

FY 2018 Year 4 Extension Annual Performance Document

Indiana Space Grant Consortium

Lead Institution: Purdue University

Director: Barrett Caldwell

Telephone Number: 765-494-9052

Consortium URL: insgc.gov

Grant Number: NNX15AI07H

Lines of Business (LOBs): NASA Internships, Fellowships, and Scholarships; STEM Engagement; Institutional Engagement; Educator Professional Development

A. 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 Indiana Space Grant Consortium is a Designated Consortium funded at a level of \$760,000 for fiscal year 2018.

B. PROGRAM GOALS:

INSGC Goals are as follows:

- *be a preferred source of information, materials, and opportunities for inspiring, preparing, and supporting individuals for NASA-related STEM education / careers.*
- *be an effective and preferred vehicle for enhancing the engagement of K-20 educators and students in NASA-related STEM activities and opportunities.*
- *raise awareness of and access to NASA-related activities, events, and opportunities for the government, institutions, and residents of the State of Indiana.*

We have also devised clear SMART Objectives in order to measure the attainment of the INSGC goals and ensure alignment with NASA PART measures. The use of SMART objectives assures that there is a clear connection between INSGC funded activities and Consortium goals in quantifiable, measureable outcomes. The SMART objectives for 2015-18 include:

- 1) All doctoral fellows who receive INSGC funding will report increased research capacity and competency as a result of their awards.
- 2) Students who participate in INSGC higher education programs will demonstrate an increased: a) interest in STEM study and careers, b) understanding of NASA programs, and c) perception of leadership skills.
- 3) At least 65% of student participants who graduate after participation in INSGC higher-education programs will seek employment with NASA, aerospace contractors, universities, and other educational institutions.
- 4) At least 30% of undergraduate students who graduate after participation in NASA higher-education programs will move on to advanced education in NASA-related fields.
- 5) At least 35 underrepresented and underserved students (minimum 25% of total students participating in funded programs) will participate in INSGC-funded higher education programs in each year of the three-year program.
- 6) At least 3 new or revised STEM courses targeting STEM skills relevant to NASA research areas will be created through INSGC support in 2015-18.

INSGC is on track to meet or exceed all 6 objectives. We are also in the planning stages to revitalize these objectives for the future.

C. PROGRAM/PROJECT BENEFITS TO PROGRAM AREAS:

INSGC has awarded funding to projects within the targeted outcomes in alignment with our proposed allocation percentages (Outcome 1: Current 74%, Proposed 74%; Outcome 2: Current 25%, Proposed 25%; Outcome 3: Current 1%, Proposed 1%). The majority of projects are awarded on a competitive model which includes peer review of annual proposals from our affiliate institutions.

NASA Outcome 1

Scholarship/Fellowships/Internships: The competitive award mechanism for scholarship/fellowship support includes students at affiliate institutions across Indiana. Scholarship awardees for FY 2018 were 41% female and 59% male. In terms of underrepresented minority (URM) students, 20% of our scholarship applicants were under-represented. Half of our applicants this year chose not to report their ethnicity. This obviously poses an unfortunate problem in reporting. Fellowship awardees were 63% female and 37% male. Based on available data, 25% of fellowship awardees are URM. NASA internships are placed and supported based on selections by NASA Centers. This year 44% of the interns were female.

Higher Education Anecdote:

From NASA MSFC intern Oscar Dillman:

I greatly appreciate your support this summer in funding my internship at NASA MSFC. The experience was very insightful, and has already greatly influenced my career choices for the future. One thing that I greatly appreciated was the financial peace of mind that the funding afforded me while in Alabama. I could focus entirely on my schoolwork instead of having to worry about finances. This was a great benefit.

My work involved studying the behavior of a type of fuel for the Mars Ascent Vehicle while in vacuum. In order to test how it would hold up in very low pressures, my partner and I

constructed a vacuum chamber to house samples and monitor the air inside the chamber for gases given off by the samples. We set up the system in such a way that it can record all of the data autonomously for an entire year before being shut off and analyzed. This was started shortly before we left and I would presume that it will continue to run until the end of this upcoming summer.

STEM Communications student Jessica Merzdorf was a Journalism, Multimedia, Social Media Intern at NASA Goddard this summer. She wrote feature articles covering some of Goddard's Earth Science research and covered news and events on campus. She also was selected to represent all of NASA Goddard's interns in the welcome video presented to Director Jim Bridenstine on his visit. Her letter ends as follows:

I am so immensely grateful for ISGC's support during this life-changing summer – I can never thank you enough for making it possible for me to come here and do this incredible work. I am so excited to return to campus next week and encourage other students to apply for NASA internships, and as I do I will also make sure to credit INSGC for your role in supporting me and making all of this possible.

NASA Outcome 2: Pre-College Anecdote:

Purdue Space Day, an annual event designed to introduce third to eighth graders to science, technology, engineering and math concepts, was held on campus in October. The event, planned and run by Purdue students, hosted more than 850 students this year. The day began with a talk by Purdue alumnus and astronaut Charles Walker. During his presentation he talked about the future of space travel and how kids can be a part of that. "They can be part of that if they continue to learn, they study hard, they decide to never stop learning. Always keep learning." Each age group then moved on to do three space-themed activities. This was a record attendance, with all available spots being filled by online registration that was full literally within seconds.

NASA Outcome 3: Informal Education Anecdote:

ETHOS Innovation Center is celebrating space and space travel along with the Apollo Anniversary with a newly acquired planetarium show, actual moon rocks, and enabling attendees to explore space with a remote mountaintop observation from the Dark Sky Observatory. Their 24-foot indoor digital planetarium will showcase a 360 degree space show for the first time seen at ETHOS. Preston Starr, a professional astronomer and observatory manager of the Dark Sky Observatory will take us on a tour of the sky and moon. Knowledge about the Moon, NASA's National Treasures from the Moon, and information about NASA, will be gleaned via the Digital Planetarium showing the featured program "We Choose Space", and interactive stations that are designed to educate and inspire audiences from any background or age. A highlight of this program will be a station in which our audiences will be able to touch and examine actual items from the moon.

ETHOS Science Center's mission is to provide children and community with opportunities to connect science to everyday life through problem solving, discovery, and critical thinking. To the Moon and Back will help children learn and love science, especially regarding space. To the Moon and Back will 1) provide experiences for our visitors to learn scientific principles about space, NASA, and one of our greatest National Treasures, Moon Rocks (content). 2) Allow for opportunities for visitors to make a real-life connection to treasures from the moon to treasures found right here on earth, connections to space and Luna, and finally, real life connections to NASA and STEM Careers (connection). 3) Provide a safe and comfortable environment so that visitors connect to ETHOS Science Center Motto: "Helping Children Learn Science. Helping Children Love

Science.” Science is engaging and fun (personal and behavior).

D. PROGRAM ACCOMPLISHMENTS:

- NASA Internships, Fellowships, and Scholarships (NIFS):

Nine internships, 53 undergraduate scholarships, ten Master’s fellowships, and four PhD fellowships were awarded by INSGC. Based on longitudinal tracking (INSGC has over 90% reporting in our longitudinal tracking over the years) 79% of our awardees and 74% of URM awardees with Significant Awards are now employed in a STEM field.

- Higher Education projects:

Community College Students Modeling the Fungal Microbiome - Students will receive hands-on training in basic microbiological techniques while exploring the mechanism by which fungi adapt to actively grow in cold environments. Students will also present their results at a regional research conference. The proposed work will provide summer training and research experience for a Community College teacher (allowing them to bring this expanded experience to their students), a student currently enrolled in Community College, with additional students working for credit during the academic year.

The SARA Telescope program at Valparaiso and Ball State Universities provides access to two research-quality telescopes for faculty and student research and used in general education, outreach, and research programs. Four undergraduates travel to Arizona to use the telescope, and the data is also used for science education (Astronomy 101 – 100 students) and outreach (Public Open House programs – 100+ participants).

Undergraduate Observational Astronomy for Research and STEM Engagement involved training UG STEM majors to carry out scientific research and provide hands-on science engagement for 120 non-STEM students, with the goal of creating STEM-literate citizens.

Regulation of Fluid Secretion in Intestinal Epithelial Cells was researched at Valparaiso University, providing direct research and mentoring experience for two community college students and one undergraduate student along with indirect experience for three additional students. Skill development includes cell biology and biochemistry along with experimental design and collection/interpretation of data.

Science Central Community College Interns - One intern is dedicated to the “Science on a Sphere” exhibit (learning how to operate the SOS exhibit; present current scientific data on SOS utilizing NASA and NOAA datasets; and develop new presentations of the data), and the other is working in the Exhibits and Facilities Department (working with the Executive Director and Exhibit & Facilities Director to determine which new exhibits are needed, assisting with researching alternatives for creating new exhibits, design and construct the exhibits and help install them). This is providing STEM workforce development.

Analyzing Unnatural Amino Acids is a project at Valparaiso University involving three 4-year college students and two community college students investigating the degradation patterns of natural vs. unnatural amino acids exposed to conditions that might exist on extraterrestrial bodies. The project provides research training and mentoring. This year’s focus is on Non-Aromatic Amino Acids.

Novel Reactivity of Transition Metal Single Atom Catalysts on a Graphene Support is a meaningful opportunity for two ITCC students to participate in cutting-edge NASA-related research while being mentored by a VU undergraduate.

Circuits II Online - Last summer through the assistance of a space grant, Circuits I (EE 210) was developed and successfully taught as an online course. This grant is for the development of the second semester of circuits (Circuits II, EE 215), which is required by all engineering majors at UE.

University of Evansville Student Launch Initiative 2018-2019 - A high-powered model rocket, capable of reaching a one-mile altitude, while carrying two scientific payloads onboard will be designed, built, and flight-tested as part of an undergraduate engineering design team at the University of Evansville.

The *AIAA Design, Build, Fly Program* provided real-world aircraft design experience for 10 engineering students at Trine University, building increased interest in aerospace programs, increasing retention, and better preparing them for STEM employment.

Purdue Northwest participation in the *Human Exploration Rover Challenge* allows students to fulfill their Experiential Learning requirements for graduation. PNW promotes STEM education throughout Indiana using the Rover and Moonbuggy in displays including the PNW Fall Student Convocation, Senior design presentations, freshman seminars, engineering recruitment dinner for HS students, NWI Space Camp, halftime of PNW basketball games, and many more resulting in well over 10,000 people interacting with the vehicles.

MURI at IUPUI is a 9-week summer research program for undergraduates that builds core research skills, research professionalism, academic/professional success skills, and discipline-specific methods and techniques.

SciIU Blog at Indiana University

Foundations in Science and Math, led by an undergraduate and graduate student team, provided intensive sessions to over 100 high school students including Introduction to the Universe, Astrophysics for Beginners, Algebra I and II, Mathematical Topics, Trigonometry, Standardized Math Tests Review, Introduction to Physics, Introduction to Chemistry, Chemistry in Food, Introduction to Biology, Accelerated Biology, Zoology, and Computer Programming. Each course is designed to prepare students for upcoming STEM courses by providing a strong foundation in the concepts and skills.

Recruitment and Retention Through Early Research Experiences for Community College Transfer Students utilizes laboratory research and mentoring to encourage transfer to 4-year programs and increase success

University of Evansville NASA Rover Challenge Vehicle Stowage Optimization

Women in Computing: Leadership and Outreach held many workshops targeting underserved schools and girls clubs to increase participation by women in computing

Connecting High School Students with STEM Careers - Over the last several years, we've found that there is a need to provide an opportunity for high school students to experience significant STEM programs and activities outside of their schools. Area teachers have shared with us on multiple occasions that an activity filled STEM field trip would help inspire their students to STEM careers. We meet this need in our community by bringing 200 students per year from the surrounding area including underrepresented areas of Madison County, Delaware County, and Indianapolis to Anderson University to participate in engaging Science and Engineering learning activities. A team of Anderson University STEM faculty will create interactive activities designed to increase students' excitement and understanding of STEM fields. The activities will be focused on learning activities that allow the students use some of the advanced instruments, and equipment that are typically only available at Universities (e.g., digital oscilloscope, wind tunnel, advanced 3D printers, and laser cutters).

The “*Purdue Now, NASA NExT*” team is competing in the Micro-g Neutral Buoyancy Experiment Design (Micro-g NExT) challenge which selects undergraduate student teams to design, build, and test a device that addresses a current problem in space exploration. Our team proposed the BOILER System, which allows an astronaut to repair a puncture in the hull of the International Space Station (ISS) as a result of a Micrometeoroid Orbital Debris (MMOD) impact by Extravehicular Activity (EVA).

