

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 NH Consortium is a Designated Consortium funded at a level of \$845,000 for fiscal year 2010.

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.*

Particular emphasis and priority is given to the following objectives:

- Providing fellowships, scholarships, and internships to the State's graduate and undergraduate (including community college) students pursuing studies in NASA-relevant science, engineering, and technology
- Providing resources, information, and training to the State's and region's educators in science, math, and technology
- Creating increased access to NASA-relevant science and technology through informal educational institutions and other programs oriented towards the general public
- Providing support for community colleges
- Creating a greater impact on recruitment of underrepresented groups
- Providing pre-service and in-service science teacher training

- Supporting informal education/public service programs
- Fostering New Hampshire's new EPSCoR projects

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

Outcome 1: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals

Dartmouth College, the University of New Hampshire (UNH), Plymouth State University (PSU), and the Community College System of New Hampshire (CCSNH) provide higher education graduate fellowship and undergraduate scholarship opportunities:

Space Grant provided a graduate student fellowship in the Physics Department at Dartmouth College to a student who conducted complicated field operations in Alaska in fall, 2010. By himself, he visited Toolik Lake, which is along the pipeline highway roughly halfway between Fairbanks and the Arctic Ocean, where he upgraded and calibrated radio receivers measuring radio waves of auroral origin. Then, back at Fairbanks, he worked together with staff to erect, tune, and calibrate four riometer antennas looking for higher frequency radio noise of auroral origin. This unusual opportunity gave this student particularly effective fieldwork training. He plans to take another trip to Alaska in March 2011, to support an ionospheric modification campaign being conducted at the HAARP facility. Space Grant at Dartmouth also supported a 1st year Ph.D. in her work on deriving neutral winds from mid-latitude radars and a 3rd year Ph.D. student in her work on interhemispheric comparisons of high-latitude convection electric fields. This latter student published two first-author papers and presented her work at three different conferences. In the Department of Earth Sciences, one graduate fellowship was awarded.

The University of New Hampshire funded four one-year Space Grant fellowships in the disciplines of Earth Sciences, Natural Resources, Ocean Sciences, and Mechanical Engineering. In addition to their research activities, these fellows participate in outreach efforts. This past year, this included the WIST Forum in Manchester, workshops for summer interns at UNH, and a workshop for Girl Scouts hosted by UNH. Two other fellowships begun in the previous year had continued funding into the current reporting period.

Space Grant scholarships support three STEM discipline (math, computer science, and remote sensing) undergraduates from the minority serving institution Elizabeth City State University. One student will graduate in December 2011. He plans to return to UNH for an internship this coming summer while exploring his graduate admission options, which includes graduate school at UNH. The second sponsored undergraduate has indicated that he will apply for admission to graduate school at UNH. The third is a sophomore, who is participating in the UNH Undergraduate Research Conference Interdisciplinary Science and Engineering Symposium.

Five undergraduate scholarships and one graduate fellowship were provided to meteorology majors at Plymouth State University (PSU). The academic and research (if applicable) progress of all supported students at PSU are routinely reviewed. All students all maintained GPAs well above 3.0. Two seniors are now actively involved in senior research projects. One is working on sea breeze problems and is planning on graduate school. The other is working with the National Weather Service (NWS) Meteorologist-in-Charge at the Nashua Regional FAA Center as part of the NWS Student Career Experience Program (SCEP) and is continuing what was started as her senior research project. The graduate student is preparing for work on convective wind research at Kennedy Space Center (KSC)/Cape Canaveral Air Force Station this coming summer.

The Dartmouth College, UNH, and PSU fellowship/scholarships programs also include travel support for a number of students, typically to conferences where they present their research. Travel included the American Geophysical Union (AGU) conference in December 2010; the Midwest Glaciology Meeting in Woods-Hole, MA; BISC 599: Advanced Microbial Physiology at the University of Southern California.

Space Grant at Dartmouth sponsors two awards given annually to selected graduate students in the space science or remote sensing fields, from among candidates nominated by faculty members. One award goes to a PhD student and the other to a Masters degree candidate. The goal is to encourage excellence among our students and giving the best students an award to list on their curriculum vitae. At least one of these awards is awarded every year and is quite competitive. Nominations are circulated to a panel consisting of one faculty member from each Space Grant department (Physics, Earth Sciences, and Engineering). The panel determines the award(s) based on the merits of the nominees. Excellence in research is the primary criterion, but departmental and community service and teaching are also considered. Typically at least one panel member has served on the previous year's panel, to provide continuity in judging the criteria. The recipients will be chosen later this year.

The Community Colleges of New Hampshire Foundation is the entity for managing the funds and grants secured by all of the seven colleges within our New Hampshire Community College System (NHCCS). The Foundation's mission is to support the colleges by making higher education more accessible. In FY 2010-2011, the Community College of NH Foundation continued its popular "Space Grant Scholarship Challenge" by awarding undergraduate scholarships to promising students in STEM disciplines. The program is designed to promote and encourage enrollment in STEM technical degree and certificate programs within the seven Colleges with an emphasis on attracting minority and under-represented students. Public Service Company of New Hampshire (PSNH), has supported the Community College System as the business partner in this scholarship program for the past ten years, contributing over \$100,000 to-date and enabling 328 scholarships to be disbursed state-wide to community college students studying engineering or technology. The goal of both NH Space Grant and PSNH is to encourage careers in STEM disciplines and thereby contribute to the development of the STEM workforce.

Students in the following areas of study are eligible for these scholarships: mathematics, engineering, technology, and mathematics/science teacher education. A committee with one representative from each of the seven community colleges, plus the Foundation Executive Director, reviews the applications submitted by the students. In 2009-2010, the Foundation received 31 applications from 22 males, 9 females. The Foundation awarded 26 x \$1,500 scholarships to 21 students (some received both the fall and spring award) in two rounds of funding, fall 2010 and spring 2011. As well, the Foundation secured \$20,000 in matching business funds from Public Service of New Hampshire (PSNH), the state's largest electric utility. In presenting the gift, the PSNH representative said:

“We at PSNH believe that giving back to the community is both a responsibility and an investment in our future. PSNH understands the importance of higher education to develop New Hampshire's capable workforce; that is why we support initiatives that benefit the business environment while improving the quality of life for New Hampshire residents.”

Many Community College students are non-traditional learners, meaning they may have a family, a mortgage, and one or more workforce jobs. For these students, whose annual tuition averages between \$3,000-\$5,500, a \$1,500 scholarship goes a long way toward making higher education possible for them. Students are grateful for this financial assistance since it enables them to pursue their dreams. The students share many meaningful stories with the Foundation, such as:

“I am profoundly grateful for the generosity of the NH Space Grant Consortium. Your gift of scholarship money awarded to me allows me to be closer to my new career as a science educator. I must also express my family's gratitude. Because of your gift, they have the opportunity to witness their mother find a way to pursue her dream and successfully raise a family. The balance I am able to model for my children is indeed a life lesson. The PSNH/NASA Space Grant Scholarship is indeed allowing me the privilege to pursue my passion for educating our youth. I truly believe our future is with those girls and boys pursuing science and math careers.” *Kathy B. -- Bedford, NH*

“Thank you very much for the \$1,500 PSNH/NASA Space Grant scholarship. I am in my fourth semester of the Teacher Education Conversion Program, working towards certification to teach Mathematics for grades 7-12. ... I think that mathematics is a primary stumbling block for many people who might otherwise choose science as a career and that in order to encourage that choice, we need to address the manner in which math is taught. I intend to teach math in a way that fosters a future generation of scientists, engineers, and math and science teachers. Thank you for your continues support in this endeavor.” *Kim P. -- Chichester, NH*

“This scholarship has allowed me the opportunity to cut down one shift a week from my job at Chili's Bar and Grill. This will give me a chance to not run directly from class to work every day of the week. It has been very stressful for me to keep up with the financial burden of continuing my education. Your generous gift has lifted some of that burden. Without having the added stress of finances, I can concentrate more fully on my studies. I think more than the

financial help, the pride you have given me has made such a difference. To know that you have deemed me worthy of such recognition has been a huge factor in my morale. Your investment in my future has become a motivator during my studies!" *Erin M. -- Concord, NH*

"I am a non-traditional Electronic Engineering Technology student at NHTI with a passionate interest in robotics engineering and research. I am 16 years old, but I graduated from high school in the summer of 2009 and became matriculated EET student in the fall of 2009. Though my interests encompass the entire field of civilian robotics, I am particularly interested in the design of educational robotics systems and electronic systems for navigation in complex spaces. Until recently, the majority of my robotics knowledge has been self-taught. As a younger student, I recognized the importance of shared knowledge. I have been involved in the FIRST Robotics Competition for four years; I will soon be entering my fifth. The FIRST program, which is based upon a philosophy of professionalism and teamwork, has helped me to prepare for the prominent collaborative elements of my chosen field. I am currently in the process of starting a robotics company ... focusing on education and research robotics. I am also intrigued by the concept of navigation and mobility in low gravity environments. In conclusion, thank you for considering me for the scholarship. I am truly excited about my education and I hope that I can someday make an impact in the field of consumer and research robotics." *William H. -- Gilmanton, NH*

"This award will ensure that both my oldest son and I can stay in college. As a mother and a full time student, I also need to support my family of six. This scholarship will allow me to remain a full time student during my (unpaid) student teaching and complete my Science Methods class. A New Hampshire woman I would like to emulate is Christa McAuliffe. I want to encourage girls to be interested in exploring science as a career because the possibilities in science are limitless. I want them to be curious about all aspects of science including aerospace and rocketry. I want students to become critical thinkers and ask in their minds: "I wonder why?" My students will be encouraged to push the boundaries for new developments in aerospace, biotechnology, and energy to improve their lives and those of generations to come. As an educator, I will positively influence the next generation of students, who are still impressionable, and develop their skills to enable them to work in the future science careers." *Raya-Jean Z. -- Bow, NH*

Space Grant makes hands-on experience available to undergraduates and graduate students through a variety of internship and NASA summer academy programs, provided through PSU, Dartmouth, UNH, and the McAuliffe-Shepard Discovery Center (MSDC):

Plymouth State University (PSU) continues to collaborate with NASA and the Air Force by providing Space Grant funded summer internships with faculty participation at the Kennedy Space Center/Cape Canaveral Air Force Station. Full support was provided to one undergraduate student's summer research at the KSC/CCAFS and subsequent travel to present her research at the Student Conference of the Annual American Meteorological Society (AMS) Meeting in Seattle. A small amount of funding was also used to partially support another student's housing at KSC/CCAFS with the rest of his support and travel

provided by WSI Incorporated for a lightning research project of some interest to KSC/CCAFS. This student also presented a paper at the AMS Student Conference and a more extensive paper at the AMS Lightning Symposium at the AMS Annual Meeting. Two graduate students, primarily supported through funds from the last FY, completed their MS theses and traveled to KSC/CCAFS to present their final results to some members of NASA and Air Force weather staffs in late April.

