



SPACE STUDIES BOARD

# **Science Prioritization at the U.S. National Academies of Sciences, Engineering, and Medicine**

**James H. Crocker**  
**Vice-Chair Space Studies Board**  
**Vice President and General Manager (ret)**  
**Lockheed Martin Space Systems Co.**

# Outline

- Brief history of the Academies and the Space Studies Board (SSB)
- SSB recent activities/reports and their Impact
- The Decadal Studies Process of the National Academies
- Conclusion



The National Academy of Sciences

**"Amid the din of war, the heat of party, the deviltries of politics, and the poisons of hypocrisy, science will be inaudible, incapable, incoherent, and inanimate."**

**Benjamin Peirce, 1863**

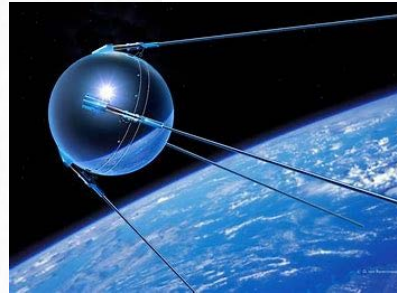


**The city of Washington, 1869.**

**Photo courtesy the Library of Congress**

# Creation of the Space Studies Board June 26, 1958

NATIONAL ACADEMY OF SCIENCES  
NATIONAL RESEARCH COUNCIL  
2101 CONSTITUTION AVENUE, WASHINGTON 25, D. C.



26 June 1958

Dear Dr. Berkner:

I am glad to express to you the great satisfaction taken by the officers of the Academy-Research Council in your acceptance of the responsibilities of the chairmanship of the new Space Science Board. We feel that the formation of this Board can have especial significance for science as we face the challenge and adventure of the new steps into space that are surely and swiftly on the way.

It is my hope that the Board will give the fullest possible attention to every aspect of space science, including both the physical and the life sciences. I believe that we have a unique opportunity to bring together scientists from many fields to survey in concert the problems, the opportunities, and the implications of man's advance into space, and to find ways to further a wise and vigorous national scientific program in this field.

We have talked of the main task of the Board in three parts -

2101 CONSTITUTION AVENUE, N. W. WASHINGTON 25, D. C. TELEPHONE EXECUTIVE 3-8100

FOR RELEASE SUNDAY, AUGUST 3rd

For further information call  
Howard J. Lewis, Ext. 310

## National Academy of Sciences Establishes Space Science Board

Washington, D.C., August 2nd -- Dr. Detlev W. Bronk, president of the National Academy of Sciences - National Research Council, announced today the formation of a 15-man Space Science Board, "to survey in concert the scientific problems, opportunities and implications of man's advance into space."

Dr. Lloyd V. Berkner, president of Associated Universities, Inc., president of the International Council of Scientific Unions and a member of the National Academy of Sciences, has been named chairman.

The Board, besides acting as the focal point for all Academy-Research Council activities connected with space-science research, will be called upon to coordinate its work with appropriate civilian and government agencies, particularly the National Aeronautics and Space Administration, the National Science Foundation, and the Advanced Research Projects Agency, and with foreign groups active in this field.

