

New Hampshire 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 New Hampshire Space Grant Consortium (NHSGC) is a Designated Consortium funded at a level of \$730,000 for fiscal year 2008.

PROGRAM GOALS

The strategic goal of the NHSGC is:

To stimulate and enhance awareness and understanding of our nation's continuing quest into Space by providing
1) Support to New Hampshire's college and university students in Space-related fields; 2) Space-related educational materials, programs, and resources to the State's educators; and, 3) Greater access to Space-related information and technology for the benefit of the State, its businesses, and citizens.

The NHSGC pursues this goal across a broad front of programs, with particular emphasis in the following areas, as related to Outcomes 1, 2, and 3:

- Outcome 1 – Providing NASA competency-building education and research opportunities for faculty and researchers within the State. Developing new NASA-related course resources for integration into STEM disciplines in the State's higher education system. Providing fellowships, scholarships, and internships to the State's graduate and undergraduate (including community college) students pursuing studies in NASA-relevant science, technology, engineering and mathematics (STEM) disciplines. At all levels, support is connected strongly to mentored research experiences for students. Awards also address the established need for a larger, more diverse U.S. technical workforce.
- Outcome 2 – Providing resources, information, and training to the State and region's educators in science, math, and technology. At the K-12 level, specific emphasis is placed on teacher/student activities incorporating realistic, "hands-on" experience, in support of State and national guidelines for science, math, and technology curricula.
- Outcome 3 – Creating increased access to NASA-relevant science and technology through informal educational institutions and other programs oriented towards the general public. The intrinsic appeal of Space exploration is utilized as a means to attract larger and more diverse audiences. Access to NASA-relevant geospatial technologies and their applications are enhanced.

PROGRAM/PROJECT BENEFIT TO OUTCOME 1

The **Plymouth State University** (PSU) awarded three scholarships to undergraduate meteorology majors, and six fellowships to meteorology graduate students (four of these to women). **Dartmouth College** awarded fellowships to 33 students: 23 undergraduate students and 10 graduate students (69% of the fellowships went to women). The fellowships were awarded in the Departments of Physics and Astronomy, Engineering Sciences, and Earth Sciences. The **Community College System of New Hampshire** (CSSNH) achieved its goal of the "Space Challenge Grant" by securing a matching donor for scholarships and then awarding 26 undergraduate scholarships to 21 promising students in STEM disciplines, including Mathematics, Energy Science, Biotechnology, and Math & Science Teaching. The **University of New Hampshire** (UNH) awarded five graduate fellowships (80% to women — one of whom is Native American) to UNH students in Physics, Earth and Environmental Science, Computer Science, Remote Sensing and Natural Resources. Although no undergraduate scholarships were awarded to UNH students this year, UNH space grant funding provided two full undergraduate scholarships to students at the HBCU Elizabeth City State University through the ECSU Center of Excellence in Remote Sensing Education and Research. The ECSU students are majoring in computer science and industrial technology. This year they are working on the Polar Grid for ECSU, which includes the installation of a 64-node computer cluster. One of the major goals of the Polar Grid project is to interconnect partner institutions through a virtual conferencing solution.

Two undergraduate meteorology students accompanied a faculty mentor from **Plymouth State University** (PSU) to Kennedy Space Center/Cape Canaveral Air Force Station to continue a research project (started in 2005) on convective winds.

The Women in Science Project at **Dartmouth College** supports first- and second-year women in part-time research internships across the Space Grant disciplines in order to deepen their initial science interests prior to choosing a major and to connect them with faculty early in their college careers. During the 2008-09 fiscal year, WISP supported 15 first and second year women who were supervised and mentored by space grant researchers; 8 worked in the Department of Physics & Astronomy, 6 in the Department of Earth Sciences, and 1 at the Thayer School of Engineering. NASA-supported WISP interns prepared and presented research posters, along

with 90 other undergraduate researchers who participated in the annual Karen E. Wetterhahn Science Poster Symposium in May 2008. This annual symposium showcases the wide range of undergraduate research at Dartmouth College and provides essential skills development for aspiring young scientists.

Space Grant funding played a critical role providing infrastructure to the "Greencube" Project, a new initiative at **Dartmouth College** whereby undergraduate students launch instrumented balloons at intervals of 6 to 12 months. The program has been extremely successful and has moved beyond the infrastructure and testing phase, with 12 students involved in the most recent launch (Fall 2008). The program was started with Space Grant support but has since achieved external funding — a real success story.

