

Montana 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 Montana Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2013.

PROGRAM GOALS

2013 SMART Objectives by Strategic Goal:

(These SMART Objectives apply to the 2013 MSGC grant year unless otherwise specified)

(1) Develop and connect interdisciplinary aerospace education programs that will build and enhance opportunities for involvement in space-based science, technology, engineering and math in Montana.

1a. By August 1st, award \$1,500 competitive scholarships to deserving undergraduate students; maintain at least a 3.5 mean grade point average (GPA); maintain at least 25% underrepresented awardees; increase the percentage of female awardees from 40% to 45% for the 2010-2014 grant period.

1b. By August 1st, award \$7,500 one-semester competitive fellowships to deserving graduate students with 3.25 GPAs or higher; maintain at least a 90% level of major awardees that continue on to STEM employment or STEM advanced education; increase the percentage of underrepresented and female awardees from 3% and 38% to 5% and 40%, respectively for the 2010-2014 grant period.

1c. Continue to strive to award at least one scholarship to each Academic Affiliate,

maintaining the number of represented institutions at a minimum of 16 per year for the 2010-2014 grant period.

1d. Award Education Enhancement grants that continue to be impactful, interdisciplinary and have diverse participants; increase the average percentage of female PIs from 19% to 22% in the 2010-2014 award; increase the number of participating affiliate institutions to 8 (from 6 in the 2005-2009 award), including an increase in the number of Tribal College participants from 2 to 3 for the 2010-2014 grant period.

1e. Increase the number of Affiliate Institutions actively participating in the BOREALIS high altitude ballooning program from 3 to 5 in the 2010-2014 award.

1f. Through the efforts of the Space Public Outreach Team (SPOT) graduate managers, continue to educate 8% or more of the Montana K-12 teachers and students (~700 and 12,000 respectively) each year about NASA-related opportunities and careers available to Montana students as those students look forward to higher education; maintain at least a 80% level of teachers who use SPOT-provided NASA materials in their classroom instruction; maintain at least 50% female, 5% underrepresented, and 10% non-MSU presenters.

1g. Seek, wherever possible, to foster programs that reach across the artificial boundaries of “precollege,” “general public,” or “higher education;” continue to participate at least three times per year (on a volunteer basis) in outreach programs such as ‘Expanding Your Horizons,’ ‘Astronomy Day,’ ‘Science Olympiad,’ and ‘FIRST Lego League Tournaments;’ continue to participate (on a volunteer basis) on Montana museum boards.

(2) Strive to build a Montana aerospace workforce, integrating women, under-represented minorities and persons with disabilities.

2a. Continue to create interdisciplinary, hands-on, and meaningful opportunities for Montana students to participate in space hardware projects; maintain at least a 90% level of major awardees that continue on to STEM employment or STEM advanced education; increase the percentage of underrepresented and female participants from 8% and 16% to 10% and 20%, respectively for the 2010-2014 grant period.

2b. Continue to offer interdisciplinary, hands-on, and meaningful summer internships for Montana students from campuses other than MSU to participate in MSGC student space hardware projects; maintain at least a 90% level of interns that continue on to STEM employment or STEM advanced education; increase the percentage of underrepresented and female participants from 8% and 16% to 10% and 20%, respectively for the 2010-2014 grant period.

2c. Continue to create interdisciplinary, hands-on, and meaningful opportunities for Montana students to design and build BOREALIS high altitude balloon experiments at the BOREALIS launch centers; maintain at least a 90% level of major awardees that

continue on to STEM employment or STEM advanced education; increase the percentage of underrepresented and female participants from 8% and 16% to 10% and 20%, respectively for the 2010-2014 grant period.

2d. Continue to offer interdisciplinary, hands-on, and meaningful summer internships for Montana students to participate in MSGC BOREALIS high altitude ballooning projects; maintain at least a 90% level of interns that continue on to STEM employment or STEM advanced education; increase the percentage of underrepresented and female participants from 8% and 16% to 10% and 20%, respectively for the 2010-2014 grant period.

2e. Increase the involvement of students from Tribal College Affiliate Institutions in the MSGC Minority Serving Institution Partnership Development Program, BOREALIS, student space hardware, undergraduate research, and internship programs from 30% to 100% involvement of at least one student in at least one program for the 2010-2014 grant period.

(3) Network Montana colleges, universities, aerospace industries, and government with national aerospace programs in government and industry, especially NASA centers and other Space Grant Consortia.

3a. Continue to hold meaningful yearly Affiliates' Meetings, maintaining at least 75% Affiliate Representative attendance; create an evaluation of the Affiliates' Meeting and obtain at least 90% satisfaction with the meeting.

3b. Continue to hold MSGC Student Research Symposiums (MSRS) for all students involved in MSGC programs; maintain at least 120 student and faculty participants from at least 15 Affiliate Institutions, and maintain at least a 95% participant agreement that the Symposium was beneficial.

