Rocky Mountain NASA Space Grant Consortium
University of Utah
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(801) 581-2478
http://utahspacegrant.com
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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 Rocky Mountain Space Grant Consortium is a Designated Consortium funded at a level of $575,000 for fiscal year 2011.

PROGRAM GOALS

Outcome 1: To demonstrably contribute to the development of the STEM Workforce with programs, projects and activities that are in direct alignment with NASA's stated education strategic goals, missions and with her defined outcomes, objectives and PART measures.

SMART Objectives:

1: Increase the percentage of our Space Grant Fellowships and Scholarships given to female students from an average of 32% in 2005-2009 to 34% in 2010-2014. Increase the percentage of awards to minority students from an average of 27% in 2005-2009 to 30% in 2010-2014. This will maintain greater diversity in our Space Grant program compared to the demographics of the State, where 23% of the students are female and 13% are minorities. This will keep our percentages well above the NCES Digest Statistics, where 22% of the students are female and 11% are minorities.

2: a) Standardize the process throughout the Consortium by which Fellowships are announced, applications solicited, applications competitively reviewed, awards made, administered and tracked. b) From 2005-2009 we awarded an average of 22 Fellowship awards each year. In 2010 we plan to award 17 Fellowships at the graduate student level. All of these awards will be above $5,000 tracking level. The number of Fellowships awarded in 2010 is less than in 2009 due to the total Space Grant funding in 2010 being $575 K rather than $785 K in 2009. c) From 2005-2009 students and faculty published an average

of 34 scientific reports each year. From 2010-2014 we plan to publish an average of 34/year.

3: Each year target at least three project areas to focus Space Grant interdisciplinary research and development selected from [1] space systems engineering (ESMD-spacecraft), [2] life support in space (SOMD-crew health, safety, medical ops), [3] space vehicle propulsion (ESMD-propulsion), [4] remote sensing by optical, infrared and microwave imaging (SOMD-space comm.) in direct alignment with NASA Enterprise priorities.

4: From 2005-2009 we awarded an average of 25 undergraduate Scholarships each year. From 2010-2014 we plan to award 29 Scholarships at the undergraduate level each year. Of these awards, 8 will be above $5,000 and 11 will be below the $5,000 tracking level**.**

5: Increase the number of minigrants awarded to junior faculty members of our Consortium as an investment in their space-related research and career development. From 2005-2009 we made an average of 2 awards. In 2010 we plan to make at least 3 awards to junior faculty members.

6: Increase the number of student Internships at space-related NASA Centers and her contractors from 10 in 2009 to 11 in 2010.

7: From 2005-2009 7% of our Space Grant students graduated with STEM degrees and entered the STEM workforce. From 2010-2014 we plan on 9% of our students graduating with STEM degrees and starting their careers in the STEM Workforce. From 2005-2009 16% of our Space Grant students graduated with bachelor degrees and entered graduate school declaring a STEM major. From 2010-2014 we plan on 18% of our students graduating with degrees and entering advanced degrees declaring a STEM major.

Outcome 2: To attract and retain students and teachers in the STEM disciplines who have a solid understanding of the subject material.

SMART Objectives:

8: From 2005-2009 we conducted an average of 9 teacher career development workshops each year. From 2010-2014 we plan to conduct 10/year.

Outcome 3: Conduct an Informal Education program to form strategic partnerships and linkages between STEM formal and informal providers leading to an expansion of the nation's future STEM workforce through awareness of the mission of NASA and the promotion of STEM literacy.

SMART Objectives:

9: From 2005-2009 we supported the activities of 3 informal STEM education partnership collaborative projects each year. From 2010-2014 we plan to support 4 informal educational collaborative projects each year.

10: Annually develop 4 sets of informal education standards-based STEM materials to enrich visual and activity experiences by informal education providers. Support satellite facilities that make this material available to teachers.

Management:

SMART Objective:

11: Provide only two points of formal Consortium contact for NASA: Program Director/PI and Contracts Officer.

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

Outcome 1:

- During 2011, the Utah State University Get-Away Special (GAS) team had a successful flight as part of NASA's Reduced Gravity Student Flight Opportunities Program which allows students to test microgravity experiments in NASA's "weightless wonder" aircraft. Five students (Iggy Matheson, Ryan Martineau, Jenica Sparrow, Landon Hillyard, and Matt Wallace) had the chance to fly and perform their boiling heat transfer experiment (FUNBOE 2.0) in the plane in the summer of 2011. Robert Barnett and Troy Munro had the opportunity to act as ground crew and help prepare the experiment for the two flight days. During the remainder of the summer, the data collected by the experiment were analyzed, and the results have been reported in two journal papers submitted to the Journal of Heat Transfer – Transactions of the ASME and the International Journal of Heat and Mass Transfer and a thesis prepared by fellowship student, Troy Munro.