# Current SSB Members

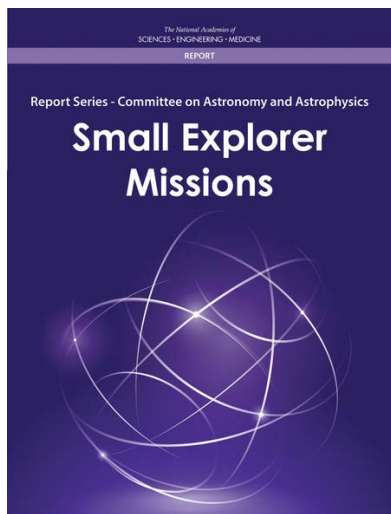
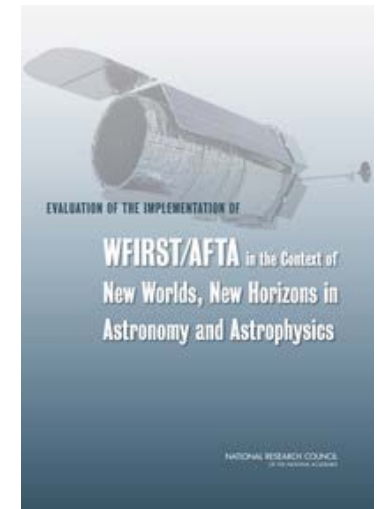
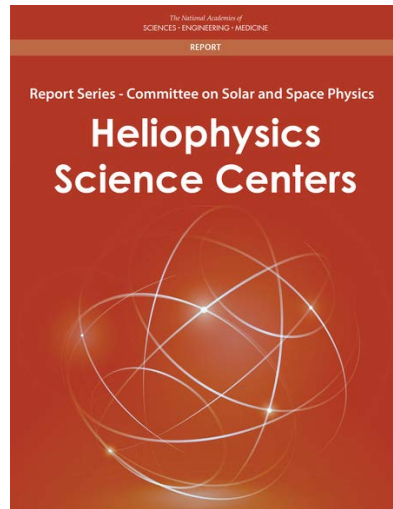
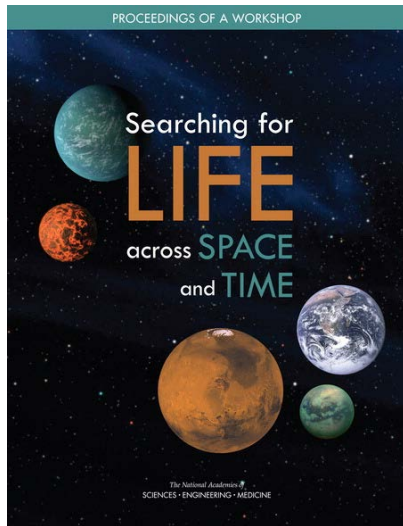
- Fiona Harrison, Chair, California Institute of Technology
- James H. Crocker, Vice Chair, Lockheed Martin Space Systems Company (retired)
- Gregory P. Asner, Carnegie Institution for Science
- Jeff M. Bingham, Consultant
- Adam Burrows, Princeton University
- Mary Lynne Dittmar, Dittmar Associates
- Jeff Dozier, University of California, Santa Barbara
- Joseph Fuller Jr., Futron Corporation (retired)
- Sarah Gibson, National Center for Atmospheric Research
- Victoria Hamilton, Southwest Research Institute
- Chryssa Kouveliotou, The George Washington University
- Dennis P. Lettenmaier, University of California, Los Angeles
- Rosaly M. Lopes, Jet Propulsion Laboratory
- Stephen J. Mackwell, Universities Space Research Association
- David J. McComas, Princeton University
- Larry Paxton, Johns Hopkins University, Applied Physics Laboratory
- Eliot Quataert, University of California, Berkeley
- Barbara Sherwood Lollar, University of Toronto
- Harlan E. Spence, University of New Hampshire
- Mark H. Thiemens, University of California, San Diego
- Erika Wagner, Blue Origin
- Paul Wooster, Space Exploration Technologies
- Edward L. Wright, University of California, Los Angeles



