

Indiana Space Grant Consortium  
Lead Institution: Purdue University  
Director: Barrett S. Caldwell, PhD  
Telephone Number: (765) 494-5873  
Consortium URL: <https://engineering.purdue.edu/INSGC>  
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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 **Indiana** Space Grant Consortium is a **Designated** Consortium funded at a level of **\$575,000** for fiscal year 2013.

## PROGRAM GOALS

INSGC Goals are as follows:

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

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

### **Scholarship / Fellowship**

*1.3 Student Involvement Higher Education* - Provide opportunities for groups of post-secondary students to engage in authentic NASA-related mission based R & D activities.

INSGC Scholarship and Fellowship applicants are managed through an open competitive application process to the INSGC-controlled website. For any

campus with at least two valid applicants, at least one undergraduate scholarship is guaranteed, ensuring that INSGC awards are provided to all academic affiliates. Applications have increased over of the past four years from our affiliates, in quality, quantity, and diversity.

## **Higher Education**

*1.1 Faculty and Research Support* – Provide NASA competency-building education and research opportunities for faculty, researchers, and post-doctoral fellows.

*1.2 Student Support* – Provide NASA competency–building education and research opportunities to develop qualified undergraduate and graduate students who are prepared for employment in STEM disciplines at NASA, industry, and higher education.

INSGC intends competitively awarded Higher Education award funds to support student participation in authentic hands-on experiences at NASA centers or industry partners, as well as team-based project activities that may occur on academic campuses. In addition, INSGC provides support for undergraduate research experience programs at multiple campuses. Competition guidelines provide strict limits on funding support for faculty, thus emphasizing student involvement and financial support.

## **Research Infrastructure**

*1.5 Targeted Institution Research and Academic Infrastructure* – Improve the ability for targeted institutions to compete for NASA research and development work.

INSGC does not favor Research Infrastructure awards at our research intensive campuses (Purdue-West Lafayette and Indiana University-Bloomington). Instead, RI funds are prioritized toward supporting young faculty and student involvement in STEM research activities at our smaller undergraduate and regional campus academic affiliates. This year an assistant professor at Valparaiso University was funded to mount a small, portable wind turbine and a photovoltaic (PV) panel outside of the VU College of Engineering, with their control and measurement electronics installed within existing laboratory space. In their new locations, the devices will enrich laboratory experiences for mechanical engineering students and portray VU's strong commitment to renewable energy. The project includes the design and installation of permanent structures for the wind turbine and PV panel as well as the selection and installation of electronics for the monitoring and control of the devices.

*INSGC Objective 1-A:* Faculty, researchers, and doctoral fellows who receive INSGC funding will report increased research capacity and competency as a result of their awards. (Objective 1.1)

INSGC strongly supports the publications of papers from faculty, researchers and doctoral fellows. According to the summary progress reports provided from researchers this year, INSGC anticipates eight scientific and education research articles and/or conference presentations as an outcome of this year's funded projects.

*INSGC Objective 1-B:* Students who participate in INSGC higher education programs will report an increased: a) interest in STEM study and careers, b) understanding of NASA programs, and c) perception of leadership skills. (Objectives 1.2 and 1.3)

Achievement of INSGC Objectives 1-A and 1-B has been achieved according to progress reports and other contacts with higher education program students. These programs are ongoing at the time of the APD report.

*INSGC Objective 1-C:* At least 60% of NASA higher education program student participants will seek employment with NASA, aerospace contractors, universities, and other educational institutions. (Objective 1.2)

*INSGC Objective 1-D:* At least 40% of undergraduate students who participate in NASA higher education programs will move on to advance education in NASA-related fields. (Objective 1.2)

*INSGC Objective 1-E:* At least 25 underrepresented and underserved students (minimum 30% of total) will participate in NASA-funded higher education programs.

53% of scholarship, fellowship, and internship students funded to date are underrepresented minorities (45 total with demographics reported at the time of this report). This figure does not include students from the Diversity Equity and Minority Affairs STEM Initiative (DEMA) and the six DURi students. This figure is not intended to include all students funded in undergraduate research programs or other faculty-led program awards, only those directly supported via scholarships, fellowships, and internships. Preliminary data indicates that INSGC will exceed 2013-14 targets for INSGC Objectives 1-C, 1-D, and 1-E.

*INSGC Objective 1-F:* At least 2 new or revised courses targeting STEM skills needed by NASA will be created through INSGC support. (Objective 1.4)

The 2013-2014 projects have resulted in 5 new or revised courses, more than doubling this target goal. The courses include two bridge programs, one astronomy course, one geology course, and one research experience course. Also, a symposium was coordinated at the American Astronomical Association Conference held here in Indiana. This internationally attended conference involved leaders from around the world that participated in the discussions and served on a panel of experts in astronomy and astronomy education for K-12 students, teacher education, undergraduates and degree seeking students. Approximately 100 participants attend the panel presentation.

