

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

SPACE STUDIES BOARD

National Academies update to European Space Science Committee (ESSC)

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JWST

- JWST launched December 18 at dawn ET, from French Guiana on an ESA's Arian-5 and was picture perfect!
- Agenda:
 - What does the National Academies do?
 - What is new in the Space Studies Board (and a tad from other boards)?
 - What is a Decadal Survey?

National Academies of Sciences, Engineering, and Medicine

What do we do?

National Academy of Sciences

On March 3, 1863 at the height of the US Civil War, President Abraham Lincoln signed an Act of Congress to create the National Academy of Sciences.

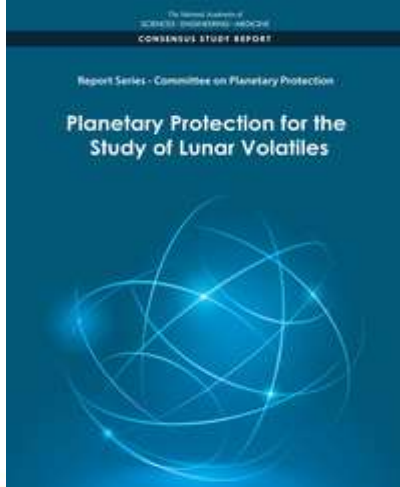
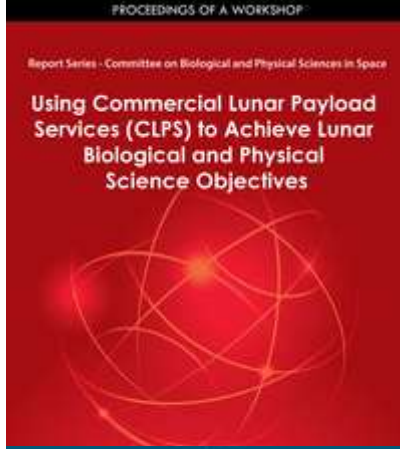
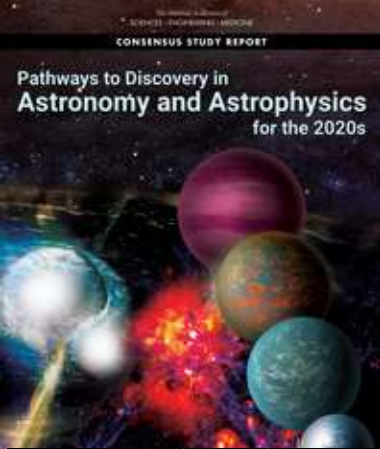


NAS and Astrobiology/Planetary Science

“... the primary scientific goals of this program are immense: a better understanding of the origins of the solar system & the universe, the investigation of the existence of life on other planets, & potentially, an understanding of the origin of life itself.”

1961 letter from the SSB to
NASA Administrator James Webb





SSB 2021 Reports

2020 reports

SSB Recent Reports

- Astro2020 Decadal Survey: Pathways to Discovery in Astronomy and Astrophysics for the 2020s (2021)
- Planetary Science and Astrobiology Decadal Survey 2023-2032 : Origins, Worlds and Life: A Decadal Strategy (2022)
- Report Series: Committee on Biological and Physical Sciences in Space - Using Commercial Lunar Payload Services (CLPS) to Achieve Lunar Biological and Physical Science Objectives: Proceedings of a Workshop (2021)
- Report Series: Committee on Planetary Protection: Evaluation of Bioburden Requirements for Mars Missions (2021)

SSB Ongoing Activities

- Decadal Survey on Life and Physical Sciences Research in Space 2023-2032
- Foundation for Assessing the Health and Vitality of NASA Science Mission Directorate's Research Communities
- Increasing Diversity in the Leadership of Competed Space Missions
- Lessons-Learned in the Implementation of NASA's Earth Venture Class
- Space Weather Operations and Research Infrastructure Workshop: Phase II
- Increasing the Use of the International Space Station U.S. National Laboratory as a Research Platform: Meeting of Experts
- CAPS short report on the White Paper from the "Standards of Evidence for Life Detection Community" held from July 19-22, 2021 was hosted by the NASA

