THE NATIONAL SPACE GRANT COLLEGE & FELLOWSHIP PROGRAM

FISCAL YEAR 2020
ANNUAL PERFORMANCE REPORT (APR)

FUNDING SOURCE:
OFFICE OF STEM ENGAGEMENT
SPACE GRANT

MANAGING ORGANIZATION:
NASA HEADQUARTERS OFFICE OF STEM ENGAGEMENT

DEPUTY PROGRAM MANAGER:
DR. ERICA J. ALSTON
ERICA.J.ALSTON@NASA.GOV

[STATE] SPACE GRANT CONSORTIUM LEAD INSTITUTION:
[THE PENNSYLVANIA STATE UNIVERSITY]

[STATE] SPACE GRANT DIRECTOR:
[DR. CHRISTOPHER H. HOUSE]
[CHH10@PSU.EDU]

COOPERATIVE AGREEMENT/GRANT NUMBER:
[80NSSC20M0097]

ACTIVITY/PROGRAM DESCRIPTION: (100 – 250 words)

The Pennsylvania Space Grant Consortium (PSGC) offers programs and projects in support of NASA priorities, aligned with the priorities of NASA Mission Directorates and the goals of the National Space Grant College and Fellowship Program, to contribute to the educational and economic priorities of the Commonwealth of Pennsylvania.

The mission of the PSGC is to expand opportunities in Pennsylvania for citizens to learn about and participate in NASA programs by supporting STEM education, training, research, and public understanding while promoting multi-faceted diversity among project participants.

The Pennsylvania State University (Penn State) provides leadership for PSGC objectives by partnering with other higher education institutions, supporting cooperative activities with NASA and aerospace-related industries, and facilitating relevant public outreach.

PSGC programs and projects are designed to suit the strengths of member institutions and serve the needs of Pennsylvania while emphasizing NASA-relevant research and hands-on discovery through competitive direct and mini-grant award programs. PSGC prioritizes funding for participants who plan to pursue STEM and NASA-related research and careers.

The PSGC supports the following institutions as Affiliate members: California University of PA, Carnegie Mellon University, Cheyney University of PA, Drexel University, Franklin & Marshall College, Gannon University, Gettysburg College, Lehigh University, Lincoln University, the Abington College and Wilkes Barre campuses of Penn State, Temple University, the University of Pittsburgh, and West Chester University of PA.

PSGC Affiliates represent all geographic regions of the Commonwealth, serve both rural and urban populations, and include two Historically Black Colleges & Universities (HBCU): Cheyney University and Lincoln University.

ACTIVITY/PROGRAM GOALS: (Bulleted list)
State the Consortium Goals and Objectives from your base proposal and augmentation proposal.

The three focus areas of NASA STEM engagement inform PSGC goals and objectives:

Goal 1: Enable contributions to NASA efforts that also align with the priorities of the NASA Mission Directorates.

- **Objective 1**: Enable student contributions to NASA efforts in exploration and discovery.
  - Offer competitive internships, fellowships, and other direct awards to inspire, engage, educate, and employ the next generation of explorers.
- **Objective 2**: Enhance research and development capacity of educational institutions.
  - Support graduate fellows through a competitive selection process, prioritizing NASA-relevant research.
  - Conduct a mini-grant program to support NASA-relevant projects.

Goal 2: Contribute to building a diverse, skilled future STEM workforce.

- **Objective 1:** A broad and diverse set of students are attracted to STEM education and careers through NASA opportunities.
  - Design and support NASA-unique authentic STEM learning opportunities.
  - Offer aerospace technology learning opportunities in dedicated space hardware laboratories.
- **Objective 2:** Students, including those from underrepresented and underserved communities, explore and pursue STEM pathways through NASA-relevant authentic learning experiences and research opportunities.
  - Promote opportunities to a diverse range of participants.
- **Objective 3:** Strategic partnerships enhance and extend the impact of NASA efforts in STEM engagement.
  - Conduct competitive Higher Education mini-grant program to encourage collaboration and NASA-relevant interdisciplinary training and research.

