Introduction to the Research Program Yearbook
ROSES-2021
Version 1.0
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In my over two decades of service at NASA HQ, I have been asked for statistics about the Research and Analysis program more times than I can count by both the science community and various NASA advisory groups. The Yearbook is SMD's attempt to provide a single, regularly updated, set of statistics about its research and analysis programs to all interested Individuals.

This is the inaugural release of the Yearbook. It is intended to serve as a "living" resource: as new analyses are performed by the SMD Data Analytics Team, the results will be added to the Yearbook.

This first release concentrates on comparing information about science teams of proposals submitted to Research Opportunities in Space and Earth Sciences (ROSES) 2021 to the cumulative information about science teams of proposals submitted to ROSES 2016, 2017, 2018, 2019, and 2020. Information about both submitted and selected proposals are discussed. Included in the data are basic demographics of PIs and Co-Is (*e.g.,* gender, race, ethnicity, disability status, career stage) as well as information about the organizations submitting proposals (*e.g.,* university or NASA center, Carnegie Classification of institutions of higher education, whether the institutions of higher education are historically black colleges and universities). Also included are data about the proposal selection rates and the duration of the review process for each of SMD's five Divisions (Astrophysics, Biological and Physical Sciences, Earth Science, Heliophysics, and Planetary Science) as well as programs that are cross-Divisional (*e.g.,* Exoplanets Research Program).

Results are presented at the SMD Directorate and Division levels; results at the program level cannot usually be reported publicly because the relatively small number of proposals submitted to each solicitation means that the identities of some researchers may be determined based solely on the solicitation and one or two demographic details.

Demographic data was sourced from the NSPIRES system which, since 2016, has offered registrants the opportunity to complete a demographic questionnaire. Carnegie Classifications of colleges and universities were derived from public data files at https://carnegieclassifications.acenet.edu/resource/. Lists of various types of minority-serving institutions maintained by the US Department of Education (https://www2.ed.gov/about/offices/list/ope/idues/eligibility.html) were used to determine if an institution that submitted a proposal was a minority-serving institution.

To make the Yearbook as useful as possible to as many groups as possible, NASA invites comments about data and analyses. Submit your questions or suggestions to hq-smd-yearbook@mail.nasa.gov.

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1. Introduction

1.a. Data Sources, Limitations, and Reporting Constraints

1.a.i. Data Sources

1.a.i.1. NASA Demographic Survey of Proposers and Reviewers

To enable analyses of trends in the demographics of NASA's proposer community and observe the efficacy of new approaches to proposal solicitation and evaluation, NASA began surveying the demographics of proposing teams and reviewers in 2016. The demographic survey initially included questions about binary gender, race, ethnicity, and ability. In 2019, a non-binary gender response was made available to survey respondents and additional career questions were added — highest degree type, highest degree year, career classification sector, and career type.

The initial survey questions and subsequent changes to them are required to follow Office of Management and Budget (OMB) guidance. A formal review of OMB's *Statistical Policy Directive No. 15: Standards for Maintaining, Collecting, and Presenting Federal data on Race and Ethnicity* is currently underway with a goal of completing revisions by summer 2024 (https://www.whitehouse.gov/omb/briefing-room/2023/01/26/initial-proposals-for-revising-the-federal-race-and-ethnicity-standards/). The Census Bureau aims to test new sexual orientation and gender identity questions in the American Community survey in 2024 according to a September 19, 2023 Federal Register notice (*Agency Information Collection Activities; Submission to the Office of Management and Budget (OMB) for Review and Approval; Comment Request; American Community Survey Methods Panel: 2024 Sexual Orientation and Gender Identity Test:* https://www.federalregister.gov/documents/2023/09/19/2023-20256/agency-information-collection-activities-submission-to-the-office-of-management-and-budget-omb-for).

In addition to this report, separate analyses conducted by the NASA Office of the Chief Scientist (OCS) will be released to the public in the form of an online dashboard and a corresponding report. The data products produced by the OCS cover different ROSES years than this Yearbook and employ different methodologies and definitions.

