

# FY 2018 Year 4 Extension Annual Performance Document

## Montana Space Grant Consortium

### Lead Institution: Montana State University

Director: Dr. Angela Des Jardins

Telephone Number: 406-994-4223

Consortium URL: <http://spacegrant.montana.edu>

Grant Number: NNX15AJ19H

Lines of Business (LOBs): 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 Montana Space Grant Consortium is a Designated Consortium funded at a level of \$760,000 for fiscal year 2018.

### **B. PROGRAM GOALS:**

#### **Strategic Goals:**

- (1) Develop and connect interdisciplinary aerospace **education** programs that will build and enhance opportunities for involvement in space-based science, technology, engineering and math (**STEM**) in Montana.
- (2) Strive to build a Montana **aerospace workforce**, integrating women, under-represented minorities and persons with disabilities.
- (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.
- (4) Expand and enhance aeronautics and **NASA-related research** activity in Montana colleges and universities.

#### **SMART Objectives:**

MSGC's Scholarship SMART Objectives are to:

- Each academic year award \$1,000 - \$2,000 competitive scholarships to deserving undergraduate students; maintain at least a 3.5 mean GPA; maintain at least 25% underrepresented awardees; increase the percentage of female awardees from 47% to 50% for the 2015-2019 grant period.

- Continue to strive to award at least one scholarship to each active Academic Affiliate, increasing the number of represented institutions from 50% to 70% per year for the 2015-2019 grant period.

MSGC's Fellowship SMART Objective is to:

- Each academic year award \$9,000 one-semester competitive fellowships to deserving graduate students with 3.5 GPAs or higher; maintain at least a 90% level of major awardees that continue to STEM employment or STEM advanced education; increase the percentage of underrepresented awardees from 8% to 10% and female awardees from 40% to 45% for the 2015-2019 grant period.

MSGC's Internship SMART Objectives are to:

- Continue to offer interdisciplinary, hands-on, meaningful summer internships for Montana students to participate in MSGC BOREALIS high altitude ballooning, space hardware, and NASA center projects; maintain at least a 90% level of interns that continue on to STEM employment or STEM advanced education; increase the percentage of underrepresented awardees from 5% to 8% and female awardees from 10% to 20% for the 2015-2019 grant period.

- Maintain at least one Tribal College participant per year, either as a NASA-supported or MSGC-supported intern.

- Increase support for aerospace industry internships – provide support for at least two industry internships per year.

MSGC's BOREALIS SMART Objective is to:

- Continue to create interdisciplinary, hands-on, meaningful opportunities for Montana students to design, build, fly and analyze data from BOREALIS high altitude balloon experiments; maintain participation of at least five Affiliate Institutions with at least one being a Tribal College; maintain at least a 90% level of major awardees that continue onto STEM employment or STEM advanced education; increase the percentage of underrepresented participants from 5% to 8% and female participants from 10% to 20% for the 2015-2019 grant period.

MSGC's ARES SMART Objective is to:

- Competitively award stipends to undergraduate students involved in STEM research; maintain at least 1/3 participating active Academic Affiliate Institutions; maintain 100% of students presenting their work; maintain at least 50% female awardees; increase the percentage of underrepresented awardees from 5% to 10% for the 2015-2019 grant period.

MSGC's Apprenticeship SMART Objectives are to:

- Competitively award Apprenticeship stipends to Montana undergraduate students involved in *major* NASA research projects; maintain 100% present their work and/or submit a paper; increase the percentage of underrepresented awardees from 10% to 12% and female awardees from 15% to 20% for the 2015-2019 grant period.

- Continue to create interdisciplinary, hands-on, and meaningful opportunities for Montana students to participate in *academic year 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 participants from 5% to 8% and female participants from 10% to 20% for the 2015-2019 grant period.

MSGC's SPOT SMART Objectives are to:

- For the undergraduate presenters, maintain at least a 90% level of major awardees that continue onto STEM employment or STEM advanced education; increase the percentage of underrepresented

participants from 5% to 8% and maintain at least 40% female participants for the 2015-2019 grant period.

- Through the efforts of the SPOT graduate managers and undergraduate presenters, continue to educate 9% or more of the Montana K-12 teachers and students (~600 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 an 80% level of teachers who use SPOT-provided NASA materials in their classroom instruction.

MSGC's Student Research Symposium SMART Objective is to:

- Continue to hold Student Research Symposiums for all students involved in MSGC programs; maintain at least 150 student and faculty participants from at least 50% of active institutions, and maintain at least a 95% participant agreement that the Symposium was beneficial.

