Results of the 2020 Planetary Science Workforce Survey conducted by the American Astronomical Society (AAS) Division for Planetary Sciences (DPS)

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Introduction

Understanding the changing demographics and needs of the planetary science community is an important part of effectively serving the community. Over the past few decades, several surveys have been conducted of the planetary community. The American Astronomical Society (AAS) Division for Planetary Sciences (DPS) conducts surveys of its membership from time to time. Surveys were conducted in 1989, 1995, 2005, 2010 and 2020 (<https://dps.aas.org/reports>). In 2011, a survey of the entire planetary science workforce contacted members of DPS and the American Geophysical Union (AGU) Planetary Sciences Section as well as attendees of the Lunar and Planetary Science Conference (LPSC) [1]. That survey found that 6% of respondents belonged to all three groups and just over 70% were members of DPS. Results of this survey have been used in many studies of planetary science community.

The 2020 DPS survey differed from previous DPS membership surveys. In order to enable comparisons to the 2011 planetary workforce survey and provide input into this Planetary Science and Astrobiology Decadal Survey (PSADS), we surveyed more than just DPS members. We therefore refer to this survey throughout this report as the 2020 Workforce Survey. We obtained email lists of planetary scientists from DPS, Geological Society of America (GSA) Planetary Geology Division, and the Lunar and Planetary Institute (LPI). The American Institute of Physics (AIP) Statistical Research Center removed duplicate email addresses, sent out the survey in April 2020 and continues to compile the results. As of early June, our response rate was 47%, with ~2400 scientists responding. Previous surveys had response rates of 62% (2011 survey), 40% (2010 DPS membership survey) and 32% (2005 DPS membership survey). Here we report on initial results from the survey. The full list of survey questions is available at https://dps.aas.org/sites/dps.aas.org/files/reports/survey2020_questionnaire.pdf.

While the AIP is preparing a final report based on the results of this survey, which will be available soon, here we summarize the findings most applicable to the PSADS to enable understanding the workforce. The questions in the Survey were based on previous DPS member surveys and the 2011 Planetary Workforce Survey. New questions were also added specifically to understand the current state of the planetary science workforce. In particular, the final two survey questions (#41 and #42) asked “What are barriers to your success?” and “What has helped you succeed?” Because these are new questions and we did not want to bias the answers, these asked for open-ended fill-in-the-blank answers. For the answers to be useful in aggregate, the AIP needs to go through and code them into categories. This requires time that was not covered by the original agreement between the AIP and the DPS, so those questions are not discussed here.

We have two recommendations that the PSADS undertake as part of their Survey process.

We strongly recommend that PSADS committee members read the final AIP report. When it is available, it will be posted at the DPS Reports site given above. The authors of that report, and this white paper, will make themselves

available to present results to the PSADS committee and answer questions about the results of the survey.

We also strongly recommend that the PSADS encourage NASA and/or NSF to fund the AIP to complete the analysis of the 2020 Workforce Survey so that the PSADS can utilize the full results as part of the Survey process. The final two questions in the 2020 Workforce Survey were open-ended (not multiple choice), which require more work to analyze. These two questions were about factors that either enabled or were a barrier to success in planetary science. It is crucial that the PSADS use the results of this analysis in their deliberations and final report. Furthermore, additional correlative information can be drawn from the data, but this needs to be requested from AIP (and paid for).

In this paper, we use several terms, defined here:

- LGBTQ+ scientists are respondents who gave at least one of the following answers:
 - “another identity” to question #34 on gender
 - “Yes” to question #35 “Do you identify as Transgender”
 - “Gay or Lesbian” or “Bisexual” or “Other” to Question #36
- Disabled scientists are respondents who gave at least one of the following answers:
 - “I have difficulty seeing even when wearing glasses” or “I have serious difficulty standing, walking, or climbing stairs” or “I have a cognitive or learning disability” or “I have a mental illness” or “I am neuroatypical” or “I have an autoimmune or pain disorder, or other chronic condition” or “I have disabling allergies, asthma, or other environmental sensitivities” to Question #38
 - “I am deaf or hard-of-hearing” to Question #38 and also younger than 60 years of age (Question #33)
- Scientists of Color (SOC) are respondents who responded to question #37 with an answer other than “White” or “Prefer not to answer”
- Underrepresented Minority Groups (URM) consists of respondents who are scientists of color who did NOT respond to question #37 with “Asian or Asian American”

Survey Results

Finding #1: Planetary Science as a field is getting larger. While ~30 current planetary scientists earned their highest degrees each year between 1990-2005, ~70 current scientists earned their degrees each year between 2015 and 2020. See white paper by Zellner et al. for data on attendance at LPSC for a similar finding.

Finding #2: Planetary Scientists have diverse backgrounds and areas of study, with 31% earning their highest degree in geoscience, 20% in planetary science, 18% in astronomy, 14 % in physics, and 17% in another field. While planetary scientists have many areas and methods of study, nearly 50% of people list geology or geomorphology as one of their primary planetary research interests (see figure 1) and more than 50% list spacecraft observations as one of their

primary research techniques. We note that while more than half of respondents use spacecraft observations as a primary research technique, which means that more than 45% of respondents do NOT use spacecraft data. This demonstrates that data and techniques other than spacecraft are just as useful to understanding planetary systems and that analysis of these data need to be funded by NASA in addition to mission data analysis programs.