Evaluation of the PSU-KSC/CCAFC internships is based on feedback from agencies supported by these research activities, feedback from conference presentations, and tracking the students in follow-on STEM-related education or professions. This was the first time that an upcoming junior was selected for the PSU - KSC/CCAFS research and she performed admirably and impressed the NASA and Air Force Meteorologists with her briefings. The same was true for the graduate student who is in the final stages of assembling his thesis from the research started at KSC/CCAFS. After briefing scientists at WSI Incorporated, they were surprised that he was only an MS student and not a PhD student, since they were impressed with the depth and quality of his research. Both students also presented the results of their research at the Cape Canaveral Chapter of the AMS. Two PSU student awardees from last year completed their theses and were awarded MS degrees. One is now working as a contractor at the NOAA Climate Data Center. The Air Force is in the process of adopting one of these student's radar techniques into their operations and is considering adopting the second student's research ideas after further evaluation this coming year.

Four engineering undergraduates received internships in two research programs at Dartmouth College. One intern gained experience as an "instrument manager," whose job was to keep track of one of Dartmouth's remote radio receiving sites in the Arctic, monitoring data daily, fixing problems, shipping parts and supplies as needed, and being in touch with the remote operator. Another three undergraduate student interns and a graduate student participated in building a large scientific radar in Central Oregon. Several students helped build components and several participated in the actual construction on-site. Space Grant at Dartmouth also funded a female student for the NASA Summer (2010) Academy at Marshall Space Flight Center.

Dartmouth also supported three graduate students in the process of scientific research in the Earth Sciences - 2 conference presenters and 1 through additional training. One student presented at the American Geophysical Union conference in San Francisco, CA and another presented at the Midwest Glaciology Meeting in Woods-hole, MA. The third student attended BISC 599: Advanced Microbial Physiology at the University of Southern California. He gained key insights into microbial physiology and was exposed to cutting edge research in the field of Geobiology. Three undergraduate physics students gained experience as interns in the Dartmouth Rocket Lab.

NH Space Grant funded a female UNH mechanical engineering major to participate in the *2010 National Helicopter Training Workshop* organized by the Connecticut Space Grant Consortium. The Lunabots team at UNH (the "Lunacats") received support for materials and supplies.

A *SURF* (Summer Undergraduate Research Fellowships) student was funded for a summer research internship at the UNH Space Science Center. The student used his SURF award over the summer 2010 to prepare the spare star sensor from the NASA IBEX mission for a sounding flight on Prof. Marc Lessard's RENU rocket. He re-calibrated the sensor for the sounding rocket electronics, the different motion of the rocket, and for anticipated star signals by making use of IBEX star sensor flight data and the calibration facilities in the UNH Magnetospheric and Ionospheric Laboratory. He also studied how the data would have to be analyzed for a slightly coning spacecraft. Unfortunately, the nose cone of the rocket didn't fully separate, and no flight data were obtained. Therefore, the student will use his expertise gained from the SURF studies to improve the star sensor analysis program for the analysis of the interstellar flow observations with IBEX. Currently, he is working on a Senior Thesis to be submitted in May 2011 based on his work. Our SURF student from 2009 wrote an Honors Thesis for his graduation in May 2010. He is now in his first year of graduate studies at the University of Alaska, Fairbanks.

Research internships for Women in Science Project (WISP) at Dartmouth provide first and second year undergraduate women with paid, part-time research opportunities with senior researchers. Internships are carried out and completed under the supervision of a sponsoring researcher, and interns present their research in a poster at the annual Wetterhahn Science Symposium in May. As an evaluation tool, interns are asked to complete pre-internship and post-internship questionnaires. Research sponsors are also asked to complete an evaluation at the conclusion of the internship. Between June, 2010-June, 2011, the NASA space grant supported 11 WISP Research Internships and costs associated with the Wetterhahn Science Symposium including poster printing and, in 2010, the keynote speaker, Dr. Fran Bagenal, Astrophysics Professor at UC Boulder. Dr. Bagenal gave an inspiring keynote address, "Erupting Volcanoes and Dazzling Auroras: Exploring the Planets", filled with spectacular visuals, fascinating science and humorous anecdotes. She also had opportunities to meet informally with students and faculty throughout the day.

WISP also contributed NASA space grant funds to support the Leadership, Equality and Diversity (LEAD) Symposium on Women in Science and Medicine organized by Dartmouth graduate and medical students to promote the advancement of women in science and medicine. LEAD attracted over 200 registered students, faculty, staff and community members and featured nationally recognized keynote speakers: Dr. Joan Herbers, AWIS president, Dr. Michele Cyr, a member of Brown's ADVANCE grant steering committee, Dr. Susan Case, associate professor at the Weatherhead Business School and Department of Women and Gender Studies at Case Western Reserve and Dr. Diane Billimoria, Professor of Organizational Behavior in at the Weatherhead School of Management at Case Western Reserve University. Attendees also participated in small group sessions, career development and training workshops, all designed to support the advancement of women across the sciences. In January, Graduate Studies hosted a lunch for graduate women to learn more about the academic career path from current women science faculty. Faculty panelists included: Meredith A. Kelly, Assistant Professor of

Earth Sciences; Laura E. Ray, Professor of Engineering; Mary R. Albert, Professor of Engineering; Kristina A. Lynch, Associate Professor of Physics and Astronomy; and Mary K. Hudson, Professor of Physics. In May, WISP and Graduate Studies will co-host a lunch event for Graduate Students as Mentors to bring undergraduate and graduate women in science together to learn more about the graduate school experience.

Through an expanded internship program at the McAuliffe-Shepard Discovery Center (MSDC), STEM-discipline college undergraduates gain experience with STEM informal education and exposure to NASA role models and NASA PI scientists, engineers, and educators. In return, the interns provide new perspectives to the MSDC staff and themselves act as role models for young visitors (K-12). This program contributes to both Outcome 1 (by providing hands on experience in science informal education to university students) and Outcome 3 (by creation and presentation of STEM informal-education activities to the general public).

This past year, two undergraduate student interns at MSDC interacted with the general public and pre-K-12 school groups as informal science educators and created special *Teen Night* STEM programs (Teen Night is a Space Grant sponsored lecture and demonstration program held monthly at the MSDC). Additionally, the interns were assigned specific projects to be prototyped during their internship for future use by MSDC informal science educators. One intern is an undergraduate from NH majoring in astrophysics and mathematics at the University of Georgia. He staffed MSDC's observatory and researched current solar activity to share with the general public, created a presentation on particle physics for Teen Night that is now in use in school outreach and field trips school talks and demonstrations, created a presentation on Euclidean and Non-Euclidean geometry – their uses in everyday life and to help in understanding the “shape” of our universe – for use with high school groups and for future distance learning experiences, complete with student assessment strategies, created a lunar scavenger hunt for use by students and the general public in MSDC exhibit galleries, and created a series of presentations on tectonic plates for elementary, middle and high school. The second intern, a NH undergraduate majoring in International Affairs/Spanish with a concentration in astronomy at UNH, developed a distance learning program based on water cycle for future use (MSDC is planning distance education for the 2011/2012 school year) and created materials for water cycle demonstrations, developed a concept for a moon base for Summer 2011 STEM Camps, and developed and presented a Teen Night program on cryogenics.

Space Grant seminar speaker support at Dartmouth and curriculum support at the Community College System provide enriched educational experiences for faculty and students:

The Space Physics community at Dartmouth consists of 5-6 faculty in the Physics Department and 2-3 faculty in the School of Engineering. With associated post-docs, students, and staff, there are 30-40 scientists and engineers in the discipline at Dartmouth. The plasma seminar is the most important weekly event that brings together this scientific community. It plays a critical role educating students, initiating new collaborations and

enhancing existing ones, and disseminating the newest knowledge in the field. Space Grant funding supported approximately 30 seminars in FY2010. Speakers included scientists from University of Houston, UNH, Michigan State, Princeton University, MIT, University of Maryland, and the Johns Hopkins University Applied Physics Laboratory. Average attendance at these seminars was approximately 30 individuals, on average about half graduate students, one-quarter faculty, and one quarter research staff or other. This successful program is unchanged in number of seminars, approximately 30 per year for each of the last five years. Attendance has gone up somewhat as Dartmouth's program in space physics has grown larger.