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

**Pre-college/Higher Education/General Public**

*2.1 Educator Professional Development* – Provide short duration professional development and training opportunities to educators, equipping them with the skills and knowledge to attract and retain students in STEM disciplines.

*2.3 Curricular Support Resources* – Provide curricular support resources that use NASA themes and content to a) enhance student skills and proficiency in STEM disciplines; b) inform students about STEM career opportunities; and c) communicate information about NASA’s mission activities.

*2.4 Student Involvement K–12* - Provide K–12 students with authentic first hand opportunities to participate in NASA mission activities, thus inspiring interest in STEM disciplines and careers; Provide opportunities for family involvement for K–12 students learning in STEM areas.

Since 2010, INSGC has continued to strongly emphasize a focused portfolio of in-service and pre-service teacher training experiences and K-12 activities. In addition to the accomplishments of our funded projects, INSGC Director Caldwell led a proposal for an NSF RET in Engineering and Computer Science Site: Empowering Teachers in the Research Process by Creating Contextualized Software Models. Participants in the proposal include Purdue University (host); Science Central; Indiana State Museum and Historic Sites Foundation; Evansville Museum of Arts, History and Science; Fort Wayne Community Schools; Indianapolis Public Schools, Metropolitan School District of Perry Township; Evansville Vanderburgh School Corporation, with 54 teachers involved. The announcement of award is forthcoming at the time of this report.

*INSGC Objective 2-A:* At least 75% of elementary and secondary educators who participate in two or more NASA training programs will use NASA resources in their classrooms. (Objective 2.2)

*INSGC Objective 2-B:* At least 60% of elementary and secondary educators who obtain NASA content-based education resources or participate in short-duration NASA education activities will use NASA resources in their classroom instruction. (Objective 2.1)

*INSGC Objective 2-C:* At least 50% of students will express interest in science, technology, engineering, and math (STEM) careers following their involvement in elementary and secondary education programs. (Objective 2.3)

*INSGC Objective 2-D:* At least 500 elementary and secondary students will participate in INSGC instructional and enrichment activities. (Objective 2.4)

The Minority Engineering Program at Purdue hosted four summer camps in 2013 that included NASA-themed hands-on engineering projects. There were 151 students who attended the four camps. The ethnicity breakdown was: 110 African American; 21 Hispanic, Latino; 3 American Indian, Native Alaskan; 8 Two or more Races; 4 Asian Americans; and 8 Caucasians. There were 52 Female and 99 Male participants. They came from 22 states and Jamaica. Almost three-quarters of them came from Indiana, Illinois, and Ohio. The campers enjoyed these

projects and several listed them as their favorite part of the camp. INSGC sponsored a presentation by Doktor Kaboom which drew over 500 K-12 students and families. The Doktor Kaboom presentation was supplemented by a hands-on activity presented by Purdue Fall Space Day student volunteers. The Purdue Fall Space Day hosted 675 K-12 students in October 2013 with 257 volunteers from 57 majors including 9 high school volunteers. These events more than demonstrate achievement of INSGC Objective 2-D. Improvements in reporting requirements and in communication with our affiliates and PIs has enabled us to better assess these objectives. Full evaluation including all projects will be available at the time of the annual OEPM reporting. Initial feedback from affiliates demonstrates full achievement of these goals. Several projects have incorporated surveys and other mechanisms to gather this information.

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

### **General Public/External Relations**

***3.1 Resources*** – Provide informal education support resources that use NASA themes and content to 1) enhance participant skills and proficiency in STEM disciplines; 2) inform participants about STEM career opportunities; and 3) communicate information about NASA's mission activities.

***3.2 Professional Development for Informal Education Providers*** – Provide opportunities to improve the competency and qualifications of STEM informal educators, enabling informal educators to effectively and accurately communicate information about NASA activities and access NASA data for programs and exhibits.

INSGC has supported several informal education activities this year, including presentations by Neil DeGrasse Tyson and Buzz Aldrin which drew over 5,000 people. Also, in a program at Valparaiso University, four trained STEM majors were involved in the engagement of non-STEM students and the general public. They supervised the campus observatory on 20 nights during fall 2013 to view celestial objects with students enrolled in the Astronomy 101 lab course and the general public. On four of those nights, they demonstrated to the non-STEM students how research is carried out. The four STEM majors also participated in seven biweekly Astronomy Open House programs, using either the observatory or planetarium (cloudy nights) to view and discuss celestial objects.

