

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 \$575,000 for fiscal year 2012.

PROGRAM GOALS

Outcome 1 – Higher Education: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals.*

Goal 1.1: Enhance diversity in the STEM workforce by providing research and higher education opportunities to women students and students from underrepresented groups.

Goal 1.2: Contribute to the STEM workforce by providing research and higher education opportunities to high-performing undergraduate and graduate students attending MnSGC institutions.

Goal 1.3: Enhance diversity in the STEM workforce by providing scholarship and fellowship support to women students and students from underrepresented groups.

Goal 1.4: Contribute to the STEM workforce by providing scholarship and fellowship support to high-performing undergraduate and graduate students attending MnSGC institutions, including support for students to participate in NASA Center internships.

Goal 1.5: Contribute to the STEM workforce by enhancing higher education opportunities for high-performing undergraduate and graduate students attending MnSGC institutions through aerospace design projects and student satellite projects.

Goal 1.6: Contribute to the STEM workforce by promoting higher education course development in areas of interest to NASA at MnSGC institutions.

Goal 1.7: Enhance diversity in the STEM workforce by promoting research and/or higher education programming at tribal college affiliates of the MnSGC.

Outcome 2 – Elementary and Secondary Education: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.*

Goal 2.1: Enhance the teaching of STEM topics, especially in schools with high underrepresented populations, by supporting precollege teachers through a variety of aerospace-related professional-development opportunities.

Outcome 3 – Informal Education: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA’s mission.*

Goal 3.1: Promote familiarity with, and interest in, aerospace and space-related STEM fields and career opportunities by offering a variety of informal education activities around the state.

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

- Outcome 1: Professor Lucy Dunne from the College of Apparel Design at the lead institution has expanded and formalized her connections with groups at Johnson Space Flight center involved in spacesuit design. Students in her classes, plus 2 summer interns, have done valuable design work for JSC resulting in awards and press coverage. This project was presented at a National Space Grant meeting and is now expanding to Space Grants in other states, including Georgia and Virginia.
- Outcome 1: High-power rocketry continues to grow within the MnSGC, with a new freshman seminar on high-power rocketry now offered at the lead institution, engineering senior design groups building competition rockets at two institutions, and high-power rocket activities at 3 community colleges, including one tribal college. There are Native American students involved in high-power rocketry at 3 different institutions.
- Outcome 2: The Office of Aeronautics at the MN Department of Transportation (MNDOT) continues to offer their popular Aerospace Camp for Teachers every summer. In this 4-day workshop teachers practice using aerospace curriculum and are given an aerospace kit for use with their own students. Teachers also learn about career options for their students in aviation and aerospace by visiting local aerospace companies, airports, and speaking with aerospace professionals.

PROGRAM ACCOMPLISHMENTS

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

Goal 1.1: Enhance diversity in the STEM workforce by providing research and higher education opportunities to women students and students from underrepresented groups.

Objective 1.1.A: Involve underrepresented groups in out-of-class higher education programs to at least a minimum percentage equal to Minnesota demographics for enrollment in higher education (Native American 1.3%, African American 8.9%, and Hispanic 2.3%, for a total of 12.5%) and 50% for women students annually.

Results: Partially achieved. Of 52 total out-of-class higher education participants, 14 were women (27%) and 20 were from underrepresented groups (38%). This indicates that we need to put renewed emphasis on recruiting and engaging especially women students in these out-of-class opportunities.

Objective 1.1.B: Involve underrepresented groups in research programs to at least a minimum percentage equal to Minnesota demographics for enrollment in higher education (12.5% – see Objective 1.1.A above) and award 50% of the research stipends to women. This year we plan to fund a minimum of 4 students from underrepresented groups and 15 women students to participate in research annually.

Results: Not achieved. Of 24 total research stipends awarded, 10 were given to women (42%) and 1 was given to a student from an underrepresented group (4%). This year we did fairly well engaging women research participants but we need to work harder, especially to recruit underrepresented students to our undergraduate and graduate research activities.

Goal 1.2: Contribute to the STEM workforce by providing research and higher education opportunities to high-performing undergraduate and graduate students attending MnSGC institutions.

Objective 1.2.A: Offer high-quality research experiences for at least 38 undergraduate students across the MnSGC annually that motivate students to work in areas of direct interest to NASA and NASA contractors or to pursue graduate studies in aerospace science and engineering.

Results: Not achieved. In all 21 undergraduate students received research stipends in 2012-2013. An additional 4 graduate students did research at the lead institution but were funded through fellowship/scholarship awards instead of with programmatic research stipends. The reduction in the number of research stipends is directly tied to recent reductions in our budget.

Objective 1.2.B: Fund graduate-level research in aeronautics and space physics in areas in which the Principal Investigators have strong, formal relationships with NASA Centers by funding at least 2 Ph.D. students, 1 in Aerospace Engineering and 1 in Space Physics annually, as well as at least 4 additional graduate students in aerospace science, engineering, and/or related fields through the fellowship budget or directly.

Results: Partially achieved. At the lead institution 3 Ph.D. students from the School of Physics and Astronomy (SPA) plus 1 Masters student in Aerospace Engineering and Mechanics (AEM) were partially supported with fellowships to do research. All students worked on research under advisers with strong formal relations with NASA Centers.

Objective 1.2.C: Provide seed funding to assist investigators with little or no previous contact with NASA develop collaborative programs with Centers and Directorates. Expect at least 1 young investigator will be partially funded annually to seek collaborative contacts with appropriate NASA Centers.

Results: Achieved. Continued support of young investigator Lucy Dunne at the U of MN Twin Cities to expand her collaboration with JSC on spacesuit design that is impacting both her research and a class she teaches on wearable technology. We continue to encourage young faculty across the MnSGC to consider focusing

their research on NASA priorities and to make contacts, both at NASA Centers and among more-senior faculty in the state who already have NASA connections.

Goal 1.3: Enhance diversity in the STEM workforce by providing scholarship and fellowship support to women students and students from underrepresented groups.

Objective 1.3.A: Provide scholarships (and fellowships) for underrepresented students to at least a minimum percentage equal to the most recent Minnesota demographics for enrollment in higher education (12.5% – see Objective 1.1.A above) and make 50% of scholarship/fellowship awards to women students annually.

Results: Achieved. Of 78 total fellowships and scholarships that were awarded, 38 were given to women (49%) and 25 were given to students from underrepresented groups (32%).

Goal 1.4: Contribute to the STEM workforce by providing scholarship and fellowship support to high-performing undergraduate and graduate students attending MnSGC institutions, including support for students to participate in NASA Center internships.

Objective 1.4.A: Offer opportunities for all qualified students at our affiliates to participate in the MnSGC Fellowship and Scholarship Program annually by providing (a) at least 30 institution-specific undergraduate scholarships, (b) at least 4 Consortium-wide undergraduate scholarships, and (c) at least 2 graduate student fellowships (partial support).

Results: Achieved. Of 78 total fellowship/scholarship awards, 50 were made to undergraduates by MnSGC affiliates (i.e. not by the lead institution and not to students attending institutions outside the consortium) and 11 went to undergraduates at the lead institution. We also gave out 5 Consortium-wide scholarships (but just 1 to an undergraduate student at an affiliate). As mentioned above, we also partially supported 4 graduate students with fellowships. Another 8 students received “scholarship” awards for summer internships at NASA Centers. A few students received awards in more than one category.

Objective 1.2.2.B: Offer scholarship support for at least 6 students to participate in NASA summer internships and other activities at NASA Centers annually. (Note that since final internship selections are made by the Centers, we cannot guarantee that this many Minnesota students will actually receive offers from NASA Centers.)

Results: Achieved. A total of 8 Minnesota students were partially-supported by the MnSGC at NASA Center internships during the summer of 2012.

Goal 1.5: Contribute to the STEM workforce by enhancing higher education opportunities for high-performing undergraduate and graduate students attending MnSGC institutions through aerospace design projects and student satellite projects.

Objective 1.5.A: Support the aerospace design program at the U of MN – Twin Cities by providing at least 5 aerospace design projects sponsored by industry or government annually.

Results: Achieved. All 7 aerospace senior design projects during the academic year of 2012-2013 were sponsored, in part, by industry or government.

Historical Objective 1.5.B: Engage a new industrial partner, ASTER Labs, in the development of instrumentation for at least 1 student-launched flight project.

Results: Achieved. An update: The U of MN – Twin Cities is now in their second year developing a HASP ballooning payload to study X-ray communication and navigation and ASTER Labs, a small start-up company, is involved in providing external mentoring for the student team.

Objective 1.5.C: Participate in the National Space Grant Student Satellite Program by maintaining at least 3 different types of active student aerospace hardware programs involving students from at least 3 different institutions in the MnSGC annually.

Results: Achieved. High-altitude ballooning, NASA-scale ballooning (payload-building), high-power rocketry, and suborbital rocketry (payload-building) programs are in place at a total of 7 institutions in the MnSGC.

Historical Objective 1.5.D: Expand student-led high-altitude ballooning and/or suborbital programs to at least 1 additional affiliate in 2010-2011.

Results: Achieved. An update: Bemidji State University continues to work with Central Lakes Community College in Brainerd and has developed a high-altitude ballooning program of in-class and outreach use, with four flights to date.

Historical Objective 1.5.E: Support participation in the NASA's USLI (University Student Launch Initiative (high-power rocketry) program) by community college students. Expect at least 1 faculty/student team to attend a USLI workshop and participate in the subsequent rocket competition in 2010-2011.

Results: Achieved. An update: The lead institution sent 1 faculty member and 1 student to the USLI summer 2012 workshop and the lead institution and one community college (not a MnSGC affiliate) built USLI rockets for the spring 2013 competition.

Goal 1.6: Contribute to the STEM workforce by promoting higher education course development in areas of interest to NASA at MnSGC institutions.

Objective 1.6.A: Support undergraduate Higher Education activities at MnSGC affiliates by providing support for at least 5 new or ongoing courses or academic programs annually.

Results: Achieved. MnSGC supported freshman seminars on high-power rocketry and RC aircraft as well as an upper-level technical elective involving high-altitude ballooning plus the annual aerospace senior design class at the U of MN – Twin Cities (lead institution). Another 9 courses around the consortium were also supported in physics, geophysics, introductory engineering, astronomy, robotics, planetary geology, and STEM teacher education.

Historical Objective 1.6.B: Develop new educational opportunities using radio controlled (RC) model aircraft design/build/fly programs. Expect course development will begin for a new freshman seminar in this area at the lead institution in 2010-2011.

Results: Achieved. An update: The RC aircraft freshman seminar was offered for the third time, with a new instructor formerly of NASA Dryden, in the spring of 2013 at the lead institution.

Goal 1.7: Enhance diversity in the STEM workforce by promoting research and/or higher education programming at tribal college affiliates of the MnSGC.

Objective 1.7.A: Enhance STEM educational opportunities at tribal college affiliates by facilitating at least 1 research or higher education program at both LLTC (a tribal college) and FDLTCC (formerly a tribal college) annually.

Results: Achieved. Both LLTC and FDLTCC now have high-power rocketry programs and LLTC will send a team to the First Nations Rocketry Competition sponsored by the WI Space Grant in spring 2013. FDLTCC continues to offer a robotics course originally developed with Space Grant funding.

Historical Objective 1.7.B: Support participation in high-power rocketry by tribal college students. Expect at least 1 high-power rocketry team to be operational at a tribal college (LLTC) starting in 2010-2011.

Results: Achieved. An update: LLTC is continues to participate annually in the Tribal College category of the First Nations Rocketry Competition. In addition, the AISES chapter at the U of MN – Twin Cities has also formed a high-power rocket team which annually enters the AISES category of that same competition.

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

Goal 2.1: Enhance the teaching of STEM topics, especially in schools with high underrepresented populations, by supporting precollege teachers through a variety of aerospace-related professional-development opportunities.

Objective 2.1.A: Improve the formal and informal teaching of science and mathematics at the precollege level by offering at least 2 formal short-duration programs annually in which at least 50% of the participating teachers subsequently use the materials/activities in their own teaching.

Results: Achieved. Five short-duration teacher workshops and two long-duration teacher workshops, engaging a total of 109 in-service teachers, were offered this year by the MnSGC. Workshop included Native Skywatchers training, by St. Cloud State University (2 workshops) and ACE Camp for teachers by MNDOT. Post-workshop participation rate is still being assessed, but preliminary data suggests that it exceeds 50%.

Historical Objective 2.1.B: Offer additional summer short courses and/or workshops annually, especially for middle school educators and/or students at several venues in Minnesota. Expect workshops or short courses specifically for middle school educators and/or middle school students will be delivered or developed at a minimum of 3 locations in 2010-2011.

Results: Achieved. An update: Our teacher activities are not usually limited to middle school, but most participants teach at that level. For example, in the summer of 2012 MNDOT offered their annual ACE Camp for Teachers on aerospace topics to 17 teachers, over 70% of whom used the materials in the first year after the workshop. St. Cloud State spearheaded Native Skywatchers workshops at 2 locations and engaged 56 teacher participants. The U of MN – Twin Cities participated in a Climate Change workshop for 16 teachers from Native American schools, including a high-altitude balloon flight. Astronomy instruction has also been provided to middle school students by one affiliate (Carleton College). Another affiliate (St. Kates) ran a ballooning program for local 4-H educators and students, mostly middle-school age.

Objective 2.1.C: Promote the teaching of mathematics, science, and pre-engineering by working with teachers from at least 3 schools annually that serve primarily underrepresented students, to familiarize them with aerospace curricula.

Results: Achieved. Two MnSGC institutions work regularly with teachers and students from 7 schools in the Twin Cities metro area on high-altitude ballooning and other aerospace topics. Three of these schools serve predominantly underrepresented students.

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

Goal 3.1: Promote familiarity with, and interest in, aerospace and space-related STEM fields and career opportunities by offering a variety of informal education activities around the state.

Objective 3.1.A: Promote aerospace and space related sciences through informal education activities around the state annually. 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).

Results: Essentially achieved. Informal education activities were offered by 7 different institutions in the MnSGC this past year, with the U of MN – Twin Cities offering multiple activities. Not all activities were done in contexts where it was practical to formally survey attendees. The affiliates that were able to do so all reported that more than 75% of the participants agreed the activities were valuable to them.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:**

Note: These values pertain only to students supported in FY12 who are classified as “significantly-supported.” Total awards = 40; Fellowship/Scholarship = 17, Higher Education/Research Infrastructure = 23. Two of the Fellowship/Scholarship awards were made to underrepresented students (1 of whom also received a research award but was counted in the F/S category), one pure Research award was to an underrepresented student, and two underrepresented students also received significant support to work on a Higher Education project.

During the FY12 program year 13 students started pursuing advanced degrees in STEM disciplines, 1 accepted a STEM position with a NASA contractor, 3 accepted STEM positions in industry, 1 accepted a STEM position in K-12 academia, 3 accepted STEM positions in higher-education academia, 6 went on to positions in non-STEM disciplines, and 3 reported having graduated and seeking STEM positions. The remaining students in our longitudinal tracking pool have not yet received the degree they were pursuing when they received their most recent Space Grant award.

- **Minority-Serving Institution Collaborations:**

We currently have one minority-serving institution, Leech Lake Tribal College (LLTC). They are an active participant and have been using MnSGC funding to provide scholarships to their students and to fund a high-power rocketry team to

compete in the First Nations Tribal Rocketry competition, at which they placed first in the spring of 2012. Their rocket team has also done STEM outreach to Boys and Girls Clubs in their community.

- **NASA Education Priorities:**

- Authentic, hands-on student experiences in science and engineering disciplines – the incorporation of active participation by students in hands-on learning or practice with experiences rooted in NASA-related, STEM-focused questions and issues; the incorporation of real-life problem-solving and needs as the context for activities.

Results: Aerospace hardware student-led teams and class projects bring hands-on NASA experiences to students at 10 different Minnesota colleges, 8 at MnSGC schools and 2 at a non-MnSGC schools collaborating with MnSGC institutions.

- Diversity of institutions, faculty, and student participants (gender, under-represented, underserved).

Results: The 14 MnSGC affiliates range from a small tribal community college to one of the nation’s largest Ph.D.-granting public universities. One affiliate is a State Agency and one is a women-only institution. Affiliates are located in all geographical areas of Minnesota. Five affiliate directors or co-affiliate directors are female. This year we exceeded our participation goals for underrepresented students in Scholarships and Higher Education, but not Research and we nearly met our high participation goals for women student in Scholarships and Research, but not Higher Education. We continue to work with our affiliates to pursue ways to increase diversity across all MnSGC activities.

- Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise. Capabilities for teachers to provide authentic, hands-on middle school student experiences in science and engineering disciplines (see above).

Results: Our 2-year middle school ballooning initiative is now over but we continue to collaborate with teachers and students at 2 middle schools doing high-altitude ballooning on their own and several other middle schools still trying to accomplish that goal themselves, in consultation with the MnSGC.

- Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.

Results: The MnSGC does not currently offer any programming in this NASA Education Priority area.

- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.

Results: High-power rocketry and robotics programs continue at our two community college/tribal college affiliates, LLTC and FDLTCC. Bemidji State University is working with Central Lakes Community College in Brainerd, not a formal MnSGC affiliate, in their high-altitude ballooning program. The U of MN – Twin Cities worked with Century (Community)

College, not a formal MnSGC affiliate, on high-power rocketry activities and on writing a STEM Pilot grant proposal.

- Aeronautics research – research in traditional aeronautics disciplines; research in areas that are appropriate to NASA's unique capabilities; directly address the fundamental research needs of the Next Generation Air Transportation System (NextGen).

Results: Two M.S. students at the lead institution worked on traditional aeronautic research topics associated with (1) use of aerodynamic modeling methods developed for full scale aircraft in modeling the aerodynamics of small UAVs and (2) optimization of propeller/propulsion systems for small UAVs.

- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.

Results: MnSGC-sponsored course development and course offerings in Environmental Science and Global Climate Change occurred at two institutions in 2012-2013. We also helped deliver content at a teacher workshop run by U of MN professor Gillian Roehrig as part of her Global Climate Change Education (GCCE) NASA grant for teachers at Native American Reservation schools.

- Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.

Results: Continued support of spacesuit design work at lead institution by professor Lucy Dunne (see Objective 1.2.C above) and support of spectroscopy research by new physics professor, Nate Linqvist, at Bethel University.

IMPROVEMENTS MADE IN THE PAST YEAR

- Further expansion of high-power rocketry activities, now at 4 MnSGC institutions plus 1 non-affiliate institution. New activities include a freshman seminar on high-power rocketry at the lead institution, collaboration between the lead institution and 1 non-member community college on a STEM Pilot proposal centered on STEM-retention using high-power rocketry, and a total of 7 high-power rocket student teams building rockets during the past year, 3 of which included Native American students.
- Expansion of connections between Lucy Dunne, professor in the College of Apparel Design at the lead institution, and two spacesuit groups at JSC. She is now working with JSC to formally organize a “Cluster” of interested research groups from Space Grant institutions around the nation to interact with JSC on spacesuit design issues, and more.
- Expanding Native Skywatchers programming for in-service teachers and for the general public conducted at St. Cloud State University and also in Native American communities, including Fond Du Lac reservation this year.
- Reactivation of Southwest MN State University as an active affiliate of the MnSGC. Their contributions in the southwest part of the state are astronomy/planetarium-based

and center around precollege teacher workshops, precollege student activities, and informal education offerings for the general public.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

- Augsburg College: M.S.-granting, private; Undergraduate Research, Informal Education
- Bemidji State University (BSU): M.S.-granting, public; Undergraduate Research, Higher Education, Pre-College
- Bethel University: M.S.-granting, private; Undergraduate Research
- Carleton College: 4-year, private; Undergraduate Research, Informal Education
- Concordia College: 4-year, private; Undergraduate Research, Higher Education
- Fond du Lac Tribal and Community College (FDLTCC): 2-year, public community college (combined with a 2-year tribal community college); Higher Education
- Leech Lake Tribal College (LLTC): 2-year, tribal community college; Higher Education
- Macalester College: 4-year, private; Undergraduate Research
- Minnesota Department of Transportation (MNDOT): State agency; Pre-College
- Southwest Minnesota State University (SMSU): 4-year, public; Pre-College, Informal Education
- St. Catherine University (St. Kates): M.S.-granting, private (main campus is women-only); Undergraduate Research, Higher Education, Informal Education
- University of Minnesota – Duluth (UMD): M.S.-granting, public; Undergraduate Research
- University of Minnesota – Twin Cities (UMTC): Ph.D.-granting, public; Consortium Administration, Undergraduate and Graduate Research, Higher Education, Pre-College, Informal Education
- University of St. Thomas (UST): M.S.-granting, private; Undergraduate Research

• **The National Space Grant Office requires two annual reports, this Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.**

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