

# FY 2019 Year 5 Extension Annual Performance Document

MT\_FY19\_Year5Ext\_APD

## Montana Space Grant Consortium

### Lead Institution: Montana State University

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

Grant Number: NNX15AJ19H

### **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 2019.

### **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.

#### **FY 2019 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 2015-2020 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 2015-2020 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 2015-2020 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 40% for the 2015-2020 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 40% for the 2015-2020 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 2015-2020 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 40% for the 2015-2020 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 40% for the 2015-2020 grant period.

MSGC's Space Public Outreach Team (SPOT) Higher Education 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 2015-2020 grant period.

MSGC's STEM Student Professional Skills Symposium SMART Objective is to:

- Hold a STEM Student Professional Skills Symposium for all students involved in MSGC programs; maintain at least 75 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 2015-2020 award period; maintain at least five participating affiliate institutions, including at least one Tribal College for the 2015-2020 grant period.

MSGC's Faculty Fellowships SMART Objective is to:

- Competitively award fellowships for Montana faculty members to create access to NASA-related training and/or professional development opportunities; maintain at least 50% of the awards at Tribal and Community Colleges; increase the number of Montana faculty members who mentor MSGC ARES or Apprenticeship students by 20% by 2023 (compared to the 2015-2017 average number).

MSGC's Research Initiation Grant SMART Objective is to:

- Award Research Initiation seed grants that help junior Montana faculty members to increase their competitiveness for direct NASA funding; maintain at least 50% of awardees submitting a NASA follow-on proposal; in coordination with awards made by Montana NASA EPSCoR, increase the average percentage of female PIs from 20% to 25% in the 2015-2020 award period.

MSGC's Precollege and Informal SMART Objectives are to:

- 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.
- 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:**

Trisheena Kills Pretty Enemy, one of our **graduate fellowship** recipients, is MTSGC's new Space Public Outreach Team manager. Trisheena recently received her bachelor's degree from Montana State University and is a former McNair Scholarship Program award recipient as well as former vice president for MSU's chapter of the American Indian Science and Engineering Society. In the Spring of 2019 she received the Daniel Voyich Award for Indigenous Community Involvement. Trisheena's enthusiasm and dedication for SPOT is taking the program to a new level of professional training for higher education student presenters to become inspirational STEM role models for K-12 students and teachers.

Carter McIver, an **undergraduate student** working with the MSGC BOREALIS program, is the first ever Montana State University Native American student to receive a Goldwater award. Carter is also a former McNair Scholarship Program award recipient and is currently enrolled in graduate school at Montana State University.

**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. FY19 saw students conduct an atmospheric science field campaign to study the July 2, 2019 total solar eclipse in Chile with a resulting publication currently in review.

### **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 3.56.

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

### **Scholarships**

Awarded 19 scholarships.

Maintain at least 3.5 mean GPA: 3.56

Maintain at least 25% underrepresented awardees: 16%. We continue to work with affiliates from underrepresented minority institutions to encourage students to apply.

Increase female awards from 47% to 50%: 58%

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

### **Fellowships**

Awarded 9 one-semester fellowships.

Maintain at least 3.5 GPA mean GPA: 3.54

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

Increase underrepresented awards from 8% to 10%: 22%

Increase female awardees from 40% to 45%: 33%

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

We awarded 22 Year 4 and Year 5 internships summer 2019. Augmentation funding will be utilized for more internships during summer 2020 during a no cost extension should that be granted. Student data for Year 4 & 5 is reflected in OEPM FY 2019.

Maintain at least a 90% level of major awardees that go to STEM employment or advanced education: 2 in graduate school, 1 in academia, 2 STEM employment, rest are still enrolled.

Increase underrepresented awards from 5% to 8%: 0% Underrepresented minorities have difficulty leaving their home for extended periods of time during the summer. We actively recruit in this area.

Increase female awardees from 10% to 40%: 36%

Maintain at least one Tribal College student award: No underrepresented minorities applied

Provide at least two industry internships per year: We had 1 industry partner in our Apprenticeship program. We assisted in securing 6 industry internships for a MSU researcher on funds.

- Higher Education projects:

### **BOREALIS** high altitude ballooning projects

A total of 34 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%: 8.8%

Increase female participants from 10% to 40%: 12% (though when counting students reported in other categories, this number is higher). We always work to recruit awesome women!

Maintain at least five participating affiliate institutions, including at least one Tribal College: 2 institutions: Montana State University, University of Montana. We are working on a new effort to further engage our Tribal Colleges and smaller campuses.

#### **ARES** undergraduate STEM research

ARES awards were made to 10 students from 6 institutions.

