

Virginia Space Grant Consortium
Progress Report
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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 Virginia Space Grant Consortium (VSGC) is a Designated Grant Consortium funded at the level \$575,000 for fiscal year 2008.

PROGRAM GOALS

Goal 1: Provide a higher education scholarship and fellowship program that provides research and education opportunities to students from diverse populations in science, math, technology and education disciplines and other aerospace-related disciplines at Consortium member institutions.

Goal 2: Foster and nurture a strong science, mathematics, and technology education base from kindergarten through 12th grade levels, together with an interdisciplinary approach whenever possible.

Goal 3: Foster a strong science, mathematics, engineering and technology educational base at the university level. Nurture interdisciplinary approaches whenever possible.

Goal 4: Model diversity in VSGC programs and activities and facilitate the National Space Grant's focus on involving women, underrepresented groups, and persons with disabilities in all aspects of education, including fellowship awards, curriculum development, and degree programs in scientific and technical fields.

Goal 5: Support science, math, engineering and technology as well as interdisciplinary public service programs through informal education and public programs with affiliates and partners.

Goal 6: Develop an effective external relations program for creating public awareness and visibility of NASA and VSGC program activities and outcomes.

Goal 7: Extend NASA and VSGC member capabilities by creating effective links between stated needs and the technical and scientific expertise of our partners and affiliates.

Goal 8: VSGC will be effectively managed to ensure that all programs sustain a high standard of quality.

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

Outcome 1

Student Research and Flight Projects Overview

In 2008, a total of 60 graduate and undergraduate students participated in VSGC research projects. Those projects were highly diverse including: student/faculty built sounding rocket payloads; an entry for the National CanSat small rocket competition; a NASA Wallops-sponsored scientific balloon payload which is a precursor for a planned lunar payload; a physics experiment on the NASA Reduced Gravity aircraft; first flight of a high reliability UAV design for the Navy; student-developed data analysis packages for optical atmospheric research instruments and a medical research project which will give VSGC its first patent.

Patrick Hopkins and the MicroMAPS Project

VSGC, in partnership with NASA Langley Research Center, Virginia Tech and the University of Virginia, established the MicroMAPS (Measurement of Air Pollution from Satellites) project to conduct research using a NASA instrument previously developed for the cancelled Clark spacecraft. The scientific objective of the MicroMAPS project was to advance understanding of the chemical and transport processes in the lower atmosphere of the Earth. The engineering objective was to demonstrate that modern, digital technology enables the mission deployment of a small, low cost instrument for atmospheric studies. More than 50 students participated in the real-world experience and scientific research. While a VSGC Undergraduate Research Scholar at the University of Virginia (UVA), Patrick Hopkins participated in the project. Patrick was supported for three more years on MicroMAPS as a VSGC Graduate Research Fellow while he led the student participation. Patrick Hopkins received his Ph. D. and his thesis was based on his development of radiative transfer algorithms for MicroMAPS. In 2008, he received a prestigious, three-year post-doctoral fellowship at Sandia National Labs to pursue his work.

RockOn! Workshop

With support from the NASA Space Grant program office and sponsorship by NASA Wallops, the Colorado and Virginia Space Grant Consortia implemented the RockOn! Workshop in June 2008. The program offered Space Grant programs nationwide the opportunity to learn to develop sounding rocket payloads, to build a payload from a kit and to fly it on a sounding rocket. The ultimate goal of RockOn! was to give participating faculty and students the knowledge and tools to build student flight programs at their institutions. VSGC students and faculty from Old Dominion University, Virginia Tech and UVA participated in the first annual RockOn!

Sounding Rocket Workshop at WFF. Along with faculty and students from 11 universities across the country, they built, tested, launched and recovered sounding rocket payloads in one week.

Mission Management for Solar System Exploration

Under the sponsorship and direction of NASA Wallops, students from Virginia Tech are working on a long-term test program to develop a payload which will map the magnetic field and topography of the lunar surface. For the last two years, elements of the payload were student-built and flight-tested on the high altitude balloon program operated by NASA, and launched from the Columbia Scientific Balloon Facility at Fort Sumner, NM.

NAVAIR Project

Under a VSGC project, a design team, composed of eight students from Virginia Tech with cooperation from Loughborough University in England, was tasked by the Naval Air Systems Command (NAVAIR), with the design of a UAV for the purpose of flying surveillance cover and incorporating reliability into the design process. A 1/3 scale model of the resulting UAV (named "Vulture") completed a successful test flight in 2008, which included an unplanned engine failure, and therefore confirmation that the design could be flown and landed on only one engine. The Vulture design is now being optimized for handling qualities.