***INSGC Objective 3-A:*** At least 4 museums and science centers in Indiana will actively engage the public in major NASA events, with exposure of at least 1000 persons to STEM content and educational opportunities available through INSGC. (Objective 3.2)

***INSGC Objective 3-B:*** At least 25 informal educators will report increased efficacy as a result of INSGC supported professional development. (Objective 3.2)

The Outreach to Space exhibit at Science Central has hosted approximately 17,000 people in both urban and rural settings. Major events have been hosted at the Children’s Museum of Terre Haute, The Indianapolis Children’s Museum, and the Evansville Museum. Thus INSGC Objective 3-A has already been documented. INSGC will be collecting data to support the attainment of the goal of at least 25 informal educators with increased efficacy as a result of INSGC supported professional development, which is part of our year-end reporting. (Objective 3-B).

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

One of the major goals for INSGC is to increase our benefit and impact to engage STEM Education across the State of Indiana. Particularly due to the fact that Indiana does not have a NASA center within the state, INSGC can be the voice of NASA and a connector of NASA activity to STEM education priorities within the State, giving Indiana residents the opportunity to learn about NASA’s mission and goals, and increasing the appreciation for NASA and it’s many accomplishments and resources. In taking a more active and visible role within the state, INSGC will increase its exposure and value. This has led to development of key relationships with individuals and programs that have similar goals and interests, whereby we can leverage the financial strength of the programs, attain synergy and improve results while minimizing the budgetary impacts.

For the 2013-2014 year, INSGC has awarded funding to projects within the targeted outcomes in alignment with our proposed allocation percentages. The outcomes and current and proposed funding percentages are as follows:

- Outcome 1 (scholarship/fellowship/internships, plus other projects): Current 75%, Proposed 75%
- Outcome 2: Current 24% Proposed 24%
- Outcome 3: Current ~1% Proposed 1%

### **Highlights and Anecdotes**

The following information is not an exhaustive list, but is representative of the significance and benefits of the INSGC programs arranged by outcome.

#### ***NASA Outcome 1***

##### **Scholarship/Fellowships/Internships**

The competitive awarding mechanism for INSGC scholarship and fellowship support includes students at affiliate’s institutions across the state of Indiana. The overall demographics for the 45 scholarship, internship, and fellowship awardees show 44% female participants and 53% underrepresented minority (URM) participants (if funding of DEMA participants is included these percentages climb to 46% female and 70% URM). NASA internships are placed and supported based on selections by NASA Centers;

corporate internships within Indiana were not placed in 2013-2014; although conversations have begun for placement of corporate interns for 2014-2015.

### **Higher Education**

*Incorporating a Real-World Environmental Consulting Experience into an Undergraduate Environmental Geology Course* - Indiana State University in Terre Haute: provided students enrolled in an undergraduate environmental geology course with the experience of being an entry level geologist for an environmental consulting firm. A consultant worked with students to identify the major components of consulting reports and provide insight and guidance about the realities of being a professional geologist in the field of environmental consulting. There were 34 students and 8 different research projects that included soil and water geochemistry. The groups were very successful, and several groups have decided to continue working on their projects to collect an even more complete set of data. Students were exposed to writing proposals, collecting samples and data in the field, preparing samples for geochemical analysis, performing various geochemical analyses, interpreting data, and writing a final report.

*Increasing STEM Retention through the Initiation of a Summer Academic Bridge Program and Coordinated Freshman Research Experience Program*; Saint Joseph's College in Rensselaer: The focus of this project is increase retention of undergraduates in the STEM majors at Saint Joseph's College for the freshman and sophomore years (Biology, Biology-Chemistry group major, Chemistry, Computer Science, and Mathematics). The project includes a Fall semester academic bridge program, and a Spring semester undergraduate research experience program (one credit hour independent study course). The Spring semester information will be received in final reporting; 24 students enrolled in the Fall semester academic bridge program and positive results were reported.

*Environmental & Multimedia Investigations into Riparian Zone Management along the White and Mississinewa Rivers of East-Central Indiana*; Ball State University in Muncie: Faculty launched an immersive-learning course at Ball State University in Indiana, an institution recognized for pairing faculty-led teams of students with community partners to develop and implement solutions for real-world problems. This course's experiential-learning model focuses upon the **public understanding of science** and comprises a collaboration of students from multimedia production and the natural sciences. The Fall 2013 interdisciplinary course led to the creation of the website ([www.waterqualityin.com](http://www.waterqualityin.com)), showcasing students' media deliverables and scientific output from their aggregate water samples collected from four sites along Buck Creek. Our community partners had identified these sites as areas of interest for potential restoration. The Delaware County Soil and Water Conservation District absorbed our website into its own in January 2014, and in doing so, it professionally branded our content. Indiana Public Radio also "picked up" and broadcast one of our media student's stories. Such exposure led to an invited student presentation at the Midwest Ecology & Evolution Conference hosted by the University of Dayton (Ohio) in March 2014. Four students—two media-oriented & two from scientific disciplines—prepared and presented a 12-minute oral presentation and at the poster display session. Additionally, five students from this course will present at the Southeastern Geological Society of America conference hosted by Virginia Tech University in April 2014. The success of the first iteration of

this immersive-learning, cross-College course, which will finish in May 2014, has led to renewed internal funding in order to expand the project into the Mississinewa/Wabash watershed as the focus for the Fall 2014 course.