Ongoing Activities

- *Space Weather Roundtable (congressionally mandated)*
- *CoPP: NASA seeks to understand what fraction of the population of a class of Small Bodies needs to be preserved as a scientific sample*
- *Solar & Space Physics/Heliophysics Decadal Survey*

FYI: Ad Hoc Committee on the Pandemic and Flying

[Aviation After a Year of Pandemic--Economics, People & Technology: A Workshop](#)

- Chair - John-Paul Clarke
- A well-attended workshop was held June 28-30, 2021. Proceedings are being developed, and expected to be posted shortly.
- Recordings and presentations from the workshop are available on the [event website](#).
- Conference proceedings will be published in December.

BPA Recent Reports

- Bringing Fusion to the US Grid (2021)
- Plasma Science: Enabling Technology, Sustainability, Security, and Exploration (2021)
- Issue at the World Radiocommunication Conference 2023 (BPA)

BPA Ongoing Activities

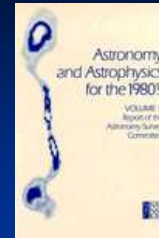
- Assessment of High Energy Density (HED) Physics
- Biological Physics/Physics of Living Systems: A Decadal Survey - Due out next CY.
- Elementary Particle Physics: Progress and Promise
- Frontiers in Synthetic Moiré Quantum Matter
- Review of FCC Order 20-48 Authorizing Operation of a Terrestrial Radio Network Near the GPS Frequency Bands

National Academies of Sciences, Engineering, and Medicine

What is a Decadal Survey?

Space Science Decadal Surveys

- Astronomy and Astrophysics
1963, 1973, 1982, 1991,
2001, 2010, (2022)
- Planetary Science
2003, 2011, (2022)
- Solar and Space Physics
2003, 2012, (2024)
- Earth Science and Applications
from Space
2007, 2018, (2029)
- Biological and Physical Research
in Space
2011, (2023)

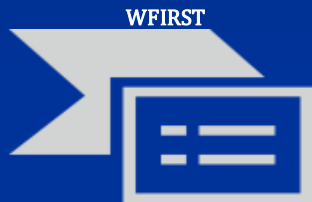


The NASA Great Observatories



A Few Past Decadal Recommended Flagships Launched or Being Built

Astrophysics Decadal

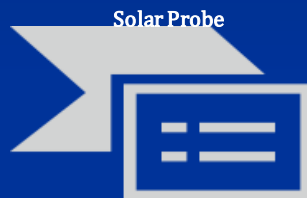


Now the Nancy Grace Roman Space Telescope

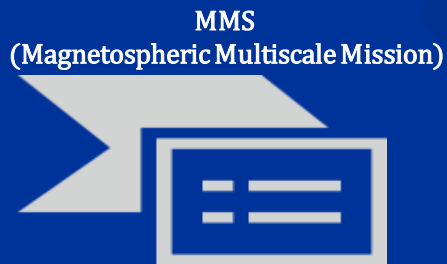


Now the James Webb Space Telescope

Heliophysics Decadal



Now the Parker Solar Probe



(Magnetospheric Multiscale Mission)

Planetary Science Decadal

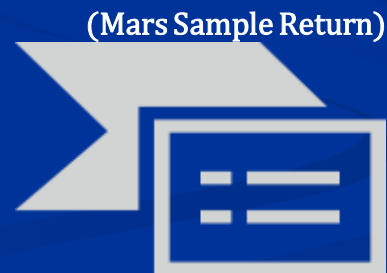
Mars Science Laboratory



Now the Curiosity Rover



Now Europa Clipper



1st Step: Perseverance Rover Caching

What does a Decadal Survey do?

- **Assess the current status of an entire scientific discipline**
- **Define and prioritize the key scientific questions to be addressed in the next decade**
- **Define and prioritize the most important initiatives to address these priorities**
- **Make recommendations to the funding agency about R&A, and ground and space-based mission development, among other areas**

Decadal Surveys (cont)

- **Conducted by the National Academies, independently of sponsoring agencies and organizations**
- **NASA is required by the Authorization Acts of 2005 and 2008 to engage with the National Academies and conduct decadal surveys in all major space science disciplines**

What is the Statement of Task?