3c. Continue to offer support for NASA center internships; maintain at least a 90% level of NASA interns that continue on to STEM employment or STEM advanced education; increase the percentage of underrepresented and female participants from 5% and 10% to 7% and 15%, respectively for the 2010-2014 grant period.

3d. Increase support for aerospace industry internships – provide support for at least one industry internship.

3e. Continue nearly 100% MSGC director attendance at Space Grant Regional and National Meetings.

(4) Expand and enhance aeronautics and NASA-related research activity in Montana colleges and universities.

4a. Continue to maintain a 100% level of NASA-related interdisciplinary Research Initiation awards; create an evaluation of the number of PIs who propose for follow-on NASA funding and obtain at least 50%; increase the percentage of underrepresented and

female PIs from 14% and 14% to 17% and 17%, respectively for the 2010-2014 grant period.

4b. Competitively award stipends to Montana State University students involved in STEM research; maintain at least a 90% level of students who present their work and/or submit a paper; increase the percentage of underrepresented and female participants from 2% and 35% to 5% and 40%, respectively for the 2010-2014 grant period.

4c. Competitively award stipends to University of Montana students involved in STEM research; increase the percentage of students who present their work and/or submit a paper to at least 70%; maintain at least 50% female awardees; increase the percentage of underrepresented awardees to 3% for the 2010-2014 grant period.

4d. Competitively award stipends to Montana Tech students involved in STEM research; increase the percentage of students who present their work and/or submit a paper to at least 70%; increase the percentage of female awardees from 43% to 48%; increase the percentage of underrepresented awardees to 3% for the 2010-2014 grant period.

4e. Continue to make stipends available to students attending institutions other than MSU, UM and Montana Tech who are involved in STEM research; increase the average number of participating Academic Affiliate Institutions from 3 to 10; increase the percentage of students who present their work and/or submit a paper from 50% to 70%; maintain at least 50% female awardees; increase the percentage of underrepresented awardees from 8 to 11% for the 2010-2014 grant period.

4f. Competitively award Apprenticeship stipends to Montana undergraduate students involved in *major* NASA research projects; have at least 90% present their work and/or submit a paper; 40% female awardees; 10% underrepresented awardees for the 2010-2014 grant period.

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

Note: Here, we have highlighted the activities not covered in the other sections below.

1) National Student Solar Spectrograph Competition (Outcome 1)

The yearly National Student Solar Spectrograph Competition (NSSSC) is MSGC's Education Program for NASA's Interface Region Imaging Spectrograph (IRIS) mission and uses state dollars as match for our Space Grant award.

The NSSSC has completed three very successful years of EP/O for the IRIS Mission with the participation of 120 students from 27 different teams reaching the finals in Bozeman. The NSSSC is a unique instrument design competition geared towards teams of multidisciplinary undergraduate students. The NSSSC teams compete in four categories: design, build, science and presentation of results. The national champion teams in each of the four categories receive scholarship awards and a visit to a NASA launch or Center to

further the students' commitment to their studies in the space sciences and engineering. Partners for the NSSSC include each of the students' home institutions, the IRIS Mission and Newport Corporation. The IRIS Mission provided build awards, scholarship awards and travel awards. The Newport Corporation provided each team a diffraction grating to be used in their design as well as a judge for three years. The home institutions provide the facilities and the faculty mentors for each team.

MSGC hosted the 2012-2013 National Student Solar Spectrograph Competition (NSSSC) May 14-16, 2013 with sixteen teams from Arkansas, California, Idaho, Indiana, Montana, South Carolina, New York and Washington travelling to Bozeman to compete for scholarship prizes and travel awards. A visit on the last day of the competition by **US Senator John Tester** proved to be a highlight for all of the students and advisors. Senator Tester addressed the competition attendees and spoke individually with over half of the teams learning first-hand what each team member was taking away from the competition.

NSSSC (MTSGC Reported) Student Highlights: **Jamesen Motley**, a member of the 2012 NSSSC Best Build Award team and a December 2013 mechanical engineering graduate of Montana State University participated in the 2013 NSSSC as a student judge. Jamesen is now employed at GE Bently Nevada as a mechanical engineer working on sensor designs. **Ethan Keeler**, a 2013 NSSSC student judge, a member of the 2012 NSSSC Best Science Award team and a now first year PhD electrical engineering graduate student at the University of Washington, won a highly prestigious NSF graduate research fellowship partly as a result of his NSSSC experience at Montana State University.

