

Pennsylvania Space Grant Consortium
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Director: Dr. Christopher H. House
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PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Pennsylvania Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2013.

PROGRAM GOALS

PSGC Goals: (1) Develop and promote opportunities for students to participate in research and discovery, including student flight projects; include programs with a focus on enhancing the participation of students from underrepresented groups. (2) Provide graduate and undergraduate training in NASA-related fields through the mechanism of fellowship and scholarship awards; increase the number of awards to students from underrepresented groups. (3) Support the development of interdisciplinary courses, curricula, and workshops, including introductory courses designed for undergraduate students not majoring in scientific or technological disciplines. (4) Model diversity in space grant leadership, programs, and activities; implement programs targeted at increasing the retention rate of students from underrepresented groups in science and engineering. (5) Provide information and programs to increase access to the excitement, knowledge, and technology from America's earth, air and space programs; establish PSGC as a viable state resource and catalyst for aerospace research, education, and economic development. (6) Cultivate a statewide network of partners from universities, industry, museums, science centers, state and local agencies to pursue aerospace research, education, and economic development goals. (7) Develop earth, air, and space programs to enhance public scientific literacy and to complement community needs.

FY 2013 SMART Objectives: Our target was to award 50 PSGC fellowships and scholarships. We intended to award ten statewide scholarships to support interns at NASA Centers. We planned to award 45 research scholarships to first-year, female, and

minority undergraduate students to gain hands-on laboratory experiences with an underlying objective of having 65% female and 30% underrepresented minority participation. We expected to support ten students in the Abington College Undergraduate Research Activities (ACURA) project, and ten for the National Radio Astronomy Observatory (NRAO) project at Penn State Abington. We expected to support five undergraduates at Franklin and Marshall College and Gettysburg College performing undergraduate research in the National Undergraduate Research Observatory (NURO) program. We aimed to have a total of 65 students participate in student space hardware programs (e.g. Student Space Programs Laboratory). We expected to have 20 student participants in the NASA-supported Penn State Flight Vehicle Design and Fabrication (FVDF) course. We aimed to support five West Chester University STEM majors in an undergraduate research program, and two HBCU students in our Lincoln University Environmental Sciences Research project. 13.8% of awards from each program were expected to be allocated to underrepresented minorities. We aimed to continue our mini-grant program by supporting four early career scientists and initializing two new higher education programs. Our goal was to have a total of 115 in-service educators participate in teacher professional development workshops (e.g. GLOBE). Through our precollege programs, we expected 25 high school and >75 middle school student participants. Finally, we aimed to support four PSGC community events.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, & 3)

PSGC Benefit to Outcome 1

Students of the Drexel University Space Systems Laboratory designed and built a one-unit cube Nanosatellite, DragonSat-1, which successfully launched in November, 2013. This project began in 2011 with the mission to capture images of aurora to observe the radiation dissipation intensity during solar events, culminated with its launch, and witnessed in person by members of the lab. *“Through my participation [in the PA Space Grant Consortium programs], I have decided that space science is where I am looking to take my education after graduation. I have applied to a Fulbright US Student research grant to conduct space systems research at the Space Systems Research Laboratory of Korea Aerospace University. If selected, I will play a leading role in the final launch-prep for KAUSAT-5, a small satellite mission to map the Earth in the infrared spectrum, while also greatly assisting the laboratory as the only native English speaker. I will observe how the South Korean education system has affected how this laboratory conducts engineering as well as spacefaring, and compare it to my own experiences at Drexel University and my NASA experiences. If selected, I will aim to attend a graduate program in the USA upon my return in the fall of 2015 and am hopeful that I continue to be involved in our nation's space program. I look forward to the future of America's space program, as I look forward to the future of my education and how I may help us further our presence in space.”* – Matthew D'Arcy, 2013 Drexel Space Systems Lab.

