

Vermont 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 Vermont Space Grant Consortium is a Capability Enhancement Consortium funded at a level of \$590,000 for fiscal year 2009.

### PROGRAM GOALS

Goals of the Vermont Space Grant Consortium (VTSGC) during the fifth year of our five-year award included continuing to develop our network of colleges and universities, industries, and other organizations interested in strengthening mathematics and science so as to increase interest and capabilities in aeronautics, space and related fields in the State of Vermont. The VTSGC has sought to encourage students at all levels from K-12 through university and graduate school to take more mathematics and science, to make connections with NASA, and to consider careers in scientific and technical fields. Through our Undergraduate Scholarship, Graduate Fellowship, and Higher Education Programs, the VTSGC has addressed critical pipeline issues, helped train the next generation of professionals, and has especially encouraged women, members of underrepresented groups, and persons with disabilities. As a Capability Enhancement Consortium, a priority for the VTSGC during the period of this award has been to enhance research infrastructure in Vermont, especially the capability to engage in research of an interdisciplinary nature. These goals and objectives, as well as the methods to be used to achieve them, are detailed in the VTSGC's Strategic Plan. A copy of the VTSGC's Vision Statement, Mission Statement and Strategic Plan can be viewed on the VTSGC's website at the URL above.

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

Several illustrations will highlight the contributions made by VTSGC programs to the three outcomes that guide NASA's Education Portfolio. As noted above, the VTSGC is committed to enhancing research infrastructure, and one way we do this is by promoting

the development of interdisciplinary, NASA-relevant research teams that cross department, college, and institutional boundaries. An illustration of how efforts to achieve this goal have produced benefits is given by the VTSGC Faculty Research and Graduate Research Assistantship support that has allowed development of a research team studying remote sensing techniques for monitoring winter snowpack and determining snow-water equivalents. This is a research topic that lies squarely in the intersection of NASA research interests and a vital state concern, with significant implications for both state economic development and emergency management decisions. VTSGC support for this project began in FY 2007 with the award of a Research Minigrant that allowed project faculty to travel to a NASA Center to discuss the proposed project with potential NASA collaborators. This was followed in FY 2008 by a Small-Scale Grant that supported initial work developing a prototype field-monitoring instrument and augmented support for a graduate research assistantship, allowing a graduate student to be come involved in the project. Based on research progress achieved with this Small-Scale support, the project team was awarded a second Small-Scale Grant in FY 2009 that supported further research developments, including field deployment of the prototype snowpack monitor, the initial acquisition of remotely sensed field data, and additional graduate student involvement. At this stage, with VTSGC support, the project team had become an integrated unit involving three UVM faculty co-investigators (two male, one female) from three departments in two colleges plus two graduate students conducting thesis research and undergraduate students participating in REU's. When the 2010 Space Grant Consortium Development Competition (CDC) was announced in June of 2010, this research team had a demonstrated level of research success and was ready to move from basic seed-money support to the next level, where funding would produce the more complete results that would make the team competitive for sustaining support from Federal agencies through regular competitive channels. Indeed, the project's faculty research group had already submitted one proposal to NSF (well-reviewed, but eventually declined) for follow-on funding. After a local review process, this project was selected to be the basis of Vermont's proposal to the 2010 CDC. For the CDC proposal, the faculty research team was expanded to include an expert in remote sensing of forest characteristics (female) from a third UVM college, a climatologist (male) from Lyndon State College in Lyndonville, Vermont, and an expert in engineering design and fabrication (male, Hispanic) from Vermont Technical College (VTC) in Randolph, Vermont. These additions not only gave this project team additional breadth within UVM, but also provided a statewide presence. The students of these three new faculty team members were also to be heavily involved in the expanded project scope. While VTC is already a VTSGC affiliate, Lyndon State College is not, so this project provided not only an expansion of the Space Grant network in Vermont, but also the possibility of a new VTSGC affiliate in the future as well as a vehicle to allow faculty and students at Lyndon to establish links with NASA, learn about NASA's mission, and become actively involved in hands-on, mission oriented research of direct interest to NASA. Consequently, through the FY 2009 Small-Scale Grant to this project, the VTSGC has not only directly contributed to the development of the STEM workforce in a discipline needed to achieve NASA's strategic goals (Outcome 1, *Employ and Educate*), but has facilitated the development of new NASA-relevant STEM educational opportunity for students and faculty (Outcome 2, *Educate and Engage*).