Demographic Survey Questions as of October 2023

1. Are you currently serving (or have previously served) as PI, PD, Co-I/Science PI, Co-PI, or Co-PD on any federally funded project?
    a. Yes
    b. No
2. Gender (select one):
    a. Male

    b. Female
    c. Other (added in 2019)
    d. I prefer not to answer
3. Ethnicity (choose one):
    a. Hispanic or Latino
    b. Not Hispanic or Latino
    c. I prefer not to answer
4. Race (select one or more):
    a. American Indian or Alaskan Native
    b. Asian
    c. Black or African American
    d. Native Hawaiian or Other Pacific Islander
    e. White
    f. Other
    g. I prefer not to report my race
5. Disability Status (select one or more):
    a. Hearing Impairment
    b. Visual Impairment
    c. Mobility/Orthopedic Impairment
    d. Other
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    b. Masters
    c. Doctorate
    d. Other
    e. I prefer not to answer
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    b. Government
    c. For-profit
    d. Nonprofit
    e. Other
    f. I prefer not to answer
8. Career Type (choose one):
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    b. Primarily Teaching
    c. Science-related
    d. Engineering/Technology-related
    e. Further Training or Education
    f. Other
    g. I prefer not to answer

Demographic Survey Data

Included in this Yearbook, demographic survey responses from Principal Investigators (PIs) and science team members are presented for proposals submitted to Research Opportunities in Space and Earth Sciences (ROSES) 2016 to ROSES 2021. In previously shared data products, incomplete ROSES 2014 and 2015 data was constructed by backfilling responses provided since ROSES 2016, when demographic survey responses began being collected. Data from ROSES 2014 and 2015 are not included in this Yearbook due to the amount of missing data.

The Biological and Physical Sciences (BPS) Division became part of the Science Mission Directorate (SMD) in ROSES 2020. Data from the Human Exploration and Operations Mission Directorate (HEOMD) Space Life and Physical Sciences Research and Applications (SLPSRA) Division for 2016 to 2019 has been added to our dataset to capture BPS proposing science teams for ROSES years 2016-2021.

Responding to the demographic survey questions was and is optional, so individuals could choose to select "prefer not to answer" for any or all demographic survey questions. For the PIs of proposals submitted to ROSES 2016-2021, this occurred for less than 10% of proposals at the SMD Directorate level.

Career questions were added to the demographic survey in 2019, with responses for PIs and science team members from previous ROSES years backfilled to the greatest extent possible. Backfilling of responses resulted in more unknown values for these questions.

In this analysis, "academic age" is defined as the number of years between an individual's final degree year and the calendar year that a proposal was submitted. About 30% of PI final degree years for ROSES 2016 to ROSES 2021 are unknown based on survey responses alone. To reduce the number of unknown academic ages, a lookup table of final degree years determined from web searches was used. This reduced unknown proposal PI academic ages to <3% for submitted proposals across SMD.

For this analysis, categorization of proposals into SMD Divisions can be found in Table 1 of the Appendix. Some programs were categorized into SMD Divisions that were not the soliciting organization. For example, the Habitable Worlds program was solicited as part of Cross-Division Research in ROSES 2021 (Appendix E) but in previous ROSES years had the Planetary Science Division and Cross-Division as its soliciting organization. In this report, this program is categorized as Cross-Division.

1.a.i.2. Data presented that is not based on Demographic survey responses

Institutional Analyses

There are three different institutional analyses that were conducted using standardized lookup tables:

1. Institution Type (see Appendix Table 2 for lookup table):
    a. Commercial organization

b. Educational organization
c. NASA center including Jet Propulsion Laboratory (JPL)
d. Non-profit organization
e. Non-U.S. organization
f. Other Government Organizations (OGA) including government labs and non-NASA Federally Funded Research and Development Centers (FFRDCs)
g. State, Local, or Federally recognized tribal government agencies
h. Unaffiliated Individuals