## **Research Infrastructure**

*Valparaiso University Renewable Energy Zone (VUREZ);* Valparaiso University: A small, portable wind turbine and a photovoltaic (PV) panel are to be permanently mounted outside of the VU College of Engineering, with their control and measurement electronics installed within existing laboratory space. In their new locations, the devices will enrich laboratory experiences for mechanical engineering students and portray VU's strong commitment to renewable energy. The project includes the design and installation of permanent structures for the wind turbine and PV panel as well as the selection and installation of electronics for the monitoring and control of the devices.

## **NASA Outcome 2**

### **Pre-College**

*NASA Impacts Our Lives:* Purdue University (West Lafayette) Minority Engineering Program 2013 Summer Workshops provided NASA-themed hands-on engineering projects during their four summer camps. The SEW6/7 camp attended the Brownsburg Challenger Center and followed that with a three-session *On Target* project. The SEW8 group performed an *Egg Drop* project and the *On Target* project. The PREFACE camp for 9<sup>th</sup> and 10<sup>th</sup> graders performed the *Good Gyration*s project during three 45 minute sessions. The MITE Boot Camp built model rockets and determined their aerodynamic properties during one of their week-long projects.

*Materials Camp for Teachers:* Purdue Calumet (Hammond) hosted The Materials Camp for Teachers. The goal is to increase the opportunities for middle and high school students to engage in STEM activities and the quality with which the instruction is provided. The teachers were provided with experiments, demonstrations, and projects using a variety of materials that could be implemented in the classroom. These activities were designed to be low or no cost, so that teachers from a wide variety of schools would be able to inspire underrepresented middle and high school student populations, in particular, to better understand and further study STEM disciplines.

*Foundations in Science and Mathematics:* Indiana University (Bloomington): This summer program consists of preparatory courses in science and mathematics for high school students in the local community. Courses are held during two separate identical two-week sessions, one in June and the other in July. The summer of 2013 saw the fourth iteration of the program, which expanded to include courses in computer science. The goal of the program is to provide a strong foundation for upcoming high school STEM classes and, in general, later learning. Students are offered introductory and advanced courses in physics, biology, chemistry, pre-calculus, calculus, and computer science. These courses consisted of hands-on activities, demonstrations, lecture style instruction,



and problem solving discussions in both groups and as individuals. The program and its courses were entirely designed and implemented by Indiana University graduate students.

*Astronomy Education Research Symposium:* Purdue University Calumet: This project focuses on the development of a community of astronomers and astronomy educators to inform changes in the way that astronomy is taught and move toward improving astronomy education. The project effort intends to organize and coordinate opportunities for discussions and a sharing of research among these leaders including spotlighting the efforts in astronomy and astronomy education here in Indiana. A symposium was coordinated at the American Astronomical Association Conference held here in Indiana. This internationally attended conference involved leaders from around the world that participated in the discussions and served on a panel of experts in astronomy and astronomy education for K-12 students, teacher education, undergraduates and degree seeking students. Approximately 100 participants attend the panel presentation. The presentations were recorded for placement on a publicly accessible server for other researchers and astronomy educators to review.

### ***NASA Outcome 3***

#### **General Public / Informal Education**

*Outreach to Space; (OTS)* Science Central (Ft. Wayne) has taken interactive exhibits, designed and built by San Francisco's famed Exploratorium with original project support from the National Science Foundation to eight different fairs, festivals and school events impacting over 17,000 people in both urban and rural settings. The hands on exhibits allow people to make connections to real world concepts, and to initiate the "fun factor" where visitors discover science is fun. The relaxed setting of the fairs and festivals is the perfect environment for people of all ages to explore space-themed content. This exhibit is uniquely designed to teach across gender, socioeconomic status and generations.

#### ***Personal Statements***

INSGC takes great pride in the positive influence on the lives of the people served. A few of the many outstanding comments regarding the role of INSGC funding in supporting their education are shown below.

*Michael Bilyeu (Internship, Purdue University)* So far my experience has been great. I have had a great time meeting some very interesting and brilliant people. The first project I was given was modifying a Thermoelectric Generator from a current model that runs on a typical methane bottle to a new model that runs on a nuclear radioisotope core (The same concept as what powers spacecraft and rovers like Curiosity, Voyager, etc.). First I had to make an entire CAD model of the existing Generator and then I had to design/create modifications that would allow it to run with a radioisotopic core and remove heat more efficiently from the cooling fins. We are getting ready to go out to our test facility next week and begin final testing and deconstruction of the original generator

and try to implement our modifications. My next project is designing a sample return mission from Mars. I will use a bimodal nuclear core as a power source and propulsion system (This is the common link between the projects). This position gives a nice balance between hands-on work and conceptual/computational physics and math. I appreciate everything you have done to help with this opportunity.