PSGC Benefit to Outcome 1

Temple University began a partnership with Montgomery County Community College in an effort to improve STEM education by implementing engineering research projects. Temple University, with support of PSGC, will continue to work with Montgomery

County Community College to share research methodologies and create workshops, train and mentor faculty to incorporate STEM interdisciplinary studies methodologies between schools (train the trainer), and establish unique programs and become ambassadors to other educational institutions to advance freshman/sophomore interdisciplinary studies through innovative product research and development.

Montgomery County Community College students are working with members of the Temple University Space Systems Laboratory in projects including RockSat payload development and the 2014 Quadrotor Challenge. The Quadrotor Challenge is designed to promote friendly and engaging competition in engineering while at the same time increasing visibility of, and interest in, the schools' respective engineering programs. Beginning in 2014, the challenge is focused on locating and observing objects in an area out of line of sight of the observation team.

PSGC Benefit to Outcome 2

Two Pennsylvania teams from Downingtown and Jamestown were selected for the sixth national Student Spaceflight Experiments Program (SSEP) flight opportunity to the International Space Station. The Downingtown STEM Academy and the Downingtown Area School District organized an experiment to observe how microgravity affects the release of the microencapsulated drug Aleve XR. The results of this experiment will provide researchers with information regarding the effects of microgravity, specifically on the release of microcapsules. Astronauts can then act accordingly on how heavy each dose needs to be in order to be effective on a particular disease. It can also contribute to manufacturing longer lasting medicines, if the microcapsule stays intact in microgravity.

The Jamestown, Pennsylvania project, organized by Jamestown High School and Jamestown Area School District, focused on a bacteria's ability to decompose soil in space. The purpose of the project was to study how human beings can live safely in outer space for extended periods of time by looking at one of Earth's decomposer's ability to function in microgravity.

PROGRAM ACCOMPLISHMENTS

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals (Employ and Educate):*

In relation to FY 2013 SMART goals, we are proud to report that our university and college programming (F/S, HE, RI) totals 564 individual participants. This includes 187 participants in nine unique student hands-on engineering programs, and 191 awarded fellowships, scholarships and internships to students in STEM fields. Of the total awards, 91 were granted to underrepresented minority undergraduate and graduate students. Twelve higher education and research infrastructure mini grants were awarded for faculty and research support. The PSGC mini-grant program is a competitive process available to faculty, researchers, post-doctoral fellows, and graduate students in an effort to build NASA competency in the areas of education and research. Additionally, PSGC developed one new course and revised three pre-existing courses.

In terms of our specific targets for our fellowship and scholarship programs, we exceeded our goal and awarded 71 PSGC statewide fellowships and scholarships with 32% of awards granted to underrepresented minorities. We exceeded our undergraduate research scholarship target with 40 new WISER/MURE/FURP researchers and 68 returning scholars. We did not meet the specific target of 30% minority participation; however, 90% of the scholarships were granted to underserved students in STEM (67% female and 23% minority, non-repeating). We fell just shy of meeting the NASA center internship award count at nine total students supported throughout the country, but we made a strong effort to offer internship funding to female students with the percentage at 67% women awardees. To compensate for the lessened NASA center support, we provided three students with summer internship funding to participate in the X-Prize Lunar Lion spacecraft project. Our overall underrepresented minority participation in fellowship and scholarship programming reached an impressive 25%, exceeding our state's growing diversity population percentages (based on the Pennsylvania State Data Center Census estimates).

In terms of our specific targets for our higher education programs, we exceeded our target with 44 students in the ACURA program, providing hands-on research and creative discovery for Penn State Abington undergraduate students that heighten interest in STEM areas, resulting in 46% participation from underrepresented minority populations, far surpassing our target of 13.8%. Eight ACURA students also participated in the NRAO project that consisted of a four day research trip to the National Radio Astronomy Observatory at the Green Bank Telescope. Students of this program are highly engaged and are focused on features near the center of the Milky Way and used a robotic radio telescope to compare observations. All of the students who participated in this program are intending to continue their majors in a STEM discipline. At Franklin and Marshall and Gettysburg colleges, NURO met its target with five students involved in undergraduate research. Research completed in the NURO program has led to senior thesis projects in the Gettysburg College Physics Department as well as faculty collaborations for a joint "spotted star" observing proposal with the Center for Astrophysics.

