

Rhode Island Space Grant Consortium
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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 Rhode Island Space Grant Consortium is a Program Consortium funded at the base level of \$430,000 for fiscal year 2012.

PROGRAM GOALS

Consortium Goals and SMART Objectives from your 2010 base proposal and budget (or as amended in subsequent submissions)

The goals and objectives for Rhode Island Space Grant Consortium (RISG) are summarized below. These summaries are abridged for brevity, but *full descriptions of our goals can be found in our 2010 Budget Package.*

A. OUTCOME 1: *Fellowship/Scholarship, Higher Education, and Research Infrastructure programs*

1. Faculty and Research Support: Our goal was to provide NASA competency-building education and research opportunities for faculty, researchers, and post-doctoral fellows. For the Lead Institution, we proposed to allocate (from NASA) a total of \$2.1K for research support. For our Affiliates, we allocated more research support in FY'12, in order to engage more faculty and students. We anticipated making 5 awards this year. The Research Review Committee will review proposals on the following criteria (in order): relevance to NASA, merit, potential for broadening Affiliate involvement (new institutions or faculty), and potential for new NASA collaborations. Included in these proposals are travel grants to conferences, NASA Centers, and Visiting Researchers. *Our success is measured by: research papers, conference presentations, and new proposed research grants.*

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. Success was **Measurable** based on the quality of the applicant pool, research papers/abstracts, presentations at the annual Symposium, and a short report (or published abstract/paper) at the end of the support period. All awards were **Acceptable** by tying directly to NASA's strategic goals and objectives. All awards were **Realistic** by their being matched. We proposed the following **Specific** awards over a one-year (**Time Frame**) in 2012: *Full-year RISG Fellowships* at Brown (2) and our Affiliates (2);

RISG Summer Teaching Fellows (at least 2); *RISG Summer Research Scholars* (at least 2 at Brown; 6 at our Affiliates); *Academic Year Scholars* at Brown (1) and our Affiliates (6); *RISG Graduate/Undergraduate Travel Grants*; Joint Industry Partnership (up to 1); *RISD Internships at NASA Centers* (4).

3. Course Development: We proposed to develop 4 NASA-related course resources for integration into STEM disciplines.

- a. **RISD Design Classes:** For the 2012-2013 academic year, the *Department of Industrial Design* proposed to focus on two classes the *Space Gloves* along with *Habitat designs in the Extreme Environment* coupled with internships awarded at the *JSC Habitability Design Center* (HDC).
- b. **Brown Engineering Systems Design Course:** We proposed to support a workshop for educators emphasizing hands-on learning through focused projects.
- c. **Bryant University:** Funds were allocated for 1 NASA-relevant curriculum development as well as supplies and a visiting speaker.

4. Travel Grants

- a. **Student Field Experiences (Lead):** We proposed to continue a popular undergraduate Spring Field Trip where undergraduates are immersed in field studies while using NASA materials (remote sensing and planetary analogs).
- b. **Affiliate Travel:** We proposed support grants to NASA Centers across the consortium.

5. Targeted Institution Research and Academic Infrastructure: We proposed to host a program for a faculty member from a Tribal College, which is part of the Nebraska Space Grant Consortium. The program was designed to engage Native American faculty members in culturally relevant STEM-related fields using culturally relevant NASA themes.

B. OUTCOME 2: HIGHER ED PROGRAMS AND PRE-COLLEGE PROGRAMS

1. Educator Professional Development:

- a. **Museum of Natural History (MNH):** 3 Educator workshops were planned at our Affiliate, the *Museum of Natural History*, all tied to 2 proposed RISG-co-sponsored exhibits.
- b. **Teacher Partnership Program:** Our 75:25 (75% Research to 25% Outreach) Program engages our RISG Fellows and Scholars through partnerships with RI K-12 teachers. They bring their current NASA-focused research into the RI classrooms, thereby providing a context to classroom materials.
- c. **Brown Summer Academy:** We proposed to support 3 classes for middle and high school students, 2 given by RISG Summer Fellows. This also enhances the teaching skills of the graduate students.

2. Curricular Support Resources: Our Affiliates (Museum of Natural History and the Ladd Observatory), Fellows, and Low-Gravity Program provide resources for students and mentoring through our outreach programs. We proposed to continue sharing research results and experiences with students through class visits, public speaking (e.g., local astronomy clubs), and special seminars.

3. Student Involvement K-12: Most of our involvement is through programs provided by our Affiliate, the *Museum of Natural History*. In addition, our Fellows and Scholars interact with K-12 students through their participation. This experience, however, is primarily to provide

teachers with STEM materials and to develop tools for informal-education skills that can be used as they become professional researchers.