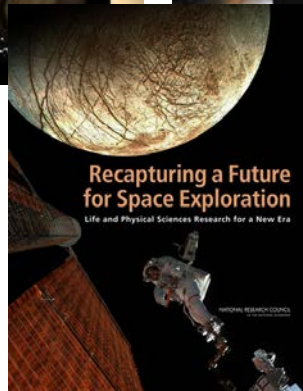
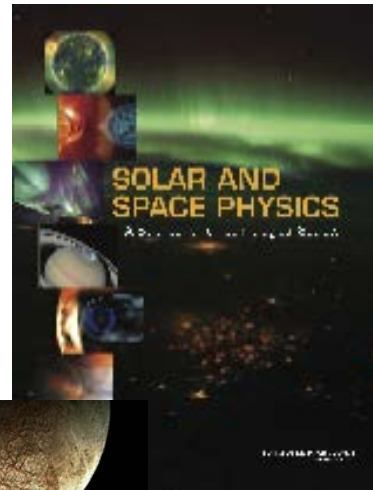
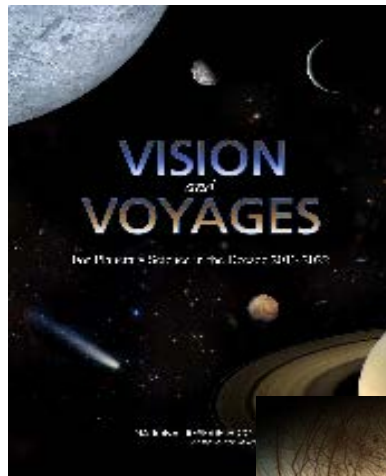
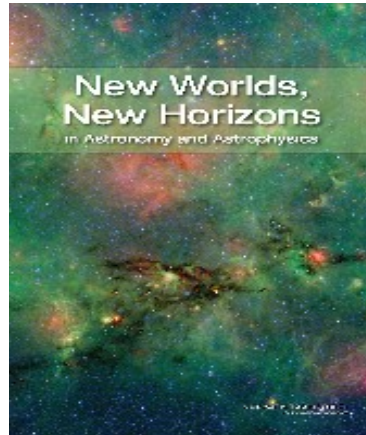
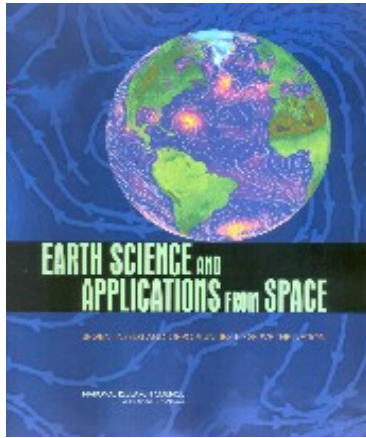
# Standing Committees and Co-Chairs

- **Committee on Astrobiology and Planetary Science**, Christopher House, Pennsylvania State University & William McKinnon, Washington University
- **Committee on Astronomy and Astrophysics**, Steven Ritz, University of California, Santa Cruz, Vicky Kalogera, Northwestern University,
- **Committee on Biological and Physical Sciences in Space**, Elizabeth Cantwell, Arizona State University, Robert Ferl, University of Florida
- **Committee on Earth Science and Applications from Space**, Chelle Gentemann, Earth and Space Research, Steven Running, University of Montana
- **Committee on Solar and Space Physics**, Sarah Gibson, National Center for Atmospheric Research, Maura Hagan, Utah State University

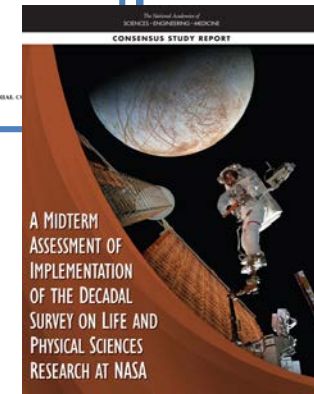
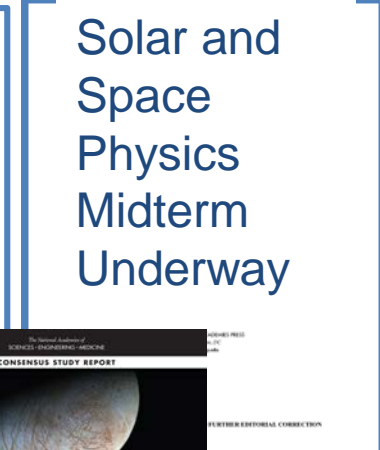
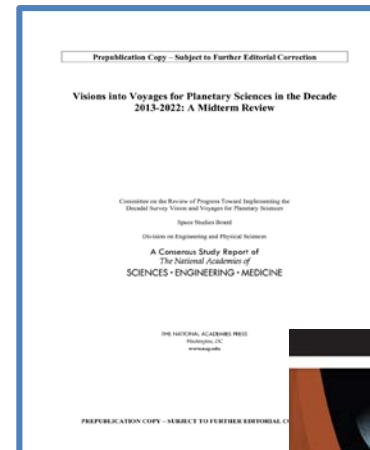
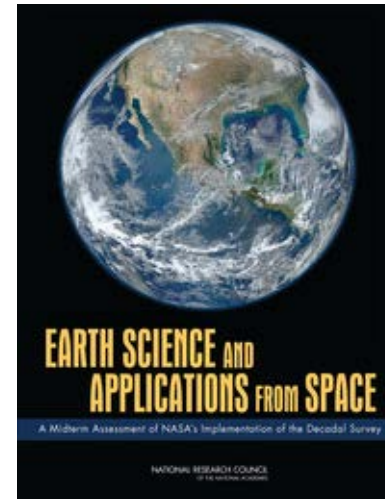
# Selected Studies and Major Reports