2. Carnegie Classification of Research Activity for Educational organizations (https://carnegieclassifications.iu.edu/classification_descriptions/basic.php). Research Activity is calculated using an educational institution's research expenditures, number of research staff, and number of doctorates granted. Kosar and Scott's "Examining the Carnegie Classification Methodology for Research Universities" explains this methodology in detail.[1]
    a. R1: Doctoral Universities: Very High Research Activity
    b. R2: Doctoral Universities: High Research Activity
    c. R3: Doctoral/Professional Universities
    d. Non R1, R2, R3, including:
        i. Masters Colleges and Universities
        ii. Baccalaureate Colleges
        iii. Special Focus Four-Year
        iv. Associate's Colleges
        v. Special Focus Two-Year
        vi. Tribal Colleges and Universities
        vii. Not Classified
3. Minority Serving Institutions (MSIs) for educational organizations using U.S. Department of Education lists of MSIs (https://www2.ed.gov/about/offices/list/ope/idues/eligibility.html)
    a. Alaskan Native and Native Hawaiian Serving Institutions (ANNHSIs)
    b. Asian American and Native American Pacific Islander Serving Institutions (AANAPISIs)
    c. Hispanic Serving Institutions (HSIs)
    d. Historically Black Colleges and Universities (HBCUs)
    e. Native American Serving Nontribal Institutions (NASNTIs)
    f. Predominantly Black Institutions (PBIs)
    g. Tribal Colleges and Universities (TCUs)

[1] Robert Kosar & David W. Scott (2018) Examining the Carnegie Classification Methodology for Research Universities, Statistics and Public Policy, 5:1, 1-12, DOI: 10.1080/2330443X.2018.1442271

Final Degree Year

As stated previously, career questions were added to the demographic survey in ROSES 2019. Where possible, responses made by individuals after these questions were added were used to fill in responses for ROSES 2016-2018. To reduce the number of unknown academic ages (calculated from final degree year) and allow for a more complete dataset, values that were collected from online sources were used to fill in missing final degree years.

1.a.i.3. Proposal Data Handling

Proposals Excluded from Data Products Include:

1. Graduate student programs. A future analysis will look at both the faculty and student PIs for these proposals.
   - Future Investigators in NASA Earth and Space Science and Technology (FINESST)
   - NASA Earth and Space Science Fellowship (NESSF)
2. Early Career Fellowship program. These proposals are generally evaluated as part of proposals submitted to other programs.
   - Planetary Science Early Career Fellowship and Early Career Award
   - Astrophysics Division Nancy Grace Roman Technology Fellowships proposals
3. Topical Workshops, Symposia, and Conferences (TWSC) program.
   - This program is treated in an unusual way and will be solicited outside of ROSES in the future.
4. Astrophysics Guest Observer and Guest Investigator programs.
   - Proposals for these programs are not submitted via NSPIRES nor is their evaluation led by NASA HQ program staff, although the overall programs are under HQ oversight.
5. C.17 Planetary Major Equipment and Facilities program.
   - Proposals submitted to this program were either as standalone proposals or appended to proposals submitted to select PSD programs. The demographics of proposing science teams are therefore captured in the analyses of the participating PSD programs and not analyzed separately.
6. ROSES 2020 E.10 SMD call for COVID Augmentations and Funded Extensions program.
   - This solicitation was only available to current awardees from other programs.
7. ROSES 2018 Lunar Surface Instrument and Technology Payloads proposals that indicated relevance to Human Exploration and Operations Mission Directorate (HEOMD) or Space Technology Mission Directorate (STMD) strategic goals.
8. Proposals with the following status listed in NSPIRES:
   - Withdrawn
   - Declined (non-compliant)
   - Completed
9. Step-1 proposals when there is a Step-2 proposal with the same PI and title.
10. Step-2 proposals when there is a redundant Step-3 proposal with the same PI and title.
    - This only applies to one solicitation, 2018 Heliophysics Technology and Instrument Development for Science.

11. Proposals from ROSES 2020 and 2021 that do not have decisional selection statuses. This applies to three proposals submitted to ROSES 2021. These statuses are listed in NSPIRES as:
    - No Decision.
    - Selectable (Pending).
12. Proposals that were not evaluated by any panel (late submissions, proposals evaluated by another program). This applies to two proposals submitted to ROSES 2016-2021.