*Katherine Florek (Internship, Purdue University)* This summer, I was supported by the Indiana Space Grant to pursue an internship with the Robotics Academy at NASA Ames Research Center in Moffett Field, California. During the course of the summer, the Robotics Academy was tasked with developing and improving many aspects of a continuing Lunar Micro Rover project. For this project, I was heavily involved in the Thermal and Structural subsystem development teams due to my Mechanical Engineering background. Due to my interest in Thermodynamics, I was cast in the role of leader and point of contact for the Thermal subsystem team.

## PROGRAM ACCOMPLISHMENTS

To date for the grant year May 17, 2013 through May 16, 2014, this grant has enabled INSGC to fund over \$313,500 in program awards with \$170,760 in projects and \$142,750 in scholarships/fellowship awards and internships.

### **NASA Outcome 1:**

#### **Higher Education**

The funding from INSGC has enabled many of our affiliates to participate in Higher Education Projects. These projects focused on Affiliate strengths in engineering, environmental studies, mathematical studies, electrical and chemistry focuses, and Lunabotics.

##### ***1.1 Faculty and Research Support***

INSGC has provided the following NASA competency-building education and research opportunities for faculty, researchers, and post-doctoral fellows.

- MURI Discovery-Indiana University Purdue University Indianapolis; undergraduate research in multidisciplinary areas including biomechanics, electrical engineering, biomedical research, and environmental chemistry
- Environmental & Multimedia Investigations into Riparian Zone Management along the White and Mississinewa Rivers of East-Central Indiana – Ball State University; pursues a collaboration between students in natural sciences and multimedia production. Students will practice and develop the skills needed to collect, analyze, and communicate scientific data to society, by taking field notes, creating multimedia projects based on data results, composing an interim riparian-zone policy and writing a final paper

- Modeling the Cognitive Effects of Microgravity: Navigation and Brain Function in Mice Lacking Functional Otolith Organs – IPFW; Studying the navigation and brain function in mice lacking functional otolith organs, this project will provide insight into the effects of long-term microgravity on brain function, as well as the effectiveness of alternative strategies to support gravity-dependent brain signals

### ***1.2 Student Support***

*Scholarships / Fellowships* – INSGC ran its open competition for the 2013-14 award year from December 1, 2012 through February 24, 2013. As noted in last year’s report, we have been working closely with our affiliates to improve the quality of the proposals and to foster communication at the affiliate institutions to broaden the scope of projects and include more fields within STEM. As part of this effort, the guidelines and qualifications documentation provided to applicants was significantly revised for this year’s competition. We received 36 scholarship/fellowship applications in 2009-2010, 64 in 2011-2012, 103 in 2012-2013, and 83 for 2013-2014. In 2011-2012 we received 33 research/outreach proposals, 43 in 2012-2013, and 36 for the 2013-2014 funding cycle. INSGC also supports summer interns, Virgil “Gus” Grissom Memorial Scholarships and Diversity Enhancement scholarships. At the time of this report, final numbers are not available on the number of applicants for 2014-2015 because the competition is still open. All indications point to an increase in applications, and improved diversity.

*Projects* – INSGC provided NASA competency-building education and research opportunities to develop qualified undergraduate and graduate students who are prepared for employment in STEM disciplines at NASA, industry, and higher education.

- Discovery Park Undergraduate Research Initiative (DURI) – Purdue University; Undergraduate research in multidisciplinary areas.
- Matching funds for Undergraduate research Grant Program – Purdue Calumet; Funds to help reduce the cost associated with undergraduate research projects.
- Diversity Equity and Minority Affairs STEM Initiative (DEMA) – Indiana University; Summer research program for students of Historically Black Colleges and Universities (HBCUs) and IU
- Increasing STEM Retention through the Initiation of a Summer Academic Bridge Program and Coordinated Freshman Research Experience Program - Saint Joseph’s College; increase retention of undergraduates in the STEM majors for the freshman and sophomore years (Biology, Biology-Chemistry group major, Chemistry, Computer Science, and Mathematics). The project includes two initiatives: (1) a Fall semester academic bridge

program, and (2) a Spring semester undergraduate research experience program (one credit hour independent study course).

