

DEMOGRAPHIC STUDY OF THE PLANETARY SCIENCE WORKFORCE. E. G. Rivera-Valentín¹, J. A. Rathbun², J. T. Keane³, S. Diniega³, C. R. Richey³, K. L. Lynch¹, L. C. Quick⁴; ¹Lunar and Planetary Institute, USRA, Houston, TX, ²Planetary Science Institute, Tucson, AZ, ³Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, ⁴NASA Goddard Space Flight Center, Greenbelt, MD.

Introduction: Diversity initiatives have attempted to bring the science community to parity with the national population. Although some initiatives have been effective, not all have been inclusive of multiple axes of representation. For example, the geosciences have seen an increase in the representation of women doctoral graduates, rising from 30% in 2000 to 49% in 2018; however, no improvement has occurred for Black / African American researchers [1]. *This is not due to a lack of interest!* For example, both Black / African Americans and Latinx / Hispanics show interest in STEM comparable to White people (e.g., [2,3]). Rather, the current lack of representation is a manifestation of a system with a history of oppression. Another manifestation is in the wage gap. A survey of the higher education workforce found that for every dollar White men make, White women make \$0.80, men of color make \$0.72, and women of color make \$0.67 [4].

In planetary science, previous workforce surveys showed that the demographics are not representative of the national population [5,6], with this lack of diversity magnified in NASA mission teams [7-9]. In order to identify trends in underrepresentation in planetary science and related fields and to inform future diversity initiatives, we conducted a demographic analysis using the American Astronomical Society's Division of Planetary Sciences (DPS) 2020 workforce survey, as well as information from national sources. In this work, we considered race, ethnicity, and the representation of women by self-identification. We note, though, that although demographic studies can help motivate diversity initiatives, they should not be the only discussion point.

Methods: In addition to the results of the AAS DPS 2011 and 2020 workforce survey, we also analyzed data from the National Center for Science and Engineering Statistics, the U.S. Census Bureau, and the U.S. Bureau of Labor Statistics, to conduct a demographic analysis of the field. The demographic groups considered follow the analysis presented in the report by NASA's Office of Diversity and Equal Opportunity [10]. Following their lead, we also compared demographic results to the National Civilian Labor Force (NCLF). The reported margin of error is to a 95% confidence level (i.e., $2-\sigma$) and represents the survey's ability to predict the demographics of the overall field.

Planetary Science Workforce: The 2011 planetary workforce survey did not include student respondents, while the 2020 survey did. To properly compare surveys we show results in Fig. 1 from the 2020 survey for student (SR) and non-student researchers (NSR) separately. Figure 1 presents the demographic data in what we term the representation ratio, which is the percent representation of the demographic in the field with respect to the percent of that demographic in the NCLF for the same year. As a result, a ratio of 1 indicates parity, a value > 1 indicates the demographic is represented above the national average, and a value < 1 indicates underrepresentation. A property of this ratio is that it directly relates to the percent by which a group is underrepresented.

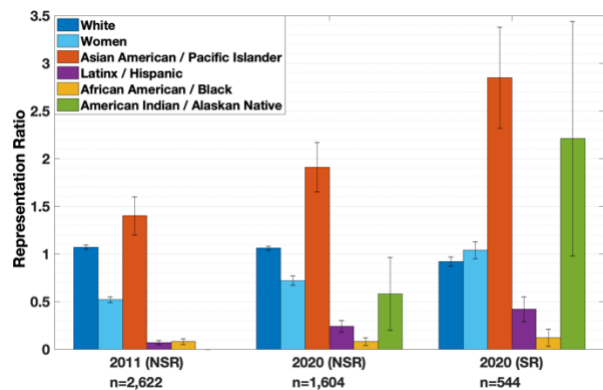


Figure 1: Representation ratio for the demographics surveyed in the 2011 and 2020 DPS workforce surveys for non-student researchers (NSR) and student researchers (SR). The x-axis label includes the year of the survey and the total number of respondents.

In 2011, women were underrepresented by $48.1\% \pm 3.4\%$. Currently, nonbinary non-student researchers account for $0.7\% \pm 0.4\%$, men for $66.5\% \pm 2.3\%$, and women for $34.7\% \pm 2.5\%$ of planetary scientists; thus, women are underrepresented by $28\% \pm 5.2\%$. Over the past nine years the representation of women increased from $25\% \pm 1.7\%$ to $34.7\% \pm 2.5\%$. However, we note that the population of women in the planetary sciences is majority White by race and $<10\%$ underrepresented racial/ethnic minority (URM).

In 2011, Black / African Americans and Latinx / Hispanics were underrepresented by $91.7\% \pm 3.2\%$ and $93.3\% \pm 2.5\%$ relative to the NCLF, respectively (i.e., a ratio of 0.07 and 0.08). *No data was presented for American Indian / Alaskan Natives in the 2011 survey.* Currently, American Indian / Alaskan Natives are

underrepresented by $42.3\% \pm 37.6\%$, Latinx / Hispanics by $76.3\% \pm 5.7\%$, and Black / African Americans by $91.6\% \pm 4.0\%$ with respect to the NCLF. We note, though, that American Indian / Alaskan Natives are historically underserved in demographic surveys. The change in representation of Latinx / Hispanics from 2011 to 2020 is $3.0\% \pm 1.0\%$, which may be tracking the 2.9% national growth of the community during the same time period. *No significant change has occurred for Black / African Americans* ($0.1\% \pm 0.6\%$). Given that $<10\%$ of women in the field are URM and that URM have seen little to no change over the past decade, the growth in representation of women may primarily be due to White women.