The field is also getting more demographically diverse: 91.5% of scientists with highest degree earned in 1970 or earlier were white, 1971-1995: ~88%, after 1995: ~75%. There are also more LGBTQ+ planetary scientists earning their degrees recently (post 2011) than in the past (pre-1990). See white papers by Rivera-Valentín et al., Strauss et al., and Vander Kaaden, et al. for more detailed analysis.

Finding #3: The vast majority of planetary scientists are employed at either Universities or Research Institutions (42.5 and 31.8%, respectively) or NASA centers (8.1%). At Universities, Asian-American scientists are overrepresented while non-binary scientists are severely underrepresented. However, Asian-American scientists are severely overrepresented as postdocs, which may account for some of their

overrepresentation at Universities. For gender, LGBTQ+ status, and scientists with disabilities, the majority group is overrepresented at Universities and in tenured positions when compared to the minority groups. 35.8% of women respondents work at research Institutes, which tend to be soft-money and employ more scientists compared to only 29.9% of men. See white paper by Rivera-Valentín for more detailed analysis.

Finding #4: The majority of scientists use NASA grants to fund their research activities. The vast majority of respondents (93%) have submitted at least one research proposal as PI. More respondents receive funding from NASA

Figure 1: Primary area of study (top) and research technique (bottom) for respondents. Note that individuals were allowed to choose more than one.

grants (54%) than by NSF grants (11%) or NASA missions (43%). Over a third of non-faculty respondents (34%) receive *the majority* of their funding from NASA grants and over a quarter (27%) receive the majority of their funding from NASA missions. This indicates that R&A is an important funding source for the community.

Recommendation #1: NASA should increase funding to R&A programs to significantly increase selection rates, which should be no less than 30%.

Since so much of the science undertaken by planetary scientists is funded by NASA's R&A program, and because the field is growing in numbers, and writing of unfunded proposals decreases productivity, increasing the funding rate is necessary. As outlined in the white paper by Rathbun et al. low selection rates disproportionately affect members of underrepresented groups, thus making planetary science less diverse and our scientific conclusions less robust.

Finding #5: While relatively few planetary scientists have proposed a mission as a PI, white men are more likely to have been involved in a mission proposal as either a PI or Co-I. The vast majority of respondents have never been the PI of a mission (84%) or instrument (77%) proposal. Additionally, involvement in mission leadership (PI or Co-I) during the proposal stage depends on the race, gender, and LGBTQ+ and disabled status. Along each of these axes, members of the majority groups (men, white scientists, non-LGBTQ+, and non-disabled) are more likely to be a mission PI or Co-I than members of the minority groups (women, scientists of color, LGBTQ+ scientists, and disabled scientists). For example, while 19% of men respondents have been the PI of a proposed mission, only 9% of women respondents have. Furthermore, while 44% of male respondents have been the Co-I of a proposed mission, only 36% of women respondents have.

Recommendation #2: NASA should continue, and increase, their efforts to diversify mission leadership. These efforts need not be geared only toward early career scientists and should consider multiple axes of identity (not just gender). Any policies implemented in order to diversify the mission leadership need to be tracked and compared to metrics and demographics and these results should be published publicly.

Finding #6: Planetary Scientists' careers are most negatively affected by the balance between their work and personal life, and members of underrepresented groups are more affected. Nearly half (48%) of all planetary scientists listed balance between work and personal life as something that negatively affects their careers. This number was higher for Underrepresented Minority groups, women, and LGBTQ+ scientists (all at 54%) but highest for non-binary scientists (64%). It was lowest for Asian-American scientists (39%). The next most popular answers overall were balance between different work activities (47%), level of success in obtaining funding (39%), and current level of funding (36%) with less variability among demographic groups. Scientists of color listed limited opportunities to progress at higher rates than white scientists (36% vs. 25%), with non-binary scientists stating that negatively affected 44% of them. Lack

of mentoring and limited access to career development were also more likely to affect scientists of color, women, non-binary and LGBTQ+ scientists. Furthermore, scientists on average picked 2.7 items that negatively effects their career while members of minority groups chose 3.0.

Finding #7: Planetary scientists generally like their colleagues. When asked which item had the largest positive effect on people's careers, the top 2 items chosen by respondents were opportunities to interact with colleagues (49%) and interactions with well-established scientists (40%). All other responses got less than 30%. There were few differences for different demographic groups, with the exception that 50% of men respondents chose opportunities to progress in your career compared to other groups where only 25-40% of respondents chose this option. This suggests that men are given more opportunities than members of other groups.

References

- [1] White, S. et al. (2011). 2011 Survey of the Planetary Science Workforce.
<https://lasp.colorado.edu/home/mop/files/2015/08/Report.pdf>

Other White Papers referenced:

Rivera-Valentín et al., "Who is missing in Planetary Science?: A Demographics study of the planetary science workforce"

Strauss et al., "Nonbinary Systems: Looking to the future of gender equity in planetary science"

Vander Kaaden, et al, "LGBTQ+ in Planetary Science"

Rathbun, et al., "Who is Missing in Planetary Science?: Strategic Recommendations to Improve the Diversity of the Field"