The PSGC-supported higher education student space hardware programs, including Penn State Students Systems Laboratory, Penn State University Student Launch Initiative, Penn State Flight Vehicle Design and Fabrication course, Temple University Student Space Exploration and Embedded Systems Laboratory, and Drexel University Space Systems Laboratory, greatly surpassed the overall student involvement targets with participation numbers totaling more than 160 participants. Attracting female student involvement in these hands-on engineering programs remains to be a challenge. Community college support expanded in FY 2013, meeting our metric with the support of two Montgomery County Community College students to conduct research at Temple University on RockSat and other robotics projects. Lastly, two higher education programs were initiated in the fiscal year, meeting our mini-grant target. PSGC funded the Gannon University High Altitude Rational Detector program, allowing students to design and build a balloon payload, participate in a launch, and collect and analyze completed flight data. PSGC also funded a Penn State University student-led radio

interferometer research project for educational and outreach purposes. This project is planned and executed entirely by undergraduate students in various STEM fields including astronomy, physics, varying fields of engineering, mathematics, computer science, and neurobiology. The students involved are developing the skills and understanding involved in radio astronomy observations, system calibration, mathematical system analysis, image analysis, electrical circuitry, scientific and high performance computing, and digital electronics. These skills not only supplement existing course material at the undergraduate level, but provide valuable experience to students later on in their academic or professional career in their respective STEM fields. To stimulate STEM interest and proactively recruit and place early-stage undergraduate students in the pipeline, scholarships were integrated into the overall management of this mini-grant program.

In terms of our specific metrics for our research infrastructure programs, we exceeded our targets for our West Chester University program with eight STEM students involved in undergraduate research, particularly in the fields of Geology & Astronomy and Physics. This program places high emphasis on increasing the number of women in these departments with the goal of women in STEM continuing into graduate programs. One West Chester University student, Kristen Moore, presented her research at the National Geological Society of America conference in fall 2013. The talk was well received, and she was invited to submit a book chapter due this May. Ms. Moore's research has also been instrumental in developing a collaborative NSF proposal between WCU, Ball State University, and Florida International University. Our Lincoln University Environmental Sciences project surpassed its target and awarded four scholarships to underrepresented minority students.

Our mini-grant program met its target to support early career scientists by expanding the research infrastructure faculty seed grant program. Four early career scientists were funded in three unique programs: low Earth orbit satellite at Penn State Wilkes-Barre, oscillating cylinder vortex formation at Penn State Altoona, and RockOn workshop for two faculty members at Harrisburg County Community College. Additionally, PSGC offered funding to support the Lunar Lion team in the first ever university-led mission to the Moon program. This project resulted in 80 undergraduate and graduate students becoming involved in space exploration by participating in hands-on engineering experiments. PSGC also supported two graduate students and two post-doctoral researchers in projects related to earth and environmental sciences, science education, and STEM outreach.

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty (Educate and Engage):*

Precollege programming supported a total of 239 in-service educators. With regards to our specific targets, we exceeded our objectives for Penn State Science Workshops for Educators and Pittsburgh University GLOBE workshops with 129 enrolled in-service teachers. Nearly half of all participating teachers served classrooms with >50% underrepresented populations, including underprivileged rural counties in Pennsylvania, and 90% of teachers reported using the course content after one year. The NASTAR