A second illustration of how VTSGC programs benefit NASA's Education Outcomes comes from our Higher Education Programs and involves support for the Autonomous Underwater Vehicle (AUV) Project at Norwich University, a VTSGC affiliate. The undergraduate student engineering team (11 members) involved in this project is developing a robot vehicle that will be 100% self-controlled and capable of navigating through a series of predefined tasks without human intervention. This project, which was initially supported using ESMD Higher Education funding, was so popular and successful that the VTSGC provided follow-on funding in both FY 2008 and FY 2009 from our main NASA award. This Norwich undergraduate engineering team has now competed their vehicle against teams from 24 other engineering programs from all over the world in San Diego California in the International AUVSI Competition, an activity that promotes development of the intelligent machines needed to solve problems of future generations. Additional design and refinement of the Norwich AUV continued during the current reporting period, and the team made additional connections with NASA researchers. Indeed, as a result of the new NASA links, one member of the team was invited by Michael Camberiate of GSFC to participate in the "Engineering Boot Camp" Program at NASA Goddard during the summer of 2010. Design problems overcome by the student team during the course of developing the Norwich AUV may be applicable to a future NASA mission planned to seek signs of life below a 3 to 5 kilometer thick ice sheet on the surface of the Jovian moon Europa. VTSGC support for AUV has benefited both Outcome 1 and Outcome 2 of the NASA Education Goals. In addition, a crosscutting feature of this project is an interaction of team members with 7<sup>th</sup> graders and their parents at the U32 School in Norwich, Vermont. This interaction not only has encouraged the 7<sup>th</sup> grade students to take more mathematics and science but also has promoted an increased awareness of NASA and its mission in the larger Norwich community (Outcome 3, *Engage and Inspire*).

A final illustration of the benefit to NASA Education Outcomes of our programs involves the VTSGC Awards Night Ceremony held in September last year. Students, their parents, and representatives of VTSGC affiliates, local school boards, and the State of Vermont attended this yearly ceremony, which honors students supported by the VTSGC's Fellowship/Scholarship, Higher Education, and Research Infrastructure programs. The 2009 Awards Night program included presentations by Vermont students who participated in VTSGC-supported NASA Summer Internships and mentored undergraduate research projects as well as demonstrations by supported student teams, such as the Norwich Autonomous Underwater Vehicle. It is a measure of the statewide impact and recognition VTSGC programs have now achieved that Vermont's Governor, Jim Douglas, and Vermont's Lieutenant Governor, Brian Dubie, the current President of the Aerospace States Association, attended the 2009 ceremony and helped to present award certificates. A representative from Senator Patrick Leahy's staff was also present. Our Awards Night generated considerable publicity for both the VTSGC and NASA in local media across the entire state and helped to highlight strategic partnerships with formal and informal STEM education providers, promote our efforts to advance STEM literacy, and raise awareness of NASA's mission among both Vermont's education community and the General Public (Outcome 3).

## PROGRAM ACCOMPLISHMENTS

### ***Outcome 1: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals (Employ and Educate)***

In order to provide NASA related competency-building education and research opportunities for students and faculty researchers, the VTSGC has strived to make significant achievements and progress in our Research Infrastructure, Fellowship/Scholarship and Higher Education programs. These are described in detail under the following three sub-headings:

#### ***1.1 Research Infrastructure:***

As a Capability Enhancement Consortium, a priority goal of the VTSGC is increasing Vermont's Research Infrastructure in areas aligned with new and continuing NASA research priorities. Vermont's NASA EPSCoR Program shares this goal. There is close cooperation between the VTSGC and VT-NASA EPSCoR in this area, and several participants involved in VT-NASA EPSCoR's currently funded research projects initiated their research projects using VTSGC Minigrants.

The primary program used by the VTSGC to promote the development of Vermont's research infrastructure is our yearly Faculty Research Proposal Competition. This competition is open to all full-time Vermont researchers at any Vermont college or university. Research Minigrants grants of up to \$5,000 to initiate research projects and collaborations with NASA colleagues and Small-Scale Grants of up to \$25,000 for more mature research projects, particularly those where a NASA contact has already been made, are available to faculty researchers through this competition. Potential uses of Research Minigrants include seed money to explore initiating NASA-related research projects, travel to a NASA Center to establish contact or collaborate with an appropriate NASA colleague, bringing a distinguished visitor or research collaborator to Vermont for a short visit, and summer support of an undergraduate or graduate student. The more extensive Small-Scale Research Grants may contain summer faculty research salary or research support for a graduate student. Small-Scale Grants typically contain travel funds to visit a NASA Center to establish or strengthen NASA collaboration, and a further expectation is the submission of a research proposal for follow-on funding from non-Space Grant and non-EPSCoR sources. For both Minigrants and Small-Scale Grants, significant cost share is required from the PI's home department or institution to demonstrate support for and a commitment to the research project.

