

National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001



Reply to Attn of: Science Mission Directorate

FEB 08 2018

Dr. Fiona Harrison
Space Studies Board
National Academy of Sciences
500 5th Street, NW
Washington, DC 20001

Dear Dr. Harrison,

I would like to express my appreciation for the recent delivery of the report of the Committee for the Review of NASA's Planetary Science Division's Restructured Research and Analysis Programs. The panel members are to be thanked and congratulated. NASA appreciates the excellent job of the Committee and applauds it for the clarity, conciseness, and thoroughness of the report. I would also like to express our gratitude to Dr. Stephen Mackwell, the committee chair, the volunteer members and National Academies' staff, who worked extremely hard in support of this effort and in its dissemination to various stakeholders.

I have reviewed the findings and recommendations of the report, and I am pleased to convey NASA's responses to them. In general, our existing planning appears, by and large, well-aligned with the report's recommendations. Please do not hesitate to contact Dr. Michael New, who can be reached at (202) 358-1766 or michael.h.new@nasa.gov, with any questions about NASA's response.

Sincerely,

A handwritten signature in blue ink, appearing to be "T. Zurbuchen", with a long horizontal line extending to the right.

Thomas H. Zurbuchen, PhD
Associate Administrator,
Science Mission Directorate

CC: California Institute of Technology /F. Harrison
Science Mission Directorate /T. Zurbuchen

- M. New
- J. Rall
- J. Green

Space Studies Board/Michael Moloney

- D. Smith

Universities Space Research Association/Stephen Mackwell

NASA Response to Review of the Restructured Research and Analysis Programs of NASA's Planetary Science Division

The Research and Analysis (R&A) program managed by NASA's Planetary Science Division (PSD), supports a broad range of planetary science activities, including the analysis of data from past and current spacecraft; laboratory research; theoretical, modeling, and computational studies; geological and astrobiological fieldwork in planetary analog environments on Earth; geological mapping of planetary bodies; analysis of data from Earth- and space-based telescopes; and development of flight instruments and technology needed for future planetary science missions. The primary role of the PSD R&A program is to address NASA's strategic objective for planetary science and PSD's science goals, which are derived in part from the 2011 National Research Council (NRC) planetary science decadal survey. The R&A program is composed of a number of thematic program elements and NASA solicits proposals from the planetary science community under the NASA Science Mission Directorate's annual Research Opportunities in Space and Earth Sciences (ROSES) NASA Research Announcement (NRA).

NASA's strategic objective in Planetary Science is to "*ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere.*" We pursue this goal by seeking answers to fundamental science questions that guide NASA's exploration of the solar system:

- How did our solar system form and evolve?
- Is there life beyond Earth?
- What are the hazards to life on Earth?

The Planetary Science Division has translated these important questions into science goals that guide the focus of the division's science and research activities:

1. Advance the understanding of how the chemical and physical processes in our solar system operate, interact and evolve
2. Explore and observe the objects in the solar system to understand how they formed and evolve
3. Explore and find locations where life could have existed or could exist today.
4. Improve our understanding of the origin and evolution of life on Earth to guide our search for life elsewhere
5. Identify and characterize objects in the solar system that pose threats to Earth, or offer resources for human exploration

The 2010 Space Studies Board (SSB) report, *An Enabling Foundation for NASA's Earth and Space Science Missions*, stated that the Research and Analysis (R&A) programs of the Science Mission Directorate (SMD)'s divisions, including the Planetary Science Division (PSD), comprise a key element of NASA's mission-enabling activities. The report recommended, in part:

"...NASA should ensure that SMD mission-enabling activities are linked to the strategic goals of the agency and of SMD and that they are structured so as to

- *Encompass the range and scope of activities needed to support those strategic goals,*
- *Provide the broad knowledge base that is the context necessary to interpreting data from spaceflight missions and defining new spaceflight missions,*
- *Maximize the scientific return from all spaceflight missions,*
- *Supply a continuous flow of new technical capabilities and scientific understanding from mission enabling activities into new spaceflight missions, and*
- *Enable the healthy scientific and technical workforce needed to conduct NASA's space and Earth science program."*

From 2011 to 2013, PSD undertook a restructuring of its R&A programs, in response to the above recommendation from the *Enabling Foundation* report, and considering input from the Planetary Science Subcommittee of the NASA Advisory Council's Science Committee and from other U.S. Government stakeholders. The restructuring was announced in late 2013, and initially implemented in the Research Opportunities in Space and Earth Sciences (ROSES) 2014 solicitation. Implementation has continued since the ROSES 2015 solicitation.

The major changes in the R&A program involved consolidating a number of prior program elements, many of which were organized by subdiscipline, into a smaller number of thematic core research program elements. Other R&A program elements underwent changes before, during, and after the reorganization but these modifications were not on the scale of those made to the core research program elements. PSD continues to update the planetary science community at the major, relevant conferences (i.e. LPSC, AAS DPS, AGU) with selection statistics, funding distributions, and keyword analyses to alleviate concerns in some sectors regarding the major realignment of funding priorities.

