



North Dakota Space Grant Consortium (NDSGC) Strategic Plan 2015-2018

Preface: Since 1990, the North Dakota Space Grant Consortium (NDSGC) has been the premier NASA higher education program in the state by supporting diverse and effective programs that aim to establish a robust and evolving NASA infrastructure. These efforts have led to a variety of programs such as high altitude ballooning, planetary space suit research, the awarding of fellowships and scholarships across the state, placing North Dakota college students as interns at NASA field centers, and providing avenues to involve females and underrepresented minorities in the NASA mission.

The past accomplishments have been made possible by the statewide affiliate institutions of Space Grant, as well as the support from the North Dakota Legislature and the University of North Dakota (UND). This support is a testimony to the confidence of North Dakota's policymakers and educators in the NASA Space Grant mission, which is to increase the number of college students pursuing science, technology, engineering, and mathematics (STEM) degrees and employment in the NASA and technical workforce. Much of the Consortium's past work could not have been possible without this support.

Although the NDSGC has demonstrated significant past success, it is time for fresh new ideas and expansions of existing successful efforts. This strategic plan has the broad goal of dramatically increasing NASA research and education in North Dakota, in terms of science and engineering, which can invigorate and motivate the state's K-12 and higher education students while also developing capabilities that might lead to new economic development.

Part I: This three-year strategic plan, in alignment with the current proposal, is a comprehensive document that defines the Consortium's goals, SMART objectives, programs, and metrics that will reinvigorate the Consortium's work. The challenge of bringing substantive, long-term, and positive change to North Dakota is a major challenge, but this proposal and our strategic plan define the way forward to accomplish these goals. The Consortium is emerging with a new set of priorities and goals designed to infuse North Dakota with the knowledge, excitement, discovery, and challenge that is NASA and the all-encompassing realm of space science and exploration.

Mission statements

The Consortium mission is guided by the overall NASA Space Grant mission, the definition of the Consortium as a Capability Enhancement Consortium, the goals of the NASA Office of Education, and its own mission statement, which are shown below:

National Space Grant Mission Statement: The NASA Space Grant College and Fellowship Program is a national network that promotes science, technology, engineering and mathematics (STEM) education through cooperative and multidisciplinary programs while recruiting and training the workforce.

Capability Enhancement Consortium: There is a required amount of funds that must be spent on graduate fellowships and undergraduate scholarships. Capability enhancement consortia should focus on the development of space-related research infrastructure in the state and provide funds for improvements in the quality of aerospace research and education. These consortia should minimize precollege and informal education investments in order to concentrate resources on building research infrastructure and improving the state's aerospace education base. The focus of expenditures and effort varies according to the resources and needs identified in the state.

NASA Office of Education Goals: The NASA Office of Education defines its goals in the context of NASA's overall strategic plan and explicitly states these goals in terms of three education outcomes. The three outcomes are:

1. Outcome 1 – Higher Education: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals through a portfolio of investments.
2. Outcome 2 – Elementary to Secondary Education: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.
3. Outcome 3 – Informal Education: Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.

North Dakota Space Grant Consortium Mission Statement: The North Dakota NASA Space Grant Consortium fulfills the Space Grant mission by involving North Dakota students, faculty, and K-12 teachers and students in multi-institutional, collaborative, NASA-relevant research and education projects, while also educating the North Dakota

citizenry about NASA, its purpose, and its missions. Our activities will demonstrably increase the qualified STEM and technical workforce that is necessary to accomplish NASA's goals while also contributing to the general education and welfare of the North Dakota populace.

In concurrence with these mission statements, the NDSGC has five overarching goals:

1. Support undergraduate/graduate student STEM experiences that will lead to enhancement of the NASA and technical workforce
2. Nurture and grow specific Research Focus Areas (RFAs) that will develop multi-institutional, collaborative research to develop expertise in several NASA-relevant research disciplines
3. Expand K-12 educator competence in space sciences to provide them the necessary tools to conduct investigations in the classroom
4. Distribute scholarships and fellowships to North Dakota undergraduate and graduate students in STEM fields with an emphasis on female and American Indian student support
5. Conduct public service projects that engage and educate the North Dakota citizenry of NASA's mission and activities.