- The statement of task for each Decadal can be found on the Space Studies **Board website** of the National Academies
- It outlines exactly what the sponsors and the National Academies negotiated for the NAS to undertake with the community. **Sponsors have no input after the SoT is in place.**
- The National Academies requires its committees to do no more or no less than what is **specified in the statement of task**
- There is additional information (**considerations**) as suggestions to make the survey most useful; they are not binding on the National Academies' Survey Committee.

Nominations Process

Nominations and self nominations are encouraged. We are looking for individuals with the following characteristics:

- **Scientific and technical expertise and objectivity;**
- **Broad thinking**, open-minded, and not an active proponent of a specific project;
- **Experience** in the management of a project, organization, or equivalent enterprise, is advantageous; and
- Willing to participate in-person or virtual (during Covid) in survey committee activities

White Papers and Early Career

- Current Survey Whitepapers are now published and available on the Bulletin of the American Astronomical Society's website.
- White papers are valued community input: every one is read
- Decadal Surveys impact ALL OF OUR future: **early career participation is encouraged**
- Fresh ideas and perspectives are respected and ingested;
Clarity is paramount
- **Flagships, medium class, and small mission concepts, as well as facility class missions, infrastructure ideas are all equally welcome**

How is a Decadal Survey Used?

- Although lawmakers and Agencies take the Decadal seriously, they are not required to do so by law, but embrace its goals and spirit.
- Implementation depends upon many factors, and can be delayed due to agency funding limitations or evolving technology advances(e.g. Europa Orbiter from the 2011 Decadal Survey)

Decision Rules

- A resilient strategic implementation plan accommodates some level of deviation from the anticipated circumstances.
 - However, as time passes and conditions in the scientific, technical, political, and social environment change
 - Decision Rules have provided more robust advice.
- A formal request for **decision rules** in the **decadal survey** statement of task began with the 2010 astronomy and astrophysics

Decision rules serve several purposes

- 1) Simply by considering alternative scenarios, the survey committee can clarify its process for setting priorities.
- 2) Reality rarely matches expectations.
- 3) Decision rules provide agencies and policy makers with flexibility and insight.

More on Decision Rules

- Decision rules can be as simple as contingency planning, for example, what to do when an international partner makes a particular selection.
- Decision rules may define alternative strategies for handling a better or worse budget scenario.
- Decision rules can provide on-ramps and off-ramps for priorities that depend on anticipated scientific discoveries or technical advances.
- Decision rules are less helpful when attempting to prescribe responses to unforeseen circumstances (e.g. mission failure) when tactical Agency responses are more appropriate.

How is a Survey Typically Conducted?

- Experts are selected and appointed by the National Academies independently — a steering committee in overall charge and supporting panels – with NAS reviewing conflict of interest in each case before receiving the NAS President's approval
- Specific actions are taken to engage the community — an effort to achieve diverse inputs via a host of outreach mechanisms
- NASA often supports studies of promising mission concepts as study input

How is a Survey Typically Conducted? (cont)

- An independent assessment of the technical risk and cost evaluation (TRACE) process is used to determine realism of ground- and space-based projects
- The report is released after a rigorous review conducted by outside experts selected by the National Academies

Typical Ground Rules

- Missions with a formal budgetary line were not reprioritized; everything else was within scope for prioritization
- Competitive mission lines (e.g., Discovery-class or smaller) or R&A-type activities were not prioritized
- Prioritization included missions that had not entered Phase A (e.g., EJSM, TSSM, Venus Flagship)

Typical Elements of a Survey Report

- Overview of relevant discipline
- Broad survey of the current state of knowledge
- Inventory of the top-level science questions
- Recommendations on optimum balance between target bodies,
large/medium/small missions, ground versus space, etc.
- Assessment of infrastructure
- Discussion of strategic technology development needs
- Prioritized list of recommended strategic space missions,
ground-based facilities and supporting research

Technical, Risk, and Cost Estimation (TRACE)

- Independent evaluation of concepts - assuring the analysis is fair, uniform, and tied to historical data to assure accuracy.
- Puts pre-phase A concepts on even footing by evaluating them with whatever information is available and describing the resultant approximation of rough life-cycle cost of a proposed concept.