The Committee on the Review of NASA's Planetary Science Division's Restructured Research and Analysis Program was charged by NASA to look closely at the new R&A program and determine if it appropriately aligns with the agency's strategic goals, supports existing flight programs, and enables future missions.

In conducting its review, the committee addressed the following questions:

1. Are the PSD R&A program elements appropriately linked to, and do they encompass the range and scope of activities needed to support the NASA strategic objective for planetary science and the Planetary Science Division science goals, as articulated in the 2014 NASA Science Plan?
2. Are the PSD R&A program elements appropriately structured to develop the broad base of knowledge and broad range of activities needed both to enable new spaceflight missions and to interpret and maximize the scientific return from existing missions?

In particular, the committee investigated whether any specific research areas or subdisciplinary groups that are critical to NASA's strategic objectives for planetary science and PSD's science goals are not supported appropriately in the current program or have been inadvertently disenfranchised through the reorganization. In order to collect the data necessary for this investigation, the committee solicited input from NASA PSD management. NASA provided information on the detailed structure of the current program, the procedures involved in funding under the new program elements, and the tools used to ensure appropriate balance across and within program elements. The committee also solicited community perspectives from

representatives of the various planetary science analysis/assessment groups and the NASA center leads⁴ for planetary science.

In response to the charge, the committee found that the current R&A structure is properly aligned with scientific priorities of the decadal survey and the Planetary Science Division 2014 science goals. In particular, the committee found that, despite early community concerns, keyword analyses of the type of task, target body, and science discipline revealed no evidence that restructuring has led to deleterious effects on the planetary science R&A program or on specific segments of the community. Furthermore, in response to the second of the two questions in the charge, the committee found that, in general, the structure of the program elements will allow NASA PSD to prepare for future spaceflight missions and to maximize science value from existing missions.

NASA's PSD is gratified that the report acknowledges the alignments to PSD's scientific priorities as stated by the 2014 science plan.

Nonetheless, the committee had concerns about some components of the current program — for example, in aspects of the proposal-review process and in support of future technology and instrumental and infrastructure capabilities — and found several areas that could be improved. The committee provides important input to NASA on how to improve the existing program and clearly address how well the current elements of the R&A program are appropriately structured to develop the broad base of knowledge and broad range of activities needed both to enable new spaceflight missions and to interpret and maximize the scientific return from existing missions.

These concerns resulted in the recommendations and NASA's responses listed below. With respect to the procedures followed by PSD in the implementation of the current program, the committee recommends the following:

On the use of "external" reviewers in peer reviews

Recommendation 1: In conducting scientific peer reviews of research proposals, NASA's Planetary Science Division should engage the services of several (at least two or three) external (mail) reviewers well in advance of panel reviews. These reviews are critical to a fair and effective proposal evaluation process, particularly when the review panels have a more interdisciplinary character. The panel chair and group chiefs, if recruited early, can take the lead in identification of appropriate external reviewers. (Additional details may be found in section "Proposal Submission and Review" in Chapter 2.)

Response 1: NASA concurs with the recommendation. It is indeed current Planetary Science Division practice to request multiple external reviews for each proposal in addition to the individual panel reviews. PSD will work more closely with its community to ensure that this occurs and the external reviewers have sufficient time to deliver a complete and in-depth review for their assigned proposals. However, as demonstrated in Dr. Rall's presentation to the *ad hoc* committee on May 12, 2016, although the restructured programs are more interdisciplinary than the old ones, the subpanels are more focused as there are more proposals in any given subtopic from which to construct these subpanels. Moreover, the response rate to requests for external reviews varies quite widely between programs and can drop below 20%. Finally, the depth and rigor of external reviews often falls well below the quality expected. In the future, PSD intends to explore methods of improving the response rate and quality of external reviews.

On the reconsideration of proposal selection decisions

Recommendation 2: NASA's Planetary Science Division should expeditiously complete establishment of the process for reconsideration of proposal selection decisions, develop and implement a formal mechanism to track debriefing and reconsideration requests across program elements, and inform the community about the process. More transparency in this area can provide the planetary science community with greater confidence that NASA has appropriate checks and balances in the selection process. (Additional details may be found in the section "Proposal Decision Reconsideration" in Chapter 2.)

Response 2: NASA concurs with the recommendation. The Planetary Science Division has now fully implemented the new, restructured programs and a revision to the SMD Policy Document 09 (SPD 09), now renamed *Debriefing and Reconsideration for NRA and CAN Proposals*, has been completed. This revision includes a formal mechanism to track reconsideration requests not just across Planetary Science Division programs but across all SMD programs.

On the solicitation, evaluation, and selection of high-risk/high-impact research

Recommendation 3: NASA needs to investigate appropriate mechanisms to ensure that high-risk/high-payoff fundamental research and advanced technology-development activities receive appropriate consideration during the review process. (Additional details may be found in the section "High-Risk/High-Payoff Research Activities and Advanced Technology" in Chapter 3.)