Six new faculty research grants were awarded during the past year as a result of our 2009 Faculty Research Competition. All six of these awards were Small-Scale Grants, although one could be more accurately described as a combination of a Research Minigrant for travel to a NASA Center and graduate student research support. Four additional related research projects were also supported in supplemental funding from the VTSGC's 2009 CDC Award, but these will be detailed in a separate report.

Funded Small-Scale Grants included an award to Prof. Jeff Frolik of the UVM School of Engineering (SoE). Prof. Frolik is the Research Coordinator of the Snowpack and Snow-Water Equivalent Faculty Research Team that whose research progress and associated benefits were discussed above. Additional team members in FY 2009 were Beverly Wemple of Geography, and Chris Skalka of Computer Science at UVM. This new Small-Scale Grant supported travel to NASA as well as augmenting Space Grant Graduate Assistantship support for a graduate student (male) doing thesis research on this topic.

A second Small-Scale Grant was awarded to Prof. Christopher Danforth of Mathematics at UVM. This award allowed Prof. Danforth to continue his collaboration with Dr. Robert F. Cahalan, Head of the Climate and Radiation Branch at the Goddard Space Flight Center. Dr. Cahalan informally co-advised Prof. Danforth's Ph.D. thesis at the University of Maryland, College Park from 2001-2006. This award also included support for a graduate student research assistant. An expectation of all VTSGC Small\_Scale Grants is that the faculty researchers will write at least one proposal to a Federal agency for follow-on funding through regular National competitive channels. Prof. Danforth has done this, and I'm pleased to be able to report that a proposal to NSF to provide support for a Postdoctoral Assistant has now been funded. Prof. Danforth has told us that preliminary results obtained with VTSGC seed funding are directly responsible for this award. To obtain additional follow-on funds for his project, Prof. Danforth also recently submitted an NoI for a NASA NRA. His project appears to be well on its way to "graduating" from our seed money Faculty Research Program and becoming self-sustaining through a combination of NSF and NASA awards.

Two additional new Small-Scale Grants were awarded in FY 2009 to Prof. Carl Brandon of VTC and Prof. Jun Yu of the UVM. Both of these awards allowed these faculty researchers to complete development of a sea ice buoy that will provide remotely-sensed data needed for studying aspects of global climate change. Prof. Yu was also separately awarded VT-NASA EPSCoR funding to partially support the involvement of a Postdoctoral Fellow in this research. His VTSGC Small-Scale Grant is thus an example of the close cooperation and coordination between the VTSGC and VT-NASA EPSCoR in our joint efforts to enhance Vermont's Research Infrastructure in NASA-relevant areas.

The final two Small-Scale Grants awarded in the VTSGC's FY 2009 Faculty Research Competition were made to Prof. James Iatrides and Prof. Mandar Dewoolkar, both of UVM's SoE. Both of these awards primarily consisted of graduate student support. A value added feature of the Iatrides award is that it is assisting in the development of Biomedical Engineering as a new area of emphasis within UVM's College of Engineering and Mathematical Sciences and College of Medicine. Indeed, the current MS level graduate program in this area is in the process of being upgraded to a PhD program that spans multiple UVM colleges. The VTSGC has established itself as a significant stakeholder in this effort. As will be reported in FY 2010, we have helped recruit a new junior faculty member to UVM's SoE (female) who is not only an expert in

this research area, but has expressed an interest in initiating research that is strongly aligned with new and continuing NASA research priorities.

Vermont's NASA EPSCoR Program currently supports much of Vermont's academic faculty research in areas of interest to NASA. However, as indicated by the above awards, the VTSGC remains an active participant in efforts to expand and enhance Vermont's NASA-related research infrastructure and build further research ties between Vermont's academic faculty and NASA.

