

MN Space Grant Consortium_2007 Annual Performance Data

Minnesota Space Grant Consortium

Lead Institution: University of Minnesota

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Affiliate members:

Augsburg College
Bemidji State University
Bethel University
Carleton College
College of St. Catherine
Concordia College
Fond du Lac Tribal and Community College
Leech Lake Tribal College
Macalester College
Minnesota Department of Transportation
Southwest Minnesota State University
University of Minnesota - Twin Cities
University of Minnesota – Duluth
University of St. Thomas

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 Minnesota Space Grant Consortium is a Designated Consortium funded at a level of \$590,000 for fiscal year 2007.

Program Relevance to NASA: Space Grant consortia build human capital and research expertise to support NASA programs and missions, expand NASA's expertise and educational networks, and bring knowledge and awareness of space to a broad range of constituents in every state. The Minnesota Space Grant Consortium (MnSGC) supports NASA's Strategic Goals and Outcomes in Education. As a higher education program, our primary contribution is toward the achievement of Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals.* MnSGC supports this outcome by financing scholarship and fellowship programs, student opportunities at NASA Centers, graduate and undergraduate research

opportunities, and curricular development in physical sciences and engineering at the college level. We also make significant contributions to Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.* This outcome is supported by in-service and pre-service teacher training and with our interactions with other NASA educational activities in Minnesota. We support Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission* by informal educational activities offered around the state.

Program Benefits to the State: The strategy of MnSGC has been to develop a mix of program elements which satisfy the needs of Minnesota and also are aligned with NASA's Strategic Plan and Educational Outcomes and Objectives. Research/internships at both the graduate and undergraduate levels are a high priority because of the need of Minnesota's high-tech industries and NASA for STEM employees. We have selected our affiliates to provide geographical diversity in order to enhance science and mathematics education in the northern part of the state. A strong higher education infrastructure already exists in much of the state, and thus this program element has been highly focused within the affiliates and includes a strong aerospace vehicle design component at the University of Minnesota. A number of affiliates have pre-college programs which focus on training of pre-service and in-service teachers. In addition we have many programs which focus on under-represented groups, and we have been successful in involving these groups in our activities.

The broad objectives of MnSGC are as follows:

- Enhance the teaching of aerospace science and engineering at post-secondary institutions.
- Develop pre-college programs to enhance teachers' experiences and to encourage students' interest in science and mathematics, with a special focus on aerospace science and engineering.
- Provide financial assistance to students interested in aerospace science and engineering.
- Deliver informal education to the public about research, development, and career opportunities in aerospace science and engineering.

Program Goals:

- Involve underrepresented groups in research programs to at least a minimum percentage equal to Minnesota demographics for enrollment in higher education.
- Offer opportunities for high-quality undergraduate research experiences.
- Support high-quality graduate research in aerospace science, engineering, and related fields.
- Provide scholarships for women and underrepresented groups to at least a minimum percentage equal to the most recent Minnesota demographics for enrollment in higher education.

- Provide scholarships on a Consortium-wide basis to students majoring in the physical sciences, mathematics, engineering, and computer science.
- Provide scholarship support for student participation in activities at NASA Centers.
- Involve underrepresented groups in higher education programs to at least a minimum percentage equal to Minnesota demographics for enrollment in higher education.
- Support the aerospace design program at UMTC.
- Participate in the National Space Grant Student Satellite Program.
- Support undergraduate Higher Education activities at MnSGC affiliates.
- Provide support to programs at targeted affiliates which need additional funds.
- Improve the formal and informal teaching of science and mathematics at the pre-college level.
- Work with teachers at schools that serve primarily underrepresented groups to promote the teaching of mathematics, science, and pre-engineering.
- Work with teachers in at least three schools that serve primarily underrepresented groups to promote the teaching of mathematics, science, and pre-engineering.
- Promote informal education in aerospace and space-related sciences.

Program Accomplishments: The scholarship and fellowship program is one of the key components of MnSGC's program. Through our scholarships and fellowships we support diversity, student activities at NASA Centers, and STEM students at all of MnSGC's academic affiliates. Our final scholarship total for the 2007-2008 grant year was 68 scholarships at 11 of 13 academic affiliates, of which 16 (24.2%) went to underrepresented students and 29 (42.6%) went to women. We have been able to achieve these impressive results by being very proactive in recruiting of qualified women and underrepresented applicants and by establishing strong relationships with our Tribal College affiliates. We supported 12 students who participated in NASA Academies and NASA Center internships (students enrolled in all accredited institutions of higher education in Minnesota are eligible to apply for NASA Center Programs and be funded by MnSGC).