Part II: To fulfill these goals, the NDSGC will focus on the five programmatic areas as defined by NASA: NASA Internships, Fellowships, and Scholarships (NIFS), Higher Education (HE), Research Infrastructure (RI), Pre-college (P-C), and Informal Education (IE). Through unique NDSGC initiatives, the consortium will focus on alignment with NASA Education Outcomes. The following goals will guide the actions of the NDSGC from 2015-2018.

Management Goals: To accomplish the program goals below, the Consortium will take the following actions to improve its management effectiveness, which will allow it to fulfill its mission.

1. Promote current Coordinator to Deputy Director by August 1, 2015. The Deputy Director will be primarily responsible for: assisting in Director tasks, program development, implementation, and assessment; maintaining working relationships with the affiliates, state, and local agencies; higher education programming; increasing the social media presence of the NDSGC; conducting pre-service and in-service teacher workshops; and APD and OEPM reporting.
2. Hire a new Coordinator who will begin working by August 1, 2015, to significantly increase the impact of Space Grant statewide. The Coordinator will be primarily responsible for: assisting in Deputy Director tasks, informal education programming, pre-college programming, expanding the NDSGC affiliate network, organizing the Annual Affiliates Meeting, compiling data for the NDSGC annual newsletter: *The Aurora*, and taking queries from students, faculty, and the general public.

3. Continue to encourage affiliates to become more directly involved in NDSGC programs, which includes both faculty and student participation. By the end of the three year proposal period, the NDSGC aims to have at least one additional consortium representative at each affiliate institution.
4. Continually improve the contents of the NDSGC website (<http://ndspacegrant.und.edu/>), with an emphasis on the increasingly competitive applications for all areas of funding.

NASA Internships, Fellowships, and Scholarships (NIFS)

1. Send qualified North Dakota undergraduate and graduate students to participate in internship programs at NASA centers. Student placement at NASA centers for a 10-week (summer) or 15-week (semester) research experience is an excellent way to match students directly with NASA researchers and to work on flight hardware and mission science. Participation in NASA center internships is also a way for graduating students to be placed in jobs directly with NASA, which supports NASA's workforce development goals. (*Outcome 1.2*)
2. Provide qualified North Dakota undergraduate and graduate students with fellowship opportunities that encourage their completion of STEM degrees and employment in the STEM workforce. The NDSGC will provide no more than two semesters of fellowship funding to one individual in order to keep the opportunity available to other North Dakota students interested in completing STEM- or NASA-relevant research. (*Outcome 1.2*)
3. Increase female pursuit of STEM degrees at North Dakota's colleges and universities by providing 51% of the Consortium's annual NIFS funding to female college students.¹
 - a. Specifically addressed through the annual award of the Lillian Goettler and Pearl I. Young Scholarships to female students in STEM at NDSU and UND, respectively.
4. Increase underrepresented minority pursuit of STEM degrees at North Dakota's colleges and universities by providing 10.5% of the Consortium's annual NIFS funding to American Indian, Black, and Hispanic college students.²
 - a. Specifically addressed through the annual award of American Indian Scholarships to students attending one of the five Tribal Colleges and committed to the pursuit of a four-year degree at UND or NDSU.
 - b. A new initiative of the NDSGC includes the implementation of a *Community College and Tribal College Bridge Program*, which will fall under the NDSGC fellowships. This program will provide the opportunity for students transferring from ND affiliate two-year colleges to UND or NDSU to complete a NASA-relevant summer research project under the advisement of

¹ http://nces.ed.gov/programs/digest/d13/tables/dt13_304.30.asp?current=yes

² http://nces.ed.gov/programs/digest/d12/tables/dt12_265.asp

UND or NDSU faculty prior to enrollment. Collaborations will also be in place between the student's two-year college faculty as well as NDSU/UND faculty in project development. This program's objective is to increase the retention of transfer students in STEM, a student population at significant risk for attrition in a STEM field, especially first-generation students. This will also give students hands-on experience in research relevant to their area of study and better help them transition from the more close-knit college environment to that of a research university. The application and selection process for these awards will be the same as the NDSGC fellowship program, yet faculty at Tribal College and Community College affiliate institutions will be consulted for potential student participant. (*Outcome 1.2*)

Higher Education (HE)