Online college courses are becoming increasingly popular as they enable students to have greater access to education and training, while learning at their own pace and at times that are convenient for them regardless of geography, weather, family, and work demands. Designing high quality learning online experiences is critical to student success and retention. The Community College System of New Hampshire currently offers over 500 on-line courses throughout its seven colleges. In order to keep pace with and improve the quality of 100% online science courses, such as the biology course at Great Bay Community College which is being supported through Space Grant, the Community College System's Department of Distance Learning is using *eDesign*, an on-line instructional design resource center. *eDesign* is a quality assurance rubric for courses taught online through the CCSNH. The program provides access to a variety of resources to enhance an instructor's knowledge, skills, and attitudes towards teaching online, as well as a framework for reviewing the quality of online course design. A portion of the NASA Space Grant involved the evaluation of the 16 online STEM courses including Algebra, Trigonometry, Astronomy, Biology, Calculus, Chemical Principles, Chemistry, Earth Science, Statistics, and Microbiology. Instructors of 43 courses were invited via email to request an *eDesign* review of their course; 16 courses were reviewed in order help the faculty of those courses improve the quality of their teaching and the students in learning in STEM related online courses, thereby increasing the rate of successful student completion of science courses and subsequent Associates' degrees.

Space Grant funding also provided curricular support resources for students in the GIS program at White Mountains Community College. Geographic Information Systems (GIS) at White Mountains Community College offers an option in Spatial Information Technology. It is a computer-based system that connects tabular or text data in a database with spatial data, such as a digital map or image. GIS allows for the compilation of various types of data from multiple sources, analysis of the data, and the display of the results in a graphical-spatial context for rapid comprehension by the audience. Support courses include cartography, remote sensing and digital image processing, database development, and survey methods. General education courses in Math, English, and Science, complete the student's experience. A one-year GIS certificate provides an academic option in Spatial Information Technology geared towards four-year graduates who wish to acquire technical expertise in GIS or working professionals who could benefit from specialized training in GIS. The WMCC program utilizes state of the art receivers and software. The NASA Space Grant funds supplement the handheld Mapping Global Positioning System (GPS) units, including Mapsource software. In addition,

White Mountains Community College offers a summer STEM camp, teaching middle school children mapping, geo-location and geo-caching skills. During the year, and throughout the summer camp, students in Environmental Science, Surveying Technology, and Geographic Information Systems degree programs will use the units and software.

Professional development for faculty has been provided through Space Grant for the Aviation program in the Community College System, through the Visiting Young Scientist program at Dartmouth, and the UNH participation at the RockOn Workshop at NASA Wallops:

Professional development for faculty was provided through Space Grant for the *Aviation Program* at Nashua Community College. The Nashua Community College is an FAA approved training facility. The Associate in Science Degree in Aviation Technology prepares men and women for professional careers in aviation maintenance. Graduates seek employment with airlines, fixed base operators, or aircraft manufacturers. The Aviation Technology (AT) program places major emphasis on the study of actual aircraft, structures, power plants, and related systems. This is a 21-month curriculum that covers a wide variety of subjects concerned with airplanes: reciprocating engines, turbines, fuel systems, propellers, ignition, electrical systems, and hydraulic systems. Aviation Technology students have a strong background in physics, electronics, and computer programming are recommended. With the NASA Space Grant, this program was enhanced by providing professional development for its educators. In utilizing NASA Space Grant funding, the AT department assistant chair traveled to a Composite Repair Lab offered by Cirrus Aircraft. The Lab is 40 hours of hands-on learning and practice repairing composite fiberglass structures and restoring the finish on the Cirrus SR-series of airplanes (SRV, SR20, & SR22). This five-day workshop is only offered to 8 technicians. Technicians develop competence through personal, supervised experience. Instruction is provided in navigating technical publications, assessing and documenting damage and documenting repairs. Quizzes, projects and a final exam evaluate the technician's knowledge and skills in composite repair. The course includes a Cirrus factory tour and opportunities to interact with Cirrus Factory Service Technicians and Field Service Design & Repair Engineers. On successful completion of the course, a certificate is issued to the technician/engineer for display at the Service Center.

The Visiting Young Scientist program at Dartmouth College seeks to retain new PhD scientists in space-related academic fields by providing an opportunity for the Visiting Young Scientist (VYS) to pursue externally funded research and teach a course to motivate undergraduate and graduate students. Teaching experience is one thing many recent graduates lack, and our objective is to place the VYS in an academic position, either at Dartmouth or elsewhere. There were a large number of applications for this year's position, with five high-quality applicants. The committee selected a women space physicist, a recent PhD from Boston University, who started the position in November 2010. Her research overlaps particularly well with that of the Physics Department faculty, so she is doing an impressive amount of research in parallel with the teaching contributions. She presented a plasma seminar in the Winter term and is co-teaching a course in the Spring term ("Critique of Futurism"). As a further note, last year's recipient

completed his term in the Department of Earth Sciences in 2010. During this reporting period, he received travel funds from Space Grant, and has since taken a permanent position at the University of Massachusetts Amherst, continuing the trend of our VYS interns obtaining good positions.

The Assistant Director of NHSGC participated in the RockOn! 2010 workshop, which is co-sponsored by Space Grants in Colorado and Virginia, and by NASA Wallops. This workshop provided hands-on experience with student rocket payloads and sounding rocket launches. The materials brought back from the workshop have been incorporated into teacher workshops at UNH.

Research infrastructure activities supported by Space Grant included the potential transfer of an observatory dome for the Community College System, Cooperative Extension GRANIT data set activities at UNH, Earth System Sciences data archiving project at UNH, and Research Development awards at UNH:

In June of 2010, a team from NH Space Grant met with representatives from White Mountains Community College. They discussed the disposition of the observatory dome owned by UNH. The GroundWinds New Hampshire LIDAR “dome” is located in the town of Bartlett in the White Mountains region of the state. The location of this facility was chosen in order to make wind and atmospheric observations in a mountainous region with relatively high aerosol levels. The University of New Hampshire and the Mount Washington Observatory no longer use the facility. Discussion has followed regarding the possibility of WMCC's use of the facility, since they teach astronomy, physics and have summer camps and community groups that could use the facility. There is interest in the donation and moving of the dome and telescope. Space Grant funding was provided to support the feasibility study regarding expenses for sighting a new building to accommodate the transfer of the dome and telescope. This venture is partnered with UNH and MWO.

The UNH Cooperative Extension GRANIT made significant progress in two project areas during FY 2010 – promoting discovery of and access to imagery, and updating the NH land cover data set. In the discovery and access to imagery project, Cooperative Extension processed selected, recent TM imagery, focusing efforts on those image data sets that are directly relevant to ongoing and planned mapping activities. Specifically, interest has been in acquiring and processing data sets to support mapping of cleared areas in the northern region of the state, and impervious surface mapping in the coastal region of New Hampshire. The processed imagery has been added to the GRANIT image catalog, and is now available to users via standard distribution channels. They have built two new Web Map Services (WMS), providing public access to 1-ft. resolution aerial photography and 6-inch aerial photography, both acquired in 2010. This resource can be added directly to user maps/documents, as well as embedded in other web mapping applications. A web page has been constructed on the GRANIT web site to describe these new data services. GRANIT staff has also published via the web a composite map document that provides single-entry access to our most commonly used

statewide and regional image data sets (including the two noted above) in conjunction with supporting vector base layers.

In cooperation with UNH Cooperative Extension, an effort to identify the imagery and image delivery services that are most useful to the NH (and regional) geospatial community was initiated. They did so by developing, testing, and distributing a web-based survey to determine the current and potential use of imagery and derivative products developed or hosted by NH GRANIT. The survey was distributed through a variety of channels including the UNH Cooperative Extension Geospatial Technologies Training Center email list, the NH GIS list server, and the NH Arc User Group email list. A total of 199 people provided responses to the survey. As a result of the survey, new emphasis on imagery distributed by NH GRANIT, and particularly products available through WMS, was incorporated into the following workshops taught by the Training Center: ArcGIS Drivers Permit, Community Mapping, GIS 101: Learning to Map in the Digital Age, GIS on Pennies a Day: Test Drive, GIS/GPS Boot Camp and Introduction to ArcGIS 10. In program evaluation, the high number of responses to the user survey was a measure of its relevancy. Further, a completion rate of 93% (e.g. 186 people out of the 199 responded completed all questions), provided further evidence of its relevance to the targeted community.

The GRANIT 2001 Land Cover data set describes 23 classes of land use/land cover. It was initially processed from 12 TM images, acquired over the period 1990 to 1999. During the current reporting period, UNH Coop Ext GRANIT staff used image-processing methodologies applied to current TM imagery to update areas mapped as cleared land. Efforts relied on TM imagery acquired in August of 1999 and August of 2009. They first normalized the two images (using “dark object subtraction”), and then conducted a change detection using object-based image analysis. To date, they have completed the data processing, and have initiated the post-processing editing/verification phase. The most significant benefit of these program activities over the past year is that increasing data assets are freely available to the public through a variety of mechanisms, including download from the GRANIT web site and access to web-based services. Our user base (including substantial representation from the K-12 as well as post-secondary educational community) utilizes the imagery to support mapping and analysis in a broad range of application areas. They will conduct a traditional accuracy assessment of the land cover mapping once the post-processing editing phase is complete.

The study of the dynamics of the Earth within the field of Earth Systems Science (ESS) at UNH is supported by increasingly powerful computer systems and large organized multi-disciplinary ESS data archives to drive progressively more complex environmental analyses, assessments and models. UNH, ranked as a “high impact university” in geosciences and environmental science citations, holds no exception to this trend. With over \$38 million of annual research support from NASA, NSF, NOAA and other federal agencies, UNH’s largest research enterprise, the Institute for the Study of Earth, Oceans and Space (EOS), processes and archives large quantities of ESS data daily for research, education, outreach, and community decision making projects. The use of earth observing satellite imagery is essential in the modern exploration of Global environmental

assessment research at EOS such as within the studies of land use / land cover change, forest ecology, terrestrial-ecosystem biogeochemistry and carbon and nitrogen cycle modeling, Arctic and Antarctic research, public health / eco-epidemiology, water systems / macro-hydrology resources, ocean processes / monitoring, and climate change. Currently the EOS data archive is accessible through standard directory and file system access. The new web based interface to the data archive though still under construction, when complete, will promote the better sharing of current and future data between research groups within EOS as well as provide for a portal for EOS data to the larger scientific community. This important ability to archive and disseminate data will also help projects at EOS meet NASA's current and NSF's new data archiving and dissemination requirements. A continued campaign to include data from all EOS research groups within the archive currently fosters future inter-group research and professional collaborations.