- A blimp-borne imager project was completed in August 2011 at Utah State University. The student project leader was undergraduate student, Crystal Frazier, who is a Native American female mechanical and aerospace engineering student. The team designed, fabricated and flew a high-resolution multispectral imaging system, known as the Integrated Camera Unit (ICU). This system used a cold gas annualar aerospike with secondary injection points to control the pan aspect. A servo motor system served as the back-up secondary control system. Aerial multispectral images were captured by the ICU from a tethered aerostat during the 25th annual AIAA/USU Small Satellite Conference.

Outcome 2:

- The 7th annual AWE+SUM (Attend Westminster, Explore Science, Use Math) camp on Westminster College's campus was held in June 2011. Forty-eight girls attended the three-day camp. Each year, girls are targeted who are entering the 8th grade in the fall, and in particular, girls are recruited who are interested in math and science, but who may not be performing at their true ability level. Efforts are also made to recruit girls from all ethnicities. For 2011, 29% of the participants were minorities. The primary goal is to show girls that math and science can be fun through applied, hands-on workshops. Workshops are led by female math, science, aviation and finance faculty members.

PROGRAM ACCOMPLISHMENTS

Outcome 1: Development of STEM Workforce

SMART Objectives:

1. During FY 2011 we awarded 65 fellowships and scholarships. Thirty-one of these were awarded to female students (48%) and 25 were awarded to minority students

(38%). We are well above our base funding goal of 34% for female students and 30% for minority students.

2. A web page for all fellowship and scholarship applications has been implemented on the consortium web site to standardize the application process. A review board at each affiliate chooses the recipients. Awards are made, administered, and tracked by each individual affiliate and our Program Coordinator works with each affiliate regularly to maintain the database of all awards and student information to feed into the longitudinal tracking system of the National Space Grant Foundation. In FY 2011, we awarded 24 graduate fellowships with base Space Grant funding, thus exceeding our objective to use base finding to provide 17 graduate fellowships. All 24 graduate fellowship awards were considered significant in the longitudinal tracking system.

A total of 44 papers were submitted to professional journals, conferences, and symposia or published by our students. Our target was 34 papers per year so we have exceeded our goal. Twenty three papers in the Proceedings of the 17th Annual SG Graduate Fellowship Symposium were published plus a total of 21 professional paper and conference submittals were made to professional journals and institutes appropriate to the relevant scientific or engineering specialty. These included IEEE Trans. Aerospace Electronic Systems, IEEE Trans. on Geoscience and Remote Sensing, IEEE Radar Conference, International Geoscience and Remote Sensing Symposium, Utah Academy of Sciences, Arts, and Letters, International Anesthesia Research Society (IARS), AIAA Regional Conference, AIAA/USU Small Satellite Conference, Intermountain Graduate Symposium, Dimensions of Critical Care Nurisng, Journal of the American Medical Informatics Association, CEDAR-GEM Workshop, and Science Unwrapped After Events Conference.

3. When awarding fellowships and improving research infrastructure, the University of Utah targeted life support in space; Utah State University targeted space vehicle propulsion and remote sensing engineering technology; Brigham Young University targeted space systems engineering and remote sensing by optical, infrared and microwave imaging. We exceeded our objective of targeting three areas by focusing on all four areas of research that were listed in our objective.

4. We awarded 41 undergraduate scholarship awards in FY 2011 exceeding our goal to award 29 undergraduate scholarships. Of these 41 undergraduate scholarship awards, none were above the $5,000 tracking level, although we consider three of our awards to be significant due to the financial support for these students being necessary for them to stay in school. We were able to award a higher number of undergraduate scholarships this year at a lower financial amount each.

5. Minigrant awards were given at the University of Utah to the geology department for publication support in analogs for planetary exploration. At Utah State University minigrant awards were given to the ETE robotics projects and the Society of

Hispanic and Professional Engineers (SHPE) NASA Space Science Day and annual conference. Therefore, we met our goal of awarding three minigrant awards for FY2011.

6: We are using FY 2011 funding to support five internships during the summer of 2012. We have made awards to two LARSS interns, one intern at NASA JPL, one at NASA Ames, and one at USU Engineering State. We are not funding the 11 interns we had originally proposed in our SMART objective because each internship is being funded at a higher amount than in the past. The internships being funded include stipend, travel and in some cases, housing costs.