MSGC's Education Enhancement Grant SMART Objective is to:

- Award Education Enhancement grants that continue to be impactful, interdisciplinary and have diverse participants; increase the average percentage of female PIs from 20% to 25% in the 2015-2019 award period; maintain at least five participating affiliate institutions, including at least one Tribal College for the 2015-2019 grant period.

MSGC's Precollege and Informal SMART Objectives are to:

- Support the Science Horizons program, bringing science educators from predominantly Native American communities to Montana State University for one week of in-depth learning and planning; strive for at least 25% female and underrepresented awards.
- 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 'Astronomy and Aerospace Day;' continue to participate, on a volunteer basis, on Montana STEM advisory boards.

MSGC's Consortium Management SMART Objectives are to:

- 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.
- Continue 100% attendance of at least one MSGC staff member at Space Grant Regional and National Meetings.
- Continue MSGC staff visits to at least four Affiliate Campuses each year.

### **C. PROGRAM/PROJECT BENEFITS TO PROGRAM AREAS:**

Jonathan Byers, one of our **graduate fellowship** recipients, secured a \$50,000 grant from the National Geographic Society while finishing his graduate degree to use drone technology, GPS and machine learning to help save endangered tree kangaroos in Papua New Guinea. Jonathan received the grant to develop a suite of tools and methods of drone 3-D imagery, GPS collars, and machine learning to better understand tree kangaroo behavior, its ecological needs and its distribution. As a result of this new technology, they can record a tree kangaroo's location and movement much more frequently, accurately and without human disturbance to the animal. This new research has potential to serve as a global role model for species research worldwide.

John Ryter, an **undergraduate student** supported by an Award for Research in Engineering and Science (ARES), co-authored with his research advisor and another MTSGC student “Effect of electrical current on the oxidation behavior of electroless nickel-plated ferritic stainless steel in solid oxide fuel cell operating conditions” in the International Journal of Hydrogen Energy. John was also a 2016 Goldwater recipient and is now a graduate student at the Massachusetts Institute of Technology.

**BOREALIS high altitude ballooning programs** at both MSU and UM continue to attract and train new students with unique interdisciplinary, hands-on, meaningful opportunities. MSU BOREALIS has begun to design and build our own zero pressure balloons for use on student flights. A major industry partner has donated the film that is used by the students in fabricating the balloons. Many new and interesting design challenges exist for students bringing this capability in house. Another challenging opportunity is to design a system that can be used for “station keeping”, in essence controlling the balloon to stay in one location during a flight by using the different wind directions that exist in the atmosphere. UM BOREALIS offers unique radiosonde flights that challenge the students with scientific interpretation of results. We are hopeful that a sponsorship by MathWorks will allow UM BOREALIS students to conduct an atmospheric science study during the July 2, 2019 total solar eclipse in Chile.

#### **D. PROGRAM ACCOMPLISHMENTS:**

Information is given below for each SMART Objective in terms of the Objective metrics (summarized from the full version in section B). For example, under scholarships, the first metric is to maintain at least a 3.5 GPA and the 2016 result is 3.70.

- NASA Internships, Fellowships, and Scholarships (NIFS):

##### **Scholarships**

Awarded 28 scholarships.

Maintain at least 3.5 mean GPA: 3.69

Maintain at least 25% underrepresented awardees: 10.8%. We continue to work with affiliates from underrepresented minority institutions to encourage students to apply.

Increase female awards from 47% to 50%: 39.3%

Increase the number of represented institutions from 50% to 70% per year: 43.5%

##### **Fellowships**

Awarded 5 one-semester fellowships.

Maintain at least 3.5 GPA mean GPA: 3.70

Maintain at least 90% of major awardees in STEM employment or pipeline: all still enrolled.

Increase underrepresented awards from 8% to 10%: 0%; We continue to actively recruit and encourage minority participation.

Increase female awardees from 40% to 45%: 60%

**Internships** with BOREALIS, space hardware, NASA, and industry

We awarded 21 Year 3 internships and will be deciding Year 4 internships in March, as well as Year 5 to adhere to probable changes with no-cost extensions of funding. Given changes in reporting deadlines with OEPM, all internships have been reported and data is reflected accurately in the system and student data tables for Year 3 (OEPM FY2018).