A comparison of the progress reported above with the SMART goals and objectives described in the VTSGC's FY 2009 proposal package shows that all targets for the current reporting period have been met or exceeded. The target for faculty awards in our FY 2009 proposal was five Small-Scale Grants and one Research Minigrant. As noted above, six Small-Scale Grants, one of which was essentially a Minigrant with graduate student support, were in fact funded by the VTSGC. As was pointed out earlier, these Research Grants will help to build and strengthen research ties between Vermont's academic faculty and NASA. Since one of the faculty PIs named in our FY 2006 Annual Report is a member of an underrepresented group, the 5-year diversity target in our original FY 2005 proposal for participation of underrepresented faculty in the VTSGC's Research Infrastructure Programs has already been exceeded, and the Hispanic faculty researcher funded in the current reporting period further adds to our progress promoting diversity in these programs. This is a major achievement since data from the UVM Office of Institutional Studies shows that of the 974 full-time faculty members at UVM in 2005, only 10 (1.03%) were underrepresented minorities in STEM areas that might be of interest to NASA, and thus eligible for VTSGC research support. One female faculty member is a Co-Investigator on the funded projects detailed above. Thus, the VTSGC has now also exceeded our target of awarding at least two faculty research grants to women during the 5-year period of this Space Grant award.

### 1.2 Undergraduate Scholarship and Graduate Research Fellowship Competitions:

Results of the sixteenth Vermont Space Grant Undergraduate Scholarship Competition were announced in May 2009 with undergraduate scholarships awarded for the 2009-2010 academic year. In the general competition, ten merit-based scholarships (from fifteen applications) were awarded to outstanding Vermont students who will be attending Vermont institutions of higher learning throughout the state. Through a Memorandum of Understanding with the Abenaki Tribal Council of Vermont, three additional VTSGC Native American Undergraduate Scholarships were also awarded to outstanding scholars of Abenaki heritage. Ten of these thirteen scholars were women. This exceeds both the target of 41% undergraduate scholarships awarded to women contained in our FY 2009 proposal and the target of 25% awarded to members of underrepresented groups. All supported undergraduate students appear to be making excellent progress toward their baccalaureate degrees.

Three additional special scholarships of \$1,500 each were awarded during the current reporting period to students in the Aviation Technology School of the Burlington

Technical Center, a VTSGC affiliate. This School has a 100% employment record, and graduates of its program, which is one of the premier programs in North America that train certified aviation and powerframe technicians, are usually offered employment either before or within hours of graduation. Because the school calendar for this program differs significantly from the usual academic year, students in this program cannot reasonably compete in the VTSGC's normal Undergraduate Scholarship Competition. To address the special needs of this affiliate, these scholarships were first authorized by the VTSGC's Board of Advisor in 2003 as part of our efforts to develop and expand the scientific and technical workforce needed in the future by NASA and aerospace companies in the private sector.

An additional VTSGC special scholarship was awarded to Cameron Mercer, an undergraduate student at Middlebury College, to support a Summer Internship at Marshall Space Flight Center. Mr. Mercer's internship activities included work on support operations and data analysis for the Mars Exploration Rovers project, including geologic analysis of rocks, Martian atmospheric monitoring, and tactical planning within the Science Operations Working Group.

In terms of graduate fellowships, the University of Vermont is the only comprehensive institution in the entire State granting graduate degrees in mathematics, science and engineering. This fact explains why the VTSGC Graduate Research Fellowships have been for graduate study at UVM. Fortunately, UVM's graduate programs in mathematics, science and engineering are strong and thriving, especially in the biomedical and remote sensing areas that form the research focus of NASA-related research in Vermont. It is important to note that our graduate awards have a strong research component and are not simply pure fellowships. Recipients work with UVM researchers who have, or are developing links to NASA, and the awards usually contain a summer research stipend as a component.

Graduate Research Fellowships that supported five graduate students were competitively awarded for the 2009-2009 academic year in the VSGC's FY 2009 Graduate Research Competition. This formally does not the target of six awards stated in our FY 2009 proposal, but it should be noted that support for two additional graduate students is contained in Small-Scale Grants awarded in our FY 2009 Faculty Research Competition. One of the five supported students is a women. At 20%, the results for women awarded VTSGC Graduate Fellowships during the present reporting period are under the goal of at least 40% given in our FY 2009 proposal. However, aggregating the present results with results from prior reporting periods, we have met our goal for participation by women in this program over the full five-year period. Unfortunately, the same statement cannot be made about meeting our target of awarding two Graduate Fellowships to members of an underrepresented group during the 5-year period of our Space Grant award. One Graduate Fellowship was awarded to a member of an underrepresented group in a prior reporting period, but none of the graduate students supported in FY 2009 was a member of an underrepresented group. Faculty mentors are strongly encouraged to propose GRA funding for women, members of underrepresented groups, and persons with disabilities in our yearly Graduate Research Competitions. Despite our proactive efforts in this regard,

it is now clear that our overall goal of two awards to underrepresented graduate students was not a realistic target as only 2% of the UVM graduate students in STEM departments are underrepresented minorities who are U.S. citizens.