PI transfers and PI changes

PI transfers are instances where the Principal Investigator (PI) of a proposal transfers institutions after proposal submission and are tracked in NSPIRES as two separate proposal IDs. PI changes occur when a proposal PI is changed after proposal submission and is also tracked in NSPIRES as two separate proposal IDs. To remove these redundancies from the demographic database, data for the original proposal team members are maintained while those of the new proposal team are excluded from analyses. This removes data for 90 proposals from the ROSES 2016-2021 dataset. Removal generally requires a semi-manual search for redundant proposal titles and correction of proposal selection statuses since these are not consistently handled across SMD Divisions. In some instances, PI transfers/changes are indicated by additional information in parentheses after the new/transfer proposal title, such as the original proposal ID or the new institution name, while others have only a duplicate proposal title provided.

Discussion of Error

Data visuals that are presented capture actual responses of all PIs and science team members and are not a representative sampling of a larger population. Sampling error and subsequent error bars are not included in data plots and bar charts for this reason. Some instances of error on the part of responses could occur, such as instances where an individual selected an incorrect response or did not understand the question, could have occurred but would be difficult to quantify.

Basic statistical tests were conducted to test the significance of the association between demographic survey responses and a proposal's selection status for gender, race using URC, and MSI categories. In the few cases where there were statistically significant differences between response categories, these differences were found to have negligible effect.

The NSPIRES system assigns unique identifiers to NSPIRES accounts, but individuals not prohibited from creating more than one NSPIRES account resulting in some unique identifiers not being, in fact, unique. An individual adding or changing email addresses, institutions, or names within an NSPIRES account does not create a new unique identifier within the NSPIRES system. In order to estimate the percentage of individuals with more than one NSPIRES unique identifier, an analysis of PIs for all proposals captured in NSPIRES was conducted and <0.5% of individuals that were PIs on ROSES 2006-2021 proposals had more than one unique identifier. In the future, the extent of non-unique NSPIRES identifiers will be assessed for all science team members. Initial work indicates that <0.5% of individuals that participated as a science team member on ROSES 2006-2021 proposals had more than one NSPIRES unique identifier.

1.a.i.4. Definitions used in this Yearbook

Career Stage

In order to estimate the career stage of proposing science team members, the academic age of each individual at the time of proposal submission is binned into career stage categories.

Academic Age = Proposal submission calendar year – final degree year

Career Stage categories:

Early career: <10 years since earning final degree
Mid-career: 10-19 years since earning final degree
Late career: 20+ years since earning final degree

Disabled

In disability status data products, the four response options available to indicate a disability (hearing impairment, visual Impairment, mobility/orthopedic impairment, and other) are merged to meet the OCS suppression guidelines (discussed in Section 3).

New PI for SMD Divisions and Directorate

In this Yearbook a "New PI" is defined as a PI that was selected by a program in a Division/Directorate in ROSES 2021 but was not selected in any program of that Division/Directorate in the previous five ROSES years.

In this Yearbook a "New PI Submission" is defined as a PI of a submitted proposal that would be a New PI if their proposal was selected. A new PI submission requires that the PI has not been selected by a program in the Division/Directorate in the last five ROSES years.

Race: Multiracial

Since individuals were able to select multiple race responses, a Multiracial category is used in this Yearbook to capture when an individual selects two or more race responses. The methodology allows the White response option to be included in Multiracial, since the individual self-identified as two races.

Race: Under-Represented Community (URC) Race Category

Due to OCS suppression guidelines (explained in Section 3), some race question responses are not able to be reported individually and have been combined into an Under-Represented Community (URC) category that encompasses:

- American Indian or Alaskan Native
- Black or African American
- Native Hawaiian or Other Pacific Islander
- More than one race selected (multiracial)

Science Team

The following NSPIRES proposal roles are included in science team analyses:

- Co-I
- Co-I/Co-PI (non-US organization only)
- Co-I/Institutional PI
- Co-I/Science PI
- Collaborator
- Consultant
- Co-PI
- Deputy PI
- Graduate/Undergraduate Student
- PI
- Postdoctoral Associate

Selected and Declined Proposal Statuses

Selection statuses used to indicate whether a proposal was selected or declined were collected from NSPIRES on February 10, 2023. Proposals were designated as Selected or Declined based on the table below.