Maintain at least a 90% level of major awardees that go to STEM employment or advanced education: Year 3 - One working at NASA Goddard, one applying to graduate schools, one in industry, rest are still enrolled. Year 4 - TBD

Increase underrepresented awards from 5% to 8%: 14% Year 3; Year 4 TBD

Increase female awardees from 10% to 20%: 23.8% Year 3; Year 4 TBD

Maintain at least one Tribal College student award: 1 Year 3; Year 4 TBD

Provide at least two industry internships per year: provided 3 Year 3; Year 4 TBD

- Higher Education projects:

**BOREALIS** high altitude ballooning projects

A total of 29 students participated that are not counted in other report categories. Many other students participated in BOREALIS projects but are reported under paid ARES, Apprenticeship, or Internship categories.

Increase underrepresented participants from 5% to 8%: 6.5%

Increase female participants from 10% to 20%: 42%

Maintain at least five participating affiliate institutions, including at least one Tribal College: 2 institutions: Montana State University, University of Montana.

**ARES** undergraduate STEM research

ARES awards were made to 21 students from 7 institutions.

Maintain at least eight participating Academic Affiliates: 6 Affiliates+lead institution

Maintain 100% of students presenting work: 100%

Maintain at least 50% female awardees: 48%

Increase underrepresented awards from 5% to 10%: 0%; We continue to actively recruit and encourage minority participation.

**Apprenticeships** - major NASA undergraduate research projects

Apprenticeship awards were made to 18 students from 5 institutions. We will again offer summer apprenticeships to reach the underrepresented group at small institutions.

Maintain at least 90% level of awardees that go to STEM employment or advanced education: all still enrolled

Maintain 100% of students presenting work: 100%

Increase female awardees from 15% to 20%: 16.7%

Increase underrepresented awards from 10% to 12%: 5.6%; We continue to actively recruit and encourage minority participation.

### **SPOT undergraduate presenters**

Awards were made to 6 SPOT presenters with recruitment ongoing.

Maintain at least a 90% level of major awardees that go to STEM employment or advanced education: All 6 still enrolled

Increase underrepresented participants from 5% to 10%: 0%, working with tribal colleges to get student presenters at their institutions.

Maintain at least 40% female participants: 33%

MTSGC continues to provide graduate student fellowship support of the SPOT manager and is actively searching for funding partners for this very successful program.

### **Student Research Symposium**

Based on our continuous analysis of our programs and events, we decided that a STEM Professional Skills Symposium would be much more beneficial to students than the Student Research Symposium that we have been holding for the last 10 years. We started the Research event ten years ago because many of our students did not have a local venue for presenting their work. Now, however, students at every campus in Montana have local or situational (e.g. Two Year College Research Day) opportunities to present. Therefore, we turned our attention to the current need - professional skills - and held our first ever Skills Symposium in lieu of the Research Symposium. Future SMART Objectives will reflect the Skills Symposium effort and drop the Research Symposium.

For the students who are unable to participate in their local research symposium or who simply enjoy talking with the public about their work, we include student research presentations at our annual Astronomy and Aerospace Day. This event will take place on April 14th, 2019.

**STEM Student Professional Skills Symposium - Annual New Event-** This fun and interactive one-day event, held October 20th, 2018 at the Museum of the Rockies in Bozeman was geared toward helping Montana STEM students with the essential professional skills needed to be successful in the modern workforce. Students participated in sessions on: “Build Your Professional Brand” hands on resume writing; “Think Outside the Box” general discovery of interests, values, careers and majors; “Building Experience” translating internships or research experiences into marketable skills; “Professional Skills” to learn about the essential skills employers are looking for including professional communication, networking and the appropriate use of Social Media; “Overcoming Obstacles” geared towards identifying stumbling blocks and developing strategies to overcome your obstacles on your way to success. The event also included a five person industry and research interactive question and answer session about different careers and the paths taken to achieve success. Fifty-five students and faculty attended the event from eleven campuses across Montana including four Tribal Colleges. The selection of the date limited the number of participants in the first year. Participant remarks of the Symposium were overwhelmingly positive.

### **Education Enhancement grants**

Awarded one grant in year 4 to one institution (details below), the Carroll College. We received two proposals from two different institutions. Starting with year 5, we are going to “rebrand” a bit how we advertise the Education Enhancement opportunity to attract additional, more diverse proposals. Increase female PIs from 20% to 25% over the entire grant period: 0% female PI this year; 57% female over the first four years of the grant.