- Environmental and Multimedia Investigations into Riparian Zone Management... (Cross-disciplinary Course development and delivery) at Ball State University, Muncie; a collaboration of students from multimedia production and the natural sciences. Students collect a range of water-quality data from local waterways and develop multimedia products that address the scientific and education mission of our community partners. Through teamwork, students are expected to acquire defensible scientific results, conduct interviews with stakeholders, and generate multimedia products. Data and media collection generated by the students is archived and available for public download at a website developed by the students in Fall 2013 ([www.waterqualityin.com](http://www.waterqualityin.com)). Of the first student cohort, 47% were women and 13% belonged to groups traditionally underrepresented in STEM disciplines.

### ***1.3 Student Involvement in Higher Education***

INSGC has been able to provide many opportunities for groups of post-secondary students engaged in authentic NASA related mission-based activities.

- Designing Racecars with Space Tech (DRST) - Purdue University Minority Engineering Program (MEP) will use this project to engage 30 attendees of MEP's Academic Boot Camp (ABC) in a 5 week space technology-related engineering design project tied to the freshman engineering curriculum at Purdue
- Urban Garden Testing – IUPUI and Indiana State University; graduate and undergraduate students at both ISU and IUPUI will get the opportunity to participate in a hands-on research project, studying the heavy metal content in soil and gain valuable field and laboratory experience
- Rock On – Trine University; hands-on activities how to build a sounding rocket payload. Students will gain hands-on NASA-related engineering experience that will better prepare them for STEM employment, and will overall gain increased interest in NASA programs.

### ***1.4 Course Development (Educate)***

INSGC is able to provide course-resources for integration into STEM disciplines.

- Incorporation of A Real-World Environmental Consulting Experience in a Geology Classroom – Indiana State University; project will include field work, collecting data, interpreting data, and submitting a final written report with the overall purpose of simulating different aspects of being an environmental consultant,

including being a field geologist, laboratory analyst, and a project manager

## **Research Infrastructure**

### ***1.5 Targeted Institution Research and Academic Infrastructure***

- Valparaiso University Renewable Energy Zone (VUREZ) – Valparaiso University; A small, portable wind turbine and a photovoltaic (PV) panel are to be permanently mounted outside of the VU College of Engineering, with their control and measurement electronics installed within existing laboratory space. In their new locations, the devices will enrich laboratory experiences for mechanical engineering students and portray VU's strong commitment to renewable energy. The project includes the design and installation of permanent structures for the wind turbine and PV panel as well as the selection and installation of electronics for the monitoring and control of the devices.

### ***NASA Outcome 2:***

#### **Pre-College**

Pre-College programs emphasized the support of activities for K-12 students to participate in STEM related activities and increase enthusiasm to pursue STEM majors at the university level. These programs include:

### ***2.1 Educator Professional Development-Short Duration***

- Astronomy Education Research Symposium – Purdue Calumet: focuses on the development of a community of astronomers and astronomy educators to inform changes in the way that astronomy is taught and move toward improving astronomy education. The project effort intends to organize and coordinate opportunities for discussions and a sharing of research among these leaders including spotlighting the efforts in astronomy and astronomy education here in Indiana.
- Nanotechnology Space Consortium Summer Teachers Fellow Program – IUPUI (Indianapolis); provide professional development opportunities for K-12 teachers that will equip them to inspire their students to pursue STEM disciplines. The overarching goals of the Teacher Fellows Program are to (a) expose in service teachers to IUPUI labs and faculty researchers conducting cutting-edge nanotechnology research, and (b) engage participants in discovery-based hands-on activities linking the multidisciplinary field of nanotechnology to grade-level math and science standards.
- Materials Camp for Teachers – Purdue Calumet: increases the opportunities for middle and high school students to engage in STEM activities and the quality with which the instruction is provided. The teachers were provided with experiments,

demonstrations, and projects using a variety of materials that could be implemented in the classroom.

### ***2.3 Curricular Support Resources***

- Astronomy Curriculum Development - Purdue University Calumet: writing and testing curriculum for astronomy courses for high school and undergraduate astronomy students that involve inquiry and authentic data. This includes presenting the curriculum to classroom teachers to field test the material and receiving feedback from the teachers and their students. The curriculum has been accepted by a publisher and several chapters are currently in progress for field testing. The material has been shared with teachers at the regional science teacher conferences, the Astronomical Society of the Pacific conferences and through listserv communication involving Indiana teachers and faculty.