2018 Summer Science Program (SSP) targets high performing high school students for real, intensive research projects. An increased emphasis on female and minority students from Indiana was made this year.

Hands-on renewable energy and automotive experience - The vision of this project is to provide post-secondary students interested in automotive design as well as renewable energy, a chance to gain hands-on real-world experience by creating a solar powered vehicle.

Development of FEA-Based Computer Simulations for Aircraft Wing Vibration is an education and research project. This project will develop a series of aircraft-related, FEA-based hands-on laboratories for engineering students at Purdue University Northwest (PNW).

Software Control of a Mars Electric Rover - A team of three senior students from three programs at Trine University, Electrical Engineering, Software Engineering and Computer Engineering, will design and develop the hardware and software needed for autonomous control of a Mars Electric Rover. This system will be mounted and demonstrated on an existing rover.

Valparaiso University Wi-Fi Enabled Pyrheliometer at the James S. Markiewicz Solar Energy Research Facility will enable two undergraduate student researchers (one from mechanical engineering and one from electrical engineering) to design and build the permanent structure as well as select and install necessary additional electronics for device integration.

- Research Infrastructure projects:

Drone Use in Agriculture and the Best Practices of Drone Use within Controlled Airspace is a collaborative project between Ivy Tech Community College, Purdue Polytechnic, and the Columbus Airport.

- Precollege projects:

OPTIONS - A Summer STEM Experience for Girls: Community College Student Project addresses the critical need of helping young women overcome cultural stereotypes and prepare for careers in engineering and computer science. At the same time, this project also promotes collaboration between junior colleges (Vincennes University) and primarily undergraduate institutions (University of Evansville).

The *UEngineering Experience* at the University of Evansville enables 24 freshman high school students to spend a full day at UE to explore engineering. Multiple small-scale, multidisciplinary projects will be completed in order to provide participants the satisfaction of seeing the results of their efforts and demonstrate what engineering has to offer.

FIRST Robotics-Travel for winning teams in the State of Indiana to attend the national championship is funded. All Indiana teams selected to compete at Nationals are provided with funding

Saturday Morning Astrophysics 2018-19 is a mobile astrophysics hands-on activity that is held in local locations on the weekends to expose K-12 students the astrophysics concepts who may not have that opportunity until much later in their academic studies

Science Central’s *Coding Club 2018* provides children on the Autism spectrum to have hands-on

experience with STEM disciplines while participating in NASA activities. Workshops focus on basic principles of coding along with current activities and missions of NASA

Educator Professional Development 2018 by Science Central developed and conducted a series of public workshops via Interactive Video Conferencing for K-6 grade teachers. The workshops directly relate to NASA activities focusing on physical science, earth/space science, the scientific process, and life sciences

Purdue Space Day provides professional development to approximately 275 university student volunteers. They are an integrated mix of multidisciplinary freshman through graduate students who promote the interdisciplinary nature of space exploration. These students work with approximately 850 3rd-8th grade students to learn about science, engineering and space exploration.

Hands-On Demonstration on Dangerous Decibel (Hearing Protection) for K-12 Students teaches children about the science of sound and provides hands-on lab activities focusing on STEM topics and skills

Advanced Industrial Robots World Discovery and Adventures Camp teaches programming skills through utilization of robots

- Informal Education projects:

To The Moon and Back! is a collaborative project with the planetarium at Ball State University and undergraduate students focusing on informal education with a focus on NASA themes and accomplishments

E. PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS:

Include summary data for the bulleted list below:

- **Diversity:**

Scholarship awardees for FY 2018 were 41% female and 59% male. In terms of underrepresented minority (URM) students, 20% of our scholarship applicants were under-represented. Half of our applicants this year chose not to report their ethnicity. This obviously poses an unfortunate problem in reporting. Fellowship awardees were 63% female and 37% male. Based on available data, 25% of fellowship awardees are URM. NASA internships are placed and supported based on selections by NASA Centers. This year 44% of the interns were female.

- **Minority Serving Institution Collaborations:**

Ivy Tech Community College partnered extensively with Indiana Space Grant Affiliates this year throughout the State. Purdue and Indiana University have strong relationships with minority serving institutions in other states and there has been continued significant partnering with the Minority Engineering Program at Purdue University.