Center educator workshops remain a successful area of K-12 development, supporting 58 in-service educators in aerospace-related, curriculum development workshops. NASTAR summer science camps supported 106 pre-college students, primarily at the middle school level. Susquehanna University's Saturday Science program met its workshop target by holding 12 meetings in the fiscal year, and exceeded its participant targets with 56 K-12 student participants, 42 parents involved, and 34 pre-service teacher participants. The Saturday Science program trains pre-service teachers in STEM areas as they prepare for careers in education, using program resources in Susquehanna University classes. The Temple University Introduction to Electrical Engineering course did not meet its student target with 12 high school participants; however, the program continues to be an excellent project for pre-college diversity with over half of the total participants from underrepresented minority populations. PSGC also supported two Pennsylvania school districts in the Student Spaceflight Experiments Program (SSEP), helping bring authentic learning experiences to K-12 students as they design and propose real microgravity experiments to fly in low Earth orbit to the International Space Station. Over 800 pre-college students participated in the 2013 Mission 4 SSEP program from two Pennsylvania communities.

Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission (Engage and Inspire):*

The PSGC met its targets for Outcome (3) by funding four community events. Events included annual family science exhibitions at local elementary and middle schools, and activities related higher education and research projects including classroom visits, science cafes, and STEM career informational gatherings. In addition, higher education programs, including the Lehigh Hopper and the Penn State Lunar Lion team, incorporate outreach components to their projects. For example, the Lunar Lion spacecraft simulator is used as a STEM demonstration at local middle and high schools and science centers to engage and inspire young students in space science and engineering-related endeavors. Also, videos are produced about the team to share with pre-college populations to expand interest in such efforts. Furthermore, PSGC continued to support a mini-grant project focused on research and learning in informal environments. A graduate student in Science Education designed an interactive program for families and groups at the Discovery Space Museum of Central PA. The museum exhibit incorporates a dynamic set of hands-on activities that provides an informal education experience for students and parents from the general public. This project is an example of the PSGC's effort to strengthen collaborations and build partnerships between the areas of education and science research, while incorporating elements of informal learning.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:**

Total awards = 572; Fellowship/Scholarship = 191, Higher Education/Research Infrastructure = 381; 91 of the total award represent underrepresented minority F/S funding. During the FY13 program year 36 students are pursuing advanced degrees in STEM disciplines, 14 accepted STEM positions at NASA contractors, 51 accepted

STEM positions in industry, 1 accepted a position at NASA, 1 accepted a STEM position in K-12 academia, 7 accepted STEM positions in academia, and 22 went on to positions in non-STEM disciplines. The remaining students have not yet received the degree that they were pursuing while they received their Space Grant award.

- **Minority-Serving Institution Collaborations:**

Lincoln University, an HBCU, is nationally recognized for African American undergraduate students receiving degrees in the physical sciences, computer sciences, biological and life sciences. Most of the students (95%) in the School of Natural Sciences and Mathematics are minority, and over 65% of these students are female. The Lincoln University Space Grant project includes scholarships for environmental related research and provides students with the opportunity to present their research at STEM conferences. In FY 2013, PSGC supported four minority Lincoln University students in the research scholarship program.

Cheyney University of Pennsylvania is the oldest of the Historically Black Colleges and Universities in America. The mission of Cheyney University is to provide a higher education option to students of lower income and of African American heritage. The university specifically targets these students when advertising all academic programs including fields of significance to NASA and PSGC. Space Grant strives to strengthen ties with Cheyney University by providing support for undergraduate student fellowships as well as specifically marketing towards Cheyney students to apply to the PSGC statewide undergraduate scholarship.

Additionally, the PSGC has extended support to minority-serving institutions by providing summer research scholarships to underrepresented students to enhance their scientific research, written and oral communication, and professional development skills at Penn State – University Park. All students participating in the Eberly College of Science summer research program are engaged in hands-on laboratory experiments in STEM fields. In FY 2013, four underrepresented students were supported from Lincoln University (HBCU) and University of Puerto Rico (Hispanic serving institution).

- **NASA Education Priorities:** PSGC programming efforts serve all NASA Education current areas of emphasis.