# DECADALS SURVEYS



# MID-DECADAL ASSESSMENTS





# RECENT DECADALS AND MID-DECADAL REPORTS

## Astronomy and Astrophysics

- *Astro2020 - Underway*
- Midterm Assessment released Aug 2016.
- New Worlds, New Horizons in Astronomy & Astrophysics, 2010-2022

## Earth Science and Applications from Space

- Thriving on Our Changing Planet: A Decadal Strategy for Earth Observation from Space, 2017-2027, released Jan. 2018
- Midterm Assessment of 2007 Decadal Survey released 2012.

## Planetary Sciences

- *Midterm Assessment released Aug. 2018*
- Vision and Voyages for Planetary Science in the Decade 2013-2022

## Solar and Space Physics (Heliophysics)

- *A Decadal Strategy for Solar and Space Physics - Underway*
- Solar and Space Physics: A Science for a Technological Society 2013-2022

## Biological and Physical Sciences

- Midterm Assessment released Jan 2018.
- Decadal Survey on Biological and Physical Sciences in Space, 2012-2022

# What Leaders Say About NAS reports

"With the variety of challenges facing our nation today - whether it is emergency preparedness, drug safety, or the care of our military veterans - the Institute of Medicine serves as a trusted source of thoughtful, authoritative deliberation."

*Michael O. Leavitt, former governor of Utah, secretary of the U.S. Department of Health and Human Services, and administrator, U.S. Environmental Protection Agency, 2009*

"I commend the National Academy of Sciences on this outstanding report. NASA has the experience, the technology, and now it has the money. It's time to fix Hubble -- Congress and the American people expect nothing less."

*Sen. Barbara Mikulski, commenting on the report Assessment of Options for Extending the Life of Hubble Space Telescope, Dec. 9, 2004*

# Purpose of the Decadal Survey

- To assess the current state of knowledge in a specific discipline
- To identify and prioritize the most important scientific questions for the next decade
- To prioritize the ground-based and space-based missions and activities that can address these questions.

# Cost and technical evaluation (CATE)

- Inclusion of independent assessment of likely cost and technical risk associated with priority mission concepts
- All the surveys to date have engaged the Aerospace Corporation to conduct independent assessments using their proprietary CATE methodology.
- The CATE analyses were typically briefed to the survey committee immediately following the final set of panel meetings
- The results of the CATE analyses of priority missions identified by the last three decadal studies allowed the survey committees to make last-minute adjustments to some mission concepts.

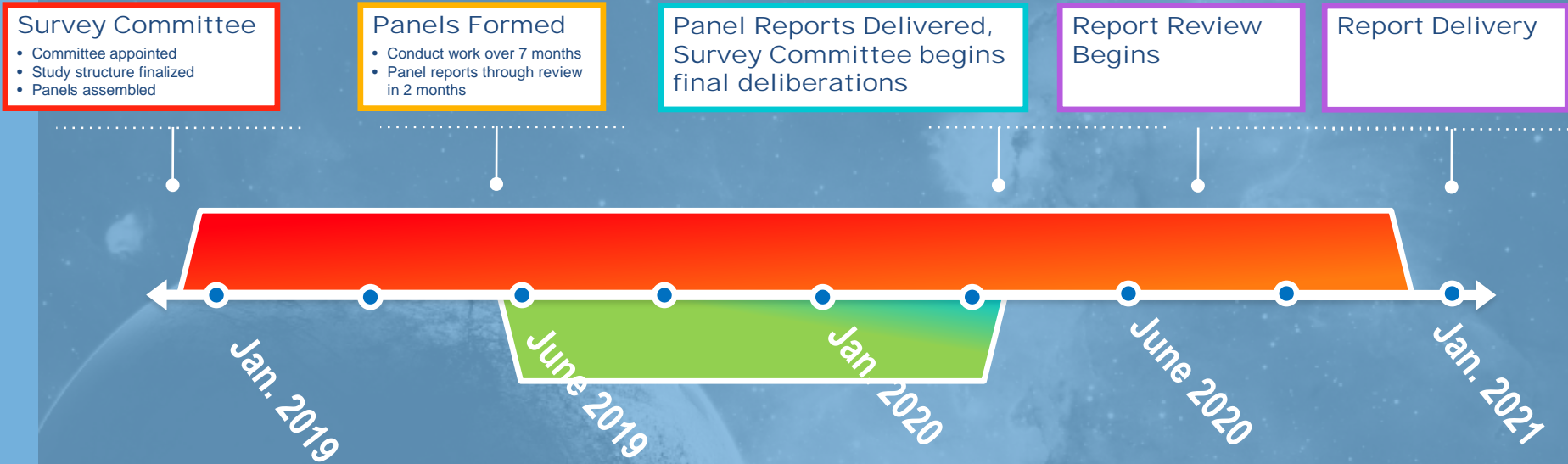
# Leadership Selection of those who:

- Have a broad and balanced view of astronomy/astrophysics
- Are well-respected by the community and seen as fair
- Have demonstrated leadership ability
- Is a consensus builder who is able to stimulate others to work collaboratively
- Is willing to shepherd the study through completion and years following release of the report when it serves to guide the field forward
- Is not heavily involved in any of the major projects anticipated to be considered for prioritization by survey committee

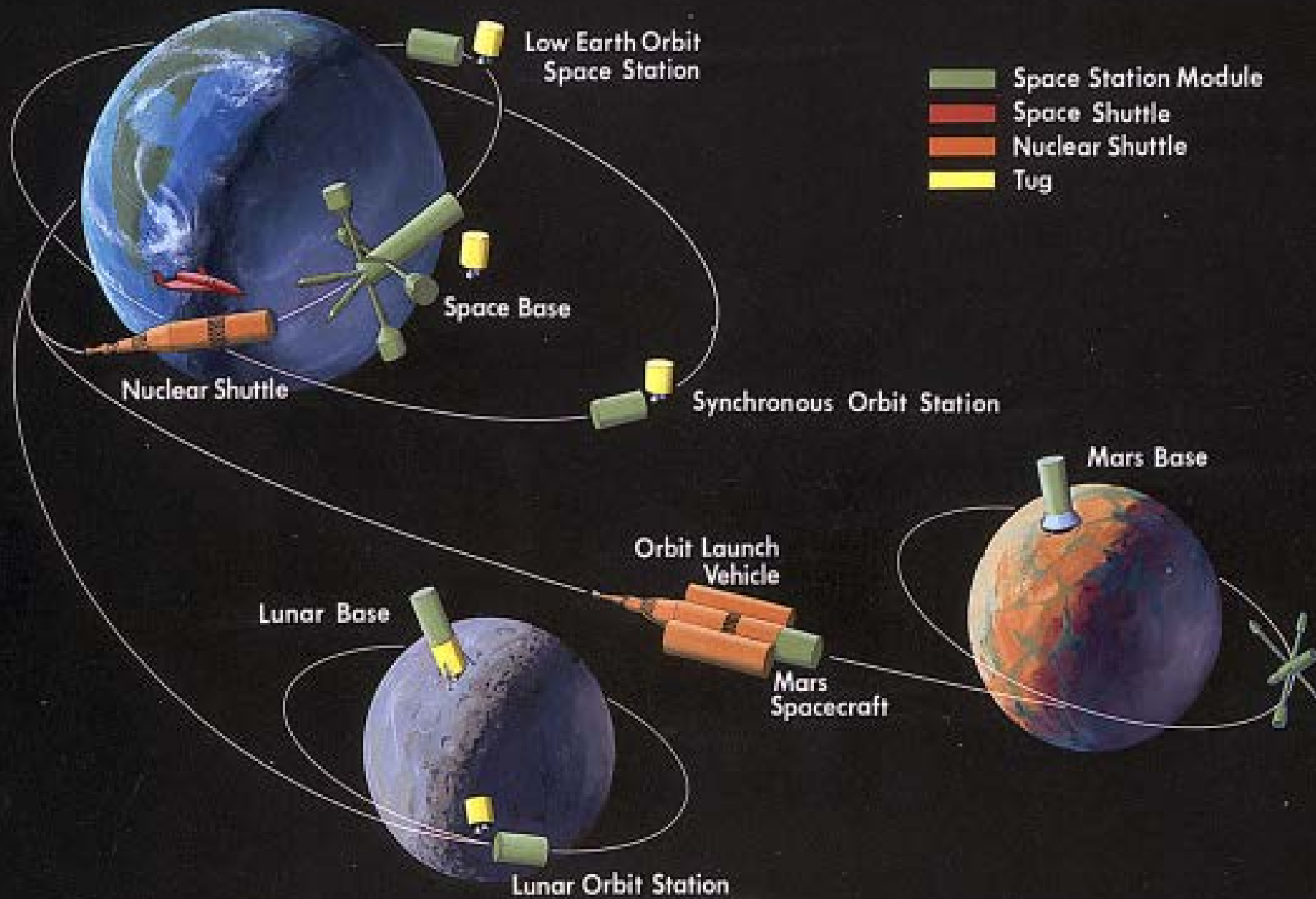
*The NAS invites nominations of theorists, observers and experimentalists, and particularly encourages candidates reflecting the diversity of the astrophysics/astronomy fields*