- **Office of Education Annual Performance Indicators:**

- o API 3.3.3: STEM-18-1 The competitive award mechanism for scholarship/fellowship support includes students at affiliate institutions across Indiana. Scholarship awardees for FY 2018 were 41% female and 59% male. In terms of

underrepresented minority (URM) students, 20% of our scholarship applicants were under-represented. Half of our applicants this year chose not to report their ethnicity. This obviously poses an unfortunate problem in reporting. Fellowship awardees were 63% female and 37% male. Based on available data, 25% of fellowship awardees are URM. NASA internships are placed and supported based on selections by NASA Centers. This year 44% of the interns were female.

- o API 3.3.5: STEM-18-5 As can be noted in OEPM reporting for the past year, publications by faculty and students engaged in INSGC research has been highly encouraged with positive results. A significant increase in reported publications has occurred. No data is available at this time for publications related to ongoing projects, but the trend is expected to continue.

F. IMPROVEMENTS MADE IN THE PAST YEAR:

Reporting and data collection: The mechanism that INSGC uses to collect reporting data from our affiliates and PIs was completely overhauled in 2018. This overhaul made it easier for PIs to accurately report on their projects, and facilitated a much easier transfer of the reported data into OEPM. Several favorable responses have been received by our affiliates, and response time to requests for reporting improved as well.

Publications: INSGC has been actively encouraging PIs to publish research and to include students in the publication and presentation of results. This manifested in larger numbers of publications being reported last year and we anticipate even higher numbers this year. Students are also being included in higher numbers for the presentation of papers and public outreach. This will benefit them in their career paths regardless of what track they pursue.

Diversity: Although not reflected in the current APD report due to timing, a strong effort was undertaken this year to increase diversity in applications to INSGC. These efforts impacted applications for funding for the 2019-2020 award year (due December 1, 2018), and therefore are not visible in the results contained in this report. We are looking forward to reporting those improved numbers in next year's APD. This effort by the Associate Director involved working closely with various minority groups on campuses of our affiliate institutions, and investigating the best ways to encourage female and minority applicants. Additionally, meetings with scholarship offices and other university personnel yielded valuable insight into several possible deterrents and associated remedies for increasing the ability to successfully complete applications by minorities.

Advisory board: INSGC is currently in the process of expanding our advisory board in addition to replacing members who have stepped down. A strategic approach to this expansion was thoughtfully developed and has resulted in a plan to build a more effective, diverse, and fully engaged board that will help facilitate the efforts INSGC has planned for the State of Indiana for the coming years. Positions will be filled in the coming months with completion expected by Fall 2019.

G. CURRENT AND PROJECTED CHALLENGES:

The lead institution of INSGC, Purdue University, is still involved in an overhaul of all business processes to streamline and improve performance. This has impacted our ability to provide timely follow-through on payment of invoices and other business processes. We are actively working with our business offices to try to reduce these delays and correct any outstanding issues. We are also striving to be in communication with our affiliates regarding these issues to keep them apprised and address any problems.

Diversity has been an increasing challenge throughout our affiliates, but as discussed above we made great strides in that this past year with the outcomes of those efforts to be reflected in next year's reporting. Applicants choosing not to report ethnicity continues to be a challenge in this area as well, but that also improved this year.

H. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION:

The INSGC office engages the Affiliates to discuss and contribute to the strategies of the consortium. All Affiliates have voting rights and responsibilities approving strategic directions and Consortium program decisions discussed at Affiliate Meetings.

Academic Affiliates

Purdue University – <i>Lead Institution</i>	Purdue University Northwest
Purdue University College of Tech at Columbus	Anderson University
Ball State University	Indiana State University
Taylor University	Indiana University – Bloomington
Indiana University Purdue University Ft, Wayne	University of Evansville
Indiana University Purdue University Indianapolis	University of Southern Indiana
Valparaiso University	Trine University

Outreach Affiliates

Children's Museum of Indianapolis	IMAX Theater
Challenger Learning Center of Northwest Indiana	Indiana State Museum
Ethos, Incorporated	Evansville Museum
Science Central	Terre Haute Children's Museum
Conner Prairie	

Corporate Affiliates and Partners

StratoStar Systems	Near Space Launch
ISTEM-Purdue University	Indianapolis Symphony Orchestra