Our graduate fellowship program is producing excellent outcomes. All graduate students awarded VTSGC Graduate fellowships during the present reporting period are making excellent progress toward earning their degrees.

### *1.3 Higher Education Programs:*

In 1996, the VTSGC initiated a category of awards called Undergraduate Program Projects to fund many of our efforts in Higher Education. In the just concluded reporting period, two supported activities in this category were the UVM Alternative Energy Racing Vehicle (AERO) Student Team and Norwich University's Autonomous Underwater Robotic Vehicle (AUV).

Prof. Jeff Frolik of UVM's Department of Electrical and Computer Engineering and Prof. Ronald Lessard of Norwich University's Department of Electrical Engineering are the faculty mentors for the AERO and AUV Student Teams, respectively. The 2009 Program Project Grants for these engineering design teams provided additional follow-on funding for design efforts initiated with earlier ESMD-Space Grant awards. Prototype vehicles designed, built, and tested by both of these student teams have successfully competed in national engineering competitions. The achievements of the UVM AERO Team are especially noteworthy. The new AERO hybrid vehicle, which uses both gas and lithium batteries and burns gas more efficiently through regenerative braking, was the recipient of three awards at the International Formula Hybrid Competition, including the Most Innovative Design and the Best Hybrid-in-Progress Chrysler's Best Hybrid System Engineering Award.

Other Higher Education activities supported by the VTSGC during the present reporting period enhanced the baccalaureate experience of undergraduate students at Vermont colleges and universities through funding faculty-mentored undergraduate research projects while strengthening faculty research efforts and building ties to NASA. Of the six undergraduate students participating in these research projects, three were women. Of the seven faculty mentors involved in these research projects, two were women.

At St. Michael's College (SMC) in Colchester, VT, Prof. Sue Kadas has coordinated mentored undergraduate research projects on topics of interest to NASA involving students in STEM disciplines during the academic year. Prof. Kadas is the SMC representative to the VTSGC's Board of Advisors. During the current reporting period, Professor Joanna Ellis-Monaghan of SMC's Department of Mathematics mentored SMC student Daniel Lewis on a research project titled "DNA Nanostructures," and Prof. Anthony Richardson and Prof. Melissa VanderKaay Tomaslo of the Department of Psychology mentored Rachel Allen on "The Impact of Physiological Stress on Cardiovascular Reactivity and Neuroendocrine Responses in Virtual Spatial Learning Tasks." Prof. James Byrne coordinated another similar program of mentored

undergraduate research at Norwich University. Prof. Byrne is a Vice Provost at Norwich and Norwich's representative to the VTSGC Board of Advisors. The Norwich program during the current reporting period involved a summer project in which faculty mentor Richard Hyde of Norwich's Physics Department mentored Norwich undergraduate Joel Heller studying "The Behavior of a Forced Harmonic Oscillator Subjected to Discontinuous Resistance."

During the current reporting period, the VTSGC also supported three mentored undergraduate research projects in the UVM Ureca! Program, coordinated by the Dean of the UVM Honors College. The aim of this program is to provide undergraduate students in all disciplines at UVM an opportunity to engage in a mentored research experience that is "over and above" the research component of a course taken for academic credit. The Ureca! Competition is structured so as to model a real life grant cycle and involves a student-written research proposal, evaluation of proposals by panels of experts, panel review reports, announcement of awards, work on the actual research project with a faculty mentor, and writing a final report detailing research results. The three Ureca! projects funded by the VTSGC all involved research topics that are aligned with NASA research priorities. The topic of the first project, conducted by UVM Chemistry student Kelly Todd, was "Reactivity of Organic Peroxides and their Contribution to Secondary Organic Aerosols." The second project, conducted by UVM Engineering student Evan Malina, was titled "Determination of Mechanical Properties by Indentation in Nanoscale Metallic Wires Using Atomic Force Microscopy," and the third project, conducted by UVM Computer Science student Simone Willett was titled "Program Specialization for Wireless Sensor Networks." All three UVM Ureca! Students, and the two students from SMC, gave presentations that highlighted the results of their research projects at the VTSGC's 2009 Awards Night Ceremony.

