

The guiding document for the decadal survey is the Statement of Task. This document provides additional counsel for the Committee and staff as they carry out their work.

Decadal Strategy for Solar and Space Physics (Heliophysics)

STUDY APPROACH

The sponsors of the decadal survey--NASA, NOAA, and the NSF--have provided general and Agency-specific guidelines for the Survey Committee. These are listed below.

General (All Sponsors)

In addition to the disciplinary science discussions, the report should highlight interdisciplinary and system science, new and emerging frontiers for solar and space physics, space weather, and the state of the profession.

The survey report should also consider experimental and theoretical plasma physics investigations that would enhance progress on the prioritized science goals.

In its recommendations, the report should consider the balance of investments for research, facilities, and other projects, based on science area, timing, cost, technical readiness, and other relevant issues.

State of the Profession (All Sponsors)

The report should produce recommendations for Agency actions that address needs identified in its assessment of the State of the Profession. Recommendations should be directed towards a particular agency as appropriate for that Agency's mandates and responsibilities.

When possible, recommendations should include either specific metrics for success or potential issues or concerns for consideration in the Agency's generation of those metrics.

The survey should discuss challenges to individuals outside of major research institutions in responding to Agency solicitations and participating in Agency projects, with a focus on Minority Serving Institutions and Primarily Undergraduate Institutions. Each Agency should provide the Committee timely data on the institutional or organizational locations of individuals responding to Agency solicitations or projects.

The survey should identify where Agency support of existing or potential new programs would ensure the continued development of scientific and technical capabilities necessary for the report's science strategy. This should include discussion of challenges of access to these programs for members of underrepresented communities, and the effectiveness, insofar as data is available, of ongoing agency programs.

The Survey Committee is also encouraged to discuss potential studies that the decadal survey cannot complete but that the Agencies might consider conducting. Effective discussions would include the specific study objectives and motivations, anticipated outcomes, any metrics or guidelines for metrics, and potential challenges or pitfalls.

National Space and Aeronautics Administration (NASA)

For NASA, the survey and report should produce recommendations for the strategic execution of compelling, innovative spaceflight science investigations in the next decade as well as for laying the groundwork for the next generation of missions in the following decades.

The survey should make recommendations for the healthy and sustainable implementation of the Heliophysics spaceflight mission programs. These include the Heliophysics Explorers, Living With a Star, Solar Terrestrial Probes, and Space Weather Science Application programs.

Recommendations should address mission sizes, mission cadence, and priorities within each program; the report should include the program budgets necessary to implement those recommendations. NASA expects to receive recommended science investigations for the Living With a Star and Solar Terrestrial Probes programs for a range of project sizes (i.e. from Missions of Opportunity to large missions), and for the Space Weather Science Application program for a restricted range of project sizes (i.e. not including large missions).

All recommendations for Living With a Star, Solar Terrestrial Probes, and Space Weather Science Application should be made as prioritization of goals and objectives to be addressed (where an objective is a narrow aspect of broader science goals that can be completed by a single spaceflight investigation). In those programs, the report should recommend major investments that would be capable of completing identified objectives. The recommended major investments should not specify mission implementations (including instrument-specific details), but should use notional mission concepts as a tool for assessing the technical readiness and budget feasibility.

NASA recognizes that establishing a long-term strategy requires early investments in a

range of technologies and techniques that may open up paths for future scientific endeavors. The survey is encouraged to, as part of a long-term strategy, make recommendations on the early development of technologies and techniques that would enable specific science investigations in and beyond the next decade.

As part of its recommendations, the survey should include consideration of opportunities for the Heliophysics programs to participate in recent and emerging National and Agency needs and activities. These include but are not necessarily limited to the following:

- a) The survey should assess to what degree the Heliophysics programs should support Space Situational Awareness/Orbital Debris research and technology. NASA specifically invites input on the scientific and/or programmatic connection(s) with its Space Weather Science Application program.
- b) NASA invites input on where its research and mission programs can support and leverage Agency human exploration and lunar exploration activities (including but not limited to the Artemis program). Recommendations on the research strategy should explicitly reference those opportunities, where appropriate. Documents describing these activities should be delivered to the Survey Committee before or at the first meeting.

In developing its recommendations, the Survey Committee should adhere to the following:

- a) The survey should not reprioritize missions that will have entered the preliminary design phase (i.e. passed KDP B) by the time of the report's publication, regardless of the mission program.
- b) The survey should not prioritize science investigations for completion by the Heliophysics Explorers program, which solicits and selects Principal Investigator-led missions via a fully open and competitive Announcement of Opportunity process.
- c) The survey should not recommend a project management paradigm for any spaceflight investigation. NASA intends to decide whether a mission will be PI-led or not based on the scope of the project, Agency needs, and other issues that may emerge in the next decade. However, NASA invites the Survey Committee to provide input on potential issues or factors that NASA may consider when making that decision for missions.
- d) In its recommendations, the Survey Committee should take into consideration the following programmatic information:
- e) NASA expects its mission programs to be balanced (based on the issues identified in the *General* section above) and to provide flexibility for implementation. The survey should provide its definition of balance that guided the recommendations and discuss the most important aspects for NASA's consideration. Recommendations should not be limited only to major investments, and should not over-specify program implementation.

- f) NASA may re-structure the Living With a Star and the Space Weather Science Application programs to better align them with Division, Agency, and National needs. Documents describing these programmatic structures will be delivered to the Survey Committee before the first meeting, and recommendations should fit within and optimize these frameworks.

National Oceanic and Atmospheric Administration (NOAA)

Survey guidance specific to NOAA will be consistent with agency statutory requirements for continuity and improvement of space weather observations, and for delivery of services and information to the public and commercial sectors. The decadal survey committee's recommendations will be framed around national needs, including but not limited to research priorities to improve space weather specification and prediction capabilities. The committee's recommendations for NOAA will, as far as practicable, align with anticipated budgets at the relevant portion(s) of the agency, with any deviations from those budgets presented. Recommendations may be organized around 1) how new technology may enhance current operations and 2) what new science is needed to expand current operations, either to enable new capabilities or to include new areas of interest. In making these recommendations, the committee will consider the need to improve current operations and support a viable path forward for the continuous improvement of space weather services to address the evolving national needs.

In particular, the committee will:

- a) Consider which scientific advances are needed to add to and improve NOAA's predictive and specification capabilities. This includes considering the overlap and interdependencies between the processes on the sun, and in the solar wind, magnetosphere, ionosphere, and upper atmosphere and encouraging the development of extended and comprehensive forecasts and specifications.
- b) Offer recommendations concerning "research to operations" and "operations to research." For example, the committee will identify areas where targeted research can accelerate the development of the operationally relevant numerical specification and prediction models and areas where operational models can be made available for use by researchers and improvement by researchers.
- c) Suggest approaches for evaluating the new capabilities of non-traditional providers of Space Weather observations, with the expectation that these capabilities will continue to increase in scope and quality. The committee will also consider how such capabilities might alter NOAA's flight mission and sensor priorities in the next decade and beyond.
- d) Consider the agencies' ability to replicate existing technologies to improve and sustain operational delivery of public services and to produce consistent and reliable science and applications data products across different generations of measurement technology as new measurement innovations are introduced.

National Science Foundation (NSF)

The survey and report should assess how the NSF portfolio of ground-based observational facilities and instrumentation, associated cyber infrastructure, laboratory-based studies, and work by investigators can address key research and application goals in solar and space physics for the next decade.

In the treatment of the Sun as a nearby laboratory for astrophysical research (i.e., Sun - as-a- star), the survey should take into consideration the alignment of its priorities with the those of the National Academies decadal survey for Astronomy and Astrophysics 2022-2032, in order to take advantage of any synergies. In the treatment of the heliosphere and geospace as a natural plasma science laboratory, the survey should take into consideration the alignment of its priorities with the recommendations of the National Academies decadal survey report *Plasma Science: Enabling Technology, Sustainability, Security, and Exploration* (2021).

Assessment on increasing the broader societal impacts of supported geospace and solar astronomy projects are welcome, including educational programs and broadening participation in solar and space physics.

The Survey Committee may recommend any changes to current and future infrastructure that it deems necessary to advance consensus priorities, including recommendations for facilities that could be developed under NSF's Mid-scale Research Infrastructure and Major Research Equipment and Facilities Construction programs.

The Survey Committee is encouraged to comment on NSF opportunities for expanding partnerships, whether private, interagency, or international.