



The Decadal Survey on Planetary Science and Astrobiology 2023-2032

Co-chairs: Robin Canup and Phil Christensen
Study Director: David H. Smith

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Mars Exploration Program Analysis Group
20 October, 2020

Process is driven by the Statement of Task

- The statement of task is posted on the survey's website:
<https://www.nas.edu/planetarydecadal>
- It outlines exactly what the sponsors—NASA and NSF—and the National Academies want the survey committee to do
- The National Academies commits to do no more and no less than that specified in the statement of task
- The website contains additional information (e.g., scope, considerations, and approach) and suggestions to make the survey most useful to NASA and NSF, but these items are not binding on the survey committee



What will be Different?

- Survey report will be organized around cross-cutting science themes and priority questions, rather than by destinations
- Survey report will not have individual chapters devoted to particular planetary bodies
- Instead, the report will contain chapters organized around priority science questions and key topics
- The survey committee will draft these priority questions by Christmas 2020



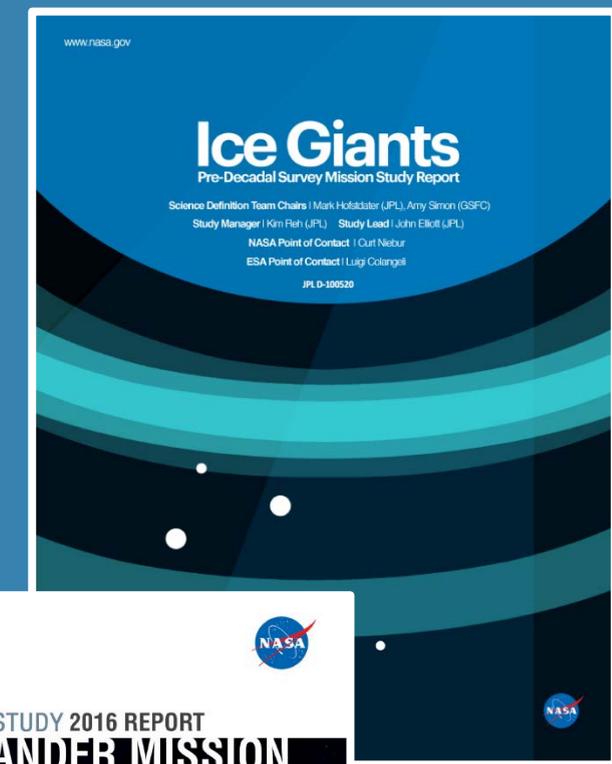
Identify Priority Questions

Examples from *Vision and Voyages* (Table 3.1)

Crosscutting Themes	Priority Questions
Building New Worlds	1. What were the initial stages, conditions and processes of solar system formation and the nature of the interstellar matter that was incorporated?
	2. How did the giant planets and their satellite systems accrete, and is there evidence that they migrated to new orbital positions?
	3. What governed the accretion, supply of water, chemistry, and internal differentiation of the inner planets and the evolution of their atmospheres, and what roles did bombardment by large projectiles play?
Planetary Habitats	4. What were the primordial sources of organic matter, and where does organic synthesis continue today?
	5. Did Mars or Venus host ancient aqueous environments conducive to early life, and is there evidence that life emerged?
	6. Beyond Earth, are there modern habitats elsewhere in the solar system with necessary conditions, organic matter, water, energy, and nutrients to sustain life, and do organisms live there now?
Workings of Solar Systems	7. How do the giant planets serve as laboratories to understand the Earth, the solar system and extrasolar planetary systems?
	8. What solar system bodies endanger and what mechanisms shield the Earth's biosphere?
	9. Can understanding the roles of physics, chemistry, geology, and dynamics in driving planetary atmospheres lead to a better understanding of climate change on Earth?
	10. How have the myriad chemical and physical processes that shaped the solar system operated, interacted, and evolved over time?

Identify Extra Mission Studies

- A key aspect of the report will be to identify and prioritize the set of large- and medium-size missions for the next decade
- Mission concept studies have been completed, and a small number more will be done, in order to better understand the science and mission design for key destinations
- **Panels and steering group will determine which extra studies will be performed by early-December 2020**
- Leading concepts will undergo independent cost and technical readiness assessments in the Spring of 2021, i.e., prior to final prioritization for inclusion in survey report



Decadal Survey Steering Group

Robin Canup, NAS*	Southwest Research Institute, Co-Chair
Philip Christensen	Arizona State University, Co-Chair
Mahzarin R. Banaji, NAS*	Harvard University
Steve Battel, NAE**	Battel Engineering
Lars Borg	Lawrence Livermore National Laboratory
Athena Coustenis	Paris Observatory
James Crocker, NAE**	Lockheed Martin Space Systems, Retired
Brett Denevi	Johns Hopkins University Applied Physics Laboratory
Bethany Ehlmann	California Institute of Technology
Larry Esposito	University of Colorado at Boulder
Orlando Figueroa	Orlando Leadership Enterprise, LLC
John Grunsfeld	Endless Frontier Associates, LLC
Krishan Khurana	University of California Los Angeles
William McKinnon	Washington University
Francis Nimmo, NAS*	University of California Santa Cruz
Carol Raymond	Jet Propulsion Laboratory
Barbara Sherwood Lollar	University of Toronto
Amy Simon	NASA Goddard Space Flight Center

*Member of the National Academy of Sciences. **Member of the National Academy of Engineering
Committee biographies are posted on the [study website](#).

- Survey leadership group
- Collective expertise spans scientific, technical and policy scope of statement of task
- Responsible for overall conduct of survey
- Formulate top-level conclusions and recommendations



Panels Organized by Destination

Moon and Mercury

chair: Timothy Grove, vice chair: Brett Denevi

Venus

chair Paul Byrne, vice chair: Larry Esposito

Mars

chair: Victoria Hamilton, vice chair: Bethany Ehlmann

Small bodies

chair Nancy Chabot, vice chair: Carol Raymond

Giant planet systems

chair: Jonathan Lunine, vice chair: Amy Simon

Ocean worlds and dwarf planets

chair: Alex Hayes, vice chair: Francis Nimmo

- Provide targeted scientific and engineering expertise
- Identify how object/class of objects may address cross-cutting scientific themes and questions
- Evaluate mission concepts
- Each vice chair is also a member of the steering group
- Panel boundaries are permeable to encourage cross-panel discussions.