Outcome 2

Virginia Aerospace Science and Technology Scholars (VASTS)

The students enroll in a semester-long online course that provides opportunities for problem solving, teamwork, to express creativity, to conduct research, and to communicate with like-minded peers and NASA mentors. Forty-eight Virginia students were selected to participate in the 2008 program. Forty-three of these students attended the Summer Academy at NASA Langley Research Center July 27 through August 1, 2008 and their evaluations attest to the program's success. A total of 114 students enrolled in the course which began in December 2008. Two summer 2009 academies are planned. Students can now receive up to four college credits through Thomas Nelson Community College in Hampton, VA for their participation in the program.

PROGRAM ACCOMPLISHMENTS

Outcome 1

VSGC Goal 1 - VSGC Scholarship/Fellowship Program

During FY08, VSGC awarded a total of \$334,100 in scholarships and fellowships to 81 students attending member institutions. Both the number and amount of scholarships/fellowships awarded in FY08 represent a new high for VSGC. VSGC received 130 applications (31% increase from the previous year) for the four existing programs (18% from underrepresented minorities; 46% from female students). For the new Freshman/Sophomore STEM Bridge program, the students were nominated by representative from their respective institutions. The breakdown of awards is listed here:

- 40 Graduate Research Fellowships totaling \$200,000
- 13 Undergraduate Research Scholarships totaling \$103,100
- 12 Teacher Education Scholarships totaling \$12,000
- 6 Community College STEM Scholarships totaling \$9,000
- 10 Freshman/Sophomore STEM Bridge Scholarships totaling \$10,000

For all five programs combined, 31% of the awards went to underrepresented minority students and 48% were awarded to female students. One fellowship was awarded to a former scholarship awardee. Six awards went to prior participants from the LARSS or ESMD internship programs. Two awards supported research in geospatial technology/remote sensing. All awardees were chosen by a diverse panel of representatives of Consortium members through a competitive selection process. Members from the review committees for all five programs were impressed with the overall quality of the pool of applicants, and especially of those chosen for funding.

VSGC Goal 1 - NASA Academy and Other Related Internships

During FY08, VSGC contributed a total of \$12,788 in stipends and travel reimbursement to support six students attending Academies and internship programs at NASA Goddard. Student stipends of \$4,000 each were provided to one student attending each of the following: NASA Academy at Goddard, NASA Robotics Academy at Goddard, and the NASA Goddard Student Internship Program (SIP). VSGC also provided travel support for one alumnus from Virginia from both the Academy at Goddard and the Robotics Academy at Goddard to return and work as staff. VSGC provided support for one community college student to work as an intern in the Security Office at NASA Langley. Of these six student placements, four were underrepresented minority students and four were female students.

VSGC Goal 1 - Freshman/Sophomore STEM Bridge Scholarship Program

For the 2008-09 academic year, the VSGC established this new program to encourage talented individuals to (STEM) related fields and research. To be eligible, students must be an underrepresented minority candidate, a first-time freshman majoring in a STEM field, and a full time student. VSGC awarded 10 students, two at each member institution, with a \$1,000 scholarship. The award will be renewable in their sophomore year. One current Undergraduate Research Scholar and one Graduate Research Fellow at each institution are serving as mentors for both Freshman Bridge students at each institution.

VSGC Goal 3 - Langley Aerospace Research Summer Scholars (LARSS)

VSGC successfully placed 184 students in mentored-research positions at NASA LaRC under the direct guidance of a scientist, engineer or technical mentor. Student placements ranged from high school seniors to graduate students, with the bulk of the students representing junior and senior undergraduates. Thirty-three percent of the students were female and 34% were minority. Seventeen state Space Grants sponsored thirty-eight of the LARSS students. The applicant pool for Summer 2009 is currently at 622 – the highest to date.

VSGC Goal 3 - NASA Langley-VSGC Geographic Information Systems (GIS) Internship Program

In the summer of FY08, the VSGC began managing the NASA Langley-VSGC GIS Internship Program for Langley. This year-round program places about 12 students in internships each semester to provide GIS data and program maintenance, space utilization, and other facilities support to the Center. Through this program, VSGC also recruits and places one intern at NASA Johnson Space Center to provide GIS support to the Center. During FY08, VSGC has successfully placed 31 interns including two at NASA Johnson in full and part-time internships.

VSGC Goal 7 - Mission Management for Solar System Exploration – MMSseX

Under this NASA Wallops sponsored initiative, 17 Virginia Tech students, five of which were female, built and flew an instrument sensor package on the High Altitude Student Platform attached to a NASA Wallops High Altitude Balloon.

VSGC Goal 7 - Virginia Student Launch Initiative – Hy-V

Ten Virginia Tech and one University of Virginia student developed the framework, experiment design, and management plan for a multi-university hypersonic propulsion development project. The goal is to launch a Mach 5 hypersonic payload on a sounding rocket at Wallops Flight Facility to look at restart issues and to develop comparison data for vitiated in the upper atmosphere as a means of calibrating the results from ground level hypersonic combustion in wind tunnels.