Table 1.a. Selection Statuses Captured in NSPIRES and Rules for Analyses

Selection Status	Treatment in Analyses
[Blank]	Exclude
Awarded	Include, code as Selected
Completed	Exclude
Declined	Include
Declined (Non-compliant)	Exclude
No Decision	If older than 2 ROSES years (2019 or before), include and code as Declined. If less than 2 ROSES years (2020 or 2021), then exclude.
Selectable (Pending)	If older than 2 ROSES years (2019 or before), include and code as Declined. If less than 2 ROSES years (2020 or 2021), then exclude.
Selected	Include
Selected (No NASA Funding)	Include, code as Selected
Selected (Other Agency Funding)	Include, code as Selected
Selected (Partial)	Include, code as Selected
Selected (Phase Down)	Include, code as Selected

Selection Rates

The selection rate for a given demographic category is calculated by dividing the number of selected proposals from PIs in a given demographic response group by the number of proposals submitted by PIs from the same response group. For example, the selection rate of proposals from female PIs would be calculated by dividing the number of selected proposals with female PIs by the number of submitted proposals with female PIs.

Unique PI

The term Unique PI indicates that we are looking at the individuals that have submitted/selected proposals within a SMD Division or the Directorate as a whole. This means that if an individuals submitted 12 proposals, they would only be counted once in data products dealing with Unique PIs.

1.a.ii. Reporting Constraints

1.a.ii.1. Office of the Chief Scientist (OCS) Suppression Guidelines for self-reported demographics

Public presentation of demographic survey data requires suppression to protect the anonymity promised to survey respondents. These suppression rules include:

a. Percentages less than 1% (including null values) are shown as <1%, and all other percentages are rounded to the nearest full digit.
b. If there are 10 or less *unique people* in a cell, the result will be reported as either <11 or NR (Not Reportable).
c. Total selections and submissions by year cannot be reported. The total number of proposals submitted across all SMD Divisions for all years can be shown.
d. Selection rates (selections/submissions) are not computed when the total submissions (the denominator) for a particular group is less than 50; or number of *unique people* selected is 10 or less.

Due to the OCS suppression guidelines, some demographic survey responses could not be reported, especially when looking at data for individual SMD Divisions. These responses and how they were handled are:

1. Gender: non-binary option
    a. Not reportable (NR) in all data visuals
2. Race: American Indian or Alaskan Native, Black or African American, Native Hawaiian or Other Pacific Islander, more than one race selected (multiracial), and Other race
    a. These five response options were individually with required submission and a separate set of visualizations are included that combined these response groups into a category called Under-Represented Community (URC).
3. Disability Status: Hearing Impairment, Visual Impairment, Mobility/Orthopedic Impairment, and Other Impairment
    b. These four response options were combined into a category called Disabled.

1.a.iii. Data Limitations

"Prefer not to answer" responses

Responding to the demographic survey questions was, and is, optional. Individuals could select "prefer not to answer" for one or all questions. To include these individuals in this Yearbook, the percentage of submitted and selected proposals where the PIs chose "prefer not to answer" for all survey questions is reported for the Directorate and each SMD Division.

Analyses using Proposals vs. Unique Individuals

Most of the data visuals presented are based on proposals, not unique Individuals. The two analyses based on unique individuals are Unique PI Cohort (2.b.i.) and New PI (2.b.ii.) and are presented at both the Directorate and SMD Division levels. For all other data products, an individual's demographic information may be counted numerous times if, for example, a PI submits multiple proposals to the same ROSES year. In science team analyses, an individual may also be counted numerous times by being in different roles and/or participating multiple proposals for a given grouping of proposals.