- a. **Gaudet Middle School Planetarium and Cormack Planetarium:** The *MNH* Director proposed to develop new STEM-based (and NASA-themed) programs for the Krupowicz Planetaria (Gaudet Middle School) using resources provided by RISG-sponsored NASA programs.
- b. **NASA Mission-related Outreach:** Fellows, Scholars, and faculty involved in NASA missions engage K-12 by describing their experiences and the need for academics in order to achieve their dreams of participating in the exploration of other worlds.

C. OUTCOME 3: GENERAL PUBLIC AND EXTERNAL RELATIONS PROGRAMS

1. Resources:

- a. **NASA-themed exhibits:** We proposed one new exhibit at the Museum of Natural History (but began planning for a second early in 2013).
- b. **Ladd Observatory Outreach Program:** We proposed weekly views of current hot topics in astronomy along with hosting annual Public Open Houses.

2. Professional Development for Informal Education Providers:

- a. **Fellows and Scholars Teacher Partnerships:** We proposed this program specifically to sustain involvement by past Fellows and Scholars in informal education, even after their fellowship ends, through small travel grants.
- b. **Professional Development:** We proposed to support travel by informal education providers at the Museum of Natural History to NASA-related workshops and NASA-Center travel.

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

Provide concise, meaningful highlights or anecdotes (no more than three) that are directly related to work completed in 2012, highlighting student and/or project accomplishments. Specify alignment to an Outcome.

A. RISD EXTREME ENVIRONMENTS: A Rhode Island School of Design graduate was hired to work in the JSC Habitability Design Center. Through RISG support, the student (Bryan Cloyd) first participated in the first Moonbuggy Studio in 2009, and then interned at the Habitability Design Center (HDC) during the 2010 Winter Session. At the special request of the HDC, the Desert RATS organizing committee specifically asked him to return the next summer in order to assist them. While there, he was able to assist in many of the field studies and helped prepare and (briefly) drive the prototype lunar rover being used in the studies. When an opportunity opened up at the HDC, Bryan was recruited to fill the spot. Bryan is the 6th RISD ID alumnus to work at the HDC, where there has been a continuous RISD presence since July of 2004 through the cooperative program with the Rhode Island Space Grant.

B. INTERNATIONAL GENETICALLY ENGINEERED MACHINE (iGEM) COMPETITION: The Brown-Stanford *iGEM* Team explores synthetic biology as a powerful new tool in space exploration. The 2012 team explored synthetic biology as a powerful new tool in space exploration. The 2012 team had three projects, centered on the theme of astrobiology. To prepare prospective microbial astronauts for the extremes of space, the *Hell Cell* created a toolbox of genes to confer survival for harsh environments. The bio-mining project created an extensible system of attaching metal binding sites to *E. coli*. This could be used for mining or

recycling of important metals in space. Finally, inspired by Carl Sagan's 1967 hypothesis of life in the clouds of Venus, the Venus Life project created cell cycle-dependent reporters, which could allow for the remote detection of cell division to test the viability of life in aerosol and extreme conditions. Together, the two teams won various awards nationally and internationally at the iGEM competition. Students supported at NASA Ames are listed under **Outcome 1** below. On-line stories can be found at the following websites:

<http://www.wired.com/wiredscience/2012/08/engineering-bacteria-for-mars/>

And

<http://phys.org/news/2012-08-students-bioengineering-bacteria-humans-survive.html>

PROGRAM ACCOMPLISHMENTS

Refer directly to the consortium goals and SMART objectives in your 2010 base proposal when describing your accomplishments.

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals:* (Discussion of achievements and progress related to your Fellowship/Scholarship, Higher Education and Research Infrastructure programs). (*Employ and Educate*)

A. Fellowship/Scholarships: Each award was competed under the categories noted below (*Specific*) and was directly related to NASA's mission and goals (*Acceptable*). Our primary metrics for our Fellows included the quality of the applicant pool, presentations at the annual symposium, and papers/abstracts (*Measurable*). Awards fell within the budget and were matched (*Realistic*). Different awards covered different award periods and require separate applications (*Time Frames*).

1. Graduate Fellowships: A grand total of **10** graduate fellowships were awarded across the entire consortium (combining full-year and summer fellows). Of this total, we awarded 8 full-year graduate awards (6 females and 2 underrepresented), 7 of which were at Brown and 1 at an Affiliate. **Two** Summer Fellows (1 female) was awarded, which matched our SMART objective. Consequently, we exceeded our goals for fellowships, in part because we leveraged two awards with the National Lunar Science Institute.