RISK Box - expand & contract the error box commensurate with available info.



Example: Decadal Early-Career Event at LPSC

Sunday, March 15, 10:00 a.m. - 12:00 p.m. Woodlands
Waterway Marriott Hotel and Convention Center.

Learn about surveys, engage with experts, ask questions.
Please attend!

Free registration at [http://sgiz.mobi/s3/Early-Career-
Event](http://sgiz.mobi/s3/Early-Career-Event)

Note: LPSC registration is NOT required

The Big Questions in Space Science

Astrophysics: How does the universe work? How did we get here? Are we alone?

Earth Sciences: How do we improve weather and air quality forecasts, understand the coupling of the water and energy cycles and ecosystem change, study sea-level rise, surface dynamics, climate uncertainty, and geological disasters?

Heliophysics: How do we understand the Sun and its interactions with Earth, the interstellar medium, and space weather?

Planetary Sciences: What is the origin and history of the solar system, are we alone, and what hazards and resources lie in space for human exploration?



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ORIGINS, WORLDS, AND LIFE

Co-Chairs Robin Canup and Phil Christensen

A Decadal Strategy for Planetary Science & Astrobiology
2023–2032

Themes

Priority Science Question Topic and Scope

Q1. Evolution of the protoplanetary disk What were the initial conditions in the Solar System? What processes led to the production of planetary building blocks, and what was the nature and evolution of these materials?

A) Origins

Q2. Accretion in the outer solar system How and when did the giant planets and their satellite systems originate, and did their orbits migrate early in their history? How and when did dwarf planets and cometary bodies orbiting beyond the giant planets form, and how were they affected by the early evolution of the solar system?

Q3. Origin of Earth and inner solar system bodies How and when did the terrestrial planets, their moons, and the asteroids accrete, and what processes determined their initial properties? To what extent were outer Solar System materials incorporated?

Q4. Impacts and dynamics How has the population of Solar System bodies changed through time, and how has bombardment varied across the Solar System? How have collisions affected the evolution of planetary bodies?

Q5. Solid body interiors and surfaces How do the interiors of solid bodies evolve, and how is this evolution recorded in a body's physical and chemical properties? How are solid surfaces shaped by subsurface, surface, and external processes?

B) Worlds & Processes

Q6. Solid body atmospheres, exospheres, magnetospheres, and climate evolution What establishes the properties and dynamics of solid body atmospheres and exospheres, and what governs material loss to space and exchange between the atmosphere and the surface and interior? Why did planetary climates evolve to their current varied states?

Q7. Giant planet structure and evolution What processes influence the structure, evolution, and dynamics of giant planet interiors, atmospheres, and magnetospheres?

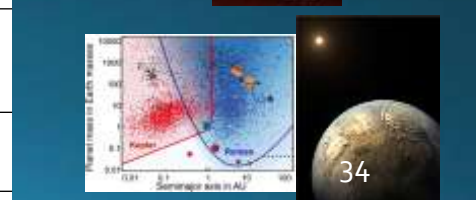
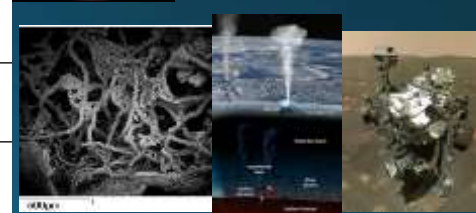
Q8. Circumplanetary systems What processes and interactions establish the diverse properties of satellite and ring systems, and how do these systems interact with the host planet and the external environment?

Q9. Insights from Terrestrial Life What conditions and processes led to the emergence and evolution of life on Earth, what is the range of possible metabolisms in the surface, subsurface and/or atmosphere, and how can this inform our understanding of the likelihood of life elsewhere?

C) Life & Habitability

Q10. Dynamic Habitability Where in the solar system do potentially habitable environments exist, what processes led to their formation, and how do planetary environments and habitable conditions co-evolve over time?

Q11. Search for life elsewhere



THANK YOU!

Space Studies Board
National Academy of Sciences
Our Next Meeting is June 8 – 10
June 8 is joint with ASEB