Maintain at least five participating affiliate institutions over the entire grant period, including at least one Tribal College: first four years of participation from five campuses: Carroll College, Flathead Valley Community College, Salish Kootenai College (a Tribal College; 2 awards), UM (3 awards), UM Western

Year 4 Title, PI, and institution: “The creation of a one-semester accelerated general chemistry course with active-learning practices in the lecture and open-ended research-like experiences in the lab,” John Rowley, Carroll College.

### **Faculty Fellowships**

Based on our continuous analysis of our programs and events, we decided that the only way to foster increased NASA-related research opportunities for Montana students was to increase the number of available mentors. At most of our Montana campuses, however, faculty members teach heavy course loads during the academic year and are not funded in the summer. Also, most of these faculty members have relatively little training in research themselves. Therefore, we decided to move some funding from our Education Enhancement opportunity into a Faculty Fellowship opportunity.

Faculty members propose for 1-5 weeks of support during the summer months for training or conducting research. The first round (awarded March 2018 with year 3 funding) of Fellowships was so well received, we offered the opportunity again with year 4 funding and wrote the opportunity into our year 5 proposal. We will continue to offer the opportunity until it is no longer needed. In year 3, we awarded four Fellowships to faculty members from three campuses: Flathead Valley Community College, Rocky Mountain College, and the University of Montana. In year 4, we awarded four Fellowships to faculty from three campuses: Carroll College, Rocky Mountain College, and the University of Montana.

- Research Infrastructure projects:

We did not originally propose to fund any research infrastructure projects in Year 4. However, in the mix of proposals submitted to our faculty Education Enhancement grant and Montana NASA EPSCoR Research Initiation grant opportunities, we recognized that MTSGC funds would be more well spent on a University of Montana research grant than a second education grant. We will submit a budget modification request to cover this change.

Awarded one Research Initiation grant in year 4 to one institution: “Development of synthetic TEMPO satellite retrievals for wildfire studies,” Lu Hu, the University of Montana.

- Precollege projects:

MTSGC assisted 7 Montana K-5 teachers from rural schools with travel to attend the Montana Learning Center STEAM training program, provided registration, travel, lodging and meals for 3 Montana high school teachers to attend the annual RockOn! workshop in Wallops, VA, and continued to support our successful Space Public Outreach Team (SPOT) program. Volunteered for several other precollege activities. See details below.

### **SPOT K-12 outreach**

In the last year, SPOT reached 2,000 Montana K-12 students; dates are set for thousands more.

Present to 9% or more Montana K-12 educators and students: 4% and rising

Maintain at least an 80% level of teachers who use SPOT-provided NASA materials in their classroom instruction: 80%

Strive for at least 25% female and underrepresented awards for K-12 teacher travel: 100%

- Informal Education projects:

#### **- Informal Education/Synergistic projects**

MTSGC did not spend any base funding on Informal projects, though MTSGC staff volunteered at several events.

- Continue to participate at least three times per year, on a volunteer basis, in outreach programs: completed six events.

- Continue to host annual Astronomy and Aerospace Day: will take place April 14th, 2019.

Sponsoring and volunteering at events across the state increases knowledge about our Higher Education opportunities among the Precollege teachers and students that is quite valuable.

- Other volunteer activities include: Montana Science Olympiad: several MTSGC staff and students volunteered. FIRST Tech Challenge & Lego League: MTSGC staff and students volunteered for the Montana regional tournament. Science Bowl (middle school and high school): MTSGC staff and students volunteered for the Montana regional tournament. Girls in Science: MTSGC staff and students volunteered in Billings. Science fairs: MTSGC staff and students volunteered at the Missoula and Billings fairs. Girls STEM Roundup: MTSGC staff volunteered in Helena

## **E. PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS:**

- **Diversity:**

All of our SMART objectives include diversity of institution and diversity of students metrics. We are on target for most of our female diversity metrics. For example, one of the traditionally toughest areas for us to recruit women and underrepresented minority students is in the higher-paid internships. As a result of continued focus, effort, and research on expanding diversity, however, we exceeded our metrics for women and minorities in internships this year. Recruiting underrepresented minorities is always tough for MTSGC. There are two primary reasons. First, Montana has a very low percentage of underrepresented minorities. Second, our largest minority (about 11% of the undergraduate population) is Native American students. Native students in STEM are primarily focused on health fields. In addition, Native culture tends to steer students away from leaving their

home communities. We continue to make extra effort to recruit Native students and to work as close as possible with our Tribal Colleges.

- **Minority Serving Institution Collaborations:**

We continue to offer support to all Tribal Colleges via our primary MTSGC Education Enhancement grant, Apprenticeship, ARES, and BOREALIS statewide programs. Highlights are given below and throughout this report. We continue to work towards the goals set out in our SMART objective.