In support of these efforts the objectives of the Space Grant funded program are three fold. First, this program works to provide valuable hands-on training experiences in database design, open source archiving software, and data management techniques to participating STEM student employees. Secondly, this program expands the EOS data archive infrastructure and makes its contents available for support of scientific programs including the linking of scientific data to STEM learning efforts. The archive supports global Environmental assessment research at EOS such as with the study of hydrological and biogeochemical linkages of land-river-coastal systems at local, regional, and global scales. Thirdly, this program works towards a larger goal of making NASA data and current geospatial processing techniques and recourses more readily available to financially and technologically limited educators and K-12 schools. The Space Grant funding supported two student interns and a professional Information Technologist acting as their mentor. The experience and knowledge of Geo-Spatial Data processing, archiving, and web based dissemination techniques that they are learning will directly benefit their future Computer Science careers.

The *NHSGC Research Development Award* is a new initiative designed to strengthen UNH research infrastructure that is directly aligned with NASA's strategic framework and to develop or strengthen UNH research ties to a NASA Center or NASA Mission Directorate. Through a campus-wide competition, two awards of \$10,000 each were granted to two researchers: one award goes to a female faculty member in the UNH Climate Change Research Center for her project "Ebullition of Methane from Flooded Environments: Measurements and Scaling of this Important Greenhouse Gas". The second award goes to a newly appointed teaching faculty member in the Physics Department for his project "Chaotic Solar Motion and its Coupling to Solar Cycles". Both projects involve student participation and support.

Outcome 2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty (including achievements focused on higher education not discussed in outcome 1) and K-12 pre-college programs.

Several Space Grant activities are geared toward promoting middle and high school students interest and proficiency in STEM related disciplines through outreach and hands-on activities: early college credit through e-Start (CCSNH), Graduate Outreach program (Dartmouth), FIRST ROBOTICS Teams (UNH), WIST Forums (FIRST, CCSNH), long distance learning (MWO), summer tech camps (PSU, MSDC, CCSNH, UNH), and a high school rocket program (UNH):

The Community College System of New Hampshire (CCSNH) continues its program called *e-Start* in which high school students earn dual high school and college credits. The goal is to use the latest internet technologies to provide students with anytime, anywhere access to a rigorous, personalized education. The NASA Space Grant funds support “e-Start” in two STEM courses, Mathematics and Biology, at Great Bay Community College. The funding provided supplies, students’ course tuition and the instructor’s stipend. Biology I covers the concepts of Scientific and Experimental Method, SI system and metric measurement, reading graphs, diagrams, and data analysis, ecology and environmental principles, and cell theory.

In the new *Graduate Outreach* program at Dartmouth College the first graduate student to participate gave presentations at the Claremont Middle School twice, and once at the Lebanon Jr. High. Attendance was approximately 100 students over the three presentations. The outreach grad did note that during his Science Café that the middle school students had a lot of questions about aliens and whether life exists on other planets.

Space Grant at UNH supported three FIRST Robotics Teams in this year’s competition: St Thomas Aquinas in Dover, NH, Manchester Central High School in Manchester, NH, and our newest addition, Oyster River High School in Durham, NH. This is the first year for the Durham team which had mentors from the Space Science Center, UNH; the Lunabots, Department of Mechanical Engineering, UNH; and Turbocam in Barrington, NH. Oyster River students walked away with two prestigious awards, the *Rookie Inspiration Award* that recognizes a rookie team for outstanding effort as a *FIRST* team in community outreach and recruiting students to engineering; and the *Highest Rookie Seed Award* that celebrates the highest-seeded rookie team at the conclusion of the qualifying rounds. The Dover team had engineering mentors from GE and Varian Semiconductor; while the Manchester team included mentors from BAE, PSNH, Gale Associates, US Navy, and a community college student in Mechanical Engineering Technology.

Space Grant sponsored FIRST’s *Women in Science and Technology* (WIST) Forum in Manchester NH in November 2010, for female high school students. For high school girls approaching a decision about what college to attend, what major to pursue, or what career paths might be open to them. The Women in Science and Technology Forum provides a unique opportunity to meet professional women and receive guidance through workshops, panel discussions and interview sessions. The two keynote speakers work in fields related to NASA’s work force and science: Dr. Julie Brigham-Grette is a member of the Climate System Research Center, and Robin Saitz is a senior vice president,

solutions marketing and communications for PTC. NHSGC provided event funding and arranged for free access to Pathevo career resources for participants. Five WIST panelists were from UNH, four women faculty (including the Assistant Director of NHSGC) and one female graduate student. There have been over 100 monthly active users to the NHSGC WIST Facebook page launched in continuing support of WIST participants.

The CCSNH White Mountains Community College faculty managed the expansion of the FIRST *Women in Science & Technology* (WIST) program to northern NH reaching females students from 12 rural schools. The event was hosted on the Berlin campus in March 2011. This program also featured women in science and technology fields discussing and sharing their career paths and education with High School and Middle School girls considering college, their major, and ultimately, their career paths. T-shirts distributed to the attendees displayed the NASA and NHSGC logos. Jillian Kilborn, Wildlife Biologist at NH Fish and Game, delivered the first keynote address on her work with the Fish and Game department in Coös County, NH. Tiffany Nardino, Education Coordinator at the McAuliffe-Shepard Discovery Center in Concord, NH gave the second keynote address on her work at the Discovery Center and opportunities for women at NASA. NHSGC Affiliates UNH and MWO also provided five of the day's panelists. The goal is to have this program serve as pilot at one community college and eventually make it accessible to girls throughout the state.

Through the Mount Washington Observatory (MWO) distance-learning program students are brought, virtually, to the Mount Washington Observatory's weather room located at the summit of Mount Washington. The students view the current weather at the highest peak in the Northeast region and learn about the MWO operations accompanied with educational content that is specific to each program. The students learn about the Earth's atmosphere and have the opportunity to speak directly to a scientist. At the end of each program the Meteorologist asks, "So, who wants to visit Mount Washington?" Immediately all hands go up in the air enthusiastically. It's very exciting to see. For each WMO program pre and post assessment questions are included. At the beginning of each program students are asked three questions that are program specific. This indicates how familiar the students are with the material. At the end of the program the same three questions are asked, which helps to identify the knowledge gained from the program. This has been extremely helpful for the program's assessment as well as to the accompanying K-12 teachers.

Here is a quote from a principal of an elementary school where the MWO Outreach Coordinator visited last fall:

"Hello Jeff. This morning as the kids lined up and got ready to head to class I asked for a show of hands for who liked the presentation you gave yesterday to K-4. They all raised their hands. I appreciate your efforts to work with such a developmentally diverse group. To have the K's sit for an hour is a feat unto itself! You kept them engaged and hit on number of topics studied in the classroom. Science became more real. Two students mentioned to me why Science and Math are so important, which was a direct reflection on your efforts. Your enthusiasm was genuine and infectious. Thanks again."

Principal, Parsonsfield Elementary

The McAuliffe-Shepard Discovery Center (MSDC) offered the following Summer STEM Camps for middle school students in Summer 2010: *Defending Earth* (Earth science, climate change, space science-remote sensing); *Space Explorer Camp - the Universe* (astronomical and space science concepts); *Rocket Adventure Camp* (principles and history of rocketry; building and launching increasingly larger and more complex rockets throughout the week); *Aviation Adventure Camp* (FAA-approved, aviation concepts including course plotting, use of instrumentation principals of flight). The summer camps are hands-on STEM adventures that build teamwork and generate excitement about STEM through practical, hands-on activities. As the culminating event in the Aviation Camp, students flew in a small plane. The pilot was very impressed with the knowledge of the students, he felt they really knew their way around the cockpit and understood the instrumentation. Students also visited Air Traffic Control at a small regional airport, where the staff was impressed by the middle schoolers' knowledge. Rocketry students were very enthusiastic about building and launching their own rockets, and used teamwork in solving problems and launching. Defending Earth students used tree cores and made their own ice cores to better understand scientific analysis of climate. Living in Space campers got to manufacture food to eat in space, learning about microgravity, weight constraints on cargo, etc., and planned and took a virtual trip to Mars. NHSGC partner Dartmouth College – Astronaut Jay Buckley, M.D. (STS-90) participated in the Defending Earth camp; students were thrilled to meet and talk with an astronaut. Dr. Buckley has been working on human physiology in space, and also climate change, since completion of his NASA mission. Evaluation of the camps was done by internal review, and discussions with the campers and their parents.

Plymouth State University (PSU) participated in the *New Hampshire TechFest* for middle and high school students, with meteorology, astronomy, and chemistry exhibits/demonstrations to interest upcoming students in STEM disciplines. UNH participated with four exhibits/demonstrations on NASA spin-offs and jobs, STEREO, tracking the BP oil spill, and the Ice Planet planetarium show. NHSGC Affiliates BAE systems demonstrated live-saving and defense technologies. A FIRST robotics team was the primary event organizer and demonstrator of robotics.

Project SMART (Science and Mathematics Achievement through Research and Training) is a summer institute at UNH that challenges, educates and motivates talented high school students in science and mathematics while acquainting them with the environment and resources of the University. The students study advanced topics in science and computers through lectures, demonstrations, hands-on laboratory experience and fields trips. It is an excellent opportunity to learn the interdisciplinary nature of the various scientific fields and how math and computers converge with scientific research. In the summer 2010 session, 44 students participated. In the space science segment of Project SMART, four high school students built the payload for a high-altitude weather balloon. A local high school teacher leads this effort and they have flown balloons every year of Project SMART for the past 5 or 6 years. This year's balloon flew two small video cameras that are purchased off-the-shelf, a Geiger counter that is integrated into telemetry via circuitry designed as part of the program, and internal and external temperature monitors that are

similarly integrated along with GPS and telemetry. For their mentored research projects, one SMART student built an antenna for ground-based arctic science studies. The antenna is designed to measure the modulation of the cosmic microwave background as it passes through regions of varying plasma density over the pole. Another high school student worked on a computational study of spacecraft charging, with direct application to the NASA Magnetospheric Multi-Scale mission. Two students extended earlier studies of magnetic waves due to pick up ions in interplanetary space.