Space Grant resources for research infrastructure were used to generate the maps and supporting documents required for the lengthy approval process for the Edward N. Lorenz Weather Station on Mount Tecumseh by the **Margret & H.A. Rey Center**. The station utilizes a cellular modem to transmit meteorological data to the Rey Center base station located in Waterville Valley. The data are an important component to the Rey Center's research transect and will allow them to delineate and monitor thermal units necessary for predictive phenology models. This integrated dataset will be utilized as reference measurements to calibrate computer models based upon remote sensing data and will aid in increasing the spatial accuracy of these models. The data gathered from the station can also be compared with other regional meteorological data collection centers such as the Mount Washington National Observatory. This comparison serves to contrast differences in micro-climates that occur across a topographically dynamic landscape.

The **Mount Washington Observatory** supported a PSU post-graduate in an internship to give him greater familiarity with meteorology and climatology. He was made familiar with the instruments and observational techniques used for hourly observations to National Weather Service standards, and was also assigned a specific project, to assess calibration and verification issues associated with the Observatory remote instrument sites located at one-thousand foot elevational intervals on Mount Washington. He has gone on to graduate studies at North Carolina State University.

PROGRAM/PROJECT BENEFIT TO OUTCOME 2

Space Grant supported two **University of New Hampshire** faculty-mentored **FIRST** Robotics teams. Since its foundation in 1992, Manchester NH's Central High School's FIRST Robotics (formerly U.S. FIRST) Team has been impacting the lives of participating students from Manchester, Hooksett and Candia, NH. This team is actively involved in community service, and each 'off season' the CHAOS team takes on some sort of public service activity. This past summer and fall, CHAOS worked on Freeman, a square dancing robot. Robots constructed by the team have been consistently successful at regional competitions, held at the Verizon Center in Manchester, Boston University, and Worcester Polytechnic Institute.

The NHSGC supported **Dartmouth College** Spatial Data Specialist worked with a variety of groups to perform outreach projects using remote sensing and GPS technology. She used GPS to introduce latitude and longitude to a local Girl Scout troop using both indoor map reading and outdoor hands on exercises. She expanded these exercises while working with the Earth Sciences students at Hanover High School. At the university level, the Spatial Data Specialist lectured in and worked with students in classes exploring the polar regions and environmental problem analysis and policy formulation as well as working with the Office of Planning Design and Construction to map campus features using differential GPS. Additionally, she attended the First Expert Group Meeting on Flood Hazard Mapping at the World Meteorological Organization in Geneva, Switzerland and gave a presentation titled "Satellite-based Flood Detection and Flood Risk Assessment."

UNH **Cooperative Extension** utilized Space Grant resources to support two activities during the past year through the State's Geographically Referenced Analysis and Information Transfer (GRANIT) laboratory: (1) Geospatial intern — During the summer of 2008, a student from New Hampshire joined GRANIT at UNH to work on a variety of geospatial projects over the two-month period. (2) MapPros! Website — The MapPros! website (<http://www.geospatialcareers.net>) educates students about geospatial career opportunities. The main focus of the site is a series of profiles of geospatial practitioners and students in geospatial technology programs.

The **Mount Washington Observatory** supported a middle school science teacher from Moultonborough Academy, giving him a unique hands-on learning experience at the Observatory's summit weather and research station atop Mount Washington.

Water Watchers is a volunteer water quality monitoring program co-sponsored by the **Margret and H.A. Rey Center** and the **Plymouth State University** Center for the Environment, and in partnership with the **NH Department of Environmental Services Volunteer River Assessment Program**. Volunteers measure pH, turbidity, conductivity, water temperature, and dissolved oxygen in the field. Collected water samples are sent to Plymouth State University Environmental Research Lab and analyzed for phosphorous, E. coli, and chloride. Together, these parameters give a measurement of the current health of the region's rivers. Developing a long-term data set will enable us to see trends in our water quality, which will help us to determine if the overall health of our rivers is stable.

The **University of New Hampshire**-based *Forest Watch* Program continues to expand across New England. Over 250 schools have been active in the program since its inception in 1991. Presently there are 221 active schools in the program comprised of 27

elementary schools, 76 middle schools, 104 high schools, 2 post secondary, and 12 organizations. Of the 221 active Forest Watch teachers, 85 are male and 136 are female. This past year's activities included a teacher workshop at Miami Beach Senior High School, using the *Forest Watch* program model over a two-day period. The teachers were assisted in the development of an environmental monitoring outreach program focused on beach erosion, sea turtle nesting habitat, and mangrove habitat monitoring. The Florida program, to be called *World Ocean Watch*, will use the *Forest Watch* model to address coastal environmental concerns in southern Florida.