VSGC Goal 7 - Microgravity Research

A multi-university, multi-Space Grant team flew a series of experiments on the NASA sponsored Zero-G aircraft to look at magnetic field lines under reduced gravity. This experiment is being flown by USRP students at Johnson Space Center as part of the Reduced Gravity Student Flight Program. Old Dominion University, University of Wisconsin, University of Missouri, and University of Colorado partnered in this research through their state Space Grant programs. Based on this work, educational materials will be produced for high school and university physics courses. Five undergraduate students, including two females, worked on the project.

VSGC Goal 7 - Early Engineering Advantage Program (eEAPw)

VSGC sponsors the eEAPw program at Old Dominion University, which is designed as a “head start” program for incoming female students in traditionally male-dominated sciences. Fifteen undergraduate students, including nine minority students, participated in the summer 2008 program. The program is also designed to enhance future academic and career opportunities in engineering.

VSGC Goal 7 - ODU Pre-Calculus Refresher Program

In summer of 2008, VSGC provided \$5,000 in support to Old Dominion University’s three-week Pre-calculus Refresher Program. The goal of this program was to improve the math readiness of incoming freshman who were interested in majoring in engineering or science at ODU. Inadequate math preparation can be a barrier to success in STEM and often leads to students changing to a non-STEM major. During this three-week class, students were given intensive homework as well as time to work on problems in class, with the help of the instructor and one undergraduate math tutor.

Outcome 2

VSGC Goal 3 - FAA Design Competition

For the third year, VSGC has managed the successful FAA Design Competition designed to address airport operations and infrastructure issues and needs. Thirty-three student teams and three individuals participated. Sixteen colleges/universities were represented and seven submitted multiple proposals. Three first-place cash awards were made, three second-place, three third-place and five honorable mentions. The three first-place teams presented at the American Association of Airport Executives Meeting held in New Orleans, LA in June 2008.

VSGC Goal 2 - Weather and Climate Education for Students With Visual Impairments

The VSGC in partnership with Technical Education Research Center (TERC), National Federation of the Blind, and NASA Johnson Space Center, received funding from the National Science Foundation (NSF) to create and field test materials to help visually impaired students learn and understand weather. During FY08, the module was drafted, pilot tested with 42 students during a regional conference, and improved by the project team. The module was then field tested in two classrooms (one in Colorado and one in Virginia) with two teachers and 10 students participating.

VSGC Goal 2 - Governor’s Academy for Innovation, Technology, and Engineering (GAITE)

The VSGC is a partner with New Horizons Regional Educational Centers, six public school divisions, Thomas Nelson Community College, NASA Langley Research Center, Northrop Grumman, Canon Virginia, and the Peninsula Council of Workforce Development on the GAITE program to create and implement academic pathways in electrical engineering technology and

mechanical engineering technology. Funding was provided to Virginia by the National Governor's Association and awarded by the Virginia Department of Education through a competitive grant process. VSGC was awarded a total of \$46,623 and is also contributing up to \$15,000 in support of the project.

VSGC Goal 2 - GEAR UP!

The program will serve a cohort of students in grades 6-7 at two middle schools and will follow these 600 students through graduation at Hampton High School and Phoebus High School over a six-year period. The GEAR UP program has four primary components: improving academic rigor, involving parents, identifying potential careers and setting career goals, providing a community of support. GEAR UP events reached a total of 148 participants including 105 students and 43 parents. An estimated 90% of the participants were underrepresented minorities and 50% were females.

VSGC Goal 2 - OVERspace (Offering Virginia Educators Resources in Spatial Practices Across the Curriculum for Excellence)

VSGC sponsors the OVERspace Program, which is a statewide program that teaches teachers how to implement GPS/GIS in the classroom. Components of the program include awareness-level demonstrations and presentations and hands-on workshops conducted onsite by OVERspace Educators who are current and former teachers trained by VSGC. Through a variety of workshops and one-hour seminars, a total of 96 teachers were trained through OVERspace. OVERspace Educators conducted a two-hour workshop for 20 precollege teachers participating in NASA Langley's precollege teacher institute.

