

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 Grant Consortium funded at a level of \$535,000 for fiscal year 2008.

PROGRAM GOALS: Our program goals and objectives are summarized below. These summaries are abridged for brevity, but full descriptions of our goals can be found in our 2008 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 \$12K for research support with 3 awards at \$4K each. For our Affiliates, we allocated \$35K for Affiliate research support in FY'08, which represented about 22% of our Affiliate allocation, consistent with our consortium emphasis on higher education. We anticipated making 5 awards at \$7K each. 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 was also to be 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. We proposed the following awards. *Success was to be measured by 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.*
 - a. Full-year *RISG Fellowships* at Brown (3) and our Affiliates (2)
 - b. Three *RISG Undergraduate Research Opportunities* (3)
 - c. *RISG Summer Research Fellows* (3)
 - d. *RISG Teaching Fellows*
 - e. *RISG Summer Research Scholars* (3) and 3 *Academic Year Outreach Scholars* (3)
 - f. Award *RISG Graduate/Undergraduate Travel Grants*
 - g. *RISG Graduate/Undergraduate Travel Grants*
 - h. Affiliate *RISG Undergraduate Research Opportunities*
 - i. Support for the *Undergraduate Low-Gravity flight Opportunity* competition
 - j. *RISD Internships at NASA Centers*
- 3. Course Development:** Develop NASA-related course resources for integration into STEM disciplines.
 - a. ***RISD Design for Extreme Environments program:*** This program was to consist of a six-credit course, run in the Department of Industrial Design during the 2008/2009 academic year with internships awarded at the *JSC Habitability Design Center* (HDC) and or other NASA centers.
 - b. ***Brown Capstone Engineering Course:*** We proposed to continue support of the capstone class offered by the Engineering Department at Brown University.
- 4. Student Field Experiences:** 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).
- 5. Targeted Institution Research and Academic Infrastructure:** We proposed to improve the ability for targeted institutions to compete for NASA research and development work through a *Visiting Research Faculty Program* in collaboration with the *Office of Diversity* at Brown.

B. OUTCOME 2: *Higher Ed programs and Pre-College Programs*

1. Educator Professional Development:

- a. **Museum of Natural History (MNH):** Educator workshops were planned at our Affiliate, the *Museum of Natural History*, all tied to the ongoing RISG-co-sponsored exhibit (through September) entitled: *Moon: Past, Present, Future*.
- 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 learning classroom materials.

c. Brown Summer Academy: We proposed to support 3 classes for middle and high school students given by RISG Summer Teaching Fellows.

2. Curricular Support Resources: Our Affiliates (RIC, MNH, and the Ladd Observatory) and 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 Natural History Museum. In addition, our Fellows and Scholars interact with K-12 students. 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. Summer Camps: Five summer camps for children (ages 5-15) are proposed at the Museum of Natural History.

b. Gaudet Middle School Planetarium and Cormack Planetarium: The Director of the Cormack Planetarium proposed to develop new STEM-based programs using resources provided by RISG-sponsored NASA programs.

c. NASA Mission-related Outreach: Fellows and Scholars 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. Moon: Past, Present, Future: We proposed to participate in the development of an exhibit that would open at the Museum of Natural History. The exhibit would feature results from past lunar missions and future lunar satellites/probes, such as *Moon Mineralogy Mapper*, *LCROSS*, and *LRO* missions.

b. Art and Science: This exhibit will attempt to draw a broader audience into NASA and the human exploration of space..

c. Geology of the Solar System: This exhibit will broaden the focus to the planets and will involve both physics/astronomy and geology departments at Brown University.

d. Educator List-serve: Relays current NASA-related news, educational opportunities, and relevant websites to educators.

e. Ladd Observatory Outreach Program: Provides weekly presentations about hot topics in astronomy.

2. Professional Development for Informal Education Providers:

a. Fellows and Scholars Teacher Partnerships: This program specifically addresses this outcome by instilling a desire (and responsibility) to provide informal education in the community even after their fellowship ends.

b. Museum Docent Program: An important part of the museum exhibits at Providence's Natural History Museum is the involvement of Planetary Geology graduate students, who interact with the public each Saturday.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, OR 3): *Provide meaningful highlights (anecdotes) that are directly related to work completed in 2008. Show specificity relative to an Outcome – highlighting student and/or project.*

A. RISD Extreme Environments Studio: Work done during the summer 2008 – building a vacuum glovebox for testing glove and other designs in a depressurized environment, and a refined mockup of a *Mark III* style lunar EVA suit. This experience led to one student working in an independent study to design a low-cost high-fidelity reduced gravity simulator. This work is ongoing. The student (a minority) was strongly influenced by his Space Grant funded work.

The Fall 2007 studio worked with 15 students to design a mobile lunar habitat (related to the work shown during this year's inaugural parade). In 2008, results of this work received international recognition in the press (see below), which generated letters coming from as far away as Australia. Such interest in the space program was made possible by the *RISG*. The RISD Professor commented: "It's very beneficial to have such recognition and the opportunity to be able to provide inspiration for so many future designers and engineers."

Four students since 2005 are working at *NASA-JSC* (through contractors). In addition to local and school press coverage, two articles in 2008 highlighted this program in *Imagine* magazine and *Popular Science* magazine. Two RISD students were in the inaugural parade along with two astronauts in the Lunar Electric Rover, on which they are now working.

B. NanoSatellite Conference: *RISG* co-hosted a one-day conference and workshop on November 7, 2008. The one-day conference was co-hosted (*Brown*, *RISG*, and *NASA Ames*) on the Brown University campus to address a critical need to identify low-cost launch vehicles needed by commercial and academic teams.

C. Museum of Natural History Programs: *RISG*-supported programs at the Museum of Natural History have had a significant impact on the community, museum, its staff, and infrastructure improvements. Institutions of higher learning have been drawn back to the museum as a place for family learning, with the "*Space Science*" room being a focal point. Museum attendance was up 35% and summer planetarium attendance up 42%. The Museum Director (Renée Gamba) was interviewed on local radio and Disney Radio about the NASA Space Science exhibits. The Museum was also featured on local television for the Moon Rock, *Mission Moon*, and *space ARTifacts* exhibits. The exhibit hall was also featured in an AMTRAK publication in 2008 as a great place to visit.

D. Research Outcome: Space Grant enabled pilot research into aerial navigation and orientation. The program's first study of bat vestibular contributions to obstacle avoidance was published in the *Journal of Vestibular Research*. The next stages in this research included continued use of transient and chronic vestibular-affecting chemicals (deuterium oxide) in combination with more precise video and behavioral measures. An outcome of this study led to an important discovery that bat's may actually use electrical synapses in their auditory brainstem to allow extremely high fidelity and speed passage of sensory information to their echolocation and motor systems. We report this here because the laboratory has just been awarded a large *Office of Navy Research* grant to further study both the behavioral, anatomical and physiological underpinnings of these initial findings. While this effort did not evolve into new NASA

funding, *RISG* provided critical gap “seed” funding at a time when *NASA*, *NIH*, and other funding agencies were undergoing major shifts in emphases.

PROGRAM ACCOMPLISHMENTS: CONNECTION BACK TO CONSORTIUM ANNUAL PERFORMANCE GOALS AND OBJECTIVES

OUTCOME 1

A. Fellowship/Scholarships

Achievements and Progress: *Our target for involvement by under-represented minority students is 18% (the percentage of minority enrollment in our state, 17.2%) and 40% for women. Our projected support for all fellowships and scholarships is \$226.4K, which exceeds the minimum for a Program Grant (\$135K) according to the Budget Call. All awards were directly related to NASA’s mission and goals. Our primary metrics for our Fellows included the quality of the applicant pool, presentations at the annual symposium, and papers/abstracts. These goals were achieved. We encouraged women and under-represented groups to apply. While we did not meet our goal for under-represented minority students, we did exceed our goal of 40% for awards to women (44%).*

a. 2008 Spring/Summer Fellowships: We continued our support for 3 Fellows.

b. 2008-2009 Academic Year Fellowships (Brown): We awarded 4 fellowships at Brown and 2 to our Affiliates.