- *Authentic, hands-on student experiences in science and engineering disciplines:*

Several PSGC projects are dedicated to undergraduate research in STEM and space hardware development, we supported nearly 500 undergraduate and graduate students in authentic, hands-on experiences in science and engineering disciplines. One example of a hands-on student experience program is the Gannon University High Altitude Radiation Detector (HARD) payload program. This program was designed to detect the arrival rates and distribution of cosmic rays and provides support for student projects as part of the effort to develop qualified undergraduate and graduate students who are well prepared for employment in STEM disciplines at NASA, industry, and higher education. Student team members acquired rich hands-on experience in electrical and computer engineering disciplines as the project is lab-

intensive and calls for active participation by students in hands-on practice as well as real-life problem solving.

➤ *Diversity of institutions, faculty, and student participants:*

PSGC strives to reach out to, welcome, and include the broadest range of students, faculty, and institutions possible in all of our programming. Recruitment emphasis is placed on underserved and underrepresented populations within STEM disciplines. Many of our affiliate institutions have an extremely diverse student body, and awards are advertised to target underrepresented groups including, Women in Science & Engineering and the National Society of Black Engineers. Additionally, several initiatives are in place to advance these diversity efforts, such as collaborations with community colleges throughout the state, outreach events focused on increasing underserved and underrepresented student involvement in STEM-related fields, and free science enrichment programs to low-income families. Internal PSGC programming focuses primarily on recruitment and retention of underrepresented students by offering research internships with high award emphasis on early-college-level women and minority undergraduates in STEM. Such diversity efforts resulted in a total of 226 women and 91 underrepresented minorities involved in college-level programs consortium-wide, totaling a combined percentage of 47% underserved higher education participation in FY 2013. Underserved and underrepresented students receiving direct monetary awards totaled 81%.

➤ *Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise:*

PSGC funded ten educator professional development workshops targeted toward middle school teachers in FY 2013. Hands-on curriculum enhancement activities took place during the Penn State Summer Science Workshops, Center for Science and the Schools weekend workshops, and the NASTAR Center teacher professional development programs. Workshops and curriculum enhancement activities are aligned with educational standards set in the state of Pennsylvania, emphasize STEM development at the middle school level, and target educators in urban and rural areas.

➤ *Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers:*

Temple University's program in electrical engineering is a summer opportunity for high school students to participate in a five-week course in Electrical and Computer Engineering. The goals of this program are to encourage secondary school students to enter the higher educational system, and to introduce students to the field and profession of engineering. PSGC supported 12 high schools students at Temple University in this program during FY 2013. Students designed small programmable autonomous robots and were engaged in activities such as laser tag and maze mapping. The Penn State Lunar Lion (mission to the moon) team is also actively involved in providing summer opportunities for secondary students participate in their robotic spacecraft project. A PSGC Lunar Lion internship awardee was responsible

for organizing outreach events for school children and adults, and to work directly with secondary school students on activities related to the project. The intern's outreach efforts were so successful that he was chosen as one of 50 social media reporters invited to Wallops Island to report on the LADDEE Launch in September 2013.

- *Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges:*

Stronger emphasis was placed on developing and expanding community college partnerships and collaborations in FY 2013. PSGC supported two Harrisburg County Community College faculty members to attend the RockOn workshop as part of a space satellite seed grant program. The faculty members plan to create higher education curriculum and engineering research projects related to the workshop for students attending the community college. Additional community college relationships are in existence between Temple University and Montgomery County Community College in an effort to improve STEM education and engineering research, and Lehigh University and local community colleges to engage students in undergraduate research and the NASA Explorer Schools project.

- *Aeronautics research – research in traditional aeronautics disciplines; research in areas that are appropriate to NASA's unique capabilities:*

Many PSGC programs are committed to aeronautics research in suit with NASA's unique capabilities. One program example is research conducted at the Drexel Space Systems Laboratory. All Drexel Space Lab projects involve researching existing technology for the development of the students' final designs. The projects are particularly more intensive in the case of the morphing airfoil as this topic is still under investigation and research. Another example is the Lehigh Hopper project that uses the spacecraft simulator as a testbed for future student instruction and basic research in spacecraft dynamics.