PROGRAM/PROJECT BENEFIT TO OUTCOME 3

From March through December of this past year, 46,998 people participated in **Christa McAuliffe Planetarium (CMP)** programs supported in whole or in part by this year's Space Grant. This included the Spacetacular Saturday aerospace fair (May 3, 2008), which drew 426 people of all ages. **PSU** faculty and a SG-supported graduate student participated in this May event by launching several instrumented weather balloons for the public that attended the event. **UNH** faculty and staff participated in the CMP special exhibits and lectures honoring NASA's 50th anniversary.

In addition to presentations at schools, the **Mount Washington Observatory's** outreach educators participate in educational activities in informal settings. Some of the programs are day or immersion experiences on Mount Washington, or at the Observatory's summit and valley (Weather Discovery Center) museums; others take place off-site at libraries, service clubs, and other venues. Among the special activities this year was the Science in the Mountains 2008 program, offered in July and August at the Weather Discovery Center. This program featured live, interactive video conferences with science centers and research sites across the country and around the world.

Success Stories:

- As evidence of the impact that *Forest Watch* has had on K-12 students, this past summer (July 7-11, 2008) two groups of *Forest Watch* students and their teachers presented their latest research findings at the International Geosciences and Remote Sensing Symposium (IGARSS'08) meetings at a Poster Session. One group consisted of four middle school girls from Gilmanton Middle School (Gilmanton, NH) and the other was a group of four high school students (two boys and two girls) from Sant Bani School (Sanbornton, NH). All of the students were very impressed and excited by their participation in IGARSS'08, and the scientists attending their poster session (2,100 total participants) were very surprised by the fact that such young students had conducted such advanced technology-based research.
- A Dartmouth undergraduate, supported as a NASA Summer Academy intern, was paired with mentor C. Michael Holloway (c.m.holloway@nasa.gov) from LARSS. She conducted research during the summer of 2008 at LARSS, presented a poster and wrote a paper for the LARSS summer intern poster session. The title of both her poster and her paper was, "Warning! Hazards in Safety-Critical Avionics Systems." Her research investigated the safety and security risks posed by automated aircraft systems. The student will graduate in June 2009 with a Bachelor of Arts degree in Computer Science. She has accepted a job, following graduation, as a Software Engineer Associate at Lockheed Martin in San Diego, CA. Her intention is to work in the area of computer security. She chose Lockheed Martin specifically to work on security issues within space sciences. Concurrent with her work, she plans to pursue a Masters degree through a Lockheed Martin program. Her longer range plans are to attend graduate school full-time for a doctorate.
- In tracking this and last year's Space Grant PSU graduate student recipients: one is now employed as an air quality meteorologist with the Maryland Department of Environmental Services, another is now working for a weather company in Norman, Oklahoma, and a third is now employed as a civil servant with the NOAA National Environmental Satellite Data Information Service (NESDIS). All of the PSU undergraduate scholarship recipients also stayed in STEM disciplines. One is now a graduate student in the Atmospheric Sciences Program at SUNY Albany and also won an AMS/Industry Graduate Fellowship. Two others are now graduate students in the MS Meteorology Program at North Carolina State University. Another is a graduate student in the Climate Program at the U. of Maine at Orono. Another former PSU undergraduate, who served as the 2007 CMP summer intern with Space Grant support, is now in the PSU Graduate Meteorology Program.

PROGRAM ACCOMPLISHMENTS

The key NHSGC accomplishments over the last grant year include:

Outcome 1

- Major awards were provided to state college/university and community college students totaling 70 scholarship/ fellowships/ internships/ higher education research opportunities for students. Of these awardees, 62.9% were female and 7.1% were under-represented (excluding Asian) minorities. These numbers exceed consortium goals for minority representation (5.0%), and for female participation (40%).
- Support was provided to 2 undergraduate students at a Historically Black College/ University participating in STEM-related programs.
- 5 undergraduate students were sponsored for NASA Academy internships at NASA Centers Langley, Ames, and Marshall. 3 other undergraduate students participated in a faculty-mentored summer research program at KSC/CCAFS.
- Opportunities were provided for students and faculty to participate in advanced seminar and research experience activities, including the Space Plasma Physics Seminar at Dartmouth College, and a speaker to a course on "Indoor Air Quality" at Lakes

Region Community College. 3 PSU undergraduates attended the 2009 Annual American Meteorological Society (AMS) Meeting (Phoenix, January 2009), where they presented their research findings.