1.b. ROSES 2021 Experiments

In ROSES 2021, SMD continued experiments in solicitation and evaluation of proposals and introduced a new required element to proposals in at least one solicitation. These experiments were focused on reducing the barriers to entry into the SMD research ecosystem. All of these experiments have defined measures of success and will be evaluated after at least three solicitation cycles have occurred. Evaluations of these experiments will be reported in future Yearbook releases.

1.b.i. Dual-Anonymous Peer Review (DAPR)

SMD continued to employ dual-anonymous peer review (DAPR) for the evaluation of proposals submitted to select program elements (Table 1.b). In ROSES 2020, nine program elements used DAPR. In ROSES 2021, nine additional program elements started using DAPR. Proposals to these program elements must be anonymized, see https://science.nasa.gov/researchers/dual-anonymous-peer-review and the detailed instructions for the preparation of proposals posted under "Other documents" on the NSPIRES pages for these ROSES elements. While five Astrophysics Guest Observer and Guest Investigator programs are included in the table of DAPR programs below, proposal data for these programs are not included in our analyses.

Table 1.b. Dual-anonymous Peer Review (DAPR) Program Elements in ROSES 2021 including the soliciting division and the ROSES year that DAPR was initiated. Please note that the Earth Science U.S. Participating Investigator and Habitable Worlds programs did not solicit proposals in ROSES 2021.

Division	ROSES 2021 Program Element Title	DAPR start (ROSES Year)
Earth Science	A.15 Cryospheric Science	2021
Earth Science	A.29 Earth Science U.S. Participating Investigator	2020
Heliophysics	B.4 Heliophysics Guest Investigator Open	2020
Planetary Science	C.7 New Frontiers Data Analysis Program	2021
Planetary Science	C.8 Lunar Data Analysis	2021
Planetary Science	C.9 Mars Data Analysis	2021
Planetary Science	C.10 Cassini Data Analysis Program	2021
Planetary Science	C.11 Discovery Data Analysis	2021
Planetary Science	C.28 Mars Science Laboratory Participating Scientist Program	2021
Astrophysics	D.2 Astrophysics Data Analysis	2020
Astrophysics	D.4 Astrophysics Theory Program	2021
Astrophysics	D.5 Neil Gehrels Swift Guest Investigator Cycle 18	2020
Astrophysics	D.6 Fermi Guest Investigator Cycle 15	2020
Astrophysics	D.9 NuSTAR General Observer Cycle 8	2020
Astrophysics	D.10 TESS Guest Investigator Cycle 5	2020
Astrophysics	D.11 NICER Guest Observer Cycle 4	2020
Cross Division	F.3 Exoplanets Research Program	2021
Cross Division	F.4 Habitable Worlds	2020

1.b.ii. Planetary Science Division No Due Dates (NoDD)

Seven programs in Planetary Science accepted proposals at any time without any preliminary statement such as a Notice of Intent or Step-1 proposal:

- C.2 Emerging Worlds
- C.3 Solar System Workings
- C.4 Planetary Data Archiving, Restoration, and Tools
- C.5 Exobiology
- C.6 Solar System Observations
- C.12 Planetary Instrument Concepts for the Advancement of Solar System Observations
- C.16 Laboratory Analysis of Returned Samples

Though the NSPIRES page for these programs display a "Proposals Due" date, this date reflects the end date for ROSES 2021, after which proposals would be submitted to the program

element with the same name in ROSES 2022. The programs with No Due Date (NoDD) reviewed proposals throughout the year with a cadence that depended on the rate at which proposals were submitted.

For more information see C.1, the Planetary Science Research Program Overview and https://science.nasa.gov/researchers/NoDD.

All seven of the NoDD programs are included in the Yearbook, except in Time from Proposal Submission to Award Notification analyses.

1.b.iv. C.11 Discovery Data Analysis Program (DDAP) removal of detailed budget requirements for submitted proposals

The Planetary Science's C.11 Discovery Data Analysis Program (DDAP) did not request NSPIRES cover page budgets or total budgets with the technical proposal. Proposers were merely asked to roughly categorize the cost of the proposed research as "small", "medium", or "large". Budgets were requested later for selectable proposals. The elimination of the requirement for a detailed initial budget is hoped to reduce the effort needed to submit a proposal to this program.