the release of *Vision and Voyages* have shown the great diversity of environments preserved in the martian rock record. Two particular types of environments have been identified as being of particular interest. First, at least a dozen distinct aqueous environments have been identified in the martian geological record between some 4.2 billion and 3.0 billion years ago.[28,29,30] Second, multiple locales with potentially recent liquid water have been identified as a result of studies of climate-related deposits.[31,32] These two types of environments have been cited as compelling locations to search for potential biomarkers and for the mechanisms that drive climate change.

Community interest has increasingly focused on these types of locales—diverse ancient stratigraphies and sites with evidence of modern aqueous fluids/ices—as targets for further science and exploration. Missions specifically designed to explore these environments were not studied for cost and feasibility in the context of *Vision and Voyages*. Nor is it clear whether missions to explore such ancient and modern environments will require the resources of a medium-class mission. Some might be executable as a small mission, while others might require flagship-class capabilities. Examples of potential approaches to the exploration of these environments that could inform Mars science priority planning for the next decade include the following:

- Multiple rovers or other mobile platforms built simultaneously with defined payload interfaces;
- Mars polar climate missions akin to those mentioned in *Vision and Voyages*;[33] and
- Landed spacecraft, appropriately prepared in light of planetary protection considerations, to search for potential biomarker at sites with possible recent surface or near-surface water.

TABLE 3 Important Technologies and Other Activities Worthy of Review (not in priority order)

Area Requiring Study	Notes
Cryogenic sample acquisition, handling, and return systems	Cryogenic sampling and sample preservation systems (e.g., for use by comet and lunar-polar sample-return missions)
Daughtercraft enhancements to large- and medium-class missions	Substantial planetary science discoveries possible with small craft that expand the scope of their mothership by conducting complementary science and/or exploration of multiple locales
Advanced radioisotope power systems	Understand the expected demand for plutonium and associated power-conversion technologies to meet power demands of large-, medium-, and, potentially, small-class missions during the next decade
Electric propulsion	Understand the technology development plans for advanced electric propulsion
Aerocapture	Understand the technology development plans for aerocapture
Optical communication	Understand the technology development plans for free-space optical communication and how far it may be usefully extended into the solar system
Autonomous operations	Computing advances allow for more spacecraft autonomy in exploration, improving science return and reducing cost