- 2 science course alternatives were provided through UNH and FIRST Place for pre- and in-service elementary teachers. Two new STEM courses were developed in the Community College System.
- Student training was supported in space hardware/software skills in *Greencube* and through student travel support to the Small Satellite Workshop (Utah, 2008).
- 2 MWO staff scientists received training in GIS for applications in air quality and climatology studies, and related terrestrial ecology studies.
- Space Grant supported the establishment of the Edward N. Lorenz Weather Station on Mount Tecumseh by the Margret & H.A. Rey Center, as well as providing support to the Tecumseh Vegetation Phenology Research Transect.
- The NASA Space Grant/PSNH scholarship program is a partnership of CSSNH with Public Service of New Hampshire, the State's largest electric utility, serving more than 490,000 homes and businesses throughout the State. PSNH has committed \$70,000 to date to the program since its inception in 2000.
- Longitudinal tracking was generated for significant student awards (Outcome 1) provided since 2006. The percentage of students that have taken their next step and have been successfully tracked through their next step, are: 100% for 2006; 100% for 2007; N/A for 2008 – none have taken next-step.

Outcome 2

- Space Grant supported the initiation by the Margret & H.A. Rey Center of the school- and community-based Water Watchers program.
- Support was provided for statewide GIS educational activities through Dartmouth, UNH and UNH Cooperative Extension, including GIS Day and the Spatial Data Specialist.
- Forrest Watch was supported. Two FIRST Robotics high school teams were supported. Project SMART was not supported, due to insufficient participant registration.

Outcome 3

- Outreach activities were supported by PSU, UNH, Dartmouth, MWO, and CMP, including Spacetacular Saturday, and public lectures by Space Grant associated scientists.
- Development for two planetarium shows at CMP was supported, including creating related supplementary standards-based education materials.
- Space Grant-supported CMP staff training included participation in the NSF-sponsored *Astronomy from the Ground Up* seminar for ISE educators (an educational collaboration of the Astronomical Society of the Pacific, National Optical Astronomy Observatory and Association of Science-Technology Centers); meetings with NASA's disabilities staff and heads of education for NASA HQ and GSFC on setting up a national advisory committee to help with the CMP program design and evaluation; participation in The Great Planet Debate at Johns Hopkins Applied Physics Lab and at the Association of Science-Technology Centers.
- Planetarium exhibits began augmentation to make accessible under Section 504 requirements.
- 2 internships were provided at the Planetarium.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- **Longitudinal Tracking:** For FY08, NHSGC provided 37 significant awards (Table B), 35 in F/S and 2 in Higher Education/Research Infrastructure. Of these, 20 (54.1%) were awarded to Females and 4 (10.8%) to underrepresented participants. For those students that were significantly supported from FY 08 funds, all are still enrolled in the degree that they were pursuing when they received their Space Grant award. For all students that were significantly supported in the period spanning FY06-FY08, 5 students graduated and are pursuing advanced STEM degrees, 3 students are working for NASA contractors, 4 students accepted STEM positions in industry, 4 are working in STEM positions at non-K-12 academic institutions, and 1 is working in a non STEM field. The remaining students have not yet received the degree that they were pursuing at the time they received their Space Grant award.
- **Course Development:** Four new courses were developed (2 at UNH, two at CSSNH) targeted at the STEM skills needed by NASA.
- **Matching Funds:** The Year-4 budget for the NHSGC contained \$777,623 in non-federal matching funds; well above the requirement for matching non-fellowship NASA funding.
- **Minority-Serving Institution Collaborations:** Space Grant at UNH maintained its initiative with Elizabeth City State University, an historically black university (HBCU) in North Carolina, by continuing scholarship support for two ECSU undergraduate students with potential interest in declaring a major in a STEM discipline.

IMPROVEMENTS MADE IN THE PAST YEAR

Statewide awareness of the CCSNH NASA Space Grant/PSNH Scholarships was increased over the previous FY, with more colleges in the System participating. This was achieved through the production and enhanced distribution of updated pamphlets, press releases, and print advertising. Electronic communication and the website were used to bring awareness to college Presidents, financial aid directors, department heads, and targeted career high schools of the availability of System educational opportunities in NASA disciplines and inform students about STEM career opportunities.