***Outcome 2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty (Educate and Engage)***

VTSGC activities this past year in our Higher Education and Precollege programs that contributed to this outcome are described in the following two sub-headings:

***2.1 Higher Education Programs:***

Components of several of the VTSGC programs described above give undergraduate students in STEM disciplines a greater appreciation for the breadth and depth of NASA's mission as well as an appreciation for the challenges presented by NASA-related research. In particular, faculty investigators in several of our FY 2009 Faculty Research Awards have actively engaged their undergraduate students by involving them in significant ways in their funded research projects. VTSGC research support thus provides new educational opportunities for these students and strengthens both the desire to pursue a career in a STEM discipline and, in some cases, the desire to go on to earn an advanced degree. The mentored undergraduate research projects described in the section above also directly educate and engage students at both a research university and two

primarily undergraduate institutions in a way that would not be possible without VTSGC sponsorship.

## 2.2 Precollege Programs:

Vermont is a small, predominantly rural state without a well-developed statewide research culture. There are only 82 high schools in the entire state, and, in many school districts, students are not fully aware of opportunities for scientific and technical careers. VTSGC precollege programs are able to access Vermont students at a key location in the pipeline leading to professional careers. Our data shows that the summer enrichment programs we have partially supported during the course of our training grant, particularly the Summer Mathematics Institute (which has now become a part of the Governor's Summer Institutes in Science and Mathematics) and an underrepresented minority component for the UVM College of Engineering and Mathematics Summer Enrichment Program in Science and Technology, have been successful in motivating precollege students from across the State. Further, the positive publicity in the press generated by these programs has increased the visibility of NASA throughout the State and facilitated our efforts at both the higher education and research infrastructure levels. The VTSGC is a founding member of the Vermont-NASA Educational Cooperative (VNEC), a group of organizations with ties to NASA and agendas that involve education at the K-12 level. We also helped to promote an interest in science among Vermont's Middle School students by our participation and support in the Junior Solar Sprint program, a project for students in grades 5 through 8 involving the design, building, and racing of mini solar/electric cars. Our Program Coordinator, Ms. Laurel Zeno has acted as Northern Vermont Area Coordinator for this program. VTSGC participation in this event includes donation of the Trophies and Certificates as well as help with the fundraising from the private sector that makes this event possible.

Two events coordinated by UVM's College of Engineering and Mathematical Sciences (CEMS) that involved the VTSGC occurred in 2009: Design Technology And Society Connection (TASC) and E-Week. Design TASC is held annually at UVM. The purpose of this competition is to give teams of high school students the challenge and satisfaction of designing, building, and testing a device to perform a specified task. The program begins in September and culminates in December when schools bring teams (maximum of five students per team) to UVM to display the devices they have created. The 2009 E-Week was held in February at the Vermont Air National Guard's Burlington facility with approximately 500 students from 35 elementary, middle and high schools in attendance. Activities included building a pasta bridge, an edible car, design of a hangar roof truss, and wind turbine and passive helicopter drop competitions. The VTSGC mounted an exhibit showcasing our programs at these events and also provided a small amount of funding support. Other precollege programs in which the VTSGC was involved during the present reporting period included the Governor's Youth Leadership Conference and the ACE Camp run by VT Department of Transportation and Aviation.

As a CAPENS Consortium, the VTSGC expends only a small percentage of our own funding on precollege activities. Our strategy in this area is to work whenever possible through affiliates such as the Vermont State Mathematics Coalition, the Fairbanks and Montshire Museums, and the Franklin Northwest Supervisory Union Indian Education Office. However, through the donated time of the Director and program staff and our collaboration with these affiliates, the VTSGC has been able to establish a strong presence in the state and region in the K-12 arena.