2. Undergraduate Scholarships and Internships: A total of **26** undergraduate awards were made (10 female and 2 underrepresented). For the **Lead Institution**, a total of 11 awards were made including: **4** Summer Scholarships (2 from under-represented groups), 6 NASA interns, and 1 inter-consortium award (Brown student in residence at the University of Washington). For our **Affiliates**, a total of 15 awards were made including: 1 Academic Year Scholarship, 8 research assistantships, 5 NASA internships, and 1 museum intern. Limited institutional matching precludes participating in NASA Center internships through SOLAR. A total of 12 *Summer Internships* at NASA Centers or Headquarters through joint classroom programs were awarded including: 5 internships from RISD (part of the NASA-RISD/JSC Design class, Summer and Winter Sessions); 5 Brown interns at NASA Ames (part of the Brown/Stanford iGEM Program); and a Brown student (majoring in Science Communications) interned at the NASA History Program Office where she created a video designed for middle-school students. In addition, we supported a RISD student, who worked locally as an intern at the *Museum of Natural History* to assist in exhibit designs for NASA-themed exhibits.

In summary, we made **36** Fellowship and Scholarship awards. The breakdown from what was proposed (*italics*) and actually awarded this report period is as follows:

- *Full-year RISG Fellowships at Brown (2) and our Affiliates (2)*: **Brown (7); Affiliates (1)**
- *Summer Fellows (at least 2)*: **Brown (2)**
- *Summer Research Award (>2 from Brown; 6 from Affiliates)*: **Brown (5); Affiliates (8)**
- *Academic Year Award (1 at Brown, 6 at Affiliates)*: **Brown (0); Affiliates (1)**
- *Summer Internships (4)*: **Brown (6); RISD (5)**
- *Joint Industry Partnership (1)*: **none** (no interest this year)

We generally exceeded our goals except for the Academic Year (AY) awards and the Joint Industry Partnership. The reduction in AY awards reflected the applicant pool, more interested in summer opportunities. The absence of an award for a joint industry partnership reflected student lack of response to the announcement this year. Disciplines involved in our program include: environmental science, chemistry, planetary geology, cosmology, and science writing.

B. Higher Education (HE):

- 1. Course Development:** We *met our goal* by supporting 4 new/revised NASA-related courses. Each class met our SMART objectives: clear goals (*Specific*); hands-on student involvement; reviewed (*Measureable*); links to NASA themes or competitions with presentations at our annual Symposium (*Acceptable*); clear objectives and matched funds (*Realistic*); and awarded for one year (*Time Frame*).
 - a. RISD Design for Extreme Environments program (2):** One revised and one new course were offered: (1) "*Design for eXtreme Environments*" (ID-24ST-07); and (2) "*Space Gloves for NASA*" (a course based on developing EVA glove designs), which was jointly offered through the departments of *Industrial Design* and *Apparel Design*, thereby working deeper into the RISD curriculum. The goals of the "*eXtreme Environments*" class change each year through direct interaction with NASA-JSC personnel. In 2012-2013, this class focused on the development of a Micro-gravity Repair Facility for use on long-duration and deep space missions. Selected students interned at NASA-JSC during Summer- and Winter Sessions assisting in the assembly of a full scale, high fidelity mockup for the next generation of a two-person pressurized space exploration vehicle - the "*Multi Mission Space Exploration Vehicle (MMSEV)*" - to be used in testing in a simulator dome and during Desert Research And Technology Studies (Desert RATS) in Arizona.
 - b. Bryant University Initiative (1):** A new course on astrobiology was offered (SCI385) as part of an effort to broaden NASA themes into the curriculum. In addition we sponsored a consortium-wide presentation: "A Molecular Assessment of Organic Matters: Earth and Beyond" George D. Cody, Ph.D. (Senior Staff Scientist, Geophysical Laboratory, Carnegie Institution of Washington).
 - c. Brown University iGEM (1):** Each year a group of students participate in a seminar (*BI1980/1960*) that focuses on the *International Genetic Engineering Machine*. This group of energetic students works with students at Stanford to compete internationally. They

presented at the national meeting in Seattle. This course is redefined each year in order to meet the international challenge.

2. RISG Graduate/Undergraduate Travel Grants: We awarded 5 travel grants to graduate and undergraduate students for enabling or stimulating their research: JPL (JPL Summer School), NASA Ames (Experiments), and NASA-related conferences (Lunar and Planetary Science Conference), and professional development (workshop for numerical modeling). We also supported a student at Bryant University to present results at the Geological Society of America meeting in Charlotte, NC. Such travel grants are extremely important for defining careers and are leveraged by departmental and institutional grants. Each award required written justification, NASA relevance, and evidence of active participation (presentations, posters, reports).