1. Provide funding for the High-Altitude Student Payload (HASP). HASP is an advanced high-altitude national ballooning program where space instrumentation can be initially tested and validated prior to flight on suborbital or orbital rockets. Participating faculty and students receive real-world experience and training in designing, building, and flying space instrumentation. (*Outcome 1.2, 1.3*)
<http://laspace.lsu.edu/hasp/>
2. Provide funding for the NASA Student Launch Competition. This is a NASA-sponsored student rocket competition where teams must design and build a rocket that will achieve an altitude as close to one mile as possible. This program provides design, engineering, and team-building experiences that increase the in-state engineering and mission operations expertise of students and faculty. (*Outcome 1.2, 1.3*)
<http://www.nasa.gov/audience/forstudents/studentlaunch/home/>
3. Provide funding for the NASA Robotics Mining Competition. This competition is for "university-level students to design and build a mining robot that can traverse the simulated Martian chaotic terrain, excavate Martian regolith and deposit the regolith into a Collector Bin within 10 minutes." (*Outcome 1.2, 1.3*)
<http://www.nasa.gov/offices/education/centers/kennedy/technology/nasarmc.html>
4. Provide funding for the NASA Rover Challenge. The challenge focuses on designing, constructing and testing technologies for mobility devices to perform in different lunar and planetary environments, and it provides valuable experiences that engage students in the technologies and concepts that will be needed in future exploration missions (*Outcome 1.2, 1.3*)
<http://www.nasa.gov/roverchallenge/home/#.VNM4OWjF-So>
5. Provide funding for the AIAA Design/Build/Fly Competition. "Student teams will design, fabricate, and demonstrate the flight capabilities of an unmanned, electric powered, radio controlled aircraft which can best meet the specified mission profile." (*Outcome 1.2, 1.3*) <http://www.aiaadbf.org/>

6. Provide Space Studies graduate students at UND with Graduate Research Assistantship (GRA) funding to conduct NASA-relevant research. The UND Department of Space Studies is the nexus of various disciplines of space research in North Dakota and provides diverse and advanced opportunities in NASA-relevant areas of science and engineering. Funded students are expected to conduct research and graduate with a publishable M.S. thesis.
<http://www.space.edu>.
7. A new initiative of the NDSGC for FY15 is to implement a *STEM Ambassador Program* for undergraduate and graduate students in a STEM field (or education with a STEM emphasis) who will devote time each semester to participate in NDSGC public service or pre-college events like high-altitude balloon launches, space camps, classroom visits, and community outreach. The student work will be minimal in comparison to Graduate Research Assistants or fellowship recipients, but the impact to the surrounding community and to the participating college students will be great. Students will be able to improve communication skills (a valued talent especially in STEM fields) and inspire the next generation of scientists and engineers. This program also has the potential to serve as an indicator of student success as a future GRA or fellowship recipient. (*Outcome 1.3, 2.4*)
8. The NDSGC will support undergraduate and graduate students at affiliate institutions completing NASA-relevant STEM research to travel to local, regional, and national conferences to present research findings. Through travel grants, students are not only able to share their research with others in the STEM community, but also to network with others in their field. (*Outcome 1.2*)
9. The NDSGC will support Summer Faculty Fellowships (SFF), which are given to faculty members who wish to revise or create a college-level course that is NASA-, STEM-, or space-relevant. Research in these same fields that supports improved STEM education for students at that faculty member's institution is also permissible. (*Outcome 1.1, 2.3*)
10. Increase North Dakota K-12 teacher knowledge and competence in NASA- and space-relevant educational content while providing K-12 students with authentic NASA-relevant educational experiences through pre-service workshops conducted by the NDSGC. (*Outcome 2.1*)
11. A new initiative of the NDSGC is to implement an annual in-service teacher workshop titled, "NASA in the Classroom," including NASA-relevant hands-on investigations and NGSS alignment. The NDSGC will conduct the workshop at a different location each year to encourage attendance by teachers who may live in more rural communities or Tribal communities. The changing location will increase affiliate involvement and invite different professors to conduct sessions

within the workshop, bringing in collaborations across STEM disciplines.
(*Outcome 2.2*)