Maintain at least eight participating Academic Affiliates: 5 Affiliates+lead institution

Maintain 100% of students presenting work: 100%

Maintain at least 50% female awardees: 36%

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 43 students from 8 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 40%: 33%

Increase underrepresented awards from 10% to 12%: 5%; We continue to actively recruit and encourage minority participation.

#### **SPOT undergraduate presenters**

Awards were made to 4 SPOT presenters with recruitment ongoing.

Maintain at least a 90% level of major awardees that go to STEM employment or advanced education: All 4 still enrolled

Increase underrepresented participants from 5% to 10%: 0%, Our SPOT manager is a Native American graduate student at MSU. She is actively working with Native American groups to recruit underrepresented presenters.

Maintain at least 40% female participants: 75%

MTCGC provides graduate student fellowship support of the SPOT manager and continues to advertise the program in an effort to find funding partners for this very successful program. At the Western Regional meeting, a former manager gave a presentation which was received so well by the consortia in attendance that programs are being and have been established in other states.

#### **NASA Days, Career Fair and STEM Student Professional Skills Symposium**

This fun and interactive four-day event, held October 2 thru 5th, 2019 at the MSU Campus and the Museum of the Rockies in Bozeman was geared toward helping Montana students and faculty learn about opportunities with NASA. Five NASA managers, two from Johnson and three from Kennedy, engaged with participants at numerous scheduled opportunities. NASA managers and JoAnn Morgan engaged Native and Tribal College students at a dinner and networking session that targeted both undergraduate and graduate students majoring in various fields of engineering, science, mathematics, business, and other NASA-related disciplines.

NASA managers started the Symposium with a panel discussion of career paths, opportunities available at different centers, and how to apply and get a job with NASA. Our keynote speaker was JoAnn Morgan who described her experiences as the only woman in the Apollo 11 launch control room. The afternoon interactive sessions had an opportunity for all students to rotate through a resume pass around/critique, in-person practice interviews, and an opportunity to tour the Museum of the Rockies or see a planetarium show. Additionally, those students interested in NASA internships were interviewed by the NASA managers for specific internship openings. Of the one hundred eighteen students and faculty registered for the Symposium 57 attended from nine campuses across Montana including two Tribal Colleges.

### **Education Enhancement grants**

Awarded one grant in year 5: “Satellite and Unmanned Aircraft System Remote Sensing for Hydrological Modeling,” Raja Nagisetty, Montana Technological University Environmental Engineering. We received two proposals from two different institutions. Due to low numbers of proposals, we will not continue this program in our new multi-year award. The main reason for the low number of proposals is that there are many more opportunities for course development now, which is a good change, and we’re happy to adapt and offer different programs.

Increase female PIs from 20% to 25% over the entire grant period: 0% female PI this year; 49% female over the entire grant period.

Maintain at least five participating affiliate institutions over the entire grant period, including at least one Tribal College: six campuses: Carroll College, Flathead Valley Community College, Montana Technological University, Salish Kootenai College (a Tribal College; 2 awards), UM (3 awards), UM Western

### **Faculty Fellowships**

Awarded five Faculty Fellowships to five different institutions to foster increased NASA-related research opportunities for Montana students and provide faculty professional development: Dennis Johnson at Aaniiih Nakota College, Ryan Hannahoe at Montana Learning Center, Scott Powell at Montana State University, Raja Nagisetty at Montana Technological University, and Patricia Duce at University of Montana.

Maintain at least 50% of the awards at Tribal and Community Colleges over the entire award period: 20% this year, 20% over the entire award period. One of the challenges in recruiting TC and CC participants was our 1:1 institution cost share requirement. Starting next year, we have changed the cost share to a personal requirement, which should make awards to TCs and CCs easier.

Increase the number of Montana faculty members who mentor MSGC ARES or Apprenticeship students by 20% by 2023 (compared to the 2015-2017 average number): we’re well on our way.

- Research Infrastructure projects:

### **Research Initiation Grants**

Awarded one grant in year 5: “Intelligent Feature Extraction Using Frozen Dictionary Learning,” Bradley Whitaker, Montana State University Electrical and Computer Engineering. We received nine proposals from two different institutions. Note: we awarded two additional grants under Montana NASA EPSCoR.

Maintain at least 50% of awardees submitting a NASA follow-on proposal: 100% this year, 100% for the three awards in the entire grant period.

Increase female PIs from 20% to 25% over the entire grant period: 0% female PI this year; 0% female over the entire grant period (three awards). We are working to increase this statistic.