3. Student Field Experiences: We supported 2 hands-on field experiences (*meeting our goal*) for undergraduate and graduate students. First, we supported three graduate students (University of Rhode Island) to perform field studies in California investigate serpentinite-rich carbonate seeps that could be related to serpentinite habitability on Mars.

Second, we supported a spring-break field trip to Southeastern Utah at Arches and Canyonlands National Park. The trip engaged 17 undergraduate students, 2 graduate students, and a professor. This count was down (from the proposed 20) due to budget limitations by leveraging partners. They visited Upheaval Dome in Canyonlands where discussed both sides of the debate regarding whether or not this feature was an impact crater. In addition, they discussed the reasons why the Colorado Plateau is often used as a Martian analogue, with specific examples in the field. Success was measured by relevance, direct contact with NASA personnel, oral/poster presentations and written student responses.

4. Minority-Serving Institutions (MSI): Rhode Island does not have a minority-serving institution of higher learning and we have not been able to initiate a substantive program. We initially had proposed to work with a tribal college in Nebraska but discovered the difficulties in working with rapid turn-around with faculty (as reported last year). Consequently we have taken two new approaches.

- *First*, we have partnered with the *Brown-Tougaloo Program (BTP)* and are offering an undergraduate summer internship at Brown working with a faculty member on a research project. Both a participating faculty at Brown and an undergraduate from *Tougaloo College* has been identified for this coming summer. We also provide nominal support for a *Tougaloo* faculty member (in residence at Brown through the *BTP*) as an on-campus mentor.
- *Second*, we are working with the *Associate Provost for Academic Development and Diversity* to establish a summer appointment for a faculty member of a tribal college to work with a Brown researcher. It remains uncertain if this program will take place this summer; nevertheless, we have a commitment by Brown to support the initiative. We are also working with a faculty member of a tribal college (*Turtle Mountain Community College*, North Dakota) in order to design a meaningful program in the context of the local community.

Consequently, we feel that we have internal support and commitment to initiate and sustain a meaningful MSI effort in the future that can be used as a model for our Affiliates in the future.

5. University Teaching and Research Award (UTRA) Supplements: This year we provided small supplements to 5 UTRA student awards to undergraduate students at Brown. Our intent was to increase awareness of Space Grant through supplements, thereby making NASA-relevant research more attractive.

C. Research Infrastructure:

1. Affiliate Faculty and Research Support: Our goal each year is to enhance and deepen NASA-related research through small seed grants limited to <\$10K per investigator (excluding undergraduate research support) for **5 grants**. All proposed research had to identify relevant NASA themes and have documented matching funds. We funded 7 research seed grants during the report period, all at our Affiliate institutions.

a. Roger Williams University: *Metallated Porphyrin and Silane-Functionalized Dyes for Microwave-Assisted Fabrication of Dye Sensitized Solar Cells.* New ways to incorporate light absorbing dye molecules into Dye-Sensitized Solar Cells including the use of microwave heating methods to fabricate and chemically modify conductive metal oxide (CMO) substrates. Results were presented at the RISG Symposium and abstracts submitted to the American Chemical Society meeting, thereby satisfying our SMART goals.

b. Roger Williams University: *The Super-ellipsoid via The Galerkin Method.* The objective is to find a numerical solution to the “Dirichlet” problem for the Helmholtz equation for a smooth super-ellipsoid in order to significantly reduce the number of terms in the infinite series needed to modify the original integral equation. Results were presented at the RISG Symposium, thereby satisfying a SMART goal.

c. Roger Williams University: *Biomimetic Organismal Regulation of Dinitrogen Oxide Gas Production a Potent Green House Gas:* Global climate change can affect the diverse metabolic activities in microbial communities that are the major drivers of terrestrial and marine nutrient cycling. This research assesses microbial metabolic responses to changes in greenhouse gas concentrations, nitrogen mineralization, decomposition and organic carbon storage in order to understand the underlying mechanisms of how global change will affect the earth’s ecosystem function. Three interdisciplinary undergraduates were supported through this program. Results were presented at the RISG Symposium and abstracts submitted to the American Chemical Society meeting, thereby satisfying our SMART goals.

d. Providence College: *Lithium-ion battery research:* Monitor mass deposition on a battery electrode during electrochemical measurements in order to assess behavior and assess the effect of electrode materials and electrolyte composition. This effort partnered with an EPSCoR Competitive Research Award (URI/Brown). This involvement met our goal to engage more Affiliate faculty and students in research.

e. Wheaton College: *Determination of Minor Planet Light Curves and Detection of Lunar Changes Associated with Recent Out-gassing.* Assisting in the development of a remote observatory (New Mexico) for student learning in astronomy. Two student assistant researchers were engaged in setting up and operating remotely at Wheaton College after installation. First results were presented at our Symposium.

f. Bryant University: Space Grant supported two studies into past climate changes. One study assessed the carbon/hydrogen isotopic ratio changes in Neolithic sites. Another used older records in order to understand recent climate changes. Two papers were published this year and two were reported at a national conference, thereby satisfying our goals.