Decadal Survey Mars Panel

Victoria Hamilton *chair*

Bethany Ehlmann *vice chair*

William Brinckerhoff

Tracy Gregg

Jasper Halekas

Jack Holt

Joel Hurowitz

Bruce Jakosky

Harry Y. McSween

Michael Manga*

Claire Newman

Alejandro M. San Martin**

Kirsten Siebach

Amy Williams

Robin Wordsworth

Southwest Research Institute

California Institute of Technology

Goddard Space Flight Center

Buffalo University

University of Iowa

University of Arizona

Stonybrook University

University of Colorado

University of Tennessee

University of California, Berkeley

Aeolis Research

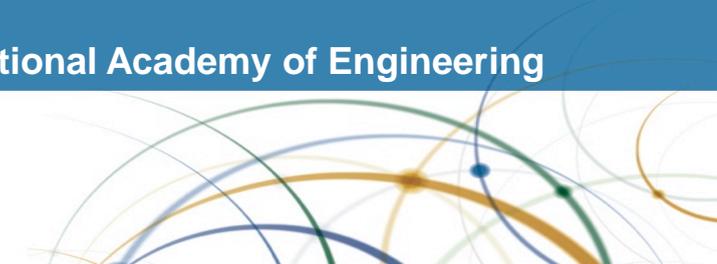
Jet Propulsion Laboratory

Rice University

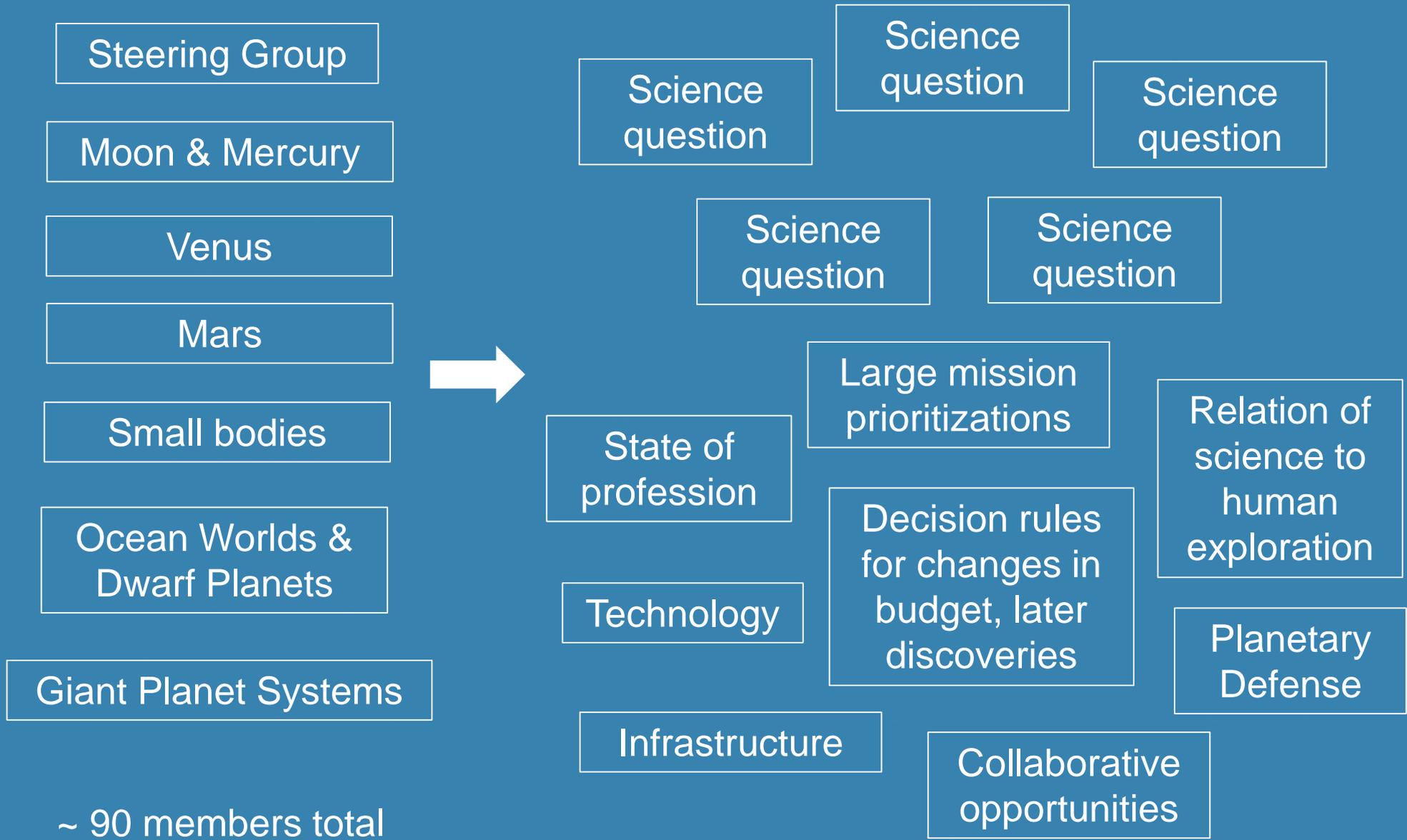
University of Florida

Harvard University

* member National Academy of Sciences ** member National Academy of Engineering



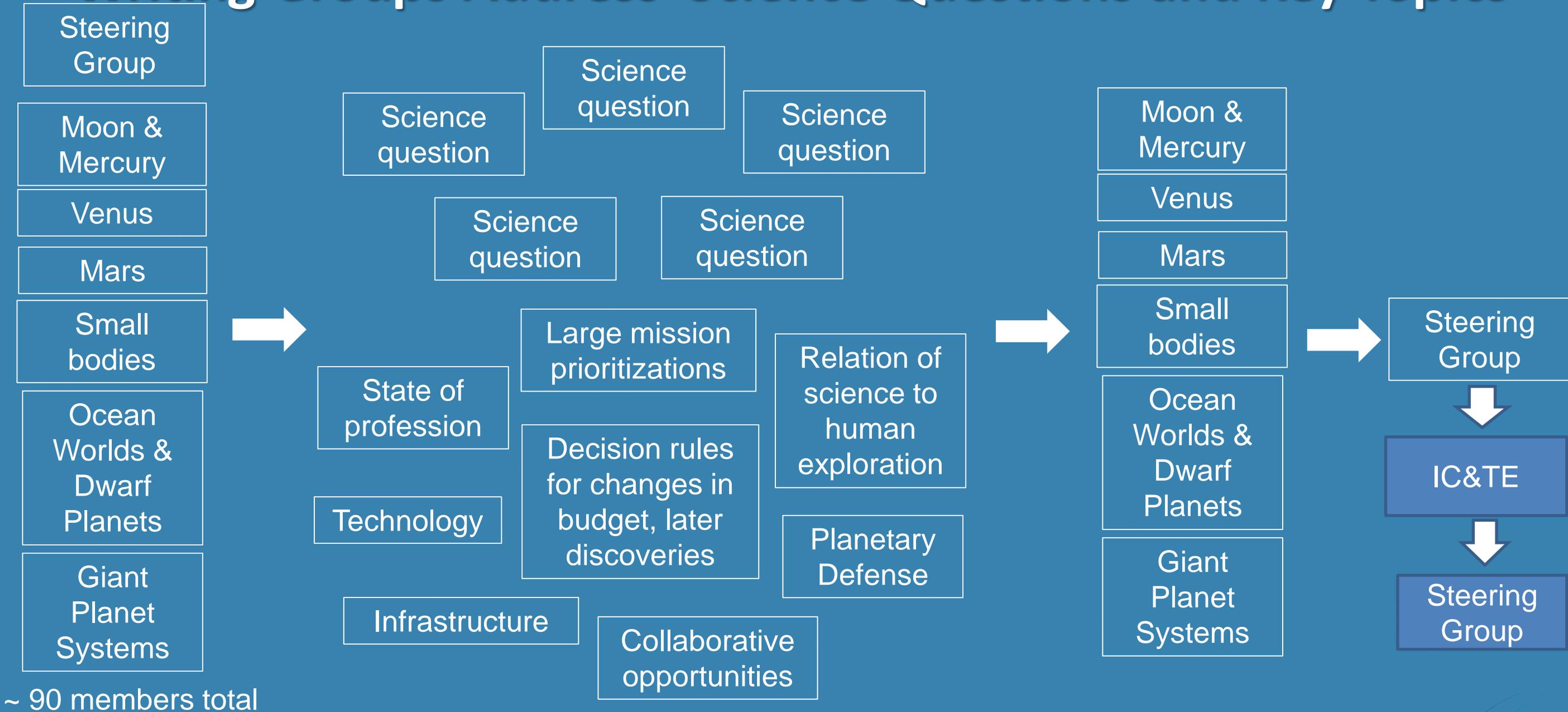
Report Organized by Science Questions and Key Topics



- Cross-cutting science questions and associated research. Likely ~ a dozen in total.
- Large mission prioritizations
- Additional topics as needed to address statement of task
- SG and panel members contribute to portions of report for which they have input and related expertise



Writing Groups Address Science Questions and Key Topics



Meeting Schedule So Far

Steering Group	Mercury-Moon	Venus	Mars	Giant Planet Systems	Ocean Worlds and Dwarf Planets	Small Solar System Bodies
30 September	23 October	6 October	26 October	20 October	9 October	15 October
2 October	More TBA	13 October	More TBA	10 November	16 October	2 November
16 October		20 October		17 November	23 October	13 November
30 October		27 October		24 November	30 October	18 November
11-12 November		10 November				23 November
8 December		24 November	The only reliable source of information about meeting dates is the survey website		Dates in (XXX) are very tentative	
		(1 December?)				