7: Seven of our fellowship students made their next career steps in FY11 (SG participation supported from FY06-FY10 funds). One is pursuing an advanced degree in a STEM discipline, one accepted a STEM position at a NASA contractor, one accepted a STEM position in industry, and three accepted STEM positions in academia. We had 20% of our students graduate with STEM degrees in FY11 (our SMART objective was 9%). In FY11 we had 8% of our students graduate with STEM degrees and pursue an advanced degree with a STEM major (our SMART objective was 18%).

Outcome 2: Attract and retain students and teachers in the STEM disciplines

SMART Objectives:

8: We conducted ten teacher workshops in FY2011. These workshops took place at the following school districts: Cache (Mendon, two), Logan, Davis, Uintah (Vernal), Emery (Castledale, two), Granite, Davis and Alpine. These workshops were coordinated in conjunction with affiliates Brigham Young University (Duane Merrell) and the Clark Planetarium. The total number of workshops was 10 which met our goal of conducting an average of 10 workshops/year during the 2010-2014 award periods.

Outcome 3: Informal Education program to form strategic partnerships/linkages

SMART Objectives

9: New partnerships were established with Alianza Academy, Salt Lake Center for Science Education, Salt Lake Arts Academy, Salt Lake Center for Science, Space Science Institute, and with Wasatch, Jackson and Woodrow Wilson Elementary schools. We facilitated more than our goal of four new STEM informal education partnerships this past year as stated in our objective.

10: We developed and distributed four sets of educational materials on-line and in hard copy. We met our objective to develop and distribute four sets of STEM educational materials. These educational materials covered the subjects of kinesthetic astronomy, density, volcanoes, scientific sampling, exo-planets, moon phases, solar system, general science and community resources.

The Clark Planetarium teamed with Dr. Cherilynn Morrow, of the Space Science Institute in Colorado, to combine curriculum on kinesthetic astronomy and package it for Utah teachers. As part of the "Girls Retreat of Wisdom" (GROW) program at Utah Valley University, two female students were mentored and prepared STEM/NASA materials to present at area high schools. Curriculum and classroom kits used in

interdisciplinary field trips geared to 5^{th} – 12^{th} grade students were developed by The Leonardo. These lesson plans are tied directly to the Utah State Core Curriculum and are currently available for download on The Leonardo education website (www.theleonardo.org/learning). All resources available from The Leonardo will be shared with teachers and then distributed to the greater education community through marketing efforts, monthly educator nights, and the mentoring that takes place in the classroom and on-site. A set of educational materials, including moon phases and the solar system, was developed and distributed to middle schools in the Logan and Cache School Districts for use in the classroom.

Management

SMART Objective

11: The organizational structure of the consortium has continued to have one Space Grant/EPSCoR Director/PI and one University Sponsored Projects Office Director as the two formal points of administrator contact with the NASA HQ Space Grant/EPSCoR Office.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- ***Student Data and Longitudinal Tracking***: Our Consortium collects required student data from each student when they apply and again when each award is made. Since 2009, our Consortium has been utilizing the services of the National Space Grant Foundation for longitudinal tracking. We have continued to work closely with the foundation staff to report all student award information. Total awards = 69; Fellowship/Scholarship = 65, Higher Education/Research Infrastructure = 4; 38% of the total awards represent underrepresented minority F/S funding. During the FY11 program year, one student is pursuing an advanced degree in a STEM discipline, one student accepted a STEM position at a NASA contractor, one student accepted a STEM position in industry, and three students accepted STEM positions in academia. The remaining students have not yet received the degree that they were pursuing while the received their Space Grant award.

- ***Diversity:*** Our Consortium made a goal to increase diversity in FY 2011 by targeting more awards to female and minority faculty and students. All of our research universities (University of Utah, Brigham Young University and Utah State University) allocated a certain portion of fellowship/scholarship and higher education funding toward this effort. This has resulted in above-average percentages of female and minority students in our reporting this year. During FY 2011 we awarded 65 fellowships and scholarships. Thirty-one of these were awarded to female students (48%) and 25 were awarded to minority students (38%). Utah's largest minority sub-population is Hispanic (13% according to 2010 census). In FY2011, we funded eight Hispanic students (12.3%) and have a goal to target this diverse group more in the future.

- ***Minority-Serving Institutions:*** There are no designated minority-serving educational institutions in Utah. However, Weber State University and Salt Lake Community

College have large Hispanic student populations with whom we have joint activities. Also, we collaborate with Hampton University (HBCU) on NASA research projects.