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

### 3.1 General Public and External Relations Programs:

To give NASA programs prominent exposure in the state and help engage and inspire the next generation of STEM practitioners, the VTSGC invites special guests to Vermont to address local audiences. NASA representatives who visited Vermont in FY 2009 included Dr. Eugene Waluschka, a Systems Physicist in the Optics Group at NASA GSFC, Dr. Michael Comberiate, Systems Manager in the Robotics Division of NASA GSFC, and Ms. Faith Davis, a RF Engineer in the Robotics Division at GSFC. The latter two NASA visitors brought a NASA Rover with them to Vermont, and all three NASA representatives participated in the VTSGC's 2009 Awards Night Ceremonies. Their participation in this event, as well as surrounding activities that included the VTSGC Student Poster Session and a seminar held the following day, helped to facilitate opportunities and interactions between GSFC and Vermont students, teachers, and academic researchers.

The VTSGC was recently named a full member of the Vermont Academy of Science and Engineering (VASE), a component of the Vermont Technology Council that advises the State of Vermont on science and technology policy. Consortium Director William Lakin was invited to participate in a recent VASE review and revision of Vermont's official Science and Technology Plan.

Additional outreach within the State has come from the VTSGC's interactions with civilian aviation interests and the Civil Air Patrol in Vermont. Vermont's Lieutenant Governor, Brian Dubie, a commercial airline pilot and current National Chair of the Aerospace States Association, has expressed a particular interest in this portion of the VTSGC's activities. The VTSGC's Program Coordinator, Ms. Laurel Zeno, is our point person for interactions in this area. Ms. Zeno is a member of the Aero Club of New England and serves as the VTSGC's representative on the Board of Burlington Technical Center's Aviation Technology School. The VTSGC has played a key role in promoting the expansion of the Aviation Technology School's facility at the Burlington Airport. Indeed, we are one of a group of stakeholders that submitted a successful proposal to the State for funds to support an expansion. The proposed new facilities will not only benefit the Aviation Technology School, but will also be used by students in Vermont Technical

College's new Aerospace Engineering Technology major, a degree program that owes its existence to an interaction of VTC and BTC through the Vermont Space Grant network. The VTSGC is also involved with the NASA Explorer School in Orleans, Vermont.

## PROGRAM CONTRIBUTIONS TO PART MEASURES

- **Longitudinal Tracking:** The VTSGC fully recognizes the importance of providing the National Program with accurate data that longitudinally tracks students supported by our programs. In past years, we have used our own database to acquire, aggregate, and report longitudinal tracking data. However, as our spectrum of supported programs has broadened and tracking participating students has become more complex, it became clear that seeking outside help would benefit our efforts. Therefore, for the first time this past year, we have contracted with the National Space Grant Foundation to longitudinally track participating students. Unfortunately, the change over from our own system to the Space Grant Foundation's service has not gone smoothly. For example, it appears that we have been using a very different interpretation of "significant student support" from that employed this year by the Foundation. This has led to a considerable degree of confusion regarding the actual number of students who participated in our programs in FY 2009. The following tracking data has been taken directly from the spreadsheet provided us by the Foundation. This data clearly understates actual student participation, and we are now working closely with the Foundation to resolve apparent discrepancies.

Significant awards in FY 2009: 27 (20 undergraduate, 7 graduate), Male :16 (59.3%), Female: 11 (40.7%), Underrepresented: 0, Persons with Disabilities: 0. All 27 students with significant awards were still enrolled in their current degree program in FY 2009. For recipients of significant awards in previous years (FY 2006-FY 2008), 35 students (26 undergraduates, 9 graduates) were still enrolled in their current degree program while 8 awardees (4 male, 4 female) have graduated and are employed in a STEM position.

- **Course Development:** No new courses were developed in FY 2009 as the result of funding from Vermont's main Space Grant award. However, one course (reported separately to ESMD) was developed for senior Mechanical Engineering students in UVM's SoE using funding from a ESMD-Space Grant award.
- **Matching Funds:** The ratio of matching funds to NASA funds in our FY 2009 proposal was 0.76 to 1.

**Minority-Serving Institutions:** Vermont has an exceptionally homogeneous population. Demographic tables from the 2000 US Census show that only 2.3% of Vermont residents identify themselves as members of an underrepresented minority in STEM areas while data from the National Center of Education Statistics Digest indicates that only 2.5% of