c. 2008-2009 RISG Undergraduate Research Opportunities: 4 students at the lead institution were supported as part of the *Undergraduate Low-Gravity Research Opportunity*. 1 student from Brown (female, chemistry) and 2 women (physics) from *Wheaton College* were supported to attend the *Lunar and Planetary Science Conference* in Houston.

d. 2008-2009 RISG Academic Year Undergraduate Outreach Scholars (proposed 3 at Brown): We had a poor response to our undergraduate outreach program but did award a highly qualified and deserving student (Tyler Lucero, Geology).

e. Summer Undergraduate Research Scholarships: (3) and 3 *Academic Year Outreach Scholars* (3):

i. Lead Institution (Proposed 3 Summer; awarded 4): Emily Tursack (Geology); Joshua Stern (bio-geochemistry); Mathew Kretschner (astronomy/physics); LeAnne Edwards (Chemistry)

ii. Affiliates: Elizabeth Yankura (*Roger Williams University*); Charles Hall (*Roger Williams University*); Jack Fuller (*Roger Williams University*); Mathew Poynton (*Providence College*).

B. Higher Education

Achievements and Progress:

a. Course Development

i. RISD Design for Extreme Environments program: This program changes its design focus each year with focused goals in collaboration with *NASA-JSC* personnel. This program includes a winter-semester internship at *NASA*, summer internships, and mentorship by graduate students who have completed the class sequence.

ii. Brown Capstone Engineering Course: Due to a family illness, the lead faculty member had to cancel this course in the spring of 2008. The course is currently being taught for the spring 2009 semester.

b. RISG Graduate/Undergraduate Travel Grants: Travel grants were awarded to 5 students over the report period.

c. Student Field Experiences: *RISG* provides support for an annual geology field trip over spring break. Students highlight planetary analogs and illustrate how remote-sensing materials can be used in the field.

d. Low-gravity Flight Opportunity Competition: Continues to engage students, create team approaches, and introduces them to *NASA* opportunities. Experiment title: *Fluid Experiments Across States: Explorations in Educational Applications*.

e. Bryant University Initiative: *Bryant University* was awarded a grant to enhance and complement research, classroom, and state-of-the-art analytical equipment. Funding will be used to support course development, seminars, and travel to *NASA*-relevant national meetings (and *NASA* Centers).

C. Research Infrastructure

Achievements and Progress:

a. Faculty and Research Support: One of our goals last year was to increase our support for research seed grants across the consortium. Some of the grants at our Affiliates supported student research assistantships over the summer.

b. American Society of Photogrammetry and Remote Sensing (New England Chapter): By request from our Affiliate University of Rhode Island, *RISG* co-hosted the New England Chapter meeting at Brown in April.

OUTCOME 2

Achievements and Progress:

1. Educator Professional Development: 3 *NASA*-related educator workshops were held over the report period (nearly 100 participants). These included: *Mission Moon, Space Exploration Home-school Educator Workshop, Space ARTiFacts Lectures*.

2. Museum of Natural History (MNH): The Museum hosts a variety of STEM-based professional development opportunities each year. These include *NASA* Lunar and Meteorite Certification workshops, as well as workshops based on, and aligning with, current *NASA* missions. The Museum also facilitates STEM workshops for local Girl Scout troop leaders, afterschool educators, Providence after school alliance, and homeschool families.

3. Brown Summer Academy: We supported three classes for middle school and high school students given by *RISG Summer Teaching Fellows*: “Exploring the Solar System” by Angela Stickle and Peter Schultz; “Astrobiology: the Search for Life in the Universe” by Seth Horowitz and Mary Bates; and a “History of Life in the Universe” by John Macaluso.

4. Student Involvement K-12:

- a. **Vacation Summer Camps:** Over the summer of 2008 the following sessions were supported at the Museum: Ages 5-6: 2 Sessions; Ages 7-9: 2 Sessions; Ages 10-12: 1 Session; Ages 13-15: 1 Session.
- b. **Girl Scouts:** March-June 2008: 28 Troops; November 2008-January 2009: 13 Troops.
- c. **Gaudet Middle School Planetarium and Cormack Planetarium**
- e. **NASA Mission-related Outreach**

OUTCOME 3

Achievements and Progress:

1. Resources: The costs for this effort represent a relatively small fraction of our budgeted dollars; our success represents extensive leveraging in order to stimulate a broader public awareness of NASA-related research in RI.

a. Exhibits:

i. **“Moon: Past, Present, Future”** (April 12, 2008 – August 31, 2008): The exhibit, student workshops, docents (including volunteers and Museum staff) and family programming were very successful at the Museum. *This included over 14,000 visitors, 3100 school children, 175 camp/after-school programs, and 130 Girl Scout programming.* A *Museum Quest* for exploring the Moon exhibit was designed. This exhibit continued to help the Museum’s presence in the community. *General museum attendance was up 35%, and summer planetarium attendance is up 42%.*

ii. **“Space ARTifacts: Imagination and Exploration”** (October 16, 2008 – January 23, 2009). After seeing the opening of our *3D-Mars* exhibit last year, a Professor at Affiliate *Rhode Island School of Design* proposed to develop an exhibit blending science and art in the newly created *Space Science Room* at the *Museum of Natural History*. Our Partner, the *Northeast Planetary Data Center*, provided supplemental planetary images and design advice. With support of RISG, the Museum successfully was awarded a mission-used *NASA Shuttle* tire, which fit well into the exhibit theme. This exhibit is highly successful *with over 4500 visitors (through 1/23/09), 1800 school groups, 160 camp/after-school programs, and 190 Girl-Scout programs* thus far. *There has been a 12% increase in school group bookings for this exhibit to date.*

iii. **Geology of the Solar System:** In order to maximize the impact of the prior two exhibits, we deferred this proposed effort to a future opening in the museum schedule and kept the exhibit over a longer time.

b. **Programs at the MNH:** Our seed money for the *Museum of Natural History* and *Cormack Planetarium* has had multiplicative effects on support from the city. For example, during a *RISG*-supported VIP opening (Governor, Superintendent, etc.) of an exhibit, the decaying ceiling was obvious. The publicity, VIP attendees, and the public response all contributed to infrastructure improvements. The relationship has provided the Museum with resources that have allowed an increase in visitor and school group attendance through its *NASA* programming. The increased visibility in the community also has provided the museum with new opportunities, including a new relationship with *Middletown Public Schools* and its planetarium.

c. **Educator List-serve:** Listserve remained active until the beginning of the summer when the Program Manager became ill.

d. **Ladd Observatory Outreach Program:** *RISG* supported a major Open House during Halloween. This support enabled broader participation, advertising, and displays related to observing the planets and the universe. Over 300 people attended.

2. Professional Development for Informal Education Providers

a. **Summer Teaching Fellows:** We proposed to fund *RI-SG Teaching Fellowships* as a response to student requests for hands-on teaching experience. This award was made to three graduate students, each developing a one-week *NASA*-themed class over the summer, one for middle; the other two, for high-school students. Three classes this year were *Exploring the Planets*, *A Life History of the Universe*, and *Astrobiology: The Search for Life in the Universe*. Each class had attendance from 10 to 20 and all received positive reviews, with some students migrating into next level courses (from middle school to high school).

b. **Development Travel Grants:** *RISG* supported several trips for the Museum Director, otherwise impossible due to the limited city budget. All trips were heavily leveraged and could be directly tied to ongoing *RISG*-supported programs and exhibits. The Museum’s Director and Curator of Education, traveled to an Astronomy Conference (*Astronomy from the Ground Up*) in San Francisco. The Museum is now hosting monthly events this year, celebrating the *International Year of Astronomy* as a direct result of this trip through the information and materials obtained. The goal is to increase visitors and to offer a series of Educator workshops planned to disperse the information and activities obtained at this conference to area Educators.

PROGRAM CONTRIBUTIONS TO PART MEASURES

➤ **Student data and Longitudinal Tracking:** *Total FY’08 awards = 78 awards (41 female, 37 male); Fellowship/Scholarship = 26 (13 women, 13 men); Higher Education/Research Infrastructure = 52 (28 women, 24 men), two of whom were under-represented minorities. Of these students, all but 3 are continuing in STEM-related careers; 12 are continuing in advanced education in NASA-related disciplines.*

➤ **Course Development:** *Number of new or revised courses targeted at the STEM skills needed by NASA that are developed with NASA support: 2 revised courses were offered over the report period.*

➤ **Matching Funds:** *Ratio of funds leveraged by NASA funding support: Our ratio of Match-to-NASA is estimated to be 1.2 to 1*

➤ **Minority Serving Institution Collaborations:** *Summarize interactions: We had planned to initiate a new program to partner faculty working at an HBLC with ongoing researchers at Brown. This was delayed due to the loss of our Program Manager. We also began discussions with the Leadership Alliance and the Brown-Tougaloo partnership to engage students and faculty with NASA-themed research. These discussions are ongoing and a meeting has been scheduled with faculty at Tougaloo.*

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: Last year our Program Manager's (PM) health began deteriorating. Increased absences last summer culminated in a three-month leave starting in late August. Without assurance of return by November 1, the difficult decision was made to look for a replacement. Brown's Office of Human Resources and Department Administrators were fully involved throughout this difficult process. Several specific goals for FY'08 depended on the active role of the PM and have been delayed: hiring administrative support; list-serve announcements; website updating; new brochures; announcement posters; Visiting Research Faculty Program for under-represented minorities. The Program Manager position was posted in November and we are currently undergoing final selection. Loss of our PM came at a challenging time for the Director who had prior commitments (review panels, foreign travel, and major reviews of facility research programs). Nevertheless, departmental managers and staff assisted in the daily operations for the consortium, thereby minimizing major gaps in continuity (purchase requests, invoices, etc.).

B. Resource allocation adjustments:

1. Capstone Engineering Class: The faculty member who offers this innovative systems-design course at Brown was unable to participate due to his wife's terminal illness. Hence, this was not offered in the Spring '08. Instead, funds were reallocated to support a *Nanosatellite Launch Vehicle Conference* described above.

2. Geology of the Solar System: This exhibit was to be developed during the latter part of this report period. The Museum decided to extend the existing NASA-themed exhibit in the summer due to the severe winter this year.

3. Evolution of the Moon: Funds were allocated to develop a musical piece depicting the entire evolution of the Moon. This was in response to public reaction to an original musical composition for *Mission Moon* exhibit and the upcoming flotilla of lunar missions. Working with the Director, an award-winning musician began creating a 45-minute composition tied to the geologic history of the Moon, from accretion to the impact by LCROSS in 2009. This work will be linked to images from the *Northeast Planetary Data Center*.

4. Web upgrades, brochures, and poster: These key components to broadening awareness were deferred due to the loss of our Program Manager.

5. Bryant University: *Bryant University* has invested about \$5 millions to renovate specialty teaching facility and research laboratories with state of the art analytical equipments. This is complemented by a major new effort at Bryant in *Environmental Sciences* (fall of 2008) and *Biology* (2009). As a result, there was an unexpected (but welcome) proposal to *RISG* to provide educational and research opportunities to students and faculty.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION: List the institutions that comprise the consortium; include the name, type of institution, and key characteristics.

Bryant University: Private university. Their *Department of Science and Technology* is starting new programs in Environmental Sciences (fall of 2008) and *Biology* (2009). Related new science courses are being designed and implemented.

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.

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 has become increasingly important to our program through NASA-themed exhibits and programs (educator workshops). In return, they have created a "Space Science Room" which is reserved for rotating exhibits related to current events, missions, or themes related to NASA.

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. They hosted our Space Grant symposium last year.

Salve Regina University: University offering PhD in the humanities. They offer 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 be hosting our next statewide consortium.

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 *Aero-Astro* (a company that makes small satellite components). This company, however, was recently bought out but the involvement with the past President/CEO remains.

IMAX provides special screenings of programs that can be used to support educator workshops. 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** provides weekly notices on topics related to astronomy as well as lectures and special events.