The Community College System of New Hampshire's *STEM Camp* hosted at the White Mountains Community College campus in August 2-6, 2010. Students had the opportunity to obtain hands-on experience as they collaborate on, developed and presented innovative projects in the areas of environmental, biomedical, oceanographic & marine engineering as well as robotics and computer technology supplemented by activities in GIS/GPS, guitar building, water quality, and alternative energy. This summer, because of the popularity of the STEM camp program last year, WMCC will have two weeks of STEM camp, each having an enrollment of 20.

Space Grant at UNH is providing travel support to the *ARLISS* (Rocket Launch for International Student Scientists) rocketry program as part of the Earth, Physical and Space Science curriculum at Weare Middle School in Weare, NH. The students have been involved in a series of progressively more challenging, and more educational, aerospace projects. Most recently they designed, built and then launched two satellite prototypes in Stanford University rockets in Nevada's Black Rock desert. Two of the former students involved in this program have matriculated into colleges where they are studying engineering, a testament to the success of this program. One of their rockets is proudly displayed in the McAuliffe-Shepard Discovery Center. This co-ed team of middle school students, with four females and four males, is planning a launch of another satellite prototype in Nevada in September 2011.

Teacher development and K-12 curriculum development are the objectives of the following Space Grant sponsored programs provided by the Rey Center, MWO, MSDC, Dartmouth and UNH:

Curious George, the world-renowned, inquisitive little monkey created by Margret and H.A. Rey, is always led by his curiosity to explore the world around him and discover how things work. The Margret and H.A. Rey Center ('Rey Center') is in a unique position to capitalize on Curious George's sense of wonder and discovery as a vehicle to strengthen interest in and understanding of STEM disciplines in elementary school students and teachers through educational programs and teacher trainings. In 2010-11, the Rey Center developed two of these education programs based on the Rey books *Curious George Flies a Kite*, and *Curious George Gets a Job* in partnership with Plymouth State University's Early Childhood Education Department. An undergraduate senior from collaborating affiliate Plymouth State University (PSU) worked with Rey Center educators to develop the lesson plans and activities for these programs. The programs will be piloted during the spring and fall of 2011.

The objective of the Rey Center's teacher training and science curriculum enhancement programs is to augment and improve the life science, Earth space science, chemical/physical science and inquiry components in science education in New Hampshire's schools. The Rey Center has developed a *Phenology and Climate Curriculum* utilizing research methods developed in the field as part of a collaborative research effort established by the Rey Center and PSU to investigate the impact of climate change on northeastern forest ecosystems. Science teachers are instructed on the phenology-climate curriculum; additionally, both teachers and students are guided through the methodology, data collection, synthesis and analysis with the intention of encouraging continued phenological and climate monitoring by both the teacher and students.

In 2010, the Rey Center partnered with PSU's Department of Biological Sciences to offer this program to students at the White Mountain Regional High School (WMRHS) in Whitefield, NH. The WMRHS Science Director spent two days in the field during the summer of 2010 with Rey Center and PSU research staff assisting in the establishment of a new research transect and learning about the methods and objectives for the study. The Science Director was excited to bring this curriculum to his students and to bring them into the field with Rey Center research staff. Originally scheduled for the fall of 2010, the implementation of the curriculum with WMRHS students was delayed to spring of 2011, due to schedule conflicts the WMRHS Science Director. The Rey Center staff did pilot the field component of the curriculum with a PSU undergraduate class in Environmental Science and Policy. The university students collected data using research protocols modeled after the vegetation and climate study on Mount Tecumseh and learned how to discuss the tangible responses in the natural world to the intangible concept of climate change.

The Rey Center program evaluation for the above included an assessment form in which students answered four reflection questions, providing an opportunity for students to explore their own learning through this experience. Most students expressed an improved understanding of the relationship between plants and vegetation, a new or improved understanding of how plants can help us monitor climate change, and a better understanding of how research methods are applied in scientific study. Some of this group learning is best captured in the following student statements:

"I understand more about what phenology is and how it is studied. I am more aware of how plant life can change based on altitude and latitude and climate conditions."

"...the program...made me see how useful tracking phenophases could be in evaluating climactic changes and their effects on forest communities."

"I understand that you have to observe and experiment and test variables several times to understand the effects, solutions, and relationships of the test subjects."

In addition to its Phenology and Climate Curriculum, the Rey Center has developed a *Mountain Weather Curriculum* that introduces middle school students to the individual

climate parameters that influence our region's weather. The curriculum includes in-classroom lecture and lab exercises as well as daily data collection from several weather stations located throughout the region, each at significantly different elevations. The first curriculum module was piloted with seventeen eighth-grade students at the Holderness Center School in Holderness, NH, on March 15, 2011. Program evaluation includes an integrated assessment component that measures pre- and post-knowledge of the students in specific weather parameters, data analysis, and scientific inquiry methods. A graduate of PSU's meteorology undergraduate program, who is currently enrolled in PSU's Masters in Science Teaching program, developed this curriculum.

Over the past reporting year the Mount Washington Observatory (MWO) education staff has developed a new K-12 educational program called the *Alpine Zone*. This program will inform students about the unique environment above the tree line in the White Mountains of New Hampshire. Classes who participate in the program will get a first-hand close look at the difference in weather and climate on Mount Washington compared to the surrounding lower elevations as well as the technology that is used to record the temperature, wind speed, and relative humidity above tree line. Students will also look at the phenology in the alpine environment. The intent of this new program is for students to gain a greater understanding of a unique environment that can be challenging to work in as well as enjoy recreational activity. In the program evaluation, each teacher will receive an evaluation form, which asks questions about the material and presentation of the program. Their feedback will be used for improving the existing program and in designing future programs.

In November 10, 2011 Mount Washington Observatory staff participated in a *Climate Change* workshop presented to teachers, which was coordinated and presented by fellow affiliate McAuliffe-Shepard Discovery Center. In June, UNH participated in the *Summer Solar Symposium* offered to middle and high school teachers by MSDC.

Dartmouth College supported middle school teachers from Indian River Middle School (West Canaan, NH), a NASA Explorer School, participating in a "Vomit Comet" flight at Johnson Space Center. The three teachers devised a microgravity experiment and carried out the experiment in flight. The results were videotaped and used in classroom exercises in the teachers' classes. This was the first time this particular program was funded.

The year-long student participation program *Forest Watch* is mentored by UNH Earth Science Professor Rock. Twenty-one schools in 4 states participated and submitted white pine biometric data and plant samples. Seventeen Teachers attended the Forest Watch workshop in December 2010, to review the 2009 findings regarding ground-level ozone. The Forest Watch coordinator visited a dozen schools to assist teachers and students in monitoring white pines at their schools. The protocols and programs, including interpretation of Landsat imagery and field study techniques, was shared with 22 students and 10 teachers in the *NASA Summer Research Experience* program, with schools participating in the DOME project, with initial research on mangroves in the Yucatan; with students in Project Smart; and with students in two UNH Natural Resource courses.

The Forest Watch program is evaluated by the participating K-12 teachers, who provide feedback and suggestions during the year and at the annual meeting.

In a new initiative, faculty from the University of New Hampshire are partnering with personnel from the New Hampshire's North Country Educational Services to create 2, 2-day workshops for upper elementary school and middle school science teachers in rural northern New Hampshire. The first workshop is in planning and will focus on land cover/use and the second one will emphasize astronomy. The purpose of the workshops will be to teach the teachers NASA-based physical and earth systems science content using an inquiry-oriented, learning environment. The teachers will explore in-depth selected interdisciplinary earth systems science concepts. To support successful science teaching in the classroom, teachers will learn content from science faculty about the unique motivational needs of early adolescents from education faculty in the two-day workshop. Drs Eleanor Abrams and Michael Middleton from the Department of Education with support from science faculty such as Dr. Barry Rock, Department of Natural Resources and Dr. Toni Galvin from the Institute for the Study of Earth, Oceans and Space are developing two workshops (24 hours of curriculum development) in the spring of 2011. The two 2-day workshops will be offered at the last two weeks in August 2011 to twenty teachers across the school districts in northern New Hampshire. Northern New Hampshire is a rural, impoverished, under-served area of New Hampshire. Many of the middle school science teachers do not have a certification in science and have stated a desire for professional development in the area of science content.

The North Country teacher workshop project is the first phase of a longer curriculum development project designed to target pre-service upper elementary and middle school students at the University of New Hampshire. The workshops enable the curriculum to be field-tested in the classroom for authenticity and to be fine-tuned as necessary before implemented on a larger scale for pre-service teachers at UNH. Two graduate students will assess the efficacy of the curriculum in the ability to successfully convey the earth systems science content to teachers in a novel pedagogical manner as well as to increase teachers' ability to teach young adolescents, a challenging group of students.

Outcome 3: Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission

Space Grant supported informal education activities include public fairs and festivals (MSDC, Rey Center) and space-related exhibits (MSDC):

The Margret and H.A. Rey Center held their annual *Curious George Cottage Family Festival* in August. Activities included planetarium shows conducted by the Mark Sylvester Planetarium at Plymouth State University and solar telescope viewing conducted by the McAuliffe-Shepard Discovery Center.