2. Lead Institution Faculty and Research Support: Our annual goal was to support 2 seed grants. Due to increased interest by our Affiliate faculty and difficulties in achieving match at Brown, we did not meet our goal this year.

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty:* (Discussion of achievements primarily focused on your Higher Education programs not discussed in Outcome 1 and your Precollege programs). (*Educate and Engage*)

1. Educator Professional Development: Our goal this year was to support 3 NASA-content educator workshops. We exceeded this goal by supporting 21 workshops (engaging 185 participants) through partnering with the *Museum of Natural History* programs and a systems engineering workshop at the *University of Rhode Island*.

a. Museum of Natural History (MNH) Programs: The *MNH* provided 20 educator workshops for approximately 175 participants incorporating NASA themes. NASA content is part of all of our programming. Of these workshops, 8 specifically focused on content and educational programming related to RISG-supported exhibits (*Exploring the Earth-Sun System* (with a focus on space weathering), *Exploring the Solar System* -- focusing on Mars and Saturn -- and *Properties of Galaxies*). Hence we exceeded our goals. In addition, the Museum's Director facilitated a series of 4 STEM-based learning experiences, utilizing NASA resources, for middle school teachers. The Museum also facilitates 2 STEM workshops for formal and informal educators from *Afterschool Programs*, *Providence After School Alliance*, home-school families and scout groups. RISG supports these efforts through materials, content, and exhibit support (Outcome 3 below).

b. The *MNH* Director also works with the Middletown School district to engage middle-school students and teachers through programs at the *Krupowicz Planetarium*. This last year she supported a series of 12 workshops engaging 32 teachers: *Astronomy; Earth, Space and Life Sciences, Astrophysics; NASA Technology and Missions; Life of Stars, Climate Change, Planetary Geology, Sun-Earth Relationship, Earth-Moon Relationship, and Space Weather*.

c. Systems Engineering Educator Workshop (URI): Through Space Grant support, two engineering University of Rhode Island professors held a *Systems Engineering Educator Workshop* at the University of Rhode Island. The primary goal was to enable teachers of mathematics, science, and technology with the skill-set to introduce systems engineering into the classroom. Ten teachers from Rhode Island public schools, representing grades 3-12 (and all disciplines) attended the two-day workshop at URI. The program included: a tour of the Ocean State Job Lot (a state discount store) distribution facility in Quonset Point, RI; five hands-on activities that can be replicated in-class; and presentations about systems engineering concepts from URI professors and students. To assess the program, participating teachers completed a survey. Moreover, yearly assessments of in-classroom activity success will also be completed. Throughout the year, teachers access an online learning supplement, Sakai, where they can interact with each other and trouble-shoot, with URI support. As an example, in one session (entitled "the Best Layout and the Shortest

Path”), students would practice the ability to optimize a layout (e.g., a distribution system) and learn about possible solution options, improvements with alternate layouts, and environmental savings. Using the shortest path board, students determine which path is the most efficient and what applications this activity can represent in real world systems.

2. Curricular Support Resources: *MNH* activities were highlighted above. In addition, Ladd Observatory provides special events that educate and engage both teachers and students, e.g., the transit of Venus. Graduate Fellows made four presentations at local schools this year, including talks about the Sun, transit of Venus, Mars, and phases of the Moon (over 281 students). These presentations provide supplemental information for teachers while addressing the students.

3. Pre-College Summer Courses: We supported 2 on-campus classes (goal of 3) for pre-college students through Brown’s Office of Continuing Education for middle and high school students. One class was “Astrobiology: the Search for Life in the Universe” taught by Seth Horowitz; the other, “Exploring the Planet and Moons of Our Solar System,” by our Space Grant Fellow.

4. Student Involvement K-12: We met our goals through programs at the *Museum of Natural History*.

Advanced STEM programming at the *MNH* aligned with state Science Grade-Span Expectations (GSEs). Over the last year the *MNH* attracted over 36,960 visitors, 6,870 school children, 565 children in camp/after-school programs, and 120 girls in Girl Scout programs. NASA content is part of all programming.

a. Krupowicz Planetarium (Gaudet Middle School) Partnership: The *MNH* has an outreach program across the Bay to engage students at the *Krupowicz Planetarium*, attached to Gaudet School. The planetarium uses hands-on experience for middle school students (1593 students this year), as well as teachers. Using Museum and NASA resources and the *Krupowicz Planetarium* students at Gaudet Middle School and Learning Academy engage in hands-on, authentic learning experiences facilitated by the *MNH*’s Director. These enriching experiences support (and are embedded in) the curriculum mapping for the Middletown Public School District.

b. NASA Mission-related Outreach: As part of our Summer Scholars Program, we provide funding for an intern to work in the Museum of Natural History in order to engage in NASA-themed exhibits. This year the undergraduate came from the Rhode Island School of Design.