2) Tribal College student highlights (Outcome 1)

Judy Hudgins, MTS GC scholar, was a member of the Mars Science Laboratory Science Team at JPL working as part of the MAHLI/MARDI/Mastcam camera science team. After her experience on MSL, she received another wonderful opportunity to work at NASA Johnson Space Center (JSC) in Houston, TX, in the Wireless Systems & Antenna branch. During her internship this past summer, she was given the task of setting up and testing a wireless network system that may lead to a possible Space Science Agreement with NASA and a private IT infrastructure company called Tall Umbrella. Another NASA related project that she has been a part of for the past two and half years is the Salish Kootenai College CubeSat. The SKC Cubesat is a small nano-satellite that will be launched in space (low earth orbit) in summer 2015. Judy is currently the Electrical Power Subsystem (EPS) team lead and has been working with fellow students to assemble solar cells for the satellite as well as work on interfacing a commercial-off-the-shelf powerboard with flight software. Judy was nominated and awarded a NASA Student Ambassador, to represent NASA and encourage STEM learning across the reservation the nation. Upon completing her degree in Computer engineering, she hopes to become a Computer Engineer and work at NASA or in the Aerospace Industry.

Robert Davis, MTS GC scholar, is currently a student at Montana State University having transferred from Salish Kootenai College in January 2014 working towards a

degree in Computer Engineering. Robert has been working with the Salish Kootenai College (SKC) Cubesat project and interned at Johnson Space Center this past summer. The goal of the SKC CubeSat is for educational purposes and community outreach. The payload of the SKC CubeSat is designed to take imagery of the Flathead Indian reservation.

Noel Stewart, MTS GC scholar and apprentice, is currently a student at Salish Kootenai College working towards a degree in Hydrology. Noel continues working with the Salish Kootenai College (SKC) Cubesat project and was a 2013 summer intern at NASA's Goddard Space Flight Center. During this internship she received the Best Summer Intern Award in the Hydrospheric and Biospheric Sciences Laboratory. She is also a NASA Student Ambassador sharing NASA science and opportunities with fellow students and her community. Noel previously attended Blackfeet Community College (BCC), graduating with two associate degrees in Business Management and Science. She will be the first of four siblings to earn a B.S. degree. Noel is also participating in an on-going research project titled, "Possible growth locations for a culturally significant flora: Blue Camas, on the Flathead Reservation and surrounding areas."

3) Hiscock Memorial Award (Outcome 1)

The \$1,500 William (Bill) A. Hiscock Memorial award is given annually to the applicant who best embodies Bill's passion for aerospace-related education. The 2013-14 AY Hiscock Memorial Award winner is MSU mechanical engineering major **Jacob Kushner**. With the Hiscock Award, Jacob will be working with Bozeman High School students to help them construct their own telescope from scratch. Through this project, Jacob aims to lead the students in discovering as much as they can about our cosmos by providing unique, hands-on learning opportunities. Through the telescope's construction, the students will learn a variety of scientific and engineering principles. Once completed, the students will take the telescope under the night sky and use it to conduct their own observations. Ultimately students will learn about the wonders of our universe and the importance of understanding science.

PROGRAM ACCOMPLISHMENTS

NOTE: THIS LIST REFERENCES OUR SMART OBJECTIVES BY OUTCOME AND REFERENCES RELATED NASA EDUCATION PRIORITIES [IN BRACKETS]. In order to be succinct, NASA Education Priorities are referred to by number: EP1. Hands-on student experiences, EP2. Middle school teachers, EP3. Summer opportunities for secondary students, EP4. Community colleges, EP5. Aeronautics research, EP6. Environmental Science and GCC, EP7. Diversity, EP8. Innovative research infrastructure.

Outcome 1:

1a. Competitive Scholarships [EP5] [EP6] [EP7]

- Awarded 22 undergraduate scholarships; mean GPA = 3.71; underrepresented = 36%;

female = 50%. All objectives met.

1b. Fellowships [EP5] [EP6] [EP7]

- Awarded seven 2013 graduate fellowships; mean GPA = 3.63; Longitudinal tracking: FY 2013: all 7 still enrolled; FY 2012: 4 still enrolled, Dr. Kathryn Williamson is the Education Specialist at the National Radio Astronomy Observatory (NRAO), Sean Shriner works for the U.S. government, Chris Sunderland has transferred to Marquette University; FY 2011: 3 still enrolled, 2 staff at Higher Ed. Institution, 1 STEM employment; FY 2010: 4 still enrolled, 3 on to STEM employment, 2 staff at Higher Ed. Institution. FY 2013 metrics: *underrepresented* = 0%; female = 43%. We continue to actively recruit and encourage minority participation.

1c. Statewide Scholarships [EP4] [EP5] [EP6] [EP7]

- 12 Affiliate Institutions receiving awards. We visited 4 affiliate institutions to enhance recruiting. We also went to the MAVEN launch to strengthen relationships with our Tribal College affiliate representatives and listen to their challenges regarding recruitment of student scholarship applications.