students enrolled in Vermont (in-state and out-of-state) are Black, Hispanic, or Native American. Vermont has no minority-serving higher educational institutions, or indeed any higher educational institutions with a significant percentage of minority student enrollment. As will be noted shortly in the Program Partners Section, one VTSGC strategy for promoting diversity in our programs involves a strong working relationship developed over the past ten years with the Franklin Northwest Supervisory Union Indian Education Office, the Education Arm of the Abenaki Tribal Council of Northern Vermont. The FNWSUIEO, which is now a VTSGC affiliate, cooperates closely with the VTSGC in our Undergraduate Scholarship Program and each year helps us to attract talented students of Abenaki Heritage to our scholarship application pool. Indeed, in our affiliate structure, the FNWSUIEO plays a role similar to a “Tribal College.” A second part of the VTSGC’s strategy for promoting diversity in our programs involves developing relations with minority-serving institutions out-of-state. In particular, the VTSGC has worked through the New York Space Grant Consortium to conduct joint weather balloon launches with Medgar Evers College, part of the City University of New York for the Central Brooklyn community. In joint CricketSat workshops for undergraduate students, Vermont and New York students work on the assembly and calibration of CricketSat temperature sensors as well as conducting flights.

### **IMPROVEMENTS MADE IN THE PAST YEAR**

One change made during the past year demonstrates the VTSGC’s commitment to the practice of “continuous process improvement” in the mounting of our spectrum of programs. In 2005, the pool of applicants for VTSGC Undergraduate Scholarships was disappointingly small. An extensive discussion with the VTSGC’s Board of Advisors uncovered a problem with publicizing these scholarships at affiliate institutions. More extensive distribution of the competition announcement plus the addition of several reminder announcements produced a larger applicant pool in 2006, but in 2007 the applicant pool unexpectedly contracted to a new low. Research revealed that the stipend for our merit-based scholarships, which had not increased in five years, was at a level that did not inspire student interest. The advertised stipend for our 2008 competition was accordingly raised, which produced the largest pool of quality applicants in the history of our yearly Undergraduate Scholarship Competition. The pool of applicants for our 2009 competition was similarly robust. However, we have now noticed a trend that, if not accounted for, may impact the size of future applicant pools for our Undergraduate Scholarships. This trend can be closely correlated with the evolution of Social Networking among students at both the high school and college levels. As the use of Facebook and Twitter becomes pervasive among this group, there is a greatly increased reliance on Social Networking as a means of communicating information and opportunities. This is coupled with an increased tendency to ignore or discount paper notices, as well as to ignore email from sources that are not immediately familiar. Since, in addition to encouraging direct student contact by VSGC-affiliated faculty, we have previously relied heavily on both posted notices and email announcements to alert students to our Undergraduate Scholarship opportunity, this new trend has implications for recruitment of our applicant pool. Consequently, we are now in the process of crossing the “digital divide” to put the VTSGC on Facebook. We will also encourage students to interact with us using Twitter and will now send out Tweets as well as emails

to announce future Undergraduate Scholarship competitions.

## PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

The University of Vermont is the VTSGC's Lead Institution and Fiscal Agent, and we are based in UVM's College of Engineering and Mathematical Sciences. Academic affiliates include: St. Michael's College, a Liberal Arts college in Colchester, VT; Norwich University, a comprehensive school with engineering programs in Norwich, VT; Vermont Technical College (VTC), part of the Vermont State College System in Randolph, VT; and the Aviation Technology School of the Burlington Technical Center (BTC), one of this country's premier programs leading to FAA Airframe & Powerplant Certification. The VTSGC and NASA thus have a presence at academic institutions throughout the state.

Other educational organizations that are VTSGC affiliates are the Vermont State Mathematics Coalition, the Fairbanks Museum and Planetarium, the Montshire Museum, and the Franklin Northwest Supervisory Union Indian Education Office (FNWSUIEO). The Vermont State Mathematics Coalition is composed of teachers at all levels, school board members, representatives from state agencies, and private sector representatives who are concerned with advancing Vermont's STEM education base. The linkage of this coalition with the statewide Space Grant network allows the VTSGC to be a stakeholder in K-12 education with only a small outlay of our own funding. The Fairbanks Museum and Planetarium and the Montshire Museum are both informal education providers with highly successful programs serving the general public. The FNWSUIEO promotes the educational objectives of the Abenaki Tribal Council of Northern Vermont. As Vermont has no Minority Serving Institutions, or indeed any Higher Educational institution with a significant percentage of students from underrepresented minorities, the active participation of the FNWSUIEO as a full affiliate in our network greatly enhances our goal to engage diverse populations in VTSGC programs. Industrial affiliates of the VTSGC include Triangle Metal Fabrications of Milton, VT and Microstrain, Inc. of Williston, VT. Both of these companies have provided significant support and training for VTSGC-supported student engineering teams.