

FY15 Year 1 APD

The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD – this document) 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.

Minnesota Space Grant Consortium

Lead Institution: University of Minnesota – Twin Cities

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Telephone Number: 612-626-9295 or 612-625-9002

Consortium URL: <http://www.aem.umn.edu/mnsgc/>

Grant Number: NNX15AI18H

LOB: NASA Internships, Fellowships, and Scholarships; STEM Engagement; Institutional Engagement; Educator Professional Development

A. 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 2015.

B. PROGRAM GOALS

Outcome 1 (With a focus on Higher Education): *Contribute to the development of the Science, Technology, Engineering, and Mathematics (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 internship, fellowship, and scholarship support to female students and to students from underrepresented groups.

Goal 1.2: Contribute to the STEM workforce by providing scholarship and fellowship support to high-performing undergraduate and graduate students attending MnSGC institutions as well as support for Minnesota students participating in internships at NASA Centers.

Goal 2.1: Enhance diversity in the STEM workforce by enhancing higher education opportunities for women students and students from underrepresented groups.

Goal 2.2: Contribute to the STEM workforce by enhancing higher education opportunities for high-performing undergraduate and graduate students attending MnSGC institutions through aerospace design projects.

Goal 2.3: Contribute to the STEM workforce by promoting higher education course development in areas of interest to NASA at MnSGC institutions.

Goal 3.1: Enhance diversity in the STEM workforce by providing research opportunities to female students and students from underrepresented groups.

Goal 3.2: Contribute to the STEM workforce by providing research opportunities to high-performing undergraduate and graduate students attending MnSGC institutions.

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

Goal 4.1: Enhance the teaching of STEM topics, especially in schools with high underrepresented populations, by supporting precollege educators through a variety of aerospace-related professional-development opportunities.

Outcome 3 (With a focus on Informal Education): *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 5.1: 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.

C. PROGRAM/PROJECT BENEFITS TO PROGRAM AREAS

- Program Area – Higher Education (Aligned with Outcome 1): Actively collaborating with the Montana, Louisiana, Colorado, and Iowa Space Grants in preparation for solar eclipse ballooning. Staff traveled to New Mexico and Montana during 2015-2016 to work on eclipse hardware face-to-face. Staff is also teaching a freshman seminar at University of Minnesota Twin Cities (UMTC) to build and test eclipse hardware, in advance of helping instruct summer 2016 eclipse ballooning training workshops.
- Program Area – Research Infrastructure and Higher Education (Aligned with Outcome 1): Bethel University faculty Chad Hoyt, Nate Lindquist, and Keith Stein have developed upper-division lab exercises based on their research. Their student research assistants have included several Space Grant students. These upper-division lab experiences have been taught to faculty from other colleges in Advanced Laboratory Physics Association (ALPhA) immersion workshops. Bethel has hosted 2 – 3 of these workshops per summer in 2011 and 2013 – 2015 and will again present ALPhA workshops in the summer of 2016.
- Program Area – Higher Education (Aligned with Outcome 1) plus Precollege (Aligned with Outcome 2) plus Informal Education (Aligned with Outcome 3): The MnSGC helped support the purchase of a Uniview Software License for the Marshall W. Alworth Planetarium at the University of Minnesota – Duluth (UMD). This allows them to leverage the programs they support with their mobile GeoDome Planetarium. In May 2016 the UMD Planetarium will host its first domecasting event using Uniview in partnership with the Adler Planetarium in Chicago, to bring their spring Kavli Fulldome Lecture to the UMD community.

D. PROGRAM ACCOMPLISHMENTS

- NASA Internships, Fellowships, and Scholarships:

Goal 1.1: Enhance diversity in the STEM workforce by providing internship, fellowship, and scholarship support to female students and to students from underrepresented groups.

Objective 1.1.A: Provide internships, fellowships, and scholarships to underrepresented students to at least a minimum percentage equal to the most recent Minnesota demographics for enrollment in higher education (20%) and make 50% of scholarship awards to female students in 2015-2016.

Results: Achieved. Of 65 total internships, fellowships, and scholarships that were awarded, 36 were given to female students (55%) and 30 were given to students from underrepresented groups (46%). There is some overlap in these percentages due to awards made to underrepresented female students.

Goal 1.2: Contribute to the STEM workforce by providing scholarship and fellowship support to high-performing undergraduate and graduate students attending MnSGC institutions as well as support for Minnesota students participating in internships at NASA Centers.

Objective 1.2.A: Offer opportunities for all qualified students at MnSGC Affiliates to participate in the internship, fellowship, and scholarship program by providing at least (a) 30 institution-specific undergraduate scholarships, and (b) two graduate student fellowships (partial support) in 2015-2016.

Results: Achieved. In all, 40 undergraduate students received research stipends in 2015-2016. An additional four graduate students conducted research at the lead institution, one of whom was funded with a fellowship and three with match research stipends. One additional graduate student was supported at an Affiliate.