1d. Education Enhancement grants [EP1] [EP2] [EP4] [EP5] [EP6] [EP7]

- Awarded two grants in FY 13 (details below) to two institutions.
- Female PIs = 0%; underrepresented PIs = 50%. While the female PI number is zero this year, our SMART objective is for the entire 2010-2014 period. Underrepresented objective met.
- FY 13 Titles, PIs, and institutions:
- “Chemistry upper-division curricular restructuring,” Colin Thomas, Carroll College (small college)
- “Einstein’s Symphony: A Gravitational Wave Voyage Through Space and Time,” Nicolas Yunes, Montana State University
- FY 12 and 13 updates -- impact metrics from the last year of activity: new courses = 1, revised courses = 13, presentations at professional meetings = 7, pending follow on grants = \$598,000 for NSF education robotics grant, awarded follow on grants = \$75,000 for several ‘Celebrating Einstein’ partnerships, public engagement = 7,500 participants; release of the Celebrating Einstein website (<http://www.celebratingeinstein.org>).

1e. BOREALIS statewide effort [EP1] [EP4] [EP5] [EP6] [EP7]

- Launch centers at MSU-Bozeman and UM-Missoula fly student experiments for any MSGC affiliate institution. As a result of the Tribal College tethered ballooning program and our main launch centers, we have BOREALIS capability at Montana State University, University of Montana, Salish Kootenai College (a Tribal College (TC)), Chief Dull Knife College (TC), Stone Child College (TC), Fort Peck Community College (TC), Blackfeet Community College (TC), and Aaniiih Nakoda College (TC) and Little Big Horn College (TC) in FY 2013. This is *nearly half of all of our Affiliate campuses*, meaning we have well exceeded our SMART Objective metric! Discussions have started concerning a Statewide collaborative project involving big data collection and analytics.
- 1 MSU and 2 UM BOREALIS students presented research posters. 2 MSU and 1 UM student presented research talks.

1f. Space Public Outreach Team [EP1] [EP2] [EP7]

- 13 students (8 female and 5 male) total from MSU, UM and the University of Great Falls. Female and non-MSU metrics met; working toward recruiting underrepresented participants. This program is continuing its transition from a long standing collaboration between NASA SDO:AIA E/PO and MSGC. MSGC continues to provide graduate student fellowship support of the SPOT managers and is currently seeking other funding partners for this very successful program. One potential partnership is with the Montana Office of Public Instruction. The managers are longitudinally tracked by MSGC and evaluated for their performance.

2a. Student Satellites [EP1] [EP6] [EP7]

- 8 major student awards; underrepresented = 0%; female = 0%. We realize this is one of our toughest areas for recruiting female and minority student participation and are working on ways to boost these levels. For example, MTSGC Apprentice Katherine Stocker is responsible for efforts to engage, via peer-tutoring of freshmen, undergraduate STEM female students at Montana State University. Longitudinal tracking: FY 2013: all still enrolled; FY 2012 two pursuing advanced degrees and the remainder still enrolled. Two additional MSU Space Science and Engineering Lab (SSEL) satellites were launched on December 6th as part of the ELaNa II. There are now three MTSGC-supported satellites in space!

2b. SSEL internships [EP1] [EP4] [EP6] [EP7]

- Awards from FY 2013 have not yet been made. FY 2012 (summer 2013): 2 students (still enrolled), 50% female, 0% underrepresented. Longitudinal tracking from FY 2011: 1 still enrolled, 1 on to STEM employment.

2c. BOREALIS launch centers [EP1] [EP6] [EP7]

- MSU BOREALIS incorporated a new satellite modem with an integrated GPS system into the flight system. Position data is streamed to the internet <http://153.90.202.22/> in near real-time and allows the FAA, local air traffic control and others to monitor the balloons flight remotely. This website also serves as an archive of position and altitude flight data. Work was initiated on adapting traditional latex sounding balloons to ascend to pre-specified altitude by venting helium with the goal of extending flight time at high altitude (> 90,000 feet). Students created a valve system, controlled via up-linking commands through the satellite mode. On September 29th they successfully provided proof of concept of their valve system where they vented sufficient helium to stop the balloons ascent at 64,000 feet. Work is ongoing to improve the functionality and control of the valve. Tim Basta was selected to present the work on this new system at the National Space Grant Meeting in October 2013. Next summer the group hopes to demonstrate a one hour flight at 90,000 feet.

- The UM BOREALIS team continued a collaboration with the Missoula Fire Sciences Laboratory. The project involves validation of a wind simulation and forecast model, WindNinja. Data needed for this work includes temperature, wind speed, and wind direction profiles. Carrying on the tradition of involving middle school and high school students, flights were conducted with students from the Missoula Valley as well as

students from Simms, MT. There was an additional Missoula Fire Science collaboration begun with MSU and UM. An MSU student designed and built a tethered balloon platform aerial imagery system which attaches to the UM tethered system for imaging wildfire spread to aide in fire forecasting and prediction research. For the 2013 CatGriz football game the UM BOREALIS team took a video of the school mascots high above the Montana landscape. Watch the flight video on YouTube at (<http://www.youtube.com/watch?v=yXs8VfaiQbM>).

- Note: In the MSU program, the AY students are volunteers (therefore not counted as ‘awards’). In the UM program, however, the AY students are paid, so we count them as awards. Also, several yet to be identified students will be supported on FY13 base funds at UM in summer 2014.

- MSU FY 2013: 30 students participated; 7% underrepresented; 13% female. For underrepresented and female students, we continue to find ways to encourage participation such as a new women in engineering and physics peer-tutoring program and holding specific women and science informational opportunities.

- MSU Longitudinal tracking: MSU FY2013: Of the 30 participants, 28 students are currently enrolled, two students graduated mid-year with both employed at STEM companies.

- UM FY 2013: 4 undergraduate students participated; 25% underrepresented; 0% female. Additionally 1 male and 2 female high school and 4 female and 8 male middle school students participated.

- UM Longitudinal tracking: All students are pursuing undergraduate degrees in STEM next year. Two 2012 undergraduates are employed in a STEM field. One 2012 student is an undergraduate in STEM and two students are pursuing graduate degrees in a STEM field. One 2011 participant is pursuing graduate studies in STEM, one is still an undergraduate student. Two 2010 undergrads are in graduate school in STEM fields, 2 are still finishing undergraduate degrees, and 2 are employed in a STEM field. The male high school student from 2010 is now at UM pursuing a STEM degree.

- As a result of UM-BOREALIS activity one refereed article was included in the Bulletin of the American Meteorological Society 2013 ; e-View doi: <http://dx.doi.org/10.1175/BAMS-D-13-00125.1>.

2d. BOREALIS internships [EP1] [EP6] [EP7]

- FY 2013 awards have not yet been made. FY 2012 (summer 2013): 6 major awards, 17% female. We continue to work towards the goals set out in our SMART objective.

- Longitudinal tracking: FY 2012: 5 are still enrolled, 1 on to STEM employment.

2e. Minority Serving Institutions [EP1] [EP4] [EP6] [EP7]

- We continue to support students and faculty on two main Tribal College (TC) projects: the Aurora Detector Project and the Remote Sensing Project. Now that funding for the MSI Partnership Development Program is finished, we support these projects via our primary MSGC Apprenticeship, ARES, and BOREALIS state-wide programs. Highlights on these two main programs and other TC activities are given below and throughout this report. We are meeting our SMART Objective metric for engaging 100% of our TCs.

- Aurora Detector Project: The last Aurora Detector was provided by MSGC staff to Little Big Horn College. All Tribal Colleges now have aurora detectors. The Montana

Aurora Detector Network can be viewed at (<http://aurora.montana.edu/>). Currently, the MSU and SKC detectors are on-line and working very well. Updates for the system are currently being investigated including possibilities of engaging affiliates directly in the redesign.

- All Tribal Colleges now have tethered blimp remote sensing systems and are looking into additional uses of the system.

- Students from Chief Dull Knife College are enrolled in Code Montana to learn basic computer programming to ready themselves for work with the MSU and UM BOREALIS students on remote sensing and big data projects.

- 16 Tribal College Faculty from 5 colleges travelled to the Kennedy Space Center for the MAVEN launch November 17-21, 2013 as part of the NASA EPSCoR Faculty development program. During the trip, MTSGC staff discussed opportunities with the TC faculty members in depth, generating increased applications to several MTSGC programs. The goals of the travel were to 1) spark interest and motivation for more Montana TC faculty to become involved in NASA research projects, both with MT NASA EPSCoR or directly with NASA, and 2) to facilitate making connections for future TC-NASA research collaborations. Example trip critique: “[The trip] provided me with a once in a lifetime experience that I will be able to share with my students at Chief Dull Knife College... The fact that NASA took a whole afternoon to meet with just the representatives from Montana to discuss with us opportunities available for our colleges and our students was something that I was very impressed with. We already have staff and faculty developing a rocket team that will hopefully compete in the “First Nations Launch Competition”. We have had numerous students go online to fill out applications for internships. We have faculty looking into grant opportunities which will involve our students more in active research and in general there is much more excitement and interaction in the hallways here at CDKC.”-- Gary Ramsey, Professor, Chief Dull Knife College

3a. Affiliates’ Meetings [EP4] [EP7]

- We held our annual Affiliates’ Meeting September 13th, 2013. Of all the 19 institutions, 58% were represented at the meeting. For the third year, our Reps will also have a chance to interact at the Student Research Symposium April 7th, 2014. In this setting, the Reps have a chance to share what is happening at their institutions, rather than the MSGC staff providing most of the dialog.

3b. MSGC Student Research Symposium (MSRS). [EP1] [EP4] [EP5] [EP6] [EP7] [EP8]

- In 2013 we hosted the fourth MSRS including 173 participants from 9 Montana campuses, 36 student talks, and 25 student posters. Participant evaluations of the Symposium were overwhelmingly positive. Six Montana companies sponsored student presentation awards. We held the MSRS 2013 in conjunction with the Montana NASA EPSCoR first annual Montana Aerospace Workshop, providing an opportunity for MSGC students to meet and network with Montana Aerospace professionals.

3c. NASA internships [EP1] [EP5] [EP6] [EP7] [EP8]

- FY 2013 awards have not yet been made. FY 2013 (summer 2013): 5 major awards, 20% female, 0% underrepresented. While our minority and female participation has been

low in the past, it is important to remember that at least 4 (including 2 female) Native American interns recruited by MSGC were being paid directly by NASA sources – an even bigger honor than being supported by MSGC! From FY 2012 (summer 2013), two interns, one male, one female, are pursuing advanced degrees, one still enrolled is interning at Google X spring semester, and 2 are still enrolled.

3d. Industry internships [EP1] [EP4] [EP5] [EP6] [EP7] [EP8]

- FY 2013 awards have not yet been made. FY 2012 (summer 2013): 3 major awards with 406 Aerospace (Bozeman, MT), 33% female, 0% underrepresented, all still enrolled.

3e. National and Regional Meeting Attendance

- We met our goal for staff attendance at regional and national meetings.
- We brought one MSU mechanical and industrial engineering and Spectrograph Competition student to the 2013 Fall National Meeting in South Carolina. He presented a poster and made several collaborations regarding high altitude ballooning efforts. We also brought our MSU BOREALIS flight director to South Carolina.

4a. Research Initiation grants [EP1] [EP4] [EP5] [EP6] [EP7] [EP8]

- No FY12 awards (all awards were made under MT NASA EPSCoR)

4b. MSU undergraduate research [EP1] [EP5] [EP6] [EP7] [EP8]

- FY 2013: 23 awards, 21.7% female, and 4% underrepresented; presentations coming in April 2014. FY 2012 awards (not reported on in the FY 2012 APD) were made to 23 students, 100% of the students presented their work, 26% female, and 0% underrepresented. We continue to encourage female and minority participation, but it should be noted that the students are chosen by the MSU undergraduate research staff (not the MSGC staff). For example, MTSGC Apprentice Katherine Stocker is responsible for efforts to engage, via peer-tutoring of freshmen, undergraduate STEM female students at Montana State University.

4c. UM undergraduate research [EP1] [EP6] [EP7] [EP8]

- FY 2013: 6 awards, 83% female, and 0% underrepresented. Presentations coming in April 2014. FY 2012 awards (not reported on in the FY 2012 APD) to 4 students, 50% female, 0% underrepresented (2 now pursuing advanced degrees, 2 on to STEM employment). We continue to encourage minority participation, but it should be noted that the students are chosen by the UM undergraduate research staff (not the MSGC staff).

4d. Montana Tech undergraduate research [EP1] [EP6] [EP7] [EP8]

- FY 2013 awards have not yet been made. FY 2012 awards were made to 2 students, 100% of the students presented their work, 0% female, and 0% underrepresented. We continue to encourage female and minority participation, but it should be noted that the students are chosen by the MT Tech undergraduate research staff (not the MSGC staff).

4e. ARES [EP1] [EP4] [EP6] [EP7] [EP8]

- In FY 2013, 8 ARES awards were made at 5 institutions including two community

colleges; 87.5% female; 0% underrepresented. All awarded students complete Responsible Conduct of Research tutorials and present their research at the MSGC Student Research Symposium or another research conference. We continue to actively recruit and encourage minority participation.

4f. Undergraduate Research Apprenticeships [EP1] [EP4] [EP5] [EP6] [EP7] [EP8]
- 4 MSGC Apprenticeship awards were made in FY13. 100% are currently scheduled to present their work at the MSRS, 25% female, and 0% underrepresented. All are still enrolled. We continue to actively recruit and encourage female and minority participation. For example, MTSGC Apprentice Katherine Stocker is responsible for efforts to engage, via peer-tutoring of freshmen, undergraduate STEM female students at Montana State University.

Outcome 2:

1g. Precollege

MSGC spent \$2,000 in match funding on Precollege projects and volunteered for several other precollege activities. See details below.

- BOREALIS K-12 student opportunity. At UM, one male HS student and two female HS students participated in the academic year program. [EP1] [EP3] [EP7]

- MSU's American Indian Research Opportunities (AIRO) Montana Assistantship Program (MAP). In summer 2013, MSGC hosted two high school MAP research students who worked with BOREALIS for 180 hours. [EP1] [EP3] [EP7]

- UM and MSU BOREALIS provided a weather balloon launch Monforton School 4th graders to learn about weather phenomena. See news coverage from KBZK at (<http://www.nbcmontana.com/news/bozeman-area-students-launch-weather-balloon-look-to-learn-from-collected-data/20129946>). [EP1]

- New in 2013, we invited four teams of middle and high school Montana students who were second place winners at the regional Science Bowl and FIRST Robotics Tournaments to our annual Student Research Symposium. Providing this exciting opportunity to the state's star middle and high school STEM competitors (potential future MTSGC students!) was so well received that we are expanding the opportunity to include the state Science Olympiad and Science Fair 2nd place teams in 2014. Recognizing the teams that were 'this close' to getting to go to a national competition has generated waves of good feeling and cooperation between MTSGC and the Montana educators coaching all the teams across the state. This has BY FAR been more beneficial than sponsoring equal amounts of costs of the competitions. \$2,000 (\$500 per team for travel). [EP1] [EP7]

Outcome 3:

1g. Informal Education/Synergistic projects

MSGC did not spend any base funding on Informal projects, though MSGC staff

volunteered at several events. Being sponsors and volunteers creates awareness about our Higher Education opportunities among the Precollege teachers and students that is quite valuable. See details below.

- September 21, 2013 MSGC hosted a Science and Engineering Festival in the MSU Bobcat Stadium with over 3,000 people in attendance. This was a statewide effort with volunteers from a couple affiliate institutions. Due to such a great reception and support we have combined this event with Astronomy Day to form the Astronomy and Aerospace Day. [EP1] [EP7]

- June 26th, 2013 NASA IRIS launch at the Museum of the Rockies' Taylor Planetarium: the public watched live footage from NASA, heard from and interacted with MSU personnel who are on the IRIS team. MSU is deeply involved in this mission to observe the Sun. Both faculty and students will be involved in IRIS science operations and in analyzing data.

- Astronomy Day, April 20th, 2013. MSGC helped arrange the associated visits by Brian Larson and Jaime Waydo. MSGC also had interactive booths for our general program, and for our BOREALIS, SPOT, and National Student Solar Spectrograph Competition programs. A total of 1800 people attended the event, calling it 'AWESOME!' For Astronomy and Aerospace Day, April 5th, 2014 MSGC has helped arrange the associated visits by Adler Planetarium President and MTSGC alum Dr. Michelle Larson and Jaime Waydo and will again host interactive booths at the event. [EP1] [EP7]

- The Director represents MTSGC on the Tribal College and University Program (an NSF STEM higher education program) boards for Chief Dull Knife College and Stone Child College. The Director also represents MSGC on the MSU Women In Science and Engineering (WISE) committee and the Montana Big Sky Space Education Evaluation Committee. [EP1] [EP7]

- MSGC attended and staffed a booth at the Montana Economic Summit. [EP1] [EP7]

- Other volunteer activities include: Science Olympiad: several MSGC staff and students volunteered. FIRST Lego League and FIRST Tech Challenge Tournament: seven MSGC staff and students volunteered for the Montana regional tournament in February, 2013. Montana Regional Middle School and Montana Regional High School Science Bowls: the MSGC director volunteered for and gave the welcome addresses (talking about MSGC) to hundreds of students at the competitions in February, 2013. [EP1]

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

Student Data and Longitudinal Tracking:

Clarification note: as instructed, the numbers below are for FY 2013 base data. Some awards allocated on FY13 base funding, such as Montana Tech undergraduate research stipends and student support associated with the UM BOREALIS program have not yet been made. See 'Program Accomplishments' section above for LT highlights from FY 2012 students.

Total FY 2013 awards so far = 113; Fellowship/Scholarship = 29, Higher

Education/Research Infrastructure = 84; 24.7% of the total awards were made to females and 8% to underrepresented minority students. F/S funding; 51.7% of the total awards were to females and 27.5% to underrepresented minorities. HE/RI funding; 33% of the total awards were to females and 1% to underrepresented minorities. Total major awards so far = 48; 42% female, 0% underrepresented, all but 3 are still enrolled. Of the 3 students not still enrolled two are pursuing an advanced STEM degree, and one is employed in a STEM field.

Minority-Serving Institutions:

Activities with our MSIs are highlighted in the Program Accomplishments: Outcome 1: 1e and 2e sections.