Research Infrastructure

1. Provide funding to affiliate faculty and their students for scientifically sound proposals to complete NASA-relevant Research Focus Area (RFA) projects that lead to long-term, self-sustaining, collaborative research endeavors in North Dakota. This program aims to match affiliate faculty directly with NASA researchers to develop research projects that can be implemented by the faculty in North Dakota. The long-term goals of this program are to increase faculty expertise in NASA-relevant research and to assist the faculty in developing independent, self-sustaining research programs. The five RFAs are: 1) astronomical/planetary science research, 2) planetary space suit research, 3) Earth sciences research, 4) materials sciences research, and 5) small satellite design, development, and construction. These were defined by the NDSGC through alignment with NASA's strategic goals and objectives. (*Outcome 1.1, 1.2, 1.5*)
2. The NDSGC will fund the UND Human Space Flight Laboratory (HSFL), contingent upon continued success in research and faculty mentorship. This includes the Spacesuit Laboratory, Spacecraft Simulators, Lunar/Mars Analog Habitat, and Pressurized Electric Rover. All aspects of the HSFL include student research and hands-on experiential opportunities for both graduate and undergraduate students. This program has expanded partnerships with multiple NASA centers in research collaborations in recent years and gives students unique opportunities not offered at any other universities. For example, in 2013 and 2014, a 10-day and 30-day mission were conducted, respectively, with three graduate students living in a confined environment as crewmembers while other students performed the duties of mission control. (*Outcome 1.1, 1.2, 1.3, 1.5*)
3. The NDSGC will fund the growing high-altitude ballooning (HAB) program and the hands-on opportunities that result in undergraduate and graduate student research.. Students are trained in tracking, launch, and chase procedures after designing and building their very own payloads. This has thus far mainly involved faculty and students at UND, but plans are to expand this program further, to involve more affiliates, and give other students the opportunity to experience STEM research in a near-space environment, first-hand. (*Outcome 1.1, 1.2, 1.3, 1.5*)

Pre-college

1. The NDSGC will fund high school team participation in the annual *For Inspiration and Recognition of Science and Technology (FIRST) Robotics Competition*. This competition challenges students to design and build their own robot to creatively complete a certain set of tasks and perform these tasks at regional and/or national competitions. The FIRST Robotics competition consistently attracts the interest and help of student families and community

members (e.g. local engineers or mechanics) and these individuals become mentors to the students as a part of their participation in the competition. (*Outcome 2.4*)

2. The NDSGC will fund high-altitude ballooning (HAB) endeavors with a focus on middle school and high school students. Graduate students, undergraduates, and faculty members have served as mentors to 8th grade students for entire grade-wide “Mega-launches” (three have occurred thus far in the previous proposal period) and the NDSGC aims to expand this effort to involve more school districts from across the state. (*Outcome 2.4*)
3. The NDSGC will support the Near-Space Balloon Competition (NSBC), in which middle and high school teams design, build, and fly their very own science and engineering payloads aboard a high-altitude balloon launched by the college-level mentors. This initiative follows a NASA Project Life Cycle methodology of proposals and design reviews to give students a unique hands-on experience in a STEM field. NSBC regularly attracts the attention and involvement of local communities as well, as this statewide competition with NASA goals is an exciting opportunity for many rural North Dakota students. (*Outcome 2.4*)
4. A new NDSGC initiative includes the implementation of a Space Grant led “Space Camp.” This camp will include Aerospace labs tours at UND, NASA-relevant and hands-on investigations, and small-scale STEM competitions. If successful in FY15, and funds are available in subsequent years, the program will expand to include a high school level opportunity, and a camp focused solely on K-12 female students. (*Outcome 2.4*)

Informal Education

1. NASA in North Dakota – Develop a state-wide public service program to educate students, teachers, and the general public about NASA’s Science Mission Directorate (SMD) missions to explore and study the solar system and universe. The new Coordinator position and *STEM Ambassadors* program will be essential to success in outreach events across the state. (*Outcome 3.1, 3.3*)

Through each of the aforementioned programs, the NDSGC will highly encourage the participation of female and underrepresented minority students, faculty, teachers, and the general public. This diversity consideration is included in each of the SMART (specific, measurable, attainable, realistic, and timely) Objectives listed in the following table.

**Note this is a duplicate table of Appendix Item #2 as requested in the 2015-2018 proposal solicitation.*

Summary Table of SMART Objectives

Program	Verb	Metric	Population	Object	Goal	Timeframe
NIFS	Fund	NIFS awarded	College students	Females	51%	Annually
NIFS	Fund	NIFