

Minnesota 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 Minnesota Space Grant Consortium is a Designated Consortium funded at a level of \$730,000 for fiscal year 2008.

PROGRAM GOALS

The mission of the Minnesota Space Grant Consortium (MnSGC) is to provide the driving force in Minnesota for higher education in aerospace sciences, aerospace engineering, and other scientific and engineering fields directly related to NASA's goals and the aerospace industry's workforce needs. 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; however, we also make significant contributions to Outcomes 2 and 3 and our efforts extend across the entire NASA Education Strategic Framework.

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

In 2008 the MN Space Grant began work training students to design and build payloads for suborbital rocket flights. A team of aerospace engineering students at the University of Minnesota designed a suborbital characterization payload for the Senior Spacecraft Design class in the spring of 2008. In the summer of 2008 two faculty members plus one student attended the RockOn workshop at Wallops Flight Facility to build and fly a suborbital payload kit. In the fall of 2008 that same student assembled another student team to design and build another characterization payload which has been accepted for flight on the next RockOn flight, scheduled for June 2009.

In the spring of 2008 U of MN aerospace engineering undergraduate student Mark Stole graduated and immediately took a position with a NASA contractor working on ISS activities at Johnson Space Center. As an undergraduate, Mark participated in high-altitude ballooning activities with the MN Space Grant and volunteered regularly at a local NASA Explorer School, to share his enthusiasm for aerospace topics with younger students. Mark did an internship at Marshall Space Flight Center the prior to graduating.

In the fall of 2008 MN Space Grant high-altitude ballooning activities at the University of Minnesota made the leap from extra-curricular into the classroom by way of a freshman seminar entitled "Introduction to Spaceflight with Ballooning." In this seminar, freshmen students, many of whom were undecided regarding their major, designed, built, and flew a miniature spacecraft into "near-space" on a helium-filled sounding balloon. Reaction to the class was overwhelmingly positive and several students claimed the experience helped push them in the direction of STEM fields for their major selection.

PROGRAM ACCOMPLISHMENTS

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

Scholarship and Fellowship Programs

Goal 1: Provide scholarships for underrepresented students to at least a minimum percentage equal to the most recent Minnesota demographics for enrollment in higher education (Native American 1.2%, African American 6.8%, and Hispanic 2.3%, for a total of 10.3%). Maintain our record of awarding about 50% scholarships to women.

We have taken a proactive approach to increase underrepresented recruitment at the UMTC. We have also improved our mentoring of underrepresented scholarship students and involving them in informal education activities for local schools with high underrepresented populations. Of the 60 total awards made so far this grant year across the MnSGC, 24 were made to underrepresented students (40%) and 18 were made to women (30%). Several affiliates have not yet awarded their 2008 scholarships but plan to do so before the end of the current grant period, so these award numbers will increase slightly.

Goal 2: Provide scholarships on a Consortium-wide basis to students majoring in the physical sciences, mathematics, engineering, and computer science. Provide at least five Consortium-wide scholarships. Continue institution-specific scholarship programs by providing at least 50 scholarships.

MnSGC has two scholarship programs. Some of the affiliates have their own institution-specific scholarship programs which are limited to students at their institutions; however, not all affiliates elect to have such a program. Therefore MnSGC also has a Consortium-wide program to which STEM students at every affiliate may apply. We have awarded five scholarships under the Consortium-wide program, of these four are to underrepresented minorities and two are to women. Affiliates, including the UMTC, have also awarded 48 institution-specific scholarships so far, of which 19 went to underrepresented students and 16 went to women.

Goal 3: Offer to provide scholarship support for at least eight students to participate in NASA summer internships and other activities at NASA Centers. (Note that since the final decisions on participants is made by the Centers, there is no guarantee that this many Minnesota students will actually receive offers.)

During the current grant period we supported four students at NASA centers: one at Langley, two at Goddard, and one at Ames. One of these awards was to an underrepresented student but none of our women applicants received offers. Although fewer Minnesota students received NASA internships offers than in some previous years, this remains one of our most effective programs in involving students in employment with NASA and the aerospace industry as well as in graduate studies in aerospace science and engineering. Essentially all students who have participated in these programs have joined the aerospace work force.

Higher Education Programs

Goal 1: Involve underrepresented groups in higher education programs to at least a minimum percentage equal to Minnesota demographics for enrollment in higher education for participation in higher education (Native American 1.2%, African American 6.8%, and Hispanic 2.3%, for a total of 10.3%).

Our higher education programs have concentrated primarily on development and support of courses in science, engineering and space studies. The number of underrepresented student participants has been small since the number of underrepresented students majoring in these areas is small. We are refocusing some of our efforts in higher education toward our tribal college affiliates in order to address this problem. In the current grant period Fond du Lac Tribal and Community College has continued to offer a course begun in the spring of 2008 entitled Contemporary Mathematics. In the spring of 2009 Fond du Lac also started offering a robotics class with Space Grant support, giving their students an opportunity to learn about both robotics and C programming.

Goal 2: Support the aerospace design program at the UMTC. Provide at least five design projects sponsored by industry or government.

The University of Minnesota offers an ABET-accredited B.S. in Aerospace Engineering. With the exception of Iowa, this is the only accredited Aerospace Engineering program in the region which includes Wisconsin, North Dakota, and South Dakota. An important component of this program is a required capstone design course. Students develop aircraft and spacecraft designs as part of this course. This grant period we offered three design courses - Aerospace Vehicle Design I, II, and III. Aerospace Vehicle Design I had a total of 71 students with four females and two minorities. Aerospace Design II had a total of 74 students with eight females and one underrepresented minority and Aerospace Design had 33 students with one female and one underrepresented minority. We involve representatives from the aerospace industry and

NASA Centers in formulating student design projects, providing guidance to design teams, and in evaluating student performance. Projects were sponsored by Lockheed Martin, Cirrus Design, Boeing, ATK, NASA Glenn, NASA Johnson, NASA Goddard, JPL, Air Force Research Lab, and Aster Labs. Student evaluations of these courses have been excellent.

Goal 3: Participate in the National Space Grant Student Satellite Program. Maintain at least two different types of active student satellite programs in MnSGC.

The objective of this goal is to provide Consortium-wide opportunities in student satellites. We have an ongoing BalloonSat program, which involves the University of Minnesota – Twin Cities and two affiliates, Concordia College and the College of St. Catherine. We also have a NanoSat program in the Aerospace Engineering Department at the University of Minnesota. We recently completed the NanoSat 5 project entitled Golden Eye – GPS Bistatic Radar for Remote Sensing and we are starting NanoSat 6 which will be passive relative-range measurement between satellites in formation via reflected GPS signals. We have also expanded our student satellite program by establishing a student team to build sounding rocket payloads. We sent three participants to the RockOn workshop at Wallops during the summer of 2008; James Flaten (MnSGC Associate Director), Demoz Gebre (the faculty member in Aerospace Engineering who directs the NanoSat Program), and a student who is currently heading up a sounding rocket payload-building student team. Their payload has been accepted for launch on the next RockOn flight in the summer of 2009 and we are sharing a canister with the Wyoming Space Grant. The payload is a flight characterization suite which goes beyond the RockOn kit, incorporating photography, magnetic field measurements, and GPS data collection.

Goal 4: Support undergraduate Higher Education activities at MnSGC affiliates. Provide support for at least three new or ongoing courses/programs.

We continue to support the Space Studies minor at Bemidji State University, development of a new STEM minor capstone course on aerospace at the College of St. Catherine, the robotics course and the contemporary mathematics course at Fond du Lac Tribal and Community College, and physics course development at Bethel University. In the fall of 2008, UMTC offered for the first time a “Gateway to Space”-type class, complete with a high-altitude ballooning project, as a freshman seminar. There were 19 students enrolled in the class, of whom four were women and two were underrepresented minorities. The physics department at UMTC also began allowing students in their Experimental Physics class to do high-altitude ballooning experiments, so we worked with them to launch a Geiger counter balloon payload in the spring of 2008. We supported the development of a new course on Spacecraft Attitude Dynamics and Control at the UMTC in spring 2008. That course had an enrollment of 23 undergraduate and two graduate students, of whom four were women and one was an underrepresented student. We continued our support of The Sverdrup Lecture Series. In the spring of 2008 the Sverdrup Lecturer was Dr. Steven Squyres, Goldwin Smith Professor of Astronomy at Cornell University and Scientific Director of the NASA MER Program.

Research Infrastructure Programs

Goal 1: Make progress toward involving underrepresented groups in research programs to at least a minimum percentage equal to Minnesota demographics for enrollment in higher education (Native American 1.2%, African American 6.8%, and Hispanic 2.3%, for a total of 10.3%). For this year we aim to have a minimum of three students from underrepresented groups participate in research.

We have set a modest goal this year of involving a minimum of three underrepresented students in research. In future years we expect to raise this number. We are working with the Undergraduate Research Opportunity Program Office at UMTC to identify potential candidates and we will also recruit candidates from our MnSGC underrepresented scholarship students. So far we have two underrepresented students working on research projects supported by MnSGC.

Goal 2: Offer opportunities for high-quality undergraduate research experiences. Provide research opportunities for at least 20 undergraduate students annually.

We are supporting undergraduate research in physics at Bethel University, Concordia College, Augsburg College, the University of St. Thomas, and the College of St. Catherine. Research projects at the University of Minnesota – Twin Cities are in aerospace engineering, physics, and astrophysics. Research projects at the University of Minnesota – Duluth are high-energy physics-related. In addition, new programs which

may involve research opportunities for students are being established at our two tribal college affiliates, Leech Lake Tribal College and Fond du Lac Tribal and Community College. These programs will contribute to our diversity effort described in the previous goal. The total number of undergraduates participating in the research program is 45.

Goal 3: *Support high-quality graduate research in aerospace science, engineering, and related fields. Support at least five graduate students in these areas through both direct research support and research fellowships.*

We are providing graduate fellowships to well-qualified students at the University of Minnesota. The University of Minnesota is the only member of the MnSGC, as well as the only institution of higher education in Minnesota, that offers advanced degrees in the physical sciences and engineering. Thus this goal is specific to the University of Minnesota. This year we are supporting three graduate students in Aerospace Engineering and one in Physics. One of the aerospace students completed his M.S. and is now working for an aerospace contractor.

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

Goal 1: *Improve the formal and informal teaching of science and mathematics at the pre-college level. We will offer at least three formal short-duration programs in which at least 50% of the participants subsequently use the materials/activities in their own teaching.*

We partially funded one Aerospace Education Career Camp for Teachers, co-sponsored by the Minnesota Department of Transportation and the FAA. We also participated in a teacher workshop for teachers at a local middle school (Cleveland Middle School in St. Paul) which was in the process of joining a former NASA Explorer School (Farnsworth Elementary School) to become an Aerospace Magnet school. These workshops served about 80 in-service teachers, including 55 women and 8 minorities, and about 60% of them have reported using workshop materials during the current school year with their students.

Goal 2: *Improve the formal and informal teaching of science and mathematics at the pre-college level. We will offer at least one formal long-duration program in which at least 25% of the pre-service-teacher participants subsequently use the materials/activities in their own teaching (or practice teaching).*

We supported the development of a STEM-minor aerospace capstone course for pre-service elementary teachers at the College of St. Catherine to accomplish this goal. Originally this class was planned to be offered during the 2008-2009 academic year, but unforeseen institutional issues have delayed that course offering.

Goal 3: *Work with teachers in at least three schools that serve primarily underrepresented groups to promote the teaching of mathematics, science, and pre-engineering.*

MnSGC works with teachers from current and former NASA Explorer Schools and other schools that primarily serve underrepresented groups to familiarize them with aerospace curricula, to lend them teaching items, and to team-teach with them if requested as they do specific STEM activities with their students. In 2008 we worked with about 20 teachers from eight different schools, including one former NASA Explorer School, that serve primarily underrepresented students. Our activities directly impacted over 200 underrepresented students in grades 4 through 12, about half of whom were girls.

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).*

Goal 1: *Promote aerospace and space-related sciences through informal education activities around the state. Survey a representative sample of participants and expect that at least 75% of respondents agree that the informal education activities were valuable to them (or to their groups, if they are a group leader).*

We provided support for informal education activities at the Soudan Mine Cosmic Radiation Research Facility, the Planetarium at Southwest Minnesota State University, and Concordia College which serves as the regional EPO for Goddard Sample Analysis of Mars. Informal education activities this year have been attended by over 8000 people and of those surveyed over 90% reacted positively to the activities.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- Student Data and Longitudinal Tracking: Total awards = 107; Fellowship/Scholarship = 60 and Higher Education/Research Infrastructure = 47. Of the Fellowship/Scholarship awards, 24 were to underrepresented minorities. Of the students significantly supported from FY06 to FY08, 8 students graduated and are pursuing advanced STEM degrees, 6 students are working for NASA contractors, 7 students accepted non-aerospace STEM positions in industry, and 1 is working at JPL.
- Course Development: Freshman seminar –Introduction to Spaceflight with Ballooning, UMTC
Spacecraft Attitude Dynamics and Control, UMTC
Aerospace Capstone Course for STEM Minor for Elementary Education Students (not yet offered) – College of St. Catherine
Robotics class – Fond du Lac Tribal and Community College
High-altitude ballooning experiments done in Experimental Physics class, UMTC
- Matching Funds: Matching funds were \$547,000 which was a 1to1 match for programmatic funding.
- Minority-Serving Institutions: Our two tribal college affiliates, Fond du Lac Tribal and Community College and Leech Lake Tribal College now have faculty that are committed to re-establishing/ expanding Space-Grant-supported STEM programming on their campuses. Possibilities include support of student research, new course development, additional STEM course offerings, and other higher education activities. Our goal is to ensure that our cooperative efforts result in development of specific, on-going STEM programming. Native American historical accomplishments in mathematics (researched for course development funded by MnSGC in 2006) are now a regular part of math offerings at Fond du Lac and we also support their new robotics class. Leech Lake has instituted a successful STEM-emphasis program which they plan to integrate in the near future.

IMPROVEMENTS MADE IN THE PAST YEAR

- Improved monitoring of outcomes of pre-college and informal education activities to quantify impact of programs on participants.
- Developing a new method for recruiting underrepresented students for participation in undergraduate research programs at UMTC in order to increase underrepresented student participation in these programs.
- Focused graduate fellowships by providing larger stipends to fewer students. This is designed to provide more-substantial support to students who are most likely to join the aerospace workforce.
- Obtained matching contributions for support of graduate students in Aerospace Engineering at UMTC.
- Increased activities in student satellite programs. Specifically, we instituted a sounding rocket payload-building program and began offering high-altitude ballooning activities in curricular settings.
- Increased interaction with Leech Lake Tribal College, including cooperation with Bemidji State University which is located nearby.
- Increased interaction with Fond du Lac Tribal and Community College, including support for a new course offering on robotics.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Augsburg College- Undergraduate programs in science; Bemidji State University- Primarily undergraduate; Bethel University- Undergraduate programs in science; Carleton College- Undergraduate programs in science; College of St. Catherine- Women-serving institution; Concordia College- Undergraduate programs in science; Fond du Lac Tribal Community College- Native American-serving institution; Leech Lake Tribal College- Native American-serving institution; Minnesota Department of Transportation- Teacher training in Aeronautics Division; Southwest Minnesota State University- Primarily undergraduate; University of Minnesota Duluth- Undergraduate science and engineering; University of Minnesota Twin Cities- Science and engineering programs through Ph.D.; University of St. Thomas- Undergraduate science and engineering.