NASA Education Priorities:

Accomplishments related to NASA Education Priorities are given in the ‘Program Accomplishments’, ‘Program Contributions to PART Measures’, or ‘Improvements’ sections. See references above to numbered Education Priorities: EP1. Hands-on student experiences, EP2. Middle school teachers, EP3. Summer opportunities for secondary students, EP4. Community colleges, EP5. Aeronautics research, EP6. Environmental Science and GCC, EP7. Diversity, EP8. Innovative research infrastructure.

IMPROVEMENTS MADE IN THE PAST YEAR

In FY 2013, we hired a new Education Specialist, who is our first staff member not at the lead institution. This has been a fantastic change for us – having staff coverage at our second most active institution.

In February 2014, we added a 20th Academic Affiliate, Missoula College. Missoula College has recently transitioned from a primarily vocational college to a true community college. Therefore, we found it appropriate to include Missoula College as a member of the Consortium.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Academic Affiliates:

Aaniiih Nakoda College, Harlem, MT; Blackfeet Community College, Browning, MT; Carroll College, Helena, MT; Dawson Community College, Glendive, MT; Flathead Valley Community College, Kalispell, MT; Fort Peck Community College, Poplar, MT; Little Big Horn College, Crow Agency, MT; Miles Community College, Miles City, MT; Missoula College, Missoula, MT; Montana State University, Bozeman, MT; Montana State University-Billings, Billings, MT; Montana State University-Northern, Havre, MT; Montana Tech, Butte, MT; Rocky Mountain College, Billings, MT; Salish Kootenai College, Pablo, MT; Stone Child College, Box Elder, MT; University of Great Falls,

Great Falls, MT; University of Montana, Missoula, MT; University of Montana-Western, Dillon, MT.

Industrial Affiliates:

Anasphere, Inc., Bozeman, MT

All 20 institutions of higher education in Montana are MSGC Academic Affiliates. Only two members of the Consortium – Montana State University-Bozeman and the University of Montana-Missoula are Research Universities offering the Ph.D. degree in fields of science (MSU and UM) and engineering (MSU only). Montana Tech offers Master's degree studies in engineering. In STEM fields, MSU-Billings, Rocky Mountain College, UM-Western, Salish Kootenai College, MSU-Northern, Carroll College, and the University of Great Falls offer Bachelors degree studies. The remaining nine affiliates, including six of the tribal colleges, are two-year institutions. Enrollments at MSGC affiliates range from over 15,000 students at Montana State University to less than 200 at Aaniiih Nakoda and Stone Child Colleges.

In FY13, 17 of our 20 Academic Affiliate institutions were 'active', meaning they were involved in at least one MSGC program during the year! Below is a list of the institutions and the primary programs they participated in. It is always our goal to garner as broad of Affiliate participation as possible in all programs.

- o Blackfeet Community College: scholarship, MAVEN launch and Kennedy Space Center meetings
- o Carroll College: undergraduate research, MSGC staff visit, education enhancement grant
- o Chief Dull Knife College: remote sensing/BOREALIS, scholarship, Affiliates' Meeting, MAVEN launch and Kennedy Space Center meetings
- o Flathead Valley Community College: scholarship, undergraduate research, National Student Solar Spectrograph Competition (NSSSC), MSRS, Affiliates' Meeting
- o Fort Peck Community College: scholarship, MSGC staff visit, MAVEN launch and Kennedy Space Center meetings
- o Miles Community College: NSSSC, MSRS
- o Missoula College: Education Enhancement and Research Initiation proposals, MSGC staff visit
- o Montana State University: scholarship, fellowship, BOREALIS, undergraduate research, education enhancement grants, SPOT, student satellites, NSSSC, NASA internship, MSRS, Affiliates' Meeting
- o Montana State University-Billings: scholarship, undergraduate research, MSRS, Affiliates' Meeting
- o Montana State University-Northern: scholarship, MSRS, MSGC staff visit
- o Montana Tech: scholarship, undergraduate research, MSRS, Affiliates' Meeting
- o Rocky Mountain College: scholarship, student satellite internship, undergraduate research, MSRS, Affiliates' Meeting
- o Salish Kootenai College: scholarship, undergraduate research, remote sensing/BOREALIS, aurora detector, MSRS, student satellites (mostly NASA TCUP

funding), NASA internships, Affiliates' Meeting, MAVEN launch and Kennedy Space Center meetings

- o Stone Child College: remote sensing/BOREALIS, MSRS, Affiliates' Meeting, MAVEN launch and Kennedy Space Center meetings

- o University of Great Falls: scholarship, undergraduate research, MSRS, education enhancement grant, Affiliates' Meeting, MSGC staff visit

- o University of Montana: scholarship, fellowship, BOREALIS, undergraduate research, NSSSC, MSRS, MSGC staff visit, Affiliates' Meeting, NASA internship

- o University of Montana-Western: scholarship, MSRS, NASA internship

The National Space Grant Office requires two annual reports, the 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.