- ***NASA Education Priorities:***
  - ***Authentic hands-on student experiences in STEM***. A female graduate student worked to develop a new algorithm for processing synthetic aperture radar (SAR) data based on factorizing the backprojection algorithm. A practical learning experience was created and implemented for students to design, assemble, and test a solar energy system for generating, controlling, and storing electric energy on a tethered blimp. The team designed, fabricated and flew a high-resolution multispectral imaging system, known as the Integrated Camera Unit (ICU). This system used a cold gas annular aerospike with secondary injection points to control the pan aspect. A team of five students had a successful flight of their boiling heat transfer experiment as part of NASA's Reduced Gravity Student Flight Opportunities Program which allows students to test microgravity experiments in NASA's "weightless wonder" aircraft. Our Consortium continues to seek out opportunities to award hands-on student experiences in the STEM fields.

  - ***Engage middle school teachers in hands-on curriculum development***. Our consortium was a team member of the multi-consortium Summer of Innovation pilot program which successfully engaged numerous middle school teachers with hands-on curriculum enhancement experiences, materials and capabilities. Our involvement with the Summer of Innovation program gave increased contact with middle school teachers and students throughout the State of Utah. Due to the increased resources and collaborations amongst middle schools, we were able to provide ten teacher workshops in FY 2011, giving middle school teachers training and hands-on curriculum material for their classrooms.

  - ***Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.*** Utah Valley University's Center for Equity in Education ran two large STEM outreach programs this year. The Expanding Your Horizons program was for local senior and junior high schools in which STEM subjects were presented to female secondary students. The Empowering Your Tomorrow program is similar in that it targeted male secondary students. Westminster College ran an AWE+SUM summer math camp for female secondary students from local high schools to expand their knowledge of math and interest them in pursuing these careers in the future.

  - ***Community colleges.*** Our consortium has three community college affiliates: Salt Lake Community College, Snow College and Utah College of Applied Technology (UCAT). These three colleges were involved with higher education programs at their institutions to expand opportunities for students in the STEM fields.

- ***Aeronautics research***. The consortium is fully engaged in the aeronautics curriculum and applications by staff and students. This year it included pilot training, ground maintenance, and flying aircraft-borne imagers, both optical and radar, for research purposes. The Hill Aerospace Museum, an affiliate of our consortium, promoted aeronautics to teachers and students.

- ***Environmental Science and Global Climate Change***. Graduate students in our consortium analyzed NASA data derived from the TIMED satellite, which specifically addresses the earth-sun energy budget. NASA LaRC made the multispectral and derived atmospheric data available for over more than a full half-solar-cycle to identify trends.

- ***Diversity of institution, faculty and student participants***. Our consortium consists of three education and research universities, one industrial firm, eight educational institutions, three government centers, and four outreach institutions. Together, all of the affiliates contributed the necessary elements toward the success of all three NASA Education outcomes and objectives. We added diversity to our affiliate board of trustees by adding more female participants and we gave an increased focus to diversity of faculty and student participants through our SMART objectives in FY2011.

- ***Enhance capacity of institutions to support innovate research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.*** Our consortium increased its efforts to support innovate research infrastructure activities to early career faculty by advertising research infrastructure project funding through the college of engineering. As a result, we funded three new projects this past year to help faculty focus their research toward NASA priorities and to help them prepare proposals for additional outside NASA funding. An example of this was our support of a female faculty member at the U of U who later submitted a proposal to NASA entitled, "Terrestrial Analog Preservation of Habitation as Observed in Sediments (TAPHOS)."

IMPROVEMENTS MADE IN THE PAST YEAR

In 2011, the management structure of our consortium was improved and became more efficient. The education administrator and the program coordinator now report directly to the director of the consortium. Our consortium also underwent an internal review with the call for proposals for a new director. As part of this process, we heeded advice from Diane DeTroye and took a close look at how our consortium was doing as a whole. All 19 affiliate trustees in our Consortium were involved in the evaluation. In going through this process, we re-focused our NASA Space Grant goals and objectives on Outcome 1, and revised our budget to give appropriate level of costs to the most significant programmatic elements. As a result of management becoming more efficient, management costs were reduced significantly and more resources were allocated towards Outcome 1 with fellowships, research infrastructure and higher education.

We set up a new system with our contracts office to improve the subcontracting process with affiliates. We were better able to track the awards to our affiliates and reduce the time it takes to get them the funding upon receipt of award at the prime institution. This new system improved communications between the lead institution and the affiliate members of our Consortium.