5. 3D-MakerBot Project: This year a new *MakerBot* was constructed in order to produce higher quality three-dimensional models of planetary surfaces, asteroids, and cometary nuclei. Dr. Seth Horowitz and Peter Schultz gave a demonstration as part of a poster session at the Geological Society of America’s annual meeting in Charlotte, NC. The demonstration proved timely and attracted a great deal of interest from all sides of the geological community (paleontologists, structural geologists, and planetary geologists). As a result, a journal article has been prepared for publication. We met our goals for this effort.

6. Summer of Innovation: In Providence, this program supports an intensive summer camp for middle-school students. In Middletown, the *Krupowicz Planetarium* was funded in August 2012 to support out-of-school STEM programming and support for middle-school teachers. *RISG* co-supports these activities.

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

A. Resources: The *Museum of Natural History (MNH, Providence)* continues to be our primary partner for educator resources/workshops and public outreach through timely exhibits. This city museum reaches a large underserved population whether as visitors, school excursions, or educator involvement. Much of this involvement uses objects and themes in exhibits linked to state standards.

1. Exhibits and Activities: The *Museum of Natural History* in Roger Williams Park (City of Providence) has a designated a room just for NASA content. We supported 2 new exhibits, thereby exceeded our goal of 1 exhibit for the year. (a) *Trekking Across Mars with Curiosity* (opened October 2012) This exhibit features past missions to Mars, describes the wide range of surface features and processes that have been discovered, and tracks the Rover as it explores the Red Planet. (b) *Dynamic Galaxies: Our Place in the Universe* (Opened February 2013) After the success of a previous exhibits on the birth of stars and exoplanets, the same Brown faculty member worked with the Museum to develop another exhibit. In this new exhibit the properties of galaxies was revealed, and what we've learned about the Universe from studying them. In addition to these two new exhibits, "*Saturn: Beyond the Rings*" (opened October 2011; closed October, 2012) and "*Space Weather: Living with a Star*" (opened January 2012, closed September, 2012) remained on display and contributed context for educator workshops at the museum throughout much of the present report period. Museum attendance over last year is up by 11%; the planetarium attendance is up 18%. This increase in attendance is attributed to installations with new content and relevance.

In addition, the transit of Venus created an opportunity to engage the public in a last-on-a-lifetime event at the Museum. RISG sponsored and open house at the MNH with over 250 participants. A live telecast of the transit was available, but at just the right moment, the clouds parted and everyone witnessed the event, rather than on a screen. RISG provided special glasses for the occasion. This program received publicity from the local media.

3. Engagement in RI Educational Programs: The MNH Director (Renée Gamba) and MNH Educator (Dawn Temple) continue to serve as *NASA Solar System Ambassadors*. She also serves on a number of panels and committees: *Providence After School Alliance STEM Advisory Team; Providence After School Alliance Experiential Learning Advisory Committee; and Middletown School Strategic Planning*. This year she added the *Gaudet School STEM Team* to her appointments. By serving on statewide committees, we ensure that NASA-themes get into the classroom in meaningful and in sustainable ways (including *Summer of Innovation*).

4. Ladd Observatory Outreach Program: This year we supported a major open house that was structured around the transit of Venus on the Brown campus. As part of this event, we supported the installment of an exhibit at Ladd Observatory of the first telescope purchased by the Brown family, which was used to observe the 1769 transit of Venus in Providence (near a street now called "Transit Street"). Rather than weekly reports on hot topics, we supported this unique opportunity this year.

5. NASA Mission-related Outreach: Exhibits at the MNH highlighted NASA missions: *Cassini-Huygens, Kepler, SOHO, SDO, STEREO, DIXI, Curiosity, and GALEX*. These exhibits are more than display. They provide relevant objects and content for educators, students, and the public. In July, RISG also partnered with the *Northeast Planetary Data Center* to host "Mars

Overnight” during the landing of the Mars Curiosity Rover. Faculty and students (about 30) stayed up late with a series of talks by researchers who are involved in the mission (a faculty member is on the team). In addition, the RISG Director made presentations about the *LCROSS* mission at two public events.

6. Krupowicz Planetarium: This planetarium is a partner in broadening the reach of NASA within the state and hosted 5 Family Fun nights last year reaching about 200 people.