Community involvement in environmental monitoring was greatly enhanced by the Rey Center Water Watchers program. The Rey Center also established Curious Kids and Curiosity Club for Home-Schoolers as programs built on the success of NHSGC supported endeavors. Curious Kids follows in the Rey Center commitment to community outreach by providing families with a place-based outdoor exploration focused on natural history. Curiosity Club for Home-schoolers uses literature, journaling, art, and hands-on science to help home schooling families meet the educational needs of their children.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

- The NHSGC has ten members. The lead institution is the University of New Hampshire, with associate Dartmouth College, and affiliates FIRST Place, the Community College System of New Hampshire, the Christa McAuliffe Planetarium, UNH Cooperative Extension, Plymouth State University, the Mount Washington Observatory (added in 2006), the Rey Center (added in 2007), and BAE Systems of North America (added in 2007)
- The University of New Hampshire (UNH), is the state's flagship research university, enrolling 11,600 undergraduates and 2400 graduate students. Research and PhD programs relevant to aerospace are offered in physics, engineering, math, computer science, and a cross-college program in natural resources and Earth system science.
- UNH Cooperative Extension provides NH citizens with research-based education and information, enhancing their ability to make informed decisions that strengthen communities, sustains natural resources, and improves the economy. Space Grant collaborations are in the areas of geospatial technology and applications, resource management, and workforce development.
- Dartmouth College, is a private liberal arts college and a member of the Ivy League. The college has 4,100 undergraduate students, 1,600 graduate students, and 600 tenure/tenure-track faculty. Aerospace-related undergraduate and doctoral degree programs are offered in physics and astronomy, engineering, computer science, and Earth science. Extensive research is conducted in solar-terrestrial physics, astronomy, satellite remote sensing, robotics, and computer science applications.
- The Community College System of New Hampshire (CCSNH, formerly the New Hampshire Community Technical College System) is New Hampshire's statewide system of two-year colleges, offering associate degrees, professional training, and transfer pathways to four-year degrees. CCSNH is comprised of seven colleges within the state: Great Bay Community College in Stratham; Lakes Region Community College in Laconia; Manchester Community College in Manchester; NHTI-Concord's Community College in Concord; Nashua Community College in Nashua; River Valley Community College in Claremont and Keene; White Mountains Community College with locations in Berlin, Conway, Littleton, and Woodsville. CCSNH is the primary provider of skilled workers and technicians in the State. Space Grant supports a NASA scholarship program for STEM students, linked to the private sector and also supports STEM curriculum development within the college system.
- Plymouth State University (PSU), is part of the University System of New Hampshire and has a current student enrollment of about 4200 undergraduates and 2600 graduate students. Space Grant funding provides research-oriented scholarships and fellowships in the meteorology program, with an emphasis on providing support to women undergraduate students.
- FIRST Place is an innovative R&D facility in Manchester, NH, linked to Dean Kamen's nationwide FIRST Robotics Competition. It provides students, teachers, and the general public an encouraging environment for exploring concepts of science and technology. FIRST Place collaborates with UNH in curriculum development for pre-college science teachers. UNH and BAE Systems provide mentors and support for NH school teams involved in FIRST competitions.
- The Mount Washington Observatory (MWO), is a non-profit organization providing environmental observation and education while supporting scientific research. Current research projects address summit weather and climate, regional air quality, and global tropospheric chemistry. MWO, UNH, and PSU work together on many activities, including internships and research projects.
- The mission of the Christa McAuliffe Planetarium (CMP), located in Concord, NH, is *to educate, incite, and entertain learners of all ages in the sciences and humanities by actively engaging them in the exploration of astronomy, aviation, and Earth and space science*. As many as 60,000 school children and other visitors explore the Planetarium annually. The Planetarium is NASA's Educator Resource Center for NH. Space Grant supports the development of Planetarium shows and exhibits, teacher workshops, and space science fairs; often in collaboration with other NHSGC affiliates.
- The Margret and H.A. Rey Center provides initiatives in environmental stewardship and informal educational programs in the astronomy and local ecological systems. NHSGC resources are used by the Rey Center to initiate several citizen science community outreach programs and cooperative research initiatives. Among these are the Tecumseh Overnights Program, Tecumseh Vegetation Phenology Research Transect, the Lorenz Weather Station, and the Water Watchers water quality monitoring program.
- BAE Systems is part of an international company that develops and supports advanced defense and aerospace systems, and is headquartered in Nashua, NH. As our first industrial partner, BAE Systems provides internship opportunities for undergraduate and graduate students from our consortium's academic institutions. BAE Systems also supports and mentors teams for FIRST Robotics, FIRST Tech Challenges, and FIRST Lego League.