- Precollege projects:

MTSGC supported teacher training at Montana Learning Center for the ANGLEs Challenge, undergraduate hands-on presenter training for the Indigenous Research and STEM Education (IRSE) program at the University of Montana, 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 3,700 Montana K-12 students; dates are set for many spring shows. Present to 9% or more Montana K-12 educators and students: 2.5% MT has 148,000 students in 147,000 square miles.

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:

MTSGC did not spend any funding on Informal projects, though MTSGC staff and students volunteered at several events. Sponsoring and volunteering at events across the state increases knowledge about our Higher Education opportunities.

- Continue to participate at least three times per year, on a volunteer basis, in outreach programs: completed more than ten events including: Montana Science Olympiad, FIRST Tech Challenge & Lego League, Montana Science Bowl, Science fairs, Montana Science Center, Montana Learning Center, ANGLEs Competition, Belgrade, MT STEM Family night, MSU Engineer-A-Thon.

- Continue to host annual Astronomy and Aerospace Day: will take place April 19th, 2020.

### **Consortium Management**

We held our annual Affiliates’ Meeting the morning prior to the Western Regional Meeting (WRM) that we hosted in Big Sky, Montana on Thursday, September 12, 2019. We had nine Affiliate reps attend, 64% of our active reps, not quite meeting our 75% goal. This was likely due to the fact that we held the meeting for extra time this year, inviting the reps to the WRM. We met our goal to have at least one staff member at each National SG meeting. Meetings are important for collaboration. In the

past year, we visited seven Affiliate campuses (Carroll College, Montana State University Billings, Montana Technological University, Rocky Mountain College, Salish Kootenai College, University of Montana, and University of Montana Western), exceeding our goal of four.

**E. Milestones:**

We have milestones aligned with each of our projects and associated SMART objectives. The milestones include dates for advertising opportunities, making offers, conducting evaluation and reporting, and scheduling events. We have not had any deviations from our proposed milestones.

**F. 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 attended and participated in the WISGC's First Nations High-Powered Rocket Launch Competition supporting the Aaniiih Nakoda College and Fort Peck Community College teams. This "First Step" event allows Tribal College students with no rocketry experience to have a unique aerospace experience that includes student presentations and networking opportunities with industry scientists and engineers. Creativity was present in each student rocket design and provided many interesting results. Aaniiih Nakoda College took third place in the Tribal Launch category. Students from Aaniiih Nakoda College, Chief Dull Knife College, Little Big Horn College, and Salish Kootenai 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-19-1                      47
- API 3.3.5: STEM-19-5                      4

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

In our previous year, April 2018 - April 2019, we made quite a few changes to our programs, including on faculty fellowships, timing of Education Enhancement and Research Initiation grants, and timing and type of summer student programs. In the last year, April 2019 - April 2020, we are letting these changes settle. In addition, we have been planning changes that will go into effect for our new five-year award, starting in April 2020. These changes include discontinuing our Education Enhancement grants and scholarships, and adding Research Activation grants, student workshops, and NASA Center trip awards. This is a lot of change to put in place and has been our focus as far as improvements. Finally, the Montana director is the National Space Grant Council chair, which takes a lot of time and requires smaller changes and innovations at home.

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

We continue to try to increase our diversity numbers, especially our Native American students. Most Native students pursue degrees in health related fields, making recruiting for other STEM fields a challenge. It will be somewhat challenging to implement our new Research Activation, student workshops, and NASA Center travel awards programs.

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

In Year 5, 14 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: Faculty Fellowship, scholarship, undergraduate research, Affiliates' Meeting
- o Blackfeet Community College: scholarship, SSPSS participation faculty & student
- o Carroll College: scholarship, Affiliates' Meeting, undergraduate research, MTSGC staff visit
- o Great Falls College - MSU: scholarship, undergraduate research
- o Flathead Valley Community College: scholarship, undergraduate research
- 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: Affiliates' Meeting, MTSGC staff visit for Challenger Center meeting
- o Montana Tech: scholarship, fellowship, undergraduate research, SSPSS, Affiliates' Meeting, internship, MSGC staff visit
- o Rocky Mountain College: scholarship, undergraduate research, Faculty Fellowship, Affiliates' Meeting, SSPSS, internship, MTSGC staff visit research symposium
- o Salish Kootenai College: Affiliates' Meeting, MTSGC staff visit
- o University of Montana: scholarship, fellowship, BOREALIS, undergraduate research, SPOT, Research Initiation Grant, Faculty Fellowship, internship
- o UM -Western: undergraduate research, scholarship, MTSGC staff visit research symposium
- o University of Providence: scholarship