# Notional Timeline-Original\*

Assumptions - 24-month Study, 1 Set of Panels



\* Slight shift because of funding timing



Thank you







SPACE STUDIES BOARD

# Background

# Outline

- Overview of NAS capabilities
- Decadal Survey Process
- Conclusion

# Advancing the Discussion

- The National Academies also convene workshops, symposia, and other events that bring together experts and practitioners to consider issues related to science, engineering, and medicine and their implications for policy and practice. In a space free from partisan pressures and preset agendas, participants share their own research and perspectives and also look beyond them—making connections within and across disciplines, sharpening questions, sparking new ideas, and exploring possible solutions.
- Some workshops focus on specialized areas, while others tackle big questions. When necessary, we can swiftly gather the nation’s top minds to address matters of urgent importance, such as how to combat an emerging virus or respond to a natural disaster.
- When there is a need for ongoing dialogue, our roundtables and forums—which are organized around a topic—offer stakeholders an opportunity to build relationships and unravel complicated issues over time.
- Regardless of the format, these gatherings go beyond bringing people together. They advance conversation, catalyze movement around an issue, and generate bold ideas.

# Connecting New Frontiers

- In addition to our landmark studies and convening activities, the National Academies pursue a range of initiatives to strengthen the scientific, engineering, and medical fields and their capacity to contribute to human welfare. This includes supporting fellowship programs that foster the career development of young scientists and collaborating with the academies of other nations that advance science globally.
- We strive to bring the benefits of science and technology to the economic, cultural, and industrial life of the nation and to the health and well-being of its citizens. In the same way the institution contributed to landmarks of American achievement such as the Apollo space program and the Human Genome Project, we continue to kindle new frontiers in science, engineering, and medicine.
- Our activities help marshal new knowledge as it develops, identifying how it can be used to meet the needs of the public and decision makers— helping move us all toward a healthier, safer, and more prosperous future.

# Free Access for All

- Individuals around the world benefit from open access to our thousands of publications at [WWW.NAP.EDU](http://WWW.NAP.EDU). Each year we receive thousands of comments from readers about how they plan to use our work to enhance their lives and communities. For example, a reader recently told us, “I am a trauma surgeon working in Bogotá, Colombia, and this material will be very useful in organizing prehospital and hospital trauma care in order to prevent deaths.”
- By applying our insights to a range of challenges, readers have helped advance change, improve their communities, and share knowledge with others.

# Affecting Policy and Practice

- Our reports and convening activities have a wide range of impacts on policy and practice, on scales ranging from the global to the individual. They guide the development of federal laws and regulations, improve the effectiveness of government programs, shape the direction of research fields, and inform public knowledge and dialogue about issues of critical importance.
- **Decadal Surveys** are a jewel in the crown of the Space Studies Board because they allow the community to come to a consensus about the scientific priorities for the next decade. This has proved so invaluable that today, all four SMD Science areas use Decadal Surveys as their guide.

# SSB Discipline Committees

- The Standing/Discipline committees provide strategic direction and oversee activities of ad hoc study committees, interact with sponsors, and serve as a communications medium between the government and the scientific community.

# Decadal Surveys Background

- Over the past 50 years there have been 6 astronomy surveys, 2 each for planetary science and for solar and space physics, and 1 each for Earth science and applications from space and for life and physical sciences research in space.
- The NASA Authorization Acts of 2005 and 2008 provided a formal legislative mandate for decadal surveys in each NASA science area.
- The 2005 act also mandated National Research Council (NRC) reviews of NASA's performance in each discipline at 5-year intervals (Public Law 109-155).
- The 2008 act called for "independent estimates of the life cycle costs and technical readiness of missions assessed in the decadal surveys whenever possible" (Public Law 110-422) and for identifying conditions or events that might trigger a reexamination of the survey's priorities.