The McAuliffe-Shepard Discovery Center (MSDC) offered its first 3-day aerospace festival. This is a regional event, attended primarily by family groups. The event included a wide variety of activities and displays on aviation, astronomy and space science. Participants were able to engage in active STEM programs offered by MSDC and the following partners: Aldrich Astronomical Society, BAE Systems, Chouinard Rocketry, Design Rhythmics Sonification Research Lab, Dr. Flush, the FAA, Fliskits, Franconia Soaring Association, Margaret & H.A. Rey Center, Mars Foundation, Moonraker (Worcester Polytechnic Institute), Mt. Washington Observatory, NASA Aerospace Education (GSFC), New England Air Museum, NH Astronomical Society, NH Aviation & Space Education Council, NH Aviation Historical Society, NH Bureau of Aeronautics, NH Union Leader, One Giant Leap, NH Parent Information Center, Plymouth State University Meteorology Department, SpaceTreasures.com, UNH Space Science & NH Space Grant. Additionally, special presentations were made by Educator Astronaut Barbara Morgan (May 1st keynote speaker), NASA (HQ) Deputy Assistant Administrator for Outreach Alan Ladwig (May 2nd keynote speaker), Zero Gravity for Educators participant Doris Seastream and Terrafugia (April 30th programs), The Robot Aexeous and Mad Science.

The festival opened a new planetarium show, *Impact Earth*, had model rocket building & rocket launching workshops, Blackhawk helicopter landing, takeoff and tours, weather balloon launches provided by affiliate PSU meteorologists and students, and many other STEM activities. Mission exhibits were provided by the UNH Space Science Center, with organization and participation by the NHSGC program coordinator. Networking opportunities were provided for those involved in aviation and aerospace, to connect high school students with college students, professors and working scientists as well as engineers from aerospace companies, and make the public aware of the many varied and exciting science and engineering activities and educational and career opportunities taking place in our region. College scholarships were awarded to three NH high school students who placed 1st, 2nd and 3rd in a statewide astronomy bowl (astronomical knowledge competition held in the planetarium) and tuition, room & board scholarships to U.S. Space & Rocket Camp (Huntsville AL) to three NH K-12 students who placed 1st, 2nd and 3rd in a statewide competition, as well as three back-up crew awardees and three honorable mentions. Astronaut Barbara Morgan and NASA HQ Alan Ladwig announced the awards, respectively. There was also had a fly-in competition and announced the winner, as a means of encouraging aviation and the use of small regional airports by private pilots. Keynote speaker Barbara Morgan talked about the STS-118 mission; and keynote speaker Alan Ladwig discussed NASA's accomplishments in its 1st 50 years and NASA's plans and goals for the next 50 years. Media coverage ensured the information went out to others beyond the Aerospacefest 2010 participants. Evaluation of the event included intercept interviews by staff/docents during event, post-event follow-up with STEM organizations, staff evaluation, and observations from Ladwig/NASA HQ.

The MSDC added components to the *Living & Working in Space* exhibit to make it more interactive and engaging to the general public. The exhibit has been moved to the south side of the second floor, where people can more easily move about and explore the exhibits. Visitors are very interested in seeing objects actually used in NASA's space

program, and in making the connection between work on Earth and work in a microgravity environment. Background work for this exhibit was done in a prior Space Grant year, through a joint internship offered by Plymouth State University (PSU) and the Discovery Center. PSU assisted us in recruiting an undergraduate from their meteorology department and providing a faculty advisor to work with the student while he interned at the Center. He was able to do significant background work on the project, which allowed us to jump right in on creating the exhibits with this most recent round of funding. Work-study students from NHTI, one of the colleges from our affiliate, the Community College System of NH, served as docents for this exhibit over the past year, studying the content and then conveying it to visiting students and families in engaging ways. The education coordinator, a young woman with a degree in both astronomy and physics from Mt. Holyoke College, was involved in the content of the exhibit graphics as well as our assistant producer, a young woman with a degree in astronomy and photography, in the design of the exhibits. This was good staff development for them, and also enabled them to serve as role models for our work-study students, volunteers and young visitors. Evaluation for this exhibit is done informally, through docent discussions with visitors and education director and exhibit designer observations of exhibit usage. As an example of the exhibit appeal: Visitors gathered to watch the Space Shuttle launch on a NASA TV broadcast on our plasma screen TV (funded by a prior year in Space Grant); the close-ups by the camera on the external tank clearly illustrated the large bolts holding it in place. Visitors were very excited to then head upstairs and see one of the actual bolts from the Space Shuttle (lent by NASA) on display. Children are fascinated by the working of the space toilet. This brings the reality of living and working in space down to Earth like nothing else!

Hands-on experiences to the general public and school groups are provided by Space Grant through the Rey Center's Water Watchers, Welch Stewardship Hikes, Family Astronomy Nights and other observing opportunities:

The Margret and H.A. Rey Center utilizes *citizen science* to create hands-on participatory programming for the general public that creates meaningful learning experiences, improving participant's science literacy and developing the knowledge and motivation that enables citizens to become actively engaged and responsible in making informed decisions about the built and natural environment. Both the Tecumseh Overnight and Water Watchers programs serve this objective, and include both Outcome 2 and Outcome 3 aspects.

Water Watchers, the Rey Center's water quality monitoring program creates a rich citizen science opportunity for both the public and local elementary school students to monitor the overall health of important local water sources. With the support of the state agency, the New Hampshire Department of Environmental Services, citizen scientists work with Rey Center staff to sample several locations to measure pH, turbidity, conductivity, water temperature, and dissolved oxygen. In 2010, the Rey Center conducted sampling with its volunteers May through October. The Center also conducted one program for a summer camp serving twelve youth. Program evaluation included tracking pre- and post-knowledge levels through informal inquiry measures; students demonstrated an improved

understanding of the importance of local water bodies for both ecological and economic uses and the methods used to assess water quality over the long-term.

The Rey Center expanded its Citizen Science and Outreach program opportunities in the summer of 2010 with a new program called *Welch Stewardship Hikes*. Welch Stewardship Hikes provide a unique opportunity for the public and organized camp or school groups to learn about the unique plant species that inhabit the open and exposed ledges of Welch Mountain in Thornton, NH. The experience includes a short hike with great views of beautiful mountain scenery and some time spent restoring the rock and branch barriers that protect the outcrop plant communities found on the ledges. In the summer and fall of 2010, the Rey Center delivered the Welch Mountain Stewardship Hike to one summer camp group serving eleven youth and two school groups serving approximately twenty-eight youth.

The objective of the Rey Center's astronomy programs is to offer engaging activities in astronomy that increase public awareness of the importance of astronomy in society, improve science literacy, and foster a sense of wonder and excitement about astronomy and discovery in science. Throughout the 2010-11 Space Grant years, the Rey Center in partnership with the McAuliffe-Shepard Discovery Center offered public stargazing and lecture events in the Waterville Valley area of the state. The partnership between the Rey Center and the McAuliffe Shepard Discovery Center provides shared expertise among our affiliates and geographical diversity to our public education programs in Astronomy.

In 2010-11, the Rey Center established monthly *Family Astronomy Nights* in collaboration with the Waterville Valley Elementary School. The program gives families the opportunity to learn about our night sky through hands-on activities and guided telescope-observing sessions; each session explores a different topic relevant to the night sky. The program partnership includes volunteers from the New Hampshire Astronomical Society who lead the outdoor viewing component. Seven sessions were scheduled during the 2010-11 space grant year serving twenty-five participants to date. Although lower than hoped for enrollment was attained in this first year, there is strong enough interest to warrant continuation in 2011-12 with plans on surveying our target population to establish the optimal day and time for the program as they go forward. Program evaluation included tracking levels of participation and pre- and post-knowledge levels through informal inquiry measures. Participants demonstrated an improved understanding of astronomy concepts presented as evidenced by the questions and discussions at each session. A unique aspect of this program is the opportunity to educate the parents alongside the children. Comments from parents frequently remarked on how much they learn at these programs.

In 2011, the Rey Center also initiated a new astronomy program called, *Dark Sky Stargazing Nights*, in collaboration with the New Hampshire Astronomical Society (NHAS). NHAS volunteers have agreed to host public stargazing events for two hours the Saturday of the month closest to the new moon affording participants some of the best conditions for observing the night sky. The program is located directly outside the Curious George Cottage, former home of Margret & H.A. Rey, who found their way to

Waterville Valley because of its dark skies. The program started with the first new moon in January of 2011; the program is subject to favorable viewing conditions. The program continues throughout 2011. There are approximately fifteen participants per session.

Space Grant provides informal education infrastructure:

The Margret and H.A. Rey Center is collaborating with fellow Space Grant Consortium Members, the University of New Hampshire's (UNH) Institute for the Study of Earth, Oceans, and Space and Plymouth State University (PSU) to develop the "H.A. Rey Observatory" to be located alongside the Curious George Cottage, Margret and H.A. Rey's former summer home, in Waterville Valley, NH. The Rey Center is currently working with site contractors to assess the physical site requirements of the facility and utilization of the dome provided by UNH and in discussion with PSU regarding the donation of equipment. In addition, the Center is pursuing match funding for the pledge of up to \$10,000 offered by UNH to support this project. Substantial progress on these efforts will be made in April and May of 2011. In another affiliate collaboration, PSU faculty and internship students worked with the Rey Center on computer and meteorological equipment issues used in their outreach programs.

Space Grant funds informal educator development:

In informal educator professional development, MSDC Education Director participated in the Association of Science-Technology Centers Annual Meeting in Honolulu, HI. This international gathering afforded the opportunity to network with Pacific Rim colleagues who do not ordinarily participate in ASTC conferences, creating the possibility of international STEM K-12 collaborations, as well as to obtain more content knowledge in astronomy and space science, and to learn and share best practices in informal science education. He visited a local elementary/middle school to observe a Hawaiian science center educator present a talk to a large group of students from the school with demonstrations as an example of methodology for other science center educators, observed presentations (song and dance) by the local school children that expressed their culture, observed an engineering challenge presented to middle school students and saw how the students responded to the challenge. He met with and explored ideas of future international collaborations with science center educators from England and New Zealand; planned collaborations include sharing what the night sky looks like in various seasons in the differing geographic locations, with visitors at all three centers. He met with staff from the Museum of Math to discuss reviewing our current and future exhibits to see how to utilize them to better explore the "M" in STEM. He also photographed the night sky, for use in presentations on astronomy at MSDC.