White non-student researchers in 2011 were represented at 1.07 ± 0.02 and are currently at 1.06 ± 0.02 times their representation in the NCLF and so have not seen a significant change in representation. In 2011, Asian American / Pacific Islanders were represented at 1.4 ± 0.2 and currently at 1.91 ± 0.26 times their representation in the NCLF. While Asian Americans / Pacific Islanders may not be underrepresented, this does not imply they do not face challenges related to their identities. Additionally, the Asian American / Pacific Islanders demographic group is an aggregate category that consists of people who trace their roots to many different countries across East and Southeast Asia, the Indian subcontinent, and Pacific islands.

One of the intents of diversity initiatives is to improve the demographics of the field. A good indicator of success is then the demographics of the student population. As seen in Fig. 1, there are three underrepresented demographic groups from NSR that have improved representation in the SR population. Women comprise $50.3\% \pm 4.2\%$ and American Indian / Alaskan Natives comprise $2.2\% \pm 1.2\%$ of SR. Within error, these two groups are represented near or above parity with respect to the NCLF. Not shown in Fig. 1, $2.6\% \pm 1.4\%$ of SR are nonbinary. In the SR population, Latinx / Hispanics are represented at $7.1\% \pm 2.2\%$ a difference of $3.1\% \pm 2.4\%$ compared to NSR. Within error, *there is no significant difference between Black / African American student researchers and non-student researchers*. This indicates that diversity initiatives are not positively impacting the representation of Black / African American planetary scientists.

Physics and Geoscience Doctoral Graduates:

Because the workforce surveys indicated that planetary scientists generally earned their degrees in physics or geoscience, we studied the demographics of doctoral graduates from those fields, specifically for women, Latinx / Hispanic, and Black / African Americans. In Fig. 2, we used a weighted least squares fit to find the percent change over time.

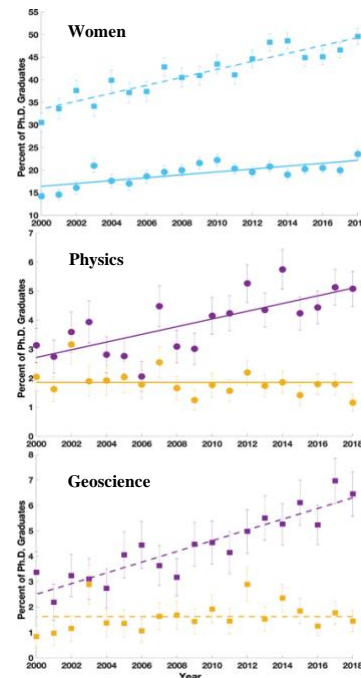


Figure 2: Percent representation of doctoral graduates for women (top) in physics (circles and solid line) and geoscience (squares and dashed line), and (bottom) Black / African American and Latinx / Hispanic (following the color coding from Fig. 1).

Since 2000, geosciences have seen an increase in the representation of women by $0.88\% \pm 0.18\%$ per year and in physics by $0.33\% \pm 0.15\%$. During the same time, Latinx / Hispanic representation in geology and physics has increased by $0.21\% \pm 0.05\%$ and $0.13\% \pm 0.06\%$, which is below the national growth. *No change has occurred for Black / African Americans in either field over the last 18 years* ($0.03\% \pm 0.04\%$). This is in contrast to the overall increase of Black / African American doctoral graduates in Science and Engineering ($0.09\% \pm 0.02\%$ per year).

Further underrepresentation occurs for women of color. Since 2000, Latinx / Hispanic women have accounted for $48.7\% \pm 4.3\%$ and $19.6\% \pm 2.9\%$ of the doctoral degrees earned by Latinx / Hispanics in geology and physics respectively, and thus are underrepresented in physics with respect to Latinx men. Black / African American women are underrepresented in both fields with respect to Black / African American men as they account for $23.3\% \pm 4.6\%$ and $34.3\% \pm 6.9\%$ of the doctoral degrees earned by Black / African Americans in geology and physics, respectively.

Together our results show that we need to work towards intersectional diversity initiatives.

This abstract is based on a [white paper](#) submitted to the Planetary Science and Astrobiology Decadal Survey.

References: [1] Bernard, R.E. & Cooperdock, E.H.G. (2018). *Nat. Geos.*, 11, 292–295. [2] Crisp, G. & Nora, A. (2012). [White paper](#). [3] Riegler-Crumb, C., et al. (2019). *Educational Researcher*, 48 (3) 133–144. [4] McChesney, J. (2018). [CUPA-HR Research Brief](#). [5] White, S. et al. (2011) <https://lasp.colorado.edu/home/mop/files/2015/08/Report.pdf>. [6] Hendrix, A. R. et al. (2020). *LPSC*, [id.2813](#). [7] Rathbun, J. A., et al. (2015) *DPS*, [id.312.01](#). [8] Rathbun, J. A., et al. (2016) *DPS*, [id.332.01](#). [9] Rathbun, J. A. (2017) *Nat. Astro.*, 1, 0148. [10] FY2018 MD-715 Report https://science.nasa.gov/science-pink/s3fs-public/atoms/files/2020-2024_Science.pdf