Thank You

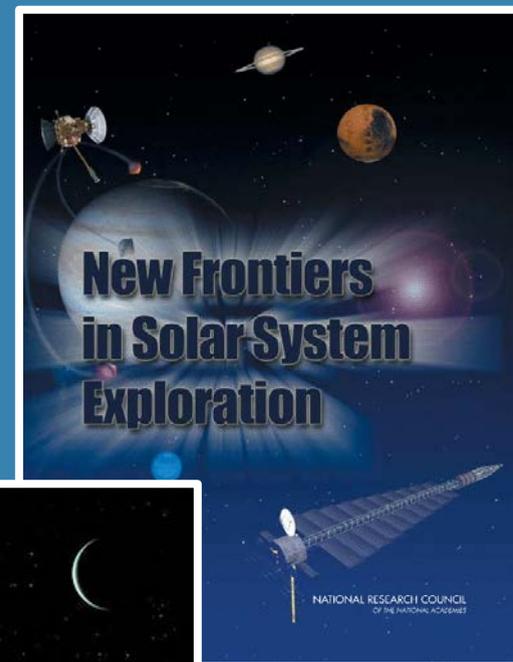
<https://www.nas.edu/planetarydecadal>



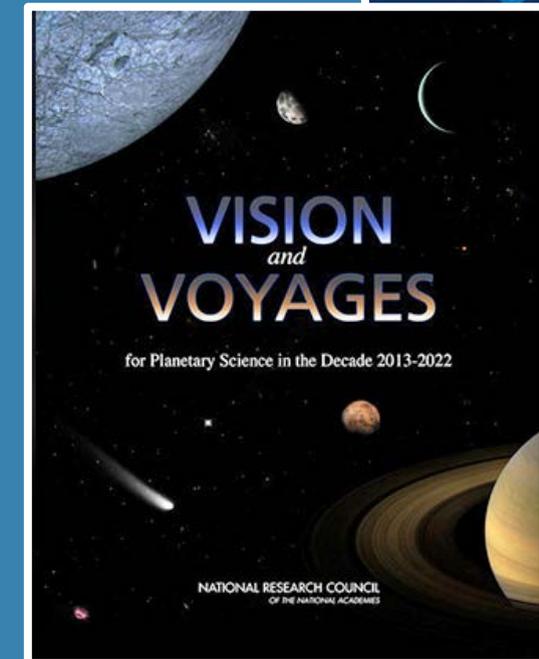
What is a Decadal Survey?

1. Assesses the current status of an entire scientific discipline
2. Defines and prioritizes key scientific questions to be addressed in the next decade
3. Prioritizes the most important initiatives to address these questions
4. Conducted by the National Academies, independently of sponsoring agencies
5. NASA Authorization Acts of 2005 and 2008 require decadal surveys in each NASA science area
6. Surveys are required to provide independent cost and technical evaluations of recommended projects/missions

Sponsoring agencies and Congress view surveys as the formal statement of priority by the US space science community, and have repeatedly stated their intent to give highest priority to the missions identified in the survey



2003-2012



2013-2022



Decadal Survey Process Overview

1. Solicit community whitepapers
2. Determine cross-cutting themes/priority topical questions.
3. Identify additional mission studies that are needed and complete studies
4. Assess how progress will be made in next decade to address priority science questions and additional specific topics in statement of task.
5. Assess all mission studies to determine those best able to address cross-cutting themes/priority questions
6. Most promising concepts assessed for cost and technical realism by independent contractor
7. Prioritize missions and overall recommendations.
8. Report external review, respond to reviewer comments, final report approval
9. Release report to NASA, NSF, and public



What is New this Time?

- A higher profile for astrobiology and planetary defense
- Recommended activities must be clearly traceable to goals/objectives
- More prominence given to decision rules to accommodate significant deviations in budget, new discoveries, or technological development
- Awareness of human exploration activities undertaken by NASA and international partners
- Identification of opportunities for multidisciplinary collaboration with other SMD divisions, NASA directorates, federal agencies, international partners and the private sector
- Consideration of issues related to the state of the profession



What are the key things a Decadal Survey provides?

- Overview of relevant disciplines

Diversity of Martian Surface



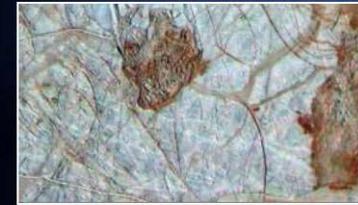
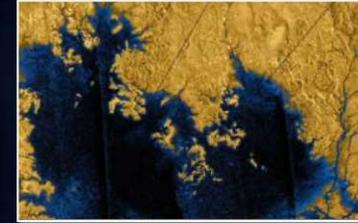
Example: 2013 Survey



What are the key things a Decadal Survey provides?

- Overview of relevant disciplines
- Broad survey of the current state of knowledge

Planetary Habitats



- What were the primordial sources of organic matter, and where does organic synthesis continue today?
- Did Mars or Venus host ancient aqueous environments conducive to early life, and is there evidence that life emerged?
- Beyond Earth, are there modern habitats elsewhere in the solar system with necessary conditions, organic matter, water, energy, and nutrients to sustain life, and do organisms live there now?