7. Public presentations: The RISG Director gave presentations at the annual convention of regional amateur astronomers dealing with recent research on observing the Moon (about 80 attendees) and to the Gem and Mineral Club (40 attendees) about the formation of the lunar dichotomy.

B. Professional Development for Informal Education Providers

1. Summer Fellows: Some graduate students (working with faculty mentors) develop a one-week NASA-themed class over the summer, for pre-college students (middle and high school). This experience varies each year depending on enrollment levels. This year we supported 2 graduate students.

2. Professional Development Travel Grants: No travel grants were awarded this year due to a busy schedule at the Museum.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:** Number of program student participants employed by NASA, aerospace contractors, universities, and other educational institutions; Number of undergraduate students who move on to advanced education in NASA-related disciplines; Number of underrepresented and underserved students participating.

The total number of student awards = 77; Fellowships/Scholarships = 36; Higher Education/Research Infrastructure = 9; All awardees are continuing their degree program; we had 4 underrepresented students participating this year.

- **Minority-Serving Institution Collaborations:** Summarize interactions. Reference the names of projects with MSI collaborations.

Rhode Island does not have a minority-serving institution of higher learning and we have not been able to initiate a substantive program. Consequently we have taken two approaches. *First*, we developed a partnership with the *Brown-Tougaloo Program and Leadership Alliance at Brown* in order to bring an undergraduate from *Tougaloo College (MS)* to the Brown campus over the summer to work with a faculty member on research project. We also provide nominal support for a *Tougaloo* faculty member (in residence at Brown through the *BTP*) as an on-campus mentor. *Second*, we are working with the *Associate Provost for Academic Development and Diversity* to establish a summer appointment for a faculty member of a tribal college (*Turtle Mountain Community College*) to work with a Brown researcher on a joint project that could engage students at his/her home institution. In addition, we have engaged a tribal faculty member for advice

in establishing this program and ensuring success. These programs are new this coming year.

- **NASA Education Priorities:** *Accomplishments related to the “Current Areas of Emphasis” stated in the 2010 Space Grant solicitation. Report on areas that apply to work proposed in your proposal and budget.*

- Authentic, hands-on student experiences in science and engineering disciplines – the incorporation of active participation by students in hands-on learning or practice with experiences rooted in NASA-related, STEM-focused questions and issues; the incorporation of real-life problem-solving and needs as the context for activities.

All Fellows and Scholars are engaged in hands-on research directly related to NASA research. In addition, various programs involve students in NASA-related learning including: the *Rhode Island School of Design’s* two classroom activities (*Design for eXtreme Environments* and *Space Gloves for NASA*); summer and winter-session *RISD* internships at NASA JSC; internships at NASA Ames through the iGEM (*International Genetically Engineered Machine*) competition; and research seed grants (involving students). We review their involvement through reports at our annual Symposium and written summaries of progress.

- Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).

We sought diligently to increase the diversity in our program over the last year through active recruitment and initiating new programs. Of the 36 fellowship and scholarship awards, 47% were women and 11% were from underrepresented groups. These percentages exceeded our targets described in our 2010 proposal (40% and 10%, respectively).

- Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise. Capabilities for teachers to provide authentic, hands-on middle school student experiences in science and engineering disciplines (see above).

Our *Museum of Natural History (MNH, City of Providence)* continues to serve as our primary source for middle-school teacher involvement. Programs are often tied to timely museum exhibits (this last year two new exhibits) with objects and illustrations that can be used to reinforce NASA themes into classroom content (consistent with state standards). The *MNH* also extends its reach through workshops at our partner *Krupowicz Planetarium* in Middletown RI directed toward middle-school teachers engaging 32 teachers through a series of 12 workshops. This extension effort is part of the *Summer of Innovation* award. The *MNH* Director also facilitated a series of 4 STEM-based learning experiences for middle school teachers that used NASA resources at the Museum. Finally, two engineering professors held a 2-day workshop (including middle-school teachers).

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

Through the *Summer Studies Programs* at Brown, Space Grant Fellows and Associates develop and present a one-week course for middle and high school students with NASA-themed content. This year offered two classes: one on astrobiology (juniors and seniors); the other, on planning solar system mission.

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

Bryant University has a growing environmental science curriculum and research program. Their focus is on recent climate change, expressed by changes in the arctic, Neolithic sites, and the recent fossil record. Using carbon and hydrogen isotopic records, they are tracking past climate changes with implications for the future.

IMPROVEMENTS MADE IN THE PAST YEAR

Succinctly describe improvements and/or adjustments made last year that demonstrate significant change(s) within the consortium. The improvements and/or adjustments that brought about change may have been in management, resource allocation, project design, project evaluation, etc.