- MTSGC staff worked with Aaniiih Nakoda College in a rocket workshop for the First Nations Rocket Launch.

- MTSGC staff also provided UAS demonstrations at Salish Kootenai College.

- Students from Chief Dull Knife College, Fort Peck Community College, and Little Bighorn Community College won funding to participate in WISGC's First Nations High-Powered Rocket Launch competition.

- **Office of Education Annual Performance Indicators:**

- API 3.3.3: STEM-18-1            38
- API 3.3.5: STEM-18-5            5

**F. IMPROVEMENTS MADE IN THE PAST YEAR:**

Based on our continuous analysis of our programs and events, we decided that a **STEM Professional Skills Symposium** would be much more beneficial to students than the Student Research Symposium that we have been holding for the last 10 years. We started the Research event ten years ago because many of our students did not have a local venue for presenting their work. Now, however, students at every campus in Montana have local or situational (e.g. Two Year College Research Day) opportunities to present. Therefore, we turned our attention to the current need - professional skills - and held our first ever Skills Symposium in October 2018 in lieu of the Research Symposium. For the students who are unable to participate in their local research symposium or who simply enjoy talking with the public about their work, we still include student research presentations at our annual Astronomy and Aerospace Day.

Also based on our continuous analysis of our programs and events, we decided that the only way to foster increased NASA-related research opportunities for Montana students was to increase the number of available mentors. At most of our Montana campuses, however, faculty members teach heavy course loads during the academic year and are not funded in the summer. Also, most of these faculty members have relatively little training in research themselves. Therefore, we decided to move some funding from our Education Enhancement opportunity into a **Faculty Fellowship** opportunity.

Given the pressure for spending down funding more rapidly, we are **changing our timelines for summer internships and faculty grants**. In past years, including year 4, we awarded summer internships the summer following the end of that grant year. For example, we are awarding year 4 summer internships in summer 2019 even though our year ends April 22, 2019. This was done by design due to late arrival (not in time for summer, yikes!) of our funds in the past. For the past several years, however, our funding has arrived on time. This, in addition to the extreme pressure

about the unavailability of no cost extensions, means that we are changing the timeline and awarding internships in the summer of our grant year. In summer 2019, we will award both year 4 and year 5 internships. Hopefully there will be no issue with the arrival of our year 5 funds! Similarly, we moved up our solicitation and award cycle for Education Enhancement, Research Initiation, and Faculty Fellowship grants by six months so they fit more completely in our grant year.

#### **G. CURRENT AND PROJECTED CHALLENGES:**

It will be a challenge to make the timing changes described in the improvement section above as we've been on the same timeline for faculty awards for 28 years, until now. We will be making special efforts to advertise and make our Affiliate Campuses aware of the change.

#### **H. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION:**

In Year 4, 17 of our 23 Academic Affiliate institutions were 'active', meaning they were involved in at least one MTSGC program during the year. Below is a list of the institutions and the primary programs in which they participated.

- o Aaniiih Nakoda College: MTSGC staff visit
- o Blackfeet Community College: scholarship
- o Carroll College: scholarship, undergraduate research, Faculty Fellowship, Education Enhancement Grant, Affiliates' Meeting
- o Chief Dull Knife College: BOREALIS
- o Great Falls College - MSU: undergraduate research, Affiliates' Meeting, SSPSS
- o Flathead Valley Community College: Faculty Fellowship, undergraduate research
- o Little Big Horn College: Affiliates' Meeting
- o Missoula College: Affiliates' Meeting
- o Montana State University: scholarship, fellowship, BOREALIS, undergraduate research, SPOT, student satellites, Affiliates' Meeting, SSPSS
- o Montana State University-Billings: undergraduate research, Affiliates' Meeting
- o Montana State University-Northern: scholarship, SSPSS
- o Montana Tech: scholarship, NASA intern travel support, undergraduate research, SSPSS
- o Rocky Mountain College: scholarship, undergraduate research, Faculty Fellowship, Affiliates' Meeting, SSPSS
- o Salish Kootenai College: Affiliates' Meeting, MTSGC staff visit
- o University of Montana: scholarship, fellowship, BOREALIS, undergraduate research, SPOT, Research Initiation Grant, Faculty Fellowship, SSPSS
- o UM -Western: undergraduate research, NASA Goddard internship, scholarship, MTSGC staff visit
- o University of Providence: scholarship, SSPSS