Objective 1.2.B: Offer internship support at least six students to participate in NASA summer internships and other activities at NASA Centers in summer 2015. (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 5 Minnesota students were supported by the MnSGC at NASA Center internships during the summer of 2015 but 6 were offered support, as planned. In future years we hope to be able to make offers earlier so we can approach additional students if some turn down our offers.

- Higher Education projects:

Goal 2.1: Enhance diversity in the STEM workforce by enhancing higher education opportunities for women students and students from underrepresented groups.

Objective 2.1.A: Involve underrepresented groups in extracurricular higher education programs to at least a minimum percentage equal to Minnesota demographics for enrollment in higher education (20%) and 50% women in 2015-2016.

Results: Not achieved. Of 61 out-of-class higher education participants, 13 were women (21%) and 10 were from underrepresented groups (16%). This objective continues to challenge us and though our results are improving, we need to continue our emphasis on recruiting and engaging women and underrepresented students in these extracurricular opportunities.

Goal 2.2: Contribute to the STEM workforce by enhancing higher education opportunities for high-performing undergraduate and graduate students attending MnSGC institutions through aerospace design projects.

Objective 2.2.A: Support the aerospace capstone design course at the UMTC by providing at least four aerospace design projects annually sponsored by the aerospace industry or by NASA.

Results: Achieved. Five (out of nine) aerospace senior design projects during 2015-2016 were sponsored, in part, by industry or government.

Objective 2.2.B: Maintain at least four different types of active student aerospace hardware programs annually involving students from at least five different institutions in the MnSGC, as well as students from community college partners.

Results: Achieved. Aerospace-related student hardware projects in high-altitude ballooning, aerial photography from tethered balloons, NASA-scale ballooning (payload-building), high-power rocketry, and RC aircraft programs operate at 7 MnSGC institutions.

Goal 2.3: Contribute to the STEM workforce by promoting higher education course development in areas of interest to NASA at MnSGC institutions.

Objective 2.3.A: Support undergraduate Higher Education activities by providing support for at least 15 UMTC College of (Apparel) Design Students (plus faculty) to participate in the JSC Wearable Technology Cluster in 2015-2016.

Results: Apparel Design Professor Lucy Dunne at the UMTC is working with 15 students this year on wearable technology, in collaboration with JSC.

Objective 2.3.B: 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. The MnSGC supports freshman seminars on high-power rocketry, ballooning, and RC aircraft as well as aerospace senior design class projects at the UMTC. The MnSGC also supported another 15 courses at 7 other institutions around the consortium in physics, geology, environmental studies, mechanical engineering, introductory engineering, astronomy, earth science, and STEM teacher education.

- Research Infrastructure projects:

Goal 3.1: Enhance diversity in the STEM workforce by providing research opportunities to women students and students from underrepresented groups.

Objective 3.1.A: Involve underrepresented groups in research programs to at least a minimum percentage equal to Minnesota demographics for enrollment in higher education (20%) and award 50% of research stipends to women. We plan to have a minimum of 4 students from underrepresented groups and 15 women students participate in research in 2015-2016.

Results: Partially achieved. Of 40 total research participants, 22 were women (55%) and 3 were from underrepresented groups (7.5%). We need to continue our emphasis on recruiting and engaging women and underrepresented students in MnSGC research. This is emphasized in discussions with research advisers.

Goal 3.2: Contribute to the STEM workforce by providing research opportunities to high-performing undergraduate and graduate students attending MnSGC institutions.

Objective 3.2.A: Offer high-quality research experiences for at least 30 undergraduate students across the MnSGC in 2015-2016.

Results: Achieved. In all, 40 undergraduate students received research stipends across the MnSGC in 2015-2016.

- Objective 3.2.B:** Support high-quality graduate research in aerospace science, engineering, and related field by supporting at least 2 graduate students in 2015-2016.
- Results:** Achieved. A total of four graduate students did research at the lead institution – one was funded with a fellowship award and the other three with match research stipends. One additional graduate student did research at an affiliate.
- Precollege projects:

Goal 4.1: Enhance the teaching of STEM topics, especially in schools with high underrepresented populations, by supporting pre-college teachers through a variety of aerospace-related professional-development opportunities.

Objective 4.1.A: Support at least two formal multi-day workshops annually for K-12 teachers which promote NASA-related topics and emphasize diversity. Expect at least 50% of the participating teachers subsequently use the materials/activities in their own teaching.

Results: Achieved. The Office of Aeronautics at the Minnesota Department of Transportation offered their annual short-duration educator workshop entitled *Aerospace Camp for Teachers* to 6 in-service educators. Augsburg College offered a workshop on technology topics to 15 educators. St. Cloud State University, a collaborating institution, worked with the MN Department of Education to offer a workshop on Native American astronomy knowledge to over 30 K-12 and informal educators. Post-workshop usage was not well-documented but anecdotally exceeded 50% for all workshops. This is an area of improvement for the future.

Objective 4.1.B: Promote the teaching of mathematics, science, and pre-engineering by working with educators from at least three schools that serve primarily underrepresented students, to familiarize them with age-appropriate aerospace curricula.