### ***2.4 Student Involvement K-12***

- The UEngineering Experience through K-12 Learning - University of Evansville: 20 female freshman high school students will have the opportunity to spend one full day at the University of Evansville to explore engineering. The project will build partnerships with the intention of broadening the program to a “college bridge” class that will meet once a week throughout the academic semester in the student’s junior and senior years, allowing for both high school and college credit.
- Foundations in Science and Mathematics - Indiana University: this summer program offers preparatory courses in science and mathematics for local high school students. The program consists of two identical two-week sessions made up of eight distinct courses in science and mathematics.
- Observational Astronomy Research by Undergraduate Students- Valparaiso University: undergraduate research opportunity in science and technical careers by helping engage non-STEM students and the general public through programs of science education using the campus observatory.
- MITE meets NASA at Purdue University is a ‘boot camp’ put on by the Minority Engineering Program for middle school students. The camp provides academic preparation as well as introduction to research activities in a week-long residential format.
- Nanotechnology Summer Schools Program: the goal of the program is to spark interest in STEM subjects through interdisciplinary field of nanotechnology. There were 48 participants including mainly sophomores, juniors, and seniors in high school with significant ethnic and minority diversity (48% of the students had a minority background).

- Purdue Space Day – Purdue University, undergraduate participation in leading general public / K12 event with a space and aerospace engineering theme
- NASA Impacts Our Lives at Purdue University is a bridge program for minority high school students transitioning to college using NASA programming.

***NASA Outcome 3:***

**Informal Education**

Informal education efforts build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA’s mission.

***Objective 3.1 Resources***

- Outreach to Space-Science Central; Funds for 10-13 interactive astronomy exhibits geared for the general public at both urban and rural events.

**PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES**

*Student Data and Longitudinal Tracking:* INSGC continues to update and follow current and previous significant awardees with our longitudinal tracking surveys and Facebook connections. We have been successful in tracking >87% of the significant awardees since 2005 and >79% of the significant awardees since 1995. Increased efforts in this year’s tracking have been successful in improved response percentages.

*Diversity:* INSGC continues to exceed targets for ethnic and gender diversity of student participants; over 44% of scholarship and fellowship awardees are female, and over 53% are members of underrepresented minorities.

*Matching funds:* Complete accounting of matching funds was not available at the time of this report. However, the reported projected match for base program funds awarded was \$448,901, or a ratio of over 1:1 for NASA funds. This amount is expected to increase as reporting is submitted.

*Minority Serving Institutions:* INSGC does not have a designated Minority Serving Institution among its academic affiliates; no Historically Black or Hispanic Serving Institutions with a focus on STEM degrees exist in the state. However, both Purdue and Indiana University (where the majority of underrepresented STEM minorities are enrolled) have strong relationships with minority serving institutions in other states. INSGC does partner with Diversity, Equity and Minority Affairs (DEMA) at IU-Bloomington, where we are able to reach several underrepresented students from eight different campuses throughout the US who come to IU for the opportunity to conduct research and receive mentorship from faculty in diverse areas of study. This provides an opportunity for undergraduate underrepresented minority students in

STEM fields to experience what it would be like to pursue a graduate degree in their field of research. There has also been significant partnering with the Minority Engineering Program at Purdue University, with conversations initiating with minority programs at other affiliate institutions.

*NASA Education Priorities:* The projects funded by INSGC are in strong correlation with NASA Education Priorities and NASA mission efforts and program competitions; examples are provided below.

- Rock On – Trine University in Angola: hands-on activities how to build a sounding rocket payload. Students will gain hands-on NASA-related engineering experience that will better prepare them for STEM employment, and will overall gain increased interest in NASA programs
- Designing Racecars with Space Tech (DRST) - Purdue University Minority Engineering Program (MEP) will use this project to engage 30 attendees of MEP's Academic Boot Camp (ABC) in a 5 week space technology-related engineering design project tied to the freshman engineering curriculum at Purdue
- Increasing STEM Retention through the Initiation of a Summer Academic Bridge Program and Coordinated Freshman Research Experience Program - Saint Joseph's College: increase retention of undergraduates in the STEM majors for the freshman and sophomore years (Biology, Biology-Chemistry group major, Chemistry, Computer Science, and Mathematics). The project includes two initiatives: (1) a Fall semester academic bridge program, and (2) a Spring semester undergraduate research experience program (one credit hour independent study course)
- Nanotechnology Summer Schools Program: the goal of the program is to spark interest in STEM subjects through interdisciplinary field of nanotechnology. There were 48 participants including mainly sophomores, juniors, and seniors in high school with significant ethnic and minority diversity (48% of the students had a minority background)

## IMPROVEMENTS MADE IN THE PAST YEAR

INSGC has continued the efforts to build and secure strong relationships across disciplines, geographies, and decision-makers throughout Indiana. We are continuing to engage in more active in partnering with other Indiana networks and organizations to integrate and promote STEM K-12 education initiatives around the State. Examples include STEM Action Coalition for Today; Techpoint Foundation, Indiana Motorsports STEM (M-STEM); STEM School Certification, Indiana Afterschool Network, Indiana Girls Collaborative, and I-STEM. As a result of partnerships that were already in place, INSGC partnered with three affiliates and several diverse school districts throughout the State for an NSF RET in Engineering and Computer Science Site: Empowering Teachers



in the Research Process by Creating Contextualized Software Models. INSGC is striving to build on current research and activities of our affiliates and partners and make more effective use of core competencies of research and outreach to benefit the entire state of Indiana.