Our major higher education programs include (1) innovative aerospace design projects at the University of Minnesota, (2) participation in student satellite programs, and (at two affiliate campuses) development of (3) an aerospace capstone course for a STEM minor primarily for elementary education majors and (4) two courses exploring Native American Heritage in STEM fields. This year 74 students worked on 15 different aerospace vehicle design projects. Lockheed Martin, Boeing, AllianTech Systems (ATK), JPL, Goddard SFC, Princeton Satellites, Johnson Space Center, Honeywell, ASTERlabs, and the Air Force Research Labs sponsored design projects. These sponsors suggested projects, evaluated student design presentations and reports, and provided technical advice to the students. This is effective as workforce development because about 85% of the students participating in this program either go to work in the aerospace field, including NASA, industry, and the armed services, or go on to graduate school. Student satellite programs include BalloonSat projects at the University of Minnesota and at two of the affiliates as well as a small satellite program directed by a minority faculty

member at the University of Minnesota. Two innovative courses in Native American STEM Heritage have been developed at one of our Tribal College Affiliates and one of those classes is currently being offered for the first time. We also support the Sverdrup Lecture Series, in which an eminent scientist visits an affiliate campus to meet with classes and to deliver public lecture.

MnSGC's main emphasis in research is support of undergraduate projects. Most of these activities are carried out under the direction of faculty at the affiliates in the areas of physics, astronomy, and geology. MnSGC provides some support to well-qualified graduate students in the physical sciences and engineering at the University of Minnesota. The University of Minnesota is the only institution of higher education in Minnesota that offers advanced degrees in the physical sciences and engineering. Most research funds go directly to student support.

MnSGC offers training to in-service and pre-service teachers related to the integration of space science into the curricula and to the promotion of NASA educational materials. MnSGC maintains strong connections with the NASA Explorer Schools in the state.

Informal education comprises a relatively small part of MnSGC's activities. We support informal educational activities at the University of Minnesota – Duluth's Soudan Mine Cosmic Radiation Research Facility, the Planetarium at Southwest Minnesota State University, the Minnesota Department of Transportation - Aviation Education Division, and the Minnesota Science Museum. We also have formed linkages with a variety of other offices at the University of Minnesota that do informal education programming, both on campus and around the local community, adding space science and aerospace topics to their mix of offerings.

Student Accomplishments: A Ph.D. student at the University of Minnesota, supported by matching funds, completed his doctorate in aerospace engineering and will join an aerospace contractor. This student served as a Teaching Assistant in the capstone senior aerospace vehicle design course and was leader for the attitude determination and control group of the student small satellite program at the University of Minnesota. His Ph.D. thesis, completed under the supervision of the MnSGC Director, was entitled *The Application of Kalman Filters to State Vector Estimation Problems*. The results have direct application to space vehicle attitude determination. He developed attitude-determination algorithms for nano-satellites and validated these algorithms using post-processed spaceflight data from the Stanford/NASA Gravity Probe B satellite. This satellite is being used to investigate several predications from Einstein's general theory of relativity. A total of four journal articles and two conference papers have resulted from this Ph.D. The student has taken a permanent position as a R&D Scientist with the Aerospace-Engineering and Technology/Advanced Technology Group at Honeywell. He will be developing integrated navigation systems, global navigation satellite system (GNSS) landing systems, and GNSS-denied navigation systems.

An undergraduate student who served as the leader of our small satellite program, Nanosat-4, joined United Space Alliance in Houston Texas as a member of their Engineering Staff after completing his Bachelors Degree in Aerospace Engineering.

Another undergraduate student we supported is currently pursuing graduate studies in Aerospace Engineering at the University of Maryland. Regarding his experiences he writes:

“Participation in the Minnesota Space Grant impacted my life significantly. The Space Grant funded my NASA Academy internship at the Goddard Space Flight Center, and it was during my time at Goddard that I toured the University of Maryland. Having been impressed by the program and the facilities, I elected to attend the University of Maryland to pursue a graduate degree in aerospace engineering. Since I graduated (from UMTC), I participated in an internship at the NASA White Sands Test Facility where I tested small-scale explosives used in pyrovalves. Upon completion of my internship, I began my graduate studies at the University of Maryland - College Park. I am presently taking aerospace courses and researching a new portable life support system to be used in space suits.”