MSDC Executive Director Jeanne Gerulskis participated in the New England Museums Association conference in Springfield, MA. She participated in sessions on exhibit design and evaluation, toured regional science centers and met with staff to discuss interpretation. The balance of MSDC staff development space grant funds will be used for the MSDC show producer and astronomer to participate in the Mutual Concerns of Air and Space Museums conference in Dayton OH in April 2010.

PROGRAM ACCOMPLISHMENTS

Outcome 1:

- Seventy-one (71) higher education students received Space Grant funding: 39 Fellowship/Scholarship, 31 Higher Education, and 1 Research Infrastructure. Of these recipients, 53 were undergraduate and 18 were graduate students. Awardee diversity was 46.5% female, 1 person was disabled, and 8.45% were under-represented (excluding Asian) minorities (this number is 9.86% if Portuguese extraction is included as Hispanic). These numbers meet or exceed Consortium 2010 proposal goals for the number of fellowships/scholarships and higher education awards, as well as minority representation (5.4% goal), but are slightly below expectations for female participation (55% goal). [NASA 2010 Educational Priorities addressed: Authentic, hands-on experience in STEM disciplines; Diversity of institutions and student participants; Environmental Science and Global Climate Change; Community Colleges – sustain and strengthen existing institutional relationships with community colleges.]
- Support was provided to 3 undergraduate students at a Historically Black College/ University who are participating in STEM-related programs and internships at the Institute for the Study of Earth, Ocean and Space at UNH. One has recently applied to graduate school at UNH. This number exceeds the proposal goal of 2 HBCU students engaged in UNH STEM programs. [Addresses NASA Ed Priorities: Authentic, hands-on experience in STEM disciplines and Diversity of institutions and student participants.]
- Three students were sponsored for summer internships/academy at NASA Centers KSC/CCAFS and Marshall Space Flight Center, and one student for the National Helicopter Training Workshop hosted by Connecticut Space Grant. [Addresses NASA Education Priorities: Authentic, hands-on experience in STEM disciplines; Diversity of student participants.]
- PSU partnered with the Weather Office at Kennedy Space Center (KSC), the 45th Weather Squadron (45 WS) at CCAFS and industry partner WSI Incorporated in Reading, MA to provide hands-on experience to their student interns. The undergraduate convective wind research is being used for forecaster training at KSC/CCAFS, for weather support planning, and for making operational forecast decisions for range activities. The lightning research provided baseline performance data on a fairly new lightning location system to WSI and KSC/CCAFS weather personnel. [Addresses NASA Ed Priorities: Authentic, hands-on experience in STEM disciplines; Diversity in student participation.]
- The Rey Center and PSU engaged 40 undergraduate students to test as a hands-on field experience the pilot program of the Phenology and Climate Curriculum developed for high school science teachers (under Outcome 2). [Addresses NASA

Ed Priorities: Authentic, hands-on experience in STEM disciplines and Diversity of institutions and student participants; and Environmental Science and Global Climate Change.]

- The eDesign Resource Center, hosted through the CCSNH BlackBoard Learning Management System, has enrolled 108 users and supported over 625 page hits. eDesign supported CCSNH instructors by identifying and sharing over 120+ resources related to online instruction and educational technology. eDesign also identified, catalogued, and shared 348 resources through Diigo, a web-based social book marking service. The resources were tagged to correspond to each of the indicators of online learning. [Addresses NASA Ed Priorities: Community Colleges – strengthen existing institutional relationships with community colleges.]
- Professional development was supported in the Aviation Technology Nashua Community College program. [Addresses NASA Ed Priorities: Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.]
- Curriculum support resources were provided for 24 GIS students at White Mountain Community College. [Addresses NASA Ed Priorities: Community Colleges – sustain and strengthen existing institutional relationships with community colleges.]
- Dartmouth Young Visiting Scientist Program selected a woman space physicist. She has developed a new STEM course entitled “Critique of Futurism”. [Addresses NASA Ed Priorities: Enable early career faculty to focus their research toward NASA priorities; Diversity in faculty participants.]
- UNH Space Grant participated in the RockOn! 2010 workshop, a collaborative effort by Space Grants in Colorado and Virginia and NASA Wallops. [Addresses NASA Ed Priorities: Diversity in faculty participants.]
- Support was provided for 30 Plasma Seminars at Dartmouth College, with typically 10 physics and engineering students attending each seminar.
- Support was provided to the WISP program at Dartmouth, including 11 internships. The Wetterhahn Science Symposium featured Prof. Fran Bagenal as the keynote speaker and had 150 participants. [Addresses NASA Ed Priorities: Authentic, hands-on experience in STEM disciplines and Diversity of student and faculty participants.]
- Cooperative Extension acquired and processed GIS data sets to support mapping of cleared areas in the northern region of the state, and impervious surface mapping in the coastal region of New Hampshire. [Addresses NASA Ed Priorities: Environmental Science.]

- An additional 2TB of NASA satellite imagery and derived products are available within the EOS Data Archive and over 5TB of EOS data are now loaded for use and download out of its prototype development interface. The full benefits of the system will be important to current K-12 educators who use NASA geospatial data and imagery, but have limited access due to available resources. The new archive only requires a web browser. [Addresses NASA Ed Priorities: Capabilities for teachers to provide authentic, hands-on middle school student experiences in science and engineering disciplines; Environmental Science and Global Climate Change.]
- Two research infrastructure awards were provided to UNH researchers to strengthen ties with a NASA Center or Directorate. [Addresses NASA Ed Priorities: Enable early career faculty to focus their research toward NASA priorities; one award - Environmental Science and Global Climate Change and Diversity in faculty participants.]
- Support was provided to the UNH Lunabots team, which consists of nine seniors in Mechanical Engineering [NASA Ed Priorities: Authentic, hands-on experience in STEM disciplines; Diversity in faculty participants.]

Outcome 2:

- Participation by PSU, UNH, BAE, and FIRST in nine exhibits and demonstrations in New Hampshire TechFest for middle and high school students to promote interest in STEM-related majors. This year, representation from chemistry was added by PSU. [Addresses NASA Ed Priorities: Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.]
- The Rey Center's Water Watchers conducted a summer camp serving 12 youths, and the Welch Mountain Stewardship Hike to one summer camp group serving eleven youth and two school groups serving approximately twenty-eight youth. [Addresses NASA Ed Priorities: Environmental Science and Global Climate Change.]
- The Rey Center, in partnership with PSU, developed two new curriculum modules for high school science teachers: Phenology and Climate Curriculum, Mountain Weather Curriculum, and two elementary school level science programs based on *Curious George*. MWO created a new student hands-on activity called Alpine Zone. The MSDC created four new summer camp curriculums for middle schoolers: Aviation Adventure Camp, Defending Earth, Rocket Adventure Camp, and Space Adventure-Living in Space. [Addresses NASA Ed Priorities: Environmental Science and Global Climate Change; Engage middle school teachers with hands-on curriculum enhancement capabilities.]

- Climate change teacher workshop hosted by MSDC with participation by MWO. Summer Solar Symposium (co-hosted MSDC, UNH) had 28 K-12 teachers. [Addresses NASA Ed Priorities: Environmental Science and Climate Change; Engage middle school teachers with hands-on curriculum enhancement capabilities.]
- MWO Educational Outreach and Distance Learning programs have serviced over 7500 participants in the past year, including 6573 K-12 students (2206 from NH). The proposal goal was 2000 participants. [Addresses NASA Ed Priorities: Environmental Science and Global Climate Change.]
- Summer camps by MSDC engaged 41 middle-high school students, including 18 under-represented or under-served, and 2 participants with disabilities. Summer camp by CCSNH served 13 (GIS) and 24 (Lego) students. [Addresses NASA Ed Priorities: Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.]
- The Women in Science & Technology (WIST) program was hosted in Manchester NH by FIRST and expanded to northern NH by the CCSNH. There was participation by multiple affiliates. In the Manchester event, 250 female high schools benefited from the experience shared by 45 STEM women professionals from a wide variety of science, technology, engineering and mathematics fields. In White Mountains event, nine high schools and three middle schools participated, with a total of 163 female students, 14 teachers and 2 guidance counselors benefiting from the experience shared by 12 STEM women professionals. [Addresses NASA Ed Priorities: Diversity of student and faculty participants.]
- 26 high school students earned college credit with the eStart mathematics and biology courses offered by Great Bay Community College.
- Dartmouth College initiated its new *Graduate Outreach* program that provides outreach to community schools and classrooms. This year's outreach activities served 100 students at a middle school and a junior high school.
- Forest Watch received participation by 21 K-12 schools in four states, involving 580 students including 285 rural and 100 urban at-risk youth. 17 teachers attended the annual Forest Watch workshop. This year, Forest Watch combined with the NASA Summer Research Program to provide hands-on experience to 22 K-12 students and 10 teachers. [Addresses NASA Ed Priorities: Environmental Science and Global Climate Change; Engage middle school teachers with hands-on curriculum enhancement capabilities.]
- UNH hosted Project Smart – a summer “camp” opportunity for high school students where they actively participate in research projects. In the summer of 2010, 44 students participated – 22 in Biotechnology and Nanotechnology; 18 in

- Marine and Environmental Science and 4 in Space Science. 23 of the students were male and 21 were female. [Addresses NASA Ed Priorities: Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers; Diversity of students.]
- Three FIRST Robotics Teams were supported in three NH high schools, including a novice team involving 48 students. [Addresses NASA Ed Priorities: Authentic, hands-on experience in STEM disciplines.]
 - Two rocket payloads included NH middle student participation. The student team consists of four female and four male students. [Addresses NASA Ed Priorities: Authentic, hands-on experience in STEM disciplines; Diversity of students.]
 - Two teacher workshops on land cover/use and astronomy are in the planning stages. The target audience is rural New Hampshire students. [Addresses NASA Ed Priority: Engage middle school teachers with hands-on curriculum enhancement capabilities.]
 - Three middle school teachers from New Hampshire's NASA Explorer School built a microgravity experiment and flew on the Vomit Comet at NASA JSC. [Addresses NASA Ed Priority: Engage middle school teachers with hands-on curriculum enhancement capabilities.]

Outcome 3:

- Aerospacefest 2010, an aerospace festival held in Concord, NH, in May 2010 with 964 participants (goal was 800 members of the public). The fair was hosted by MSDC with participation by Space Grant partners PSU, UNH, BAE Systems of NA, MWO, CCSNH, Rey Center, and participation by NASA GSFC, NASA HQ. [Addresses NASA Ed Priority: Authentic, hands-on student experiences in science and engineering disciplines.]
- The Rey Center in partnership with MSDC held six public stargazing events in the NH Waterville area, serving approximately ninety-four participants, and held seven sessions (25 participants) of Family Astronomy Night. [Addresses NASA Ed Priority: Authentic, hands-on student experiences in science and engineering disciplines.]
- The Curious George Cottage Family Festival (held each year in August) was attended by 430 people in 2010. Several astronomical activities in this fair were made available through partnership with affiliates PSU and MSDC. [Addresses NASA Ed Priority: Authentic, hands-on student experiences in science and engineering disciplines.]
- Professional development workshop participation by MSDC informal educators.

- MSDC enhanced the Living and Working in Space Exhibit. Last year 60,904 people visited the Living & Working in Space exhibit. Visitors were primarily intergenerational family groups, but also included students on school field trips (c. 20%), teens participating in SuperStellar Friday Teen Night activities and children and youth in summer STEM camps (1%), senior groups (1%), corporate and foundation groups (5%). [Addresses NASA Ed Priority: Authentic, hands-on student experiences in science and engineering disciplines.]

PROGRAM CONTRIBUTIONS TO PART MEASURES

- **Student Data and Longitudinal Tracking:** Seventy-one awards were provided in this period (see Program Accomplishments, first bullet of Outcome 1), of which 54 are deemed significant. Total significant awards ($\geq \$5000$, or ≥ 160 hours) = 54; Fellowship/Scholarship = 36, Higher Education/Research Infrastructure = 18; 4 of the total awards (7.4%) represent underrepresented minority F/S funding (these numbers become 5 and 9.26%, respectively, if Portuguese is included as Hispanic). All current program year students are still enrolled in STEM-related disciplines. Of the FY06-FY10 students that proceeded to the “next step” during FY10, 5 are pursuing advanced degrees in STEM disciplines, 1 accepted a STEM position at a NASA contractor, 1 accepted a STEM position in industry, 3 accepted STEM positions in K-12 academia, 3 accepted STEM positions in academia, and 1 went on to a position in a non-STEM discipline.
- For all students that were significantly supported in the period spanning FY06-FY10, 17 are pursuing advanced degrees in STEM disciplines, 4 accepted STEM positions at NASA contractors, 13 accepted STEM positions in industry, 5 accepted STEM positions in K-12 academia, 11 accepted STEM positions in academia, and 19 went on to positions in non-STEM disciplines. The remaining students have not yet received the degree that they were pursuing while the received their Space Grant award.
- **Course Development:** One higher education course development (Dartmouth). Nine modules were developed for K-12 (Rey Center, WMO, MSDC).
- **Matching Funds:** The Match to NASA funding ratio is currently 132%.
- **Minority-Serving Institutions:** NHSGC maintained its initiative with Elizabeth City State University, and historically black university (HBCU) in North Carolina, awarding 3 scholarships to undergraduates in STEM disciplines related to NASA’s workforce. These students participated in summer internships and/or other research programs at UNH under an UNH faculty mentor.

IMPROVEMENTS MADE IN THE PAST YEAR

MWO has a new Outreach Coordinator, a former MWO Weather Observer who recently spent a year in Antarctica working as a meteorologist. The role of the Outreach Coordinator is to provide educational programs to students and teachers of K – 12.

For Space Grant funded efforts at PSU, two small undergraduate scholarships that had been proposed in the augmentation budget were converted to a single full 1-year graduate fellowship. This was done to support a student from an under-represented group. The PSU summer undergraduate stipend was also increased to be in line with other summer research programs--the first such increase in 5 years. PSU was able to find additional support from a commercial company (WSI Incorporated) to support to fund a second graduate student. WSI also helped support the PSU faculty mentor.

PSU and MWO are going to fund a joint position between the two institutions, where the person selected would be the Director of Research at MWO and a research faculty member at PSU. This will provide a much closer strategic partnership between PSU and MWO, with increased collaboration on research projects and educational activities.

In 2010, the Rey Center was scheduled to conduct fourteen Tecumseh Overnights, a place-based, environmental education program that guides small groups up Mount Tecumseh in Waterville Valley, NH for an overnight adventure that combines programs on northeastern ecology, climate change, and astronomy. Due to a combination of staffing difficulties and low enrollment in the program, the Rey Center canceled the program for the summer of 2010. The Rey Center has expanded outreach efforts to recreation centers and camp programs outside of Grafton County to improve enrollment and anticipates this program will run in 2011.

The Rey Center created three new public outreach programs: Family Astronomy Night, Welch Stewardship Hikes, and Dark Sky Stargazing Nights. The MWO created a new program called Alpine Zone.

Three-day aerospace festival at the MSDC was expanded from a former one-day event. 78% of the NHSCG affiliates participated in Aerospacefest 2010: UNH – NHSCG HQ, STEREO, EOS; Plymouth State University Meteorology Department; NHTI – Concord Community College (one of the Community College System of NH's colleges); BAE Systems; Mt. Washington Observatory; and H.A. Rey Center. The event experienced a 73% increase in visitors and new sponsors interested in supporting STEM efforts. Focus was on strategic links for STEM, and aviation was made a much more significant component of the event.

Rather than having the MSDC Education Team select summer camp topics unilaterally, MSDC's full Leadership Team reviewed the camps from the prior year that were most successful, and analyzed the elements that made them so; the Education Team then incorporated this analysis in their draft design of the camps and presented them to the Leadership Team for review and approval. MSDC paired up younger, new informal

educators with more experienced staff in designing the workshops to allow for staff development and new ideas. There was a delay in contracting a professional evaluator and marketing the scholarships for the camps to underserved, economically challenged middle school students. These items have been moved forward to 2011's STEM Camps.

For the interactive component of the Living & Working in Space exhibit, the MSDC now uses an iPad at the exhibit with NASA links and incorporating the exhibit into our hard copy scavenger hunt. We are still in the process of setting up the iPad display, so they will be able to evaluate usage and describe it in future reports. Much more interest is generated in the exhibits and more knowledge is garnered from them when there are docents on hand to discuss the similarities and different challenges of working on Earth and in space. Even with descriptive panels and activities, the connections are not always clear. The addition of videos and still shots using the iPad should help augment the displays.

This year, Community Colleges of New Hampshire Foundation decreased the marketing budget since in the recent past they have received sufficient qualified applications for the scholarships well in excess of available funds. Indicative of this decreased marketing received 31 applications for 25 scholarships, down from 46 received last year. However, interest increased in the e-Start Biology course at Great Bay Community College; which had 14 students enrolled, four more than the previous year. Indicative of the marketing effort is increased participation, such as in the e-Start Biology course at Great Bay Community College and, for the first time, applications from Nashua Community College Aviation Technology students. However, by offering promotional materials to be used for WIST, the event has had much larger than expected participation.

Within the PSNH/NASA Space Grant scholarship program, by directly contacting the 35 students in the Aviation Technology Program at Nashua Community College, the Community Colleges received five applications for scholarships and awarded all of those students, including two who are not of Caucasian ethnicity. This is a new program area (Aviation) for the Foundation to present awards. Nashua Community College is an FAA approved training facility. The Associate in Science Degree in Aviation Technology aligns well with NASA's mission as the program prepares men and women for professional careers in aviation maintenance. The Aviation Technology program places major emphasis on the study of actual aircraft, structures, power plants, and related systems. Through this 21-month curriculum, students emerge with a strong background in physics, electronics, and computer programming. AT students typically transfer to the following four-year colleges: Daniel Webster College, Wentworth Institute and UMass Lowell. Nashua Community College's Aviation Technology Program is new to participating in the NH Space Grant Program.

The funding designated to enhance the capacity of the north country by enabling access to continuing education for community college faculty were re-directed to the WIST program.

Dartmouth College initiated better advertising locally for the NASA Summer Academy. Web site and announcements were posted in multiple places, including the new Physics Department student lounge.

UNH initiated a new research infrastructure award. These awards were announced this spring, and continue through the summer.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

The NHSGC has nine members. The lead institution is the University of New Hampshire, including UNH Cooperative Extension, with associate Dartmouth College, and affiliates FIRST Place, the Community College System of New Hampshire, the McAuliffe-Shepard Discovery Center, Plymouth State University, the Mount Washington Observatory (added in 2006), the Margret and H.A. Rey Center (added in 2007), and BAE Systems of North America (added in 2007).

The University of New Hampshire (UNH), located in Durham, NH, is the state's flagship research university, enrolling 12,183 undergraduates (55% female) and 2286 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.

A part of UNH is Cooperative Extension that 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, located in Hanover, NH, is a private liberal arts college (ninth oldest in the nation) and a member of the Ivy League. The college has 4,100 undergraduate students, 1,893 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), located in Plymouth, NH, 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 programs. 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), in the White Mountains of NH, 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 Space Grant activities, including internships and research projects.

The mission of the McAuliffe-Shepard Discovery Center (MSDC), 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, in the Waterville Valley, honors the legacy of Margret and Hans Rey, authors of Curious George books and *The Stars, a New Way to See Them*, among other works. The 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 of North America 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.