An annual staff planning session will be held in April 2014 to enable the INSGC staff to strategically plan for the upcoming 2014-2015 year. This session will include practical components such as enhancing our award review and selection process, improvements on collection of data on our measures of success, planning for collection of data for the 5 Year Review, and brainstorming on adding value for the State by attaining increased relevance as a prominent and credible source of research, policy knowledge, information, and problem-solving regarding STEM and NASA. This planning session is intended to grow out of discussions already underway with senior leadership at the INSGC lead institution.

Based on feedback from affiliates, applicants for research and outreach project funding, and changes in business procedures, a major revision was made for the INSGC Affiliate's Manual. The prior manual was written in 2010. It was determined that not only were significant updates required for the Affiliate Manual, but a second manual dedicated to project PIs was needed. Information for running a successful affiliate is not the same information needed for running a successful project, and vice versa. For the Affiliate Manual updates, committee was formed to update guidelines and procedures for affiliate membership. Business procedures were updated and more fully explained to minimize confusion and delays. A complete collection of samples of all paperwork was included. New affiliate directors were updated in the contact list, and the manual was made both more complete and more concise. A new PI manual was created to provide guidance on proposal execution, important characteristics of successful projects, reporting requirements, cost-share, and all associated paperwork. This manual is provided to PIs of projects selected through the proposal competition. Guidelines for the proposal process itself were revised and improved and were provided online on the website for all applicants. These guidelines cover types of awards, proposal and budget requirements, sample proposals and budgets, and important qualities sought in INSGC proposals. This information is expected to improve the quality of proposals and the effectiveness of funded projects for the coming year. Much positive feedback has already been received from applicants on the clarity and helpfulness of the documents.

## PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

INSGC office engages the Affiliates to work with our office to discuss and contribute to the strategies of the consortium.

All Affiliates (Academic, Outreach, Corporate) have voting rights and responsibilities approving strategic directions and Consortium program decision discussed at Affiliate Meetings. INSGC generally holds two affiliates meetings per year. In the fall, the annual

Fall Teleconference is conducted in two phases: one teleconference is focused on Academic Affiliates, while the second is focused on Outreach Affiliates. The Spring Affiliate meeting is generally held on the campus of one of the Affiliates. The 2014 Annual Affiliate meeting will be held on April 7, 2014 at Science Central in Ft. Wayne. A tentative plan is to hold the 2015 meeting at the University of Southern Indiana in Evansville.

Efforts are underway to engage with regional campuses across the State, and to attempt to find a way to engage with community colleges. The community college system in Indiana is particularly challenging to work with, as there is very little oversight or a central mechanism within the community college system. INSGC anticipates that a solution may be reached in the coming year, based on efforts this year, to find a workable plan of engagement. The current list of INSGC Affiliates is provided below.

### **Academic Affiliates**

Purdue University – *Lead Institution*

Anderson University (John Millis)

Ball State University (Ronald Kaitchuck)

Indiana State University (Susan Berta)

Indiana University – Bloomington (Cathy Pilachowski and Lynda Delph)

Indiana University Purdue University Fort Wayne (Steve Gillam)

Indiana University Purdue University Indianapolis (David Coats)

Purdue University Calumet (Adam Rengstorf)

Purdue University College of Technology at Columbus (Jack Head)

Saint Joseph's College (Jennifer Coy)

Taylor University (Jeff Dailey)

Trine University (Jamie Canino)

University of Evansville (Phil Gerhart)

University of Southern Indiana (Glenn Kissel)

Valparaiso University (Bruce Hrivnak)

### **Outreach Affiliates**

Children's Museum of Indianapolis (Becky Wolf)

Challenger Learning Center of Northwest Indiana (Rebecca Manis)

Ethos, Incorporated (Patsy Boehler)

Evansville Museum (Mitch Luman)

IMAX Theater (Craig Mince)

Indiana State Museum (Peggy Fisherkeller)

Indiana Challenger learning Center of Decatur Township (Cyndy Meier)

Science Central (Martin Fisher)

Terre Haute Children's Museum (Lynn Hughes)

### **Corporate Affiliates**

StratoStar Systems (Jason Kruegger)

### **Partners**

Indiana Afterschool Network (Debbie Zipes)  
ISTEM-Purdue University (William Walker)  
Wisdom Tools (Sony Kirkley)

Below is a copy of a valid signature from Barrett S. Caldwell indicating submission of this progress report.

Submitted on behalf of Indiana Space Grant Consortium

A handwritten signature in black ink, appearing to read 'Barrett S. Caldwell', written over a horizontal line.

Barrett S. Caldwell, PhD, Director  
Indiana Space Grant Consortium