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OF THE NATIONAL ACADEMIES

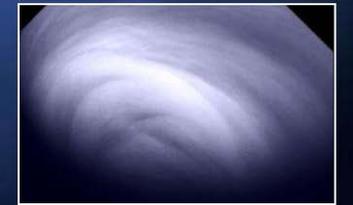
Example: 2013 Survey



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- Broad survey of the current state of knowledge
- Inventory of top-level science questions and research activities

- How do the giant planets serve as laboratories to understand the Earth, the solar system and extrasolar planetary systems?
- What solar system bodies endanger and what mechanisms shield the Earth's biosphere?
- Can understanding the roles of physics, chemistry, geology, and dynamics in driving planetary atmospheres and climates lead to a better understanding of climate change on Earth?
- How have the myriad chemical and physical processes that shaped the solar system operated, interacted, and evolved over time?



NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

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Example: 2013 Survey



What are the key things a Decadal Survey provides?

- Overview of relevant disciplines
- Broad survey of the current state of knowledge
- Inventory of top-level science questions and research activities
- Recommendations on optimum balance between target bodies, large/medium/small missions, ground versus space, etc.

The Discovery Program

- The Discovery Program has produced spectacular and cost-effective science, and can continue to do so well into the future.



The New Frontiers Program

- New Frontiers missions can address high priority and technically complex science goals that are beyond the capabilities of Discovery missions.



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NATIONAL RESEARCH COUNCIL
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Example: 2013 Survey

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- Recommendations on optimum balance between target bodies, large/medium/small missions, ground versus space, etc.
- Assessment of infrastructure



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

Technology Development Priorities

- High priority missions for future study and technology development:
 - *Titan Saturn System Mission*
 - *Neptune Orbiter and Probe*
 - *Mars Sample Return Lander and Orbiter*



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Example: 2013 Survey

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- Inventory of top-level science questions and research activities
- Recommendations on optimum balance between target bodies, large/medium/small missions, ground versus space, etc.
- Assessment of infrastructure
- Discussion of strategic technology development needs
- Identification and ranking of large/medium space missions (with cost and technical evaluation), plus recommendations on other initiatives

Flagship Priority 1: MAX-C

- The view expressed by the Mars community is that Mars science has reached a point where the most fundamental advances will come from study of returned samples.
- MAX-C will perform *in situ* science and collect and cache samples, beginning a three-mission campaign to return samples from Mars.
- Mars Sample Return is enabled by ESA participation throughout the campaign.
- Of the three missions in the campaign, only MAX-C is recommended for 2013-2022.
- The campaign is multi-decadal, and its priority is based on its anticipated total science return and total cost.



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Example: 2013 Survey

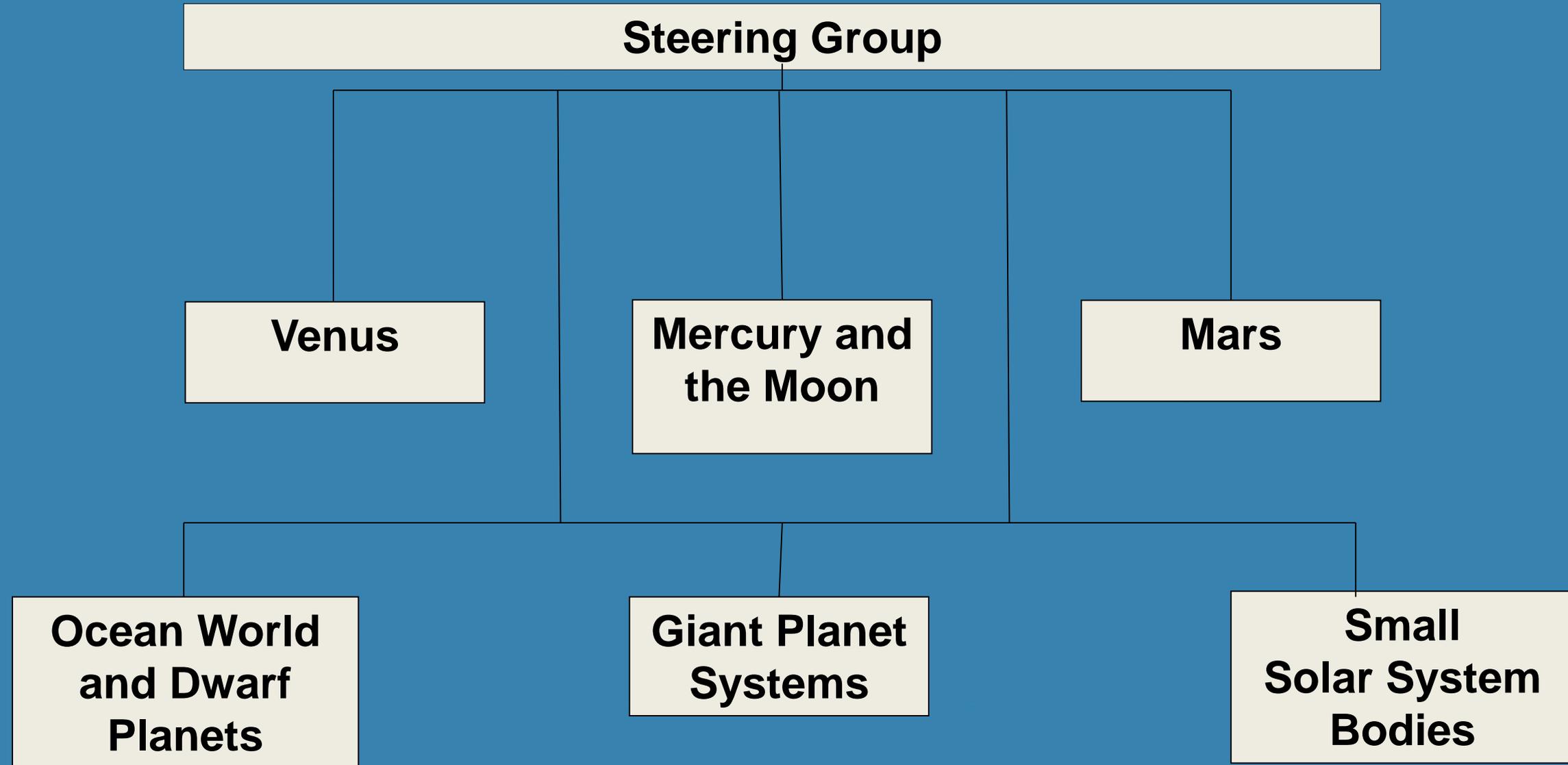
Emphasis on Community Inclusivity

Example: Early-Career Events

- **Event 1:** March 27—Kickoff Webinar for Early Career Professionals
~340 participants
https://youtu.be/j1j_tbj9Wl4
- **Event 2:** May 7—Writing White Papers for the Planetary Science and Astrobiology Decadal Survey: Overview and Perspectives from the Experts
>350 participants
<https://vimeo.com/418576172>
- **Event 3:** July 2—Perspectives and Lessons Learned: Decadal Surveys in Space Science
~350 participants
<https://vimeo.com/436536613>



Organization



Key Dates

1. Survey officially began—20 March, 2020
2. Deadline for public nominations—1 May, 2020—347 nominations (~300 unique)
3. Co-Chairs announced—18 May, 2020
4. Deadline for science whitepapers—15 July, 2020 —**333 submitted**
5. Deadline for mission whitepapers—15 August 2020—**96 additional submissions**
6. Steering Group members appointed—September, 2020
7. All other whitepapers—15 September, 2020 – **100+ more submissions**
8. Panel members appointed—September to October, 2020
9. External review of survey report—4th quarter, 2021
10. Survey report released—late 1st quarter, 2022
11. End of dissemination/NASA contract—late 1st quarter, 2023



Roll of Panels

- Includes who member's collective expertise spans the topical focus, including relevant science themes, supporting relevant object-specific
- Receive and analyze community input in all forms
- Ingest and assess community drafted whitepapers and mission study reports
- Determine what additional mission concepts need to be studied
- Panel boundaries are not rigid demarcation lines
- Panel boundaries are permeable and some specific planetary bodies fall within the purview of multiple panels
- Permeable boundaries are designed to foster discussion and cross-panel activities