Goal 3: Strengthen understanding of STEM through powerful connections to NASA.

- **Objective 1:** Youth are introduced to STEM concepts through NASA-related resources.
  - Conduct competitive Pre-College mini-grant program for professional development to promote K-12 STEM education.
- **Objective 2:** Students gain exposure to STEM careers through direct and virtual experiences with NASA people and work.
  - Conduct competitive Pre-College mini-grant program to facilitate public STEM engagement.

Dedication to Diversity and Inclusion

The PSGC actively works to engage participants from historically underrepresented groups in the STEM fields, and the following Space Grant programs have consistently included strong participation by women and members of underrepresented minorities: Temple University Student Space Exploration and Environmental Systems Laboratory (SSEESL), the undergraduate research programs at Cheyney University of PA and Lincoln University, and the undergraduate research programs at Penn State - Abington College (ACURA) and Penn State - University Park (WISER and MURE).

ACTIVITY/PROGRAM CONTRIBUTIONS TO PERFORMANCE GOALS (PG) AND SUCCESS CRITERIA

List appropriate FY 2020 PGs and Success Criteria, and write a brief description of the project activity's contribution to each.

PG 3.3.3: Provide opportunities for students to engage with NASA's aeronautics, space, and science people, content, and facilities in support of a diverse future NASA and aerospace industry workforce.

> **PG 3.3.3 Success Criteria:** Meet or exceed the national average in two of the four categories of student diversity for NASA STEM enrollees in internships, fellowships, or other student engagement opportunities. Diversity Categories: (1) students across all institutional categories and levels (as defined by the U.S. Department of Education), (2) racially or ethnically underrepresented students (Hispanics and Latinos, African Americans, American Indians, Alaska Native, Native Hawaiians and Pacific Islanders), (3) women, and (4) persons with disabilities at percentages that meet or exceed national averages for science and engineering enrollees, as determined by the most recent, publicly available data from the U.S. Department of Education's National Center for Education Statistics.

Response to PG 3.3.3 and PG 3.3.3 Success Criteria goes here:

The PSGC offers programming for K-12 and post-secondary students while focusing on providing and enhancing higher educational opportunities. The PSGC's student diversity targets align with the National Center for Education Statistics (NCES, 2019/most recent data) enrollment for Pennsylvania, with a combined 18.5% percentage of students who are members of underrepresented minorities in STEM fields (Black or African American 11.4%, Hispanic 6.8%, Pacific Islander 0.1%, American Indian or Alaska Native 0.2%; Note: PA data also records "two or more races" at 3.4%). PSGC program participation goals for FY20 were to include at least 50% female and at least 18.5% students who are members of underrepresented minorities in STEM fields.

The PSGC met those targets for direct-funded program participation (223 students), with 60.9% female students and 23.2% underrepresented minorities. The PSGC also met targets for total participation (264 students), with 53% female students and 20.1% students who are members of underrepresented minorities in STEM fields.

PG 3.3.4: Enhance the effectiveness of education investments using performance assessment and evaluation-driven processes.

> **PG 3.3.3 Success Criteria:** Achieve milestone(s) in the implementation of performance assessment and evaluation of STEM engagement investments. Milestone: Award one competitive agreement to conduct a multi-year, third-party, project-level evaluation of the National Space Grant College and Fellowship Project.

Response to PG 3.3.4 and PG 3.3.4 Success Criteria goes here:

PSGC programs and projects intentionally have been designed to align with and support NASA goals and the specific priorities of the NASA Mission Directorates. Our Assessment Plan has been developed to test and ensure that the implementation of our programs effectively deliver results aligned with NASA priorities. The PSGC assessment strategy and specific SMART goals and targets are based on Federal, Agency, and OSTEM performance and evaluation priorities and requirements.

Broadly, the PSGC has established multi-year goals and objectives with performance metrics across the four-year grant period of performance from spring 2020 through spring 2024. The lead institution, PSGC Affiliate institutions, and recipients of PSGC mini-grants will follow standardized procedures to propose, plan, implement, assess, and evaluate project activity efforts. Narrative and financial reports, along with project and longitudinal data collected or aggregated related to individual participants, as well as broader impacts, are collected and reported to NASA as scheduled to ensure that efforts supported by the PSGC can be compared to pre-award baseline data for assessment and evaluation of PSGC progress related to mission, goals, and outcomes and to recognize special achievements. Improvements to efforts will be implemented as indicated.

The PSGC uses three different program outcome measurements: products (number of papers, posters, curricula, websites, etc.); qualitative data related to post-activity perceptions (such as measurements of changes in knowledge/perception/interest or STEM knowledge); and quantitative data (such as participant numbers and categories of fields of study). All programs have a target of >18% underrepresented minority participation, and most programs have a target of at least 50% female participation. Engineering intensive programs have a target of >20% female participation.

PG 3.3.5: Provide opportunities for students to contribute to NASA's aeronautics, space, and science missions and work in exploration and discovery.

> **PG 3.3.3 Success Criteria:** Number of paper presentations and peer-reviewed research publications (and beginning in FY2021 to include student proposed solutions and products) resulting from STEM engagement investments. (Target number is 1,300)

Response to PG 3.3.5 and PG 3.3.5 Success Criteria goes here:

PSGC support led to subsequent proposals – 3 known totaling $117,000 in additional funding:

- **Funded Proposal ($103,000)**, X-RAYS FROM OBLIQUELY ROTATING MAGNETIC MASSIVE STARS, West Chester University of Pennsylvania, K. Schwarz, 2020
- **Funded Proposal ($4,000)**, PLUTO Simulations of Magnetized Massive Star Winds, West Chester University of Pennsylvania, K. Schwarz, 2020
- **Funded Proposal ($10,000)**, Supercomputer Simulations of Magnetized Massive Star Winds, West Chester University of Pennsylvania, K. Schwarz, 2020

PSGC Affiliate publications and presentations:

- **Publication**, Spectral 3D reconstruction of impressionist oil painting based on macroscopic OCT imaging, PSU - Abington, X. Zhou, D. In, X. Chen, H.M. Bruhn, X. Liu, and Y. Yang, J. Optical Society of America, 2020
- **Publication**, Assessment of self-regulated learning from participating in extracurricular research projects, Gannon University, W. Lee and N. Conklin, Proceedings, 2020
- **Publication**, Proof-of-concept prototype of wideband VHF-based video streaming for e-health interventions in remote rural areas, Gannon University, W. Lee, M. Altamimi, J.P. Arockia Doss, O.M. Salameh, R.T. Bryan Rivera, and N.B. Conklin, Proceedings, 2020
- **Publication**, Demonstrating the Potential of CFD Transition Modeling for Racing Sailplane Design, PSU - UP, Christopher J. Axten and Mark D. Maughmer, Proceedings, 2020
- **Presentation**, Dynamic evolution of flow structures and viscosity during basaltic magma emplacement and crystallization in an upper-crustal sill, West Chester University of Pennsylvania, Srogi, L., Soldati, A., Lutz, T., Watson, N. & Pollock, M., American Geophysical Union, December 2020
- **Presentation**, Relationship between groundwater flow, tides, and salt pond formation at the Delaware salt marsh, West Chester University of Pennsylvania, M. Powers, D. Nikitina, Dr. Martin Helmke, C. Knight, M. Payzine, Geological Society of America, 2020
- **Presentation**, Surf and Turf: Photometry of Scallop-Shell Stars in Taurus, Gettysburgh College, Dr. Jacquelynne Milingo, American Astronomical Society Meeting #235, 2020
- **Presentation**, 3D MHD simulations of the magnetized O star wind of $\theta 1$ Orionis C, West Chester University of Pennsylvania, Marc Gagne, MOBSTER-1 conference, 2020
- **Presentations** (33), WISER|MURE|FURP Symposium, Wednesday, November 11, 2020 – 29 undergraduate presentations
- **Proposals** (27), PSGC 2020 Graduate Fellowships

ACTIVITY/PROGRAM ACCOMPLISHMENTS: ***(250 – 500 words)***

In FY 2020, through Fellowships, Internships, Scholarships, and Higher Education programs, the PSGC enabled 578 undergraduate students and 196 graduate students to participate in authentic science, technology, engineering, and mathematics (STEM) activities.

The PSGC reported 379 direct student participants, 53% female and 20% members of underrepresented groups in STEM, with 223 students receiving individual awards. In addition, through Pre-college and Informal Education outreach projects, 530 K-12 students were engaged in activities related to STEM topics, and 75 K-12 educators participated in activities to better equip them to educate Pennsylvania students to enter the US STEM workforce.

The Student Space Laboratory Program (SSPL) at Penn State-UP was awarded a 2020 BIG Idea Challenge grant to design an instrument to measure the composition of lunar soil in permanently shadowed regions. The technology uses a laser to determine the location and concentration of resources, such as water ice.

NASA Internships, Fellowships, and Scholarships: The National Space Grant Foundation (NSGF) selected three PSGC students for spring 2020 NASA Center internships: Peter Collins, Ph.D. program Penn State-UP (MSFC); Gedalia Koehler, sophomore Drexel University (MSFC); and Edward Zovinka, junior Saint Francis University (JSC). The PSGC supported four summer 2020 NASA Center internships: Athena Chan, undergraduate Temple University (ARC); Dylan Lew, undergraduate Temple University (LRC); Jamie O'Brien, undergraduate Olin College of Engineering (LRC); Myah Rather, undergraduate Penn State-UP (GSFC). During spring 2021, the NSGF supported Jerell D. Aquino, undergraduate Penn State-UP (KSC).

The PSGC awarded 27 Graduate Fellowships, 14 to females (52%) and 5 to members of underrepresented groups (19%). Seventeen students received Statewide Undergraduate Research Scholarships, eight to females (47%). WISER/MURE/FURP undergraduate research internships were awarded to 106 students: 90 females (85%) and 28 members of underrepresented groups (36%).

Higher Education: The PSGC supported 264 students in higher education projects, 141 females (53%) and 81 from underrepresented groups (30%). Student space hardware programs included PSU SSPL (3 students), PSU Flight Vehicle Design and Fabrication (5 undergraduates), PSU Liontech Rocket Lab (6 students), Temple University Student Space Exploration and Embedded Systems Laboratory (7 students), and Drexel University Space Systems (11 students).

Pre-college: The PSGC awarded mini-grants to: 1) Marine Advanced Technology Education (MATE) PA, for STEM workshops in the Philadelphia region. Students worked virtually to design and build remotely operated vehicles capable of operating underwater; and 2) the Enon Coulter Economic Development Council and the IEEE Philadelphia Section to present a virtual summer robotics outreach workshop for elementary and secondary students in Philadelphia.

Research Infrastructure: The PSGC supported a project led by Dr. Morgan Fedorchak at the University of Pittsburgh that simulated microgravity utilizing the parabolic flight research platform to study differences in permeability across the cornea and sclera that could affect the use of topical medications to treat ocular issues such as Space-Associated Neuro-Ocular Syndrome (SANS) in astronauts. Four faculty, 150 graduate students and 40 undergraduates were involved in the research.

Informal Education: PSGC Fellows participated in five hours of outreach or mentoring per semester.

ACTIVITY/PROGRAM IMPROVEMENTS MADE IN THE PAST YEAR:

(*e.g. activity management, cost efficiencies) (100 – 250 words)*

The addition of a new Program Delivery Specialist to oversee the data and participant tracking of our consortium programs, communicate with program partners, and create program manuals has greatly enhanced the efficiency and effectiveness of our grant administration and reporting responsibilities.

The COVID-19 pandemic resulted in restrictions for lab access, travel to on-site research locations and conferences, and cancellation of competitions and conferences. Affiliate PIs and project leads have been resilient and have done their best to transition to remote work whenever possible, and most work has continued.

ACTIVITY/PROGRAM PARTNERS AND ROLE OF PARTNERS IN ACTIVITY EXECUTION:

Bulleted list or table. May include a brief description of how partners were involved in the project activity.

- California University of PA – "UAV Education" – PSGC Affiliate public university (bachelor, master, and doctoral degrees)
- Carnegie Mellon University – "Summer Research Program" – PSGC Affiliate private research university (bachelor, master, and doctoral degrees)
- Cheyney University of PA – "STEM Research Program" – PSGC Affiliate public HBCU (bachelor degree)
- Drexel University – "Space Systems Lab" – PSGC Affiliate private research university (bachelor, master, and doctoral degrees)
- Franklin and Marshall College – "NANOGrav Student Teams of Astrophysics ResearcherS" – PSGC Affiliate private college (bachelor degree)
- Gannon University – "Undergraduate Research" – PSGC Affiliate private university (bachelor, master, and doctoral degrees)
- Gettysburg College – "National Undergraduate Research Observatory" – PSGC Affiliate private college (bachelor degree)
- Lehigh University – "Undergraduate Research" – PSGC Affiliate private research university (bachelor, master, and doctoral degrees)
- Lincoln University – "Undergraduate Research" – PSGC Affiliate public HBCU (bachelor and masters degrees)
- Montgomery County Community College – "STEM Research" – PSGC Affiliate public community college (associate degree)
- Pennsylvania State University - University Park – Lead institution – PSGC Affiliate public research university (bachelor, masters, and doctoral degrees)
- Pennsylvania State University - Abington College – "Undergraduate Research" – PSGC Affiliate Commonwealth campus of Penn State (bachelor degree)
- University of Pittsburgh – "Undergraduate Research" – PSGC Affiliate public research university (bachelor, master, and doctoral degrees)
- Temple University – "Student Space Exploration and Embedded Systems Lab" – PSGC Affiliate public research university (bachelor, master, and doctoral degrees)

- West Chester University of PA – "Undergraduate STEM Research" – PSGC Affiliate public university (bachelor, masters, and doctoral degrees)
- Messiah College – "Gamma Ray Detector" (higher education mini-grant project)
- Pennsylvania State University - Wilkes Barre – "Undergraduate Engineering Research" (higher education seed project)
- University of Pittsburgh - Johnstown – "Robotics Outreach" (mini-grant K-12 outreach project)
- PA M.A.T.E. Regional (Philadelphia) – "ROV Outreach and Professional Development" (mini-grant K-12 outreach and professional development project)
- Enon Coulter Economic Development Council (Philadelphia) – "Robotics Outreach" (mini-grant K-12 outreach project)

CURRENT AND PROJECTED CHALLENGES:

Identify any current or projected challenges in the implementation or execution of activities. Explain how the management team is working to address the challenges identified and/or how National Program Staff can assist.

The ongoing pandemic has presented several challenges for the PSGC. Several PASGC Affiliate institutions, space hardware labs, and mini-grant project leads were unable to run their programs as proposed because of restrictions in lab access, travel, cancellation of competitions and conferences. Affiliate PIs and project leads of mini-grant-funded work have been resilient and have done their best to transition to remote work whenever possible, but projects that involved mentoring or hands-on collaboration have had to be postponed or cancelled in some cases. The PSGC director has been in direct conversation with PIs to help adjust and move forward.

REFERENCES (optional – include only if needed):

(APA style reference list)