- *Environmental Science and Global Climate Change – research and activities to better understand Earth's environments:*

Research and activity projects with an emphasis on environmental science and global climate change are in place at Lincoln, Penn State, Susquehanna, and Temple universities. Lincoln University is designed to increase the number of minority students entering graduate school and enhance Lincoln's Environmental Science program. In order to promote research, PA Space Grant offers student scholarships to provide students the opportunity to present their research at STEM conferences. At Penn State, a mini grant project was supported with the goal of determining the relatedness among individuals of grayleaf willow along an environmental gradient from dry continental climate in inland West Greenland to a maritime climate near coastal West Greenland. This project is inherently related to global climate change research. Additionally at Penn State, three educator workshops were supported by Space Grant through the Center for Science and the Schools that focused on environmental science topics such as wind energy, climate change, and sustainability.

Susquehanna University's Science Experience program continued to develop as part of Saturday Science, instructed by a member of the Environmental Sciences faculty, to include special environmental research activities focused on global climate change for rural middle school students. Finally, Temple University's involvement in RockSat-C included elements of environmental science research by measuring environmental contents of the upper atmosphere. The 2013 RockSat project involved sampling of the atmosphere at predetermined altitudes for carbon dioxide.

- *Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities:*

The PSGC expanded the mini grant program in FY 2013 with the goal of offering additional support to early career faculty in research and educational development in NASA-related activities. Two new mini grant programs specifically meet this NASA Education priority: 'Multiscale analysis of vortex formation behind an oscillating cylinder' (Penn State – Altoona), and 'Design, development and implementation of a Low Earth Orbit satellite' (Penn State – Wilkes-Barre). Additionally, post doctoral researcher support has been extended to enhance innovative research infrastructure and promote institution-wide science-based collaboration.

IMPROVEMENTS MADE IN THE PAST YEAR

In FY 2013, the PSGC nearly doubled the number of mini grant awards to affiliate and non-affiliate consortium partners in areas of higher education and research infrastructure development. The lead institution maintains strong focus on National Space Grant goals and objectives, and ensures impacts are aligned with NASA's Strategic Plan and the needs of Pennsylvania. Additionally, following the resignation of the previous Assistant Director, Heather Nelson, the consortium has reduced administrative personnel and is now managed under a three-employee team. This adjustment has allowed the consortium to reevaluate program needs and strategic planning, streamlining consortium management and making program development and distribution more efficient.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

- **The Pennsylvania State University:** Lead institution; 4-year university. Manages undergraduate and graduate student scholarships and fellowships, undergraduate research programs, NASA and industry internships, K-12 educator professional development workshops, public outreach events, and hosts three unique space systems laboratories and flight courses; mini grant recipient.
- **California University of Pennsylvania:** Affiliate; 4-year university. Manages atmospheric sciences/remote sensing research group.
- **Carnegie Mellon University:** Affiliate; 4-year university. Manages "Go Research!" summer undergraduate research program; involved in Lunar Lion X-Prize team internship.