A. Management Changes:

No changes in management we made this year but we provide a status report about our response to the 2011 Progress Report:

In response to our last Progress Report, we proposed that we would seek improvement in our diversity, both in our fellowship/scholarship awards and in our involvement of Minority Serving Institutions. As described above, we have increased the diversity in our tracked fellowship and scholarship award and have exceeded our target levels. As spelled out in our 5-year proposal (2010), our target for women was 40%. Over the report period, we 47% of the significant awards were women. For underrepresented groups, our target was 10%; this year we achieved 11% participation. We had recognized this weakness in our program, even before the review and sought balance this year.

Also as described elsewhere in this report, we have initiated new programs to engage Minority Serving Institutions. As spelled out in our Improvement Plan, we proposed to partner with existing diversity programs at Brown. Since RI does not have an MSI in its borders, we have established a *Brown-Tougaloo Partnership* that will bring an underrepresented student to the Brown campus to work with a faculty member. Working with this office and faculty at *Tougaloo*, a student has been identified and will work with a faculty member in physics on looking for gravitational lensing expressed by the distortion of distant galaxies. Faculty members from other institutions also have expressed interest in hosting students in the coming year.

Our second effort focused on tribal colleges. Working with the *Associate Provost for Academic Development and Diversity* at Brown to identify a faculty member from a tribal college to work with a Brown researcher over the summer. We are seeking to implement this program in the coming summer. In preparation, we have discussed some of the issues with a faculty member at a Midwest tribal college and discovered some of the deeper issues in such an initiative. We are working with this faculty member to develop reasonable strategies and expectations.

Finally, in conjunction with this improvement, we are working with underrepresented faculty members (Brown and RISD) to identify promising students or collaborative programs in order to increase such participation further. A professor in Computer Science is engaged in a program on tele-robotics and has agreed to host summer interns from an MSI or underrepresented student from other RI institutions.

B. Resource allocation adjustments:

No significant resource allocation adjustments were made this year beyond those described last year.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

List the institutions that comprise the consortium; include the name, type of institution, key characteristics, and role.

Brown University: Lead institution. This is a private university with a variety of undergraduate and graduate degree programs. Given that the grant is based here it is fairly involved with the grant and providing support.

Bryant University: Private university. Their relatively new programs in Environmental Sciences and Biology have begun to flourish and receive strong institutional support especially as they are learning how RISG can benefit them.

Community College of Rhode Island: Community college. This two-year community college provides opportunities for re-training and a stepping-stone to a four-year institution (including Brown).

Graduate School of Oceanography: *GSO* is part of the state-supported *University of Rhode Island* system (Narragansett Bay campus) exclusively for graduate studies and research on oceanography. They are the *Sea Grant* Lead for the state. Their NASA research includes remote sensing, astrobiology (past *National Astrobiology Institute* Lead), and climate.

Providence College: Four-year liberal arts institution. This past year their Affiliate Representative has received some seed funding from RISG and has started to gain an enhanced understanding of the program.

Rhode Island College: Primary training institution for teachers in the state. It houses the NASA's *Educator Resource Center*.

Rhode Island School of Design: *RISD* is a nationally ranked private college in the arts and design. *RISD* has been a very active of the consortium through innovative curricula linking industrial design classes with NASA centers (JSC, KSC).

Museum of Natural History: *MNH* is funded by the *City of Providence* and is located in historic Roger Williams Park. It contains the *Cormack Planetarium* where NASA-related programming is often featured. This museum features rotating NASA-themed exhibits and programs and offers supporting educator workshops and K12 programs.

Roger Williams University: *RWU* is a private institution (MAT, Masters of Public Administration, Architecture, Law, Criminal Justice) with growing programs in environmental and international studies

Salve Regina University: University offering PhD in the humanities. They offer a number of programs in the STEM fields.

University of Rhode Island: Lead state-supported undergraduate/graduate institution (identified here as "*URP*") and a *Land Grant* institution. *RISG* supports students and faculty in engineering and geology. They will host the *RISG* Symposium.

Wheaton College: Private liberal arts college with several faculty members who are involved in NASA-related research (studies into the satellites of the outer planets (using Galileo and Cassini data), astronomy, and environmental science.

Other Partners: In addition to our formal Affiliates, *RISG* has active partners including the:

Northeast Planetary Data Center (NEPDC at Brown) is funded through NASA's Planetary Geology and Geophysics Program and is an active partner through cooperative programs (exhibits) and access to planetary image data.

Ladd Observatory: Ladd provides weekly notices on topics related to astronomy as well as lectures and special events.

Krupowicz Planetarium: This planetarium is located at one of the schools within the Middletown Public School System and provides an outlet for increased outreach.

The National Space Grant Office requires two annual reports, this 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.