Results: Achieved. Four MnSGC Affiliates worked with educators and students from eight pre-college schools, four on high-altitude ballooning. Four of the schools serve predominantly underrepresented students.
 - Informal Education projects:

Goal 5.1: 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 5.1.A: Promote aerospace and space-related sciences through at least 20 informal education activities around the state. Survey a representative sample of participants with results that at least 75% of respondents agree that the informal education activities were valuable to them (or to their groups, if respondent is a group leader).

Results: Achieved. Informal education activities were offered by thirteen of fourteen members of our consortium this past year, with most offering multiple activities. Not all informal education activities were conducive to a formal survey of attendees, but Affiliates that were able to do so reported that more than 75% of polled participants agreed that the activities were valuable to them.

E. PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS

- **Diversity:**

Office of Education Annual Performance Indicators: Provide numerical values for consortium contributions to API's.

- APIED-15-1 52 (Number of NIFS to racially or ethnically underrepresented students, women, and persons with disabilities.)
- APIED-15-2 76 (Number of educators.)
- APIED-15-4 58 (Number of informal education events.)
- APIED-15-5 2334 (Number of K-12 students.)

The 14 MnSGC Affiliates range from a small tribal college to one of the nation's largest Ph.D.-granting public universities. One Affiliate is a State Agency and one is one of the nation's largest women-only higher education institution. Affiliates are located in all geographical areas of Minnesota. Five affiliate directors are female. This year we met our participation goals for underrepresented students in Internships/Scholarships/Fellowships and were close in Higher Education (out-of-class activities), but not in Research. We met our participation goals for women students in Internships/Scholarships/Fellowships and Research, but not in Higher Education (out-of-class activities). We continue to work with our affiliates to pursue ways to increase participant diversity across all MnSGC activities.

- **Minority-Serving Institution(MSI) Collaborations:**

We currently have one Affiliate classified as an MSI, Leech Lake Tribal College (LLTC). They are an active participant, using MnSGC funding to provide scholarships to their students and to support a high-power rocketry team. They have competed in the First Nations Tribal Rocketry competition in Wisconsin annually since 2012. Their rocketry team does 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; and 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 7 at MnSGC institutions.

- 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: The MnSGC helped provide stratospheric balloon flights for students from four middle schools this year, as well as continuing to consult with two other middle schools who are providing their own high-altitude ballooning flights.

- 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 area.

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

Results: High-power rocketry activities continue at our two community college/tribal college affiliates, LLTC and FDLTCC. Bemidji State University works with Central Lakes Community College in Brainerd, which is not a MnSGC affiliate, on a joint high-altitude ballooning program. Century (Community) College, also not a

MnSGC affiliate, is sending students to the UMTC for summer internships and has entered our 2015-2016 Space Grant Midwest Rocketry Competition.

- 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: Professor W. Garrard, Director of the MnSGC, has been working on research using wind tunnel tests to verify mathematical models used to represent aerodynamic wing flutter for purposes of control system design. This project is closely aligned with research sponsored by NASA Armstrong.

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

Results: Bemidji State University offers curriculum-based research activities in Environmental Science and Global Climate Change. Macalester College does Geology research on glaciers and lake cores to study climate change.

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

Results: The MnSGC supports NASA-related research by early-career faculty at Bethel University (Physics), St. Catherine University (Biophysics), Concordia College (Physics), and Bemidji State University (Biology).

F. IMPROVEMENTS MADE IN THE PAST YEAR

- The UMTC worked with all MnSGC affiliates to close out 2010-2015 budgets during 2015. Any unspent funds were reallocated to further programmatic goals. Completing this exercise and including individuals who are new to our program, will allow us to stay more on top of Affiliate reimbursement requests in the future.
- St. Catherine University collaborated with AIAA and Air-Space Minnesota to host an Industry and Education dialog in support of the aerospace industry in Minnesota. The key note speaker was Dr. Sandra Magnus, a NASA space shuttle astronaut. These collaborations will continue and this event brought visibility to St. Catherine University's fledgling physics department.
- UMTC accepted students from MnSGC Affiliate institutions for on-campus MnSGC-sponsored summer internships in 2015. Three students from three different Affiliates were placed in two different labs in the Aerospace Engineering Department at UMTC, two focused on stratospheric ballooning and one working on HASP/CubeSat development. This effort increased research collaboration between institutions within our consortium.

G. CURRENT AND PROJECTED CHALLENGES

- After serving 25 years as Director of the Minnesota Space Grant Consortium, Professor William Garrard will step down during the winter/spring of 2017. MnSGC will follow NASA procedures to name a new Director. Discussions are being initiated with stakeholders to ensure a smooth transition without interruption to MNSGC activities.
- We continue to try various tactics and learn from the experiences of other Space Grants as we confront the challenge of achieving our demographic target percentages of students, particularly in aerospace-themed out-of-class Higher Education projects since numbers of female and underrepresented students in aerospace-related departments are small. We have had more success achieving diversity targets in NIFS and Research Infrastructure awards that are more diverse in STEM.

H. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

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