Response 3: NASA concurs with this recommendation. The Planetary Science Division is working with the Science Mission Directorate's front office on a directorate-wide assessment of whether the SMD R&A program has an effective process in place to most effectively solicit, review and select evolutionary vs. revolutionary projects, *i.e.*, high-impact but speculative work vs. more gradual work in which there is high confidence that it will succeed. The goal is to assess if the current practice of soliciting by topic and evaluation for merit followed by flagging high-risk/high-impact projects for the selection official adequate, or should SMD consider other practices. PSD will work with its Advisory Committee to develop functional definitions of "High Risk" and "High Payoff" and then apply them to assess the adequacy of current practices of solicitation, evaluation & selection. In addition, SMD and the Division Directors have tasked the NAC Science Committee and the four science advisory committees to provide NASA with advice in this area.

On the alignment of R&A program structure and funding with the Planetary Science Division's science goals

Recommendation 4: A formal assessment by NASA of how well the program structure and funding are aligned with the Planetary Science Division's science goals should be conducted at least every 5 years, appropriately phased to the cycle of decadal surveys and midterm reviews. (Additional details may be found in the section "Funding Distribution Among Program Elements" in Chapter 3).

Response 4: NASA concurs with this recommendation. We charge our advisory committee to conduct an annual review of our accomplishments against the Planetary Science Division's

science goals through the annual Government Performance and Results Act/Modernization Act (GPRAMA) report. This report is reviewed and graded by the division's advisory committee (formerly the Planetary Science Subcommittee (PSS) of the NASA Advisory Council, now replaced by the Planetary Science Advisory Committee (PAC)). Further, the NASA Science Plan is typically updated every three to four years and while the planetary science goals and objectives are durable and do not change significantly, that does provide an opportunity to tweak the R&A structure or change priorities. We do not ask our advisory committee to comment on the alignment of the R&A program structure or funding against these science goals, though. It is NASA's intention to include an assessment of this alignment in the charge to the next decadal survey committee.

On the efficacy with which the current R&A program supports existing and future missions

Recommendation 5: NASA should support the development of the technologies required to return astrobiological and cryogenic samples to Earth and the appropriate containment, curation, and characterization facilities consistent with the Planetary Science Division's science goals and planetary protection requirements. (Additional details may be found in the section "Enable New Spaceflight Missions" in Chapter 4).

Response 5: NASA concurs with this recommendation. The Planetary Science Division has investments in various instrument development and technology programs such as are MatISSE (Maturation of Instruments for Solar System Exploration) and PICASSO (Planetary Instrument Concepts for Advancement of Solar System Observations), for both high and low technology readiness levels, respectively. Program elements also exist for the development of instrument technology for future New Frontiers missions (Homesteader), future astrobiological instrumentation for Europa and other ocean world missions (COLDTech – Concepts for Ocean worlds Life Detection Technology), missions to study the interiors of the gas giants and the surface of Venus and Mercury (HOTTech – Hot Operating Temperature Technology), planetary studies through emerging platforms such as CubeSats (SIMPLEx – Small, Innovative Missions for Planetary Explorations; PSDS3 – Planetary Science Deep Space SmallSat Studies), and research activities in extreme environments on Earth (PSTAR – Planetary Science & Technology through Analog Research). The Planetary Science Division will continue to work closely with the Astromaterials Curation Facility to upgrade existing curation facilities and develop new ones as needed. Additionally, the Planetary Science Division will investigate establishing a new program to solicit development of spacecraft technology for the return of cryogenic and astrobiological samples.

On sustaining critical scientific and technical expertise

Recommendation 6: In making funding decisions for the various research and analysis program elements, NASA should consider the need to sustain critical scientific and technical expertise and the instrumental and facility capabilities required for scientific return on future missions, as discussed in the 2011 planetary science decadal survey. (Additional details may be found in the section "Enable New Spaceflight Missions" in Chapter 4.)

Response 6: NASA concurs with this recommendation. In the coming decades, NASA and its international partners will develop and operate an increasing number of sample return missions (e.g., Hayabusa-2, OSIRIS-REx, Mars Sample Return, Mars Moon eXperiment). In order to be fully and adequately prepared for this future, PSD has acknowledged that information is needed

to understand the planetary community's laboratory capabilities and challenges, and to define the magnitude of the stress on research and training needs. In preparation for the next Decadal Survey in Planetary Science, NASA requested that the National Academies of Science perform a study addressing the following questions:

1. What laboratory analytical capabilities are required to support PSD (and partner) analysis and curation of existing and future extraterrestrial samples?
 - a. Which of these capabilities currently exist, and where are they located (including international partner facilities)?
 - b. What existing capabilities are not currently accessible that are/will be needed?
2. Whether the current sample laboratory support infrastructure and NASA's investment strategy meets the analytical requirements in support of current and future decadal planetary missions.
3. How can NASA ensure that the science community can stay abreast of evolving techniques and be at the forefront of sample analysis?

The *ad hoc* study team has been appointed and is currently at work.

NASA is also embarking on a new Internal Scientist Funding Model in part to ensure that we maintain core capabilities at the Centers for sample and data analysis, instrument development, and sample curation. PSD is in the process of evaluating its existing science support facilities (*e.g.*, Ames Vertical Gun, Planetary Aeolian Lab, GEER, RPIFs) to determine future needs. PSD is also considering issuing a solicitation for new and continuing facilities.