Outcome 3

VSGC Goal 6 - NASA Langley Research Center/ Wallops Flight Facility/ Johnson Space Center

PROGRAM CONTRIBUTIONS TO PART MEASURES

- **Student Data and Longitudinal Tracking:** Since 2006, VSGC has awarded a total of 277 significant awards to 237 unique students including 215 scholarships and fellowships to 177 students. A total of 62 awards have been made to 60 unique students in higher education and research infrastructure projects. Twenty percent (20%) of the awards represent underrepresented minority fellowship/scholarship funding. Four students are employed in STEM with an aerospace contractor while four students are employed in a STEM position with non-aerospace contractors. Seven students have accepted positions in K-12 STEM education, one student is employed in another STEM academic field. One student is currently in a post-doc position. Fourteen students have graduated and are pursuing advanced STEM degrees. A total of 206 awardees are still enrolled in a STEM degree program.
- **Course Development:** Three new courses in geospatial technology were developed at three community colleges in Virginia as part of the GTEVCC project. Tidewater Community College offered Photogrammetry after participating in the planning grant. Virginia Western Community College offered an independent study course in the advanced applications of GIS, and John Tyler Community College incorporated GIS into its architectural design course;
- **Matching Funds:** VSGC projects estimated leveraging of NASA funds as \$1.38 in non-federal funding for each Space Grant dollar and \$5.62 from all sources;
- **Minority-Serving Institutions:** VSGC sponsored a faculty member from Norfolk State University as a Space Grant faculty fellow at NASA Langley. VSGC is developing a Space Grant minority serving institution proposal with Hampton University to initiate a student spaceflight program.

IMPROVEMENTS MADE IN THE PAST YEAR

- Established web-based longitudinal tracking system for former student awardees;
- Significantly enhanced partnerships with NASA Langley Research Center and NASA Wallops Flight Facility and NASA Johnson Space Center;
- Employed additional Education Specialist staff member;
- Secured additional office space for two staff members with room for two more;
- Created and implemented an online application process for the Scholarship/Fellowship program;
- Significantly increased scholarship/fellowship applications and percentage of minority awards (31%) and female awards (48%).

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Member institutions and multiple program partners:

- College of William and Mary;
- Hampton University;
- Old Dominion University;
- University of Virginia;
- Virginia Tech;
- NASA Langley Research Center;
- NASA Goddard Space Flight Center's Wallops Flight Facility;
- State Council of Higher Education for Virginia - coordinates system of higher education in Virginia;

- Virginia Community College System – state agency overseeing 23 community colleges in Virginia that provide comprehensive higher education and workforce training programs;
- Virginia Department of Education - Virginia agency for K-12 education
- MathScience Innovation Center - K-12 math and science program;
- Science Museum of Virginia - informal science education;
- Virginia Air and Space Center - informal science education;
- Virginia’s Center for Innovative Technology - technology focus for Virginia companies.

Other program partners include:

Business and Professional Organizations

- Virginia Association of Science Teachers – VSGC sponsorship of state conference;
- Hampton Roads Technology Council – VASTS marketing; industry networking;
- National Society of Black Engineers – LARSS marketing and recruitment;
- American Association of Airport Executives – FAA University Design Competition;
- Airport Consultants International – FAA University Design Competition;
- National Association of State Aviation Officials – FAA University Design Competition;
- Airport Consultants Council – FAA University Design Competition.

Educational Non Profit Organizations

- CHROME – VSGC is a sponsor and collaborative partner;
- National Institute of Aerospace – partner in LARSS;
- StarDate Radio – VSGC-sponsored programming;
- American Indian Higher Education Consortium - sponsorship of LARSS students;
- Technical Education Research Center (TERC) – partner in NSF grant
- Univesrity Aviation Association – FAA University Design Competition.

School Systems/Precollege Programs

- New Horizons Regional Education Center – partner in GAITE;
- Thomas Nelson Community College – partner in GAITE and VASTS;
- Hampton City Schools – partner in GEAR UP.

Industry

- Canon Virginia, Inc. – partner in GAITE;
- Northrop Grumman – partner in GAITE;
- Aerojet – VASTS sponsor;
- Analytical Mechanics Associates, Inc.- VASTS sponsor;
- ATK Space Systems – VASTS and Hy-V sponsor;
- Dominion – VASTS sponsor;
- Lockheed Martin Space Systems Company – VASTS sponsor;
- Sierra Lobo, Inc. – VASTS sponsor;
- UNISYS – VASTS sponsor;
- Rome – LARSS sponsor
- ATK-Gazole – Hy-V sponsor.

State and Local Government

- Virginia Community College System – affiliate member and partner for multiple programs;
- Virginia Department of Education – affiliate member and partner for multiple programs;
- Virginia General Assembly – legislative support for VASTS and aerospace sector.

Non-Member Universities

- Norfolk State University – VSGC faculty sponsorship for NASA LaRC research;
- Morgan State University – LARSS sponsor.

Federal Government

- Federal Aviation Administration – partner/sponsor for FAA University Design Competition;
- NASA Academy/Goddard Space Flight Center;
- National Space Grant Foundation – multiple program partnerships;
- NASA Johnson Space Center – VASTS, GIS Internship Program;
- NASA Headquarters – RockOn!;
- Kennedy Space Center – ESMD Interships;
- US Department of Education – Gear Up project;
- US Navy – NAVAIR and UAV projects.