# Decadal Surveys Input

- All of the surveys utilized broad community input via multiple town meetings, solicitation of scientific or mission-oriented white papers, and other outreach efforts.

*Each and every survey conducted since the first in astronomy in 1964 has employed a modified organizational structure and study methodology to fit their particular situation.*

# Decadal Surveys Study Process

- **Alternating meetings of the survey committees and their supporting panels**
  - The public start of the decadal study process typically occurs with the first meeting of the survey committee. Thereafter, meetings of the panels and survey committee alternate. Survey committees typically hold five or six full meetings plus numerous additional conference calls. Panels typically meet three times each (plus additional conference calls, as necessary) and complete their work prior to the third or fourth meeting of the survey committee.
- **Community input via the solicitation of white papers**
  - All four recent decadal surveys included a mechanism by which members of the relevant scientific communities could submit white papers discussing important scientific, technical, or programmatic issues. The solicitation typically occurs soon after the first meeting of the survey committee. The submission deadline is timed so that the white papers are available for consideration by the supporting panels soon after their first meetings.

# Decadal Survey Structure

- All of the surveys were led by a **Steering Committee**, consisting of 15-20 senior members of the relevant disciplines, including scientific, programmatic, technical and policy.
  - The Steering Committee is responsible for the overall conduct of the study, for aggregating and adjudicating panel recommendations, and for drafting top-level conclusions and recommendations.
  - They drew input from a set of 10-15 member **Survey Panels**, some of which were discipline-oriented and others of which were organized on cross-cutting themes.
  - Chairs of the Survey Panels are members of the Steering Committee.

# What use is a Decadal to Agencies?

Page 39, Lessons learned in Decadal Planning in Space Science: Summary of a Workshop: The National Academies Press, ISBN 978-0-309-29067-8, 2013

Why does NASA care about the decadal surveys? The answer is that they are both swords and shields. They are swords because a high decadal ranking provides a program manager with an argument supporting a new activity. They are shields because they protect highly ranked programs from attack. The first decadal survey in any discipline is always difficult. The 2007 Earth science decadal survey was an amazing achievement because nobody at NASA thought that that community could be “corralled.”

Hartman noted that there are plenty of areas for improvement. The issue of mission costing has been raised multiple times so far. The NRC is not going to do a better job of costing their recommended program than can NASA. It is an inherently difficult endeavor and a primary cause of many of the criticisms leveled against NASA

From a NASA perspective, the principle challenge facing future decadal surveys is how to maintain the NRC’s “golden glow” NASA and the NRC should each do what they do best. At one time, the idea of decadal surveys containing only science priorities was attractive to Hartman. But now she is convinced that such a decadal survey would be too vague to serve the role of both a sword and a shield. While the future will be dominated by more and more complex science questions, those holding the purse strings will be more and more focused on total cost and cost control. In such an environment, a “three-worlds” approach might be best. That is, future surveys should formulate their programs in the context of three budgetary scenarios. First is the “heavenly” world we all hope we have. Second is the “nominal” world representing an extrapolation of currently prevailing circumstances. Third is the “evil” world we do not want to experience. NASA would specify these budgetary scenarios, and there would be sufficient spread between them to encompass all likely fiscal environments. Having NASA specify the three scenarios in the statement of task for a new decadal survey would help protect the NRC’s reputation and leave it free to do the things it does best.

# Decadal Survey Impact

- Mid-Decadal Assessments have allowed the scientific community to have an open interchange with the Agencies responsible for implementing the Decadal Survey.
- DECISION RULES allow the Decadal Survey to set priorities for unexpected changes in the environment (mission over-runs, congressional budget changes, etc.)
  - Most recently used effectively in the Solar & Space Physics Decadal Survey with Solar Probe.
  - Past effective uses include Mars Sample Return and Europa orbiter.



The Decadal Survey process, run by the NAS, produces a consensus report on US science priorities for astronomy & astrophysics, earth sciences and applications, solar and space physics, planetary sciences and microgravity sciences in space.