We continued to improve the process of verifying space grant and matching funds allocated at each affiliate. Invoices from affiliates for subcontracts now require receipt documentation as well as matching documentation with each submittal.

In 2011, as part of the process to obtain a new director effective 1 September 2012, we formulated a plan to implement improvements for years 3-5 in the following areas: (1) we brought our percentages of expenditures in Outcomes 1, 2 and 3 into alignment with the national average for NASA Space Grant Consortia; (2) we revised our management structure, making our consortium more efficient and reducing management costs; and (3) we increased our efforts in the areas of diversity and made our student awards to 40% females and 30% minorities. As a result of a new director and the changes above, we would like to change some of our original SMART objectives (set in 2010) to be more in alignment with our budget change for years 3-5. The following changes to SMART objectives are proposed.

SMART Objectives (proposed changes for years 3-5):

1: Increase the percentage of our Space Grant Fellowships and Scholarships given to female students from an average of 32% in 2005-2009 to 40% in 2010-2014. Increase the percentage of awards to minority students from an average of 27% in 2005-2009 to 30% in 2010-2014. This will maintain greater diversity in our Space Grant program compared to the demographics of the State, where 23% of the students are female and 13% are minorities. This will keep our percentages well above the NCES Digest Statistics, where 22% of the students are female and 11% are minorities.

2: a) Improve the process throughout the Consortium by which Fellowships are announced, applications solicited, applications competitively reviewed, awards made, administered and tracked. Our Consortium web site will be revised to have application links from each of the three research universities: U of U, BYU, and USU, so that student applicants can see the specific requirements set forth from these three affiliate institutions. b) From 2005-2009 we awarded an average of 22 Fellowship awards each year. In 2010 we plan to award 17 Fellowships at the graduate student level. All of these awards will be above $5,000 tracking level. The number of Fellowships awarded in 2010 is less than in 2009 due to the total Space Grant funding in 2010 being $575 K rather than $785 K in 2009. c) From 2005-2009 students and faculty published an average of 34 scientific reports each year. From 2010-2014 we plan to publish an average of 34/year.

5: Increase the number of research infrastructure minigrants awarded to junior faculty members of our Consortium as an investment in their space-related

research and career development. From 2005-2009 we made an average of 2 awards. In 2010 we plan to make at least 5 awards to junior faculty members.

6: In 2010 we proposed to fund 11 student internships each year at NASA Centers. In 2012-2014 we propose to award four student internships each year (stipend plus round trip travel) to participate in summer research at NASA centers.

11: Provide one single point of contact for our consortium, namely Dr. Joseph Orr, Director/PI. Our Education Administrator and Program Coordinator will report directly to Dr. Orr and help facilitate all consortium activities, including reporting, proposal preparation, and responding to NASA's requests.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Education and Research Universities:
(1) Utah State University provides graduate student mentors in space vehicle propulsion.
(2) University of Utah provides graduate student mentors in life sciences.
(3) Brigham Young University provides graduate student mentors in remote sensing.

Industry:
(4) ATK Aerospace Systems provides internship opportunities and workshops for women.

Education Institutions:
(5) Weber State University delivers a summer outreach program for women.
(6) Southern Utah University provides undergraduate and graduate student mentors in the STEM fields.
(7) Snow College is a two-year college which prepares students to go onto a four-year university in the STEM fields; they also work with the K-12 schools within their region.
(8) Dixie State College is a four-year college which focuses on preparing K-12 teachers in biology and physical sciences in our Higher Education programs.
(9) Utah College of Applied Technology emphasizes the importance of technical training and improving skills in the workplace today.
(10) Salt Lake Community College provides mentors for undergraduate minority students in physics and astronomy.
(11) Westminster College provides a summer program for precollege women students.
(12) Utah Valley University provides mentoring for physics students to assist K-12 teachers in the STEM fields.

Government Centers:
(13) Idaho National Laboratory provides summer internships for students.
(14) Space Dynamics Laboratory provides matching funds and internships for students in space vehicle propulsion.
(15) Hill Air Force Base conducts teacher workshops and also provides tours and information for the public as informal education.

Outreach Institutions:
(16) Clark Planetarium provides teacher workshops and outreach to the community.
(17) Aerospace Heritage Foundation of Utah/Hill Aerospace Museum provides teacher workshops and public outreach.
(18) North American Native Research & Education Foundation conducts Summer of Innovation workshops for Native Americans.
(19) The Leonardo science center provides public outreach and internships.