

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

**DIVISION ON ENGINEERING AND PHYSICAL SCIENCES
SPACE STUDIES BOARD**

Planetary Science and Astrobiology Decadal Survey 2023-2032

Please note: The guiding document for the Decadal Survey is the Statement of Task (found at www.nas.edu/planetarydecadal). The scope, considerations, and approach shown here are additional counseling for the Committee and staff while they carry out their work.

SCOPE

In order to ensure the committee provides actionable advice and to ensure consistency with other advice developed by the National Academies, guidelines for the scientific scope of the survey are as follows:

1. The report should address and be organized according to the significant, overarching questions in planetary science, astrobiology, and planetary defense.
2. Basic or supporting ground- and space-based, laboratory, field, and theoretical research in astrobiology is within scope. Any findings and recommendations in the area of astrobiology should take into consideration the National Academies' report *An Astrobiology Strategy for the Search for Life in the Universe* (2018);
3. Interactions between solar and heliospheric phenomena and the atmospheres, magnetospheres, and surfaces of solar system bodies are within scope. Reassessment of recommendations treated in the National Academies' *Solar and Space Physics: A Science for a Technological Society* (2012) is out of scope;
4. Excluding analog studies, focused study of the Earth system, including its atmosphere, magnetosphere, surface, and interior, is out of scope (these topics are treated in the National Academies' *Thriving on our Changing Planet: A Decadal Strategy for Earth Observation from Space* (2017);
5. Studies of meteorites and other extraterrestrial materials in terrestrial laboratories that further planetary science goals are in scope but findings and recommendations in this area should take into consideration the National Academies' report *Strategic Investments in Instruments and Facilities for Extraterrestrial Sample Curation and Analysis* (2018).
6. Recommendations for ground- and space-based investigations to detect exoplanets are out of scope (these topics are being addressed by "ASTRO2020: Decadal Survey on Astronomy and Astrophysics" currently in progress). However, the identification of scientific issues and questions related to the study of exoplanets, including the comparative planetology and potential habitability of solar and extrasolar planets, is in scope.
7. Scientific investigations of near-Earth objects, both for the impact hazard presented to Earth and the future exploration and resource opportunities, are within scope. Findings and recommendations in this area should take into consideration the

National Academies' report *Defending Planet Earth: Near-Earth-Object Surveys and Hazard Mitigation Strategies* (2010) as well as more recent National Academies' and community studies related to this area such as the *Near-Earth Object Observations in the Infrared and Visible Wavelengths* (2018)

8. Findings and recommendations concerning planetary protection policies are out of scope. But, the identification of planetary protection considerations for recommended missions—as recommended in the National Academies' *Review and Assessment of the Planetary Protection Policy Development Processes* (2018)—and research or technology development to mitigate concerns about biological contamination are in scope.
9. Recommendations regarding new construction of major new ground-based observatories are out of scope (these are addressed within the scope of the ASTRO2020 decadal survey currently in progress). The role that current and contemplated new ground-based facilities can play in advancing planetary science is in scope. How the facilities under consideration in the ASTRO2020 survey (when available) could benefit planetary science is within scope.
10. The scientific identification and initial validation of technosignatures is in scope but the application of such signatures in survey studies is out of scope. Recommendations in this area should take into account the summary of the Technosignatures Workshop found in the meeting report *NASA and the Search for Technosignatures* (2018) as well as the National Academies' reports *An Astrobiology Strategy for the Search for Life in the Universe* (2018) and *Exoplanet Science Strategy* (2018).

CONSIDERATIONS

National Science Foundation Recommendations

For NSF, the survey will be most effective if it is aspirational, inspirational, and transformative. The decadal survey should assess how the current NSF portfolio of facilities and individual investigator grants address these priorities, as well as how currently planned and new facilities under consideration in the ASTRO2020 survey could benefit the planetary science priorities. The study may recommend changes to NSF's portfolio of facilities, including initiating divestment actions, as it deems necessary to advance the science and to optimize the value of current and future facilities. The decadal survey steering committee is encouraged to comment on NSF opportunities for expanding partnerships, whether private, interagency, or international.

National Aeronautics and Space Administration Recommendations

The report should reflect NASA's statutory responsibility for flight mission investigations. The committee is strongly encouraged to adhere to the following guidelines as they draft the principal components of the NASA implementation portion of the report:

1. Recommendations for individual flight investigations for initiation between 2023 and 2032 as follows (note that dollar values given below do not include launch vehicle or Phase E costs; full Life Cycle Costs for PI-led missions may be as much as double these values):

- a. Flight investigations believed executable for less than approximately \$500 million (candidates for the Discovery or SIMPLEx programs) should not be identified or prioritized. They will be proposed by community investigators to address the science goals and challenges called for in the statement of task;
 - b. The report should consider whether specific flight investigations with costs in the approximate range \$500-900 million (New Frontiers class) should continue to be specified or whether this mission class should be open in a manner similar to the Discovery program; If specific flight investigations are recommended, the report should provide a candidate list of objectives for each mission;
 - c. The report should identify specific destinations and science goals for “large strategic missions” with costs projected to exceed \$900 million;
 - d. The prioritization of flight investigations for Mars and the Moon should be integrated with flight investigation priorities for other solar system objects into a single prioritized list of all recommended missions;
 - e. The findings and recommendations contained in Visions into Voyages for Planetary Science in the Decade 2013-2022, together with other recent National Academies’ reports on topics relevant to planetary science, astrobiology and planetary defense should be used as input to the decadal efforts. Missions identified in these reports that have not yet been confirmed for implementation must be reprioritized;
 - f. The study will assess whether NASA’s plans for Mars Sample Return (MSR) play an appropriate role in the research strategy for the next decade. The study may include findings and recommendations regarding those plans, as appropriate, including substantive changes in NASA’s plans. Recommendations may include, but are not limited to, actions ranging from increased investments (upscope) to reduced investments (downscope) and termination. It is not necessary to rank MSR, among other recommended activities for space; and
 - g. It is understood that initiation of missions on these lists will depend on actual resource availability.
2. Recommendations for NASA-funded supporting research required to maximize the science return from the flight mission investigations and to provide the context and impetus for future flight mission investigations;
 3. A discussion of strategic technology development needs and opportunities relevant to NASA planetary science programs; and,
 4. A discussion of (a) how planned and potential human space flight activities will provide new opportunities for planetary science and (b) what areas of planetary science will provide information needed to support human space flight activities.

APPROACH

The organization of the study is sized based upon prior planetary decadal surveys. The committee will consist of a steering group—approximately 15-20 members, responsible for the overall organization and execution of the study, and the production of a final consensus report

that will undergo the usual National Academies review processes—and five or six supporting panels—approximately 10-12 members each—responsible for providing the scientific and technical breadth to span the diverse suite of scientific topics and potential solar system destinations.

The scheme used to allocate the domain of study among the panels should support delivery of a report organized according to the significant, overarching questions in planetary science, astrobiology, and planetary defense. Individual panels may span multiple solar system target bodies, with specific panel structure determined by the National Academies and the committee's chair(s). An important role of the panels will be to evaluate input from the research community about issues of scientific and programmatic priorities in the field. In keeping with prior planetary science decadal surveys, the work of the study panels will be integrated and incorporated as chapters in the final survey report.

One representative from each of the panels shall serve on the steering group. The composition of the steering group and panels will take full advantage of the diversity of the planetary science, astrobiology, and planetary defense communities in factors such as gender, race, ethnicity, career stage, types and sizes of institutions, geographic distribution, etc. It is imperative that some early career researchers be invited to serve on panels.

In assembling the committee and panels, calls for nominations will be sent to the planetary science, astrobiology, and planetary defense communities and sponsors. National Academies' staff will nominate a candidate for chair after consultation with the Space Studies Board, the Committee on Astrobiology and Planetary Science and other relevant stakeholders. The chair will work with committee staff and others to develop the structure for the study and a slate of nominees for the balance of the committee's membership.

In assembling the slate of nominees for the steering group and panels, committee staff will follow National Academies' procedures for reducing and balancing biases, and for ensuring that the steering group and panels have the needed expertise across disciplines and diversity among their members, including gender, career stage, underrepresented groups, types and sizes of institutions, and geographic distribution.

In designing and pricing the study, the Academies should include resources for independent and expert cost analysis support to ensure that all flight mission cost estimates can be meaningfully intercompared and are as accurate as possible given the varying maturity of project concepts and other recognized uncertainties. The prioritized list of science missions should be developed with the anticipated resources in mind.

The final report must represent a comprehensive and authoritative analysis of the subject domain and represent the community stakeholders. The study activity will include town hall meetings, sessions at geographically dispersed professional meetings, and aggressive use of electronic communications for soliciting and aggregating inputs from across the community and country. It is anticipated that a call for white papers will be issued prior to the commencement of the study itself. The committee may also convene focused workshops on special topics of interest. Other input-gathering methods will be explored and used, including a pre-study event to inform early-career researchers about the scope of, and their potential role in, the decadal survey.

PRODUCTS

It is suggested that the committee produce three products: a complete, integrative report of the findings and recommendations of the study, incorporating the reports of the supporting panels; an abbreviated high-level presentation of the main findings and recommendations suitable for distribution to the general public; and a web-based archive of report-relevant documents, including all community white papers and mission studies.