- **Cheyney University (HBCU):** Affiliate; 4-year university. Manages undergraduate scholarship program.
 - **Drexel University:** Affiliate; 4-year university. Operates Drexel Space Systems Laboratory.
 - **Franklin & Marshall College:** Affiliate; 4-year university. Manages the NURO undergraduate research in astronomy program.
 - **Gettysburg College:** Affiliate; 4-year university. Manages the NURO undergraduate research in astronomy program.
 - **Lehigh University:** Affiliate; 4-year university. Manages undergraduate and graduate student and NASA explorers schools project; mini grant recipient for the hopper spacecraft simulator project.
 - **Lincoln University of Pennsylvania (HBCU):** Affiliate; 4-year university. Administers undergraduate student scholarship.
 - **NASTAR Center:** Affiliate; industry. Manages STEM education programs for student and teachers.
 - **Penn State University – Abington:** Affiliate; 4-year university. Manages undergraduate research program, ACURA; facilitates radio astronomy investigations program at the National Radio Observatory.
 - **Susquehanna University:** Affiliate; 4-year university. Operates Saturday Science program for pre-service educators and K-12 students.
 - **Temple University:** Affiliate; 4-year university. Manages the Student Space Exploration and Embedded Systems Laboratory, summer program in electrical engineering for high school students, and undergraduate scholarship program.
 - **University of Pittsburgh:** Affiliate; 4-year university. Manages NASA Space Grant fellowship program for undergraduate students; Education Resource Center elementary and middle school GLOBE program.
 - **West Chester University:** Affiliate; 4-year university. Manages the undergraduate research program to increase numbers in STEM majors.
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- **Academic STEM Alliance (Bald Eagle, Bellefonte, Penns Valley Area School Districts):** Program partner; K-12 school district. Involved in Centre County pre-college and informal education programs.
 - **The Aerospace Corporation:** Industry partner. Involved in Penn State SSPL projects.
 - **Air & Waste Management Association:** Program collaborator; community/local. Involved in University of Pittsburgh ERC pre-college GLOBE educator workshops.
 - **Allentown Area School District:** Program partner; K-12 school district. Involved in activities related to the Lehigh University NASA Explorer Schools projects.
 - **American Institute of Aeronautics and Astronautics:** Program partner; professional society. Involved in activities related to the Drexel Space Systems Laboratory.
 - **Atlanta Scuba Divers Club:** Program partner; community/local. Involved in pre-college MATE regional challenge.

- **Beechwood Farms Nature Reserve – Audubon Society of Western Pennsylvania:** Program collaborator; non-profit organization. Involved in University of Pittsburgh ERC pre-college GLOBE educator workshops.
- **Bethlehem Area School District:** Program partner; K-12 school district. Involved in activities related to the Lehigh University NASA Explorer Schools projects.
- **Boeing:** Program partner; industry: Involved in Penn State FVDF course activities.
- **Carnegie Science Center:** Program partner; museum. Involved in University of Pittsburgh ERC pre-college GLOBE educator workshops.
- **Center for Science and the Schools:** STEM education network member. Involved in educator professional development workshops at Penn State University.
- **Colorado Space Grant Consortium:** Higher education program partner: Involved in RockSat program.
- **Columbia Scientific Balloon Facility (CSBF):** Other NASA HQ Program Office. Involved in Gannon University’s High Altitude Radiation Detector project.
- **The Discovery Space of Central Pennsylvania:** STEM public outreach partner. Involved in research infrastructure pilot study mini grant.
- **Downingtown Area School District:** Program partner; K-12 school district. Involved in SSEP projects.
- **Downingtown STEM Academy:** Program partner; professional society. Involved in SSEP projects.
- **Engineers Club of Philadelphia:** Program partner; professional society. Involved in pre-college MATE regional challenge.
- **The Franklin Institute:** Program partner; museum. Involved in activities related to the Drexel Space Systems Laboratory.
- **Harrisburg Area Community College:** Mini grant recipient, community college. Faculty participation in RockOn workshop.
- **Institute of Electrical and Electronics Engineers (IEEE):** Program partner; professional society. Involved in pre-college MATE regional challenge.
- **Jamestown Area School District:** Program partner; K-12 school district. Involved in SSEP projects.
- **Jamestown High School:** Program partner; K-12 school. Involved in SSEP projects.
- **Lockheed Martin:** Program partner; industry. Involved in Penn State SSPL projects.
- **Louisiana State University:** Program partner; 4-year university. Involved in Gannon University’s High Altitude Radiation Detector project.
- **Montgomery County Community College:** Program partner; community college. Involved in projects and activities in collaboration with the Temple University Space Systems Laboratory.
- **NASA Ames Research Center:** Internship partner; government institution. Hosts Space Grant students for summer internships.
- **NASA Astrobiology Institute:** Program partner; government institution. Involved in teacher professional development workshops and student internships.
- **NASA Glenn Research Center:** Program partner; government institution. Involved in the Lehigh University hopper spacecraft simulator project.
- **NASA Goddard Space Flight Center:** Internship partner; government institution. Hosts Space Grant students for summer internships.

- **NASA Jet Propulsion Laboratory:** Internship partner; government institution. Hosts Space Grant students for summer internships.
- **NASA Kennedy Space Center:** Program collaborator; government institution. Involved in Temple University Space Systems Laboratory higher education student projects.
- **NASA Langley Research Center:** Internship partner; government institution. Hosts Space Grant students for LARSS summer internships.
- **NASA Marshall Space Flight Center:** Internship partner; government institution. Hosts Space Grant students for summer internships.
- **NASA Wallops Island Flight Facility:** Program partner; government institution. Involved in Space Grant RockOn program.
- **National Center for Earth and Space Science Education (NCESS):** Mini grant recipient; STEM education network. Involved in SSEP projects.
- **National Institute of Aerospace:** Program partner; non-profit organization. Involved in activities related to the Drexel Space Systems Laboratory.
- **National Radio Astronomy Observatory:** Program partner; government facility. Hosts undergraduate research in astronomy for Penn State Abington teams.
- **National Weather Service:** Program collaborator; federal agency. Involved in California University of Pennsylvania remote sensing program.
- **Pennsylvania Department of Education, Office of Environment and Ecology:** Program collaborator; state government: Involved in University of Pittsburgh ERC pre-college GLOBE educator workshops.
- **Pennsylvania School for the Deaf:** Program partner; K-12 school. Involved in Temple University robotics programs.
- **The Pennsylvania State University Applied Research Laboratory:** Mini grant recipient; 4-year university. Operates the higher education X-Prize Lunar Lion team; collaborates with Penn State SSPL projects.
- **The Pennsylvania State University – Altoona:** Mini grant recipient; 4-year university. Mini grant award for oscillating cylinder project.
- **The Pennsylvania State University, Office of Physical Plant (Steam Plant):** Mini grant recipient; 4-year university. Operates the research infrastructure geochemical alteration and biological colonization of volcanic substrates project.
- **The Pennsylvania State University – Wilkes Barre:** Mini grant recipient; 4-year university. Mini grant award for Low Earth Orbit Satellite program.
- **Penn State Public Broadcasting:** STEM public outreach partner. Involved in marketing and outreach for informal education events and programs.
- **Philadelphia Math & Science Coalition:** Program partner; community/local. Involved in recruitment activities for NASTAR Center education programs.
- **Philadelphia Area School District:** Program partner; K-12 school district. Involved in Temple University Space Systems Laboratory projects.
- **Rowan University:** Program partner; 4-year university. Involved in pre-college MATE regional challenge.
- **Sanaartormermik Ilinniarfik, Sisimiut, Greenland:** Program partner; K-12 school. Involved in research infrastructure climate study mini grant.

- **Selinsgrove Area Intermediate School:** Program partner; K-12 school. Involved in Susquehanna University Saturday Science program.
- **Selinsgrove Area School District:** Program partner; K-12 school district. Involved in Susquehanna University Saturday Science program.
- **Society of Manufacturing Engineers:** Program partner; professional society. Involved in pre-college MATE regional challenge.
- **Video Ray, MATE Center.** Program partner; industry. Involved in pre-college MATE regional challenge.
- **Villanova University:** Program partner; 4-year university. Involved in pre-college MATE regional challenge.
- **Washington County Department of Public Safety:** Program collaborator; community/local. Involved in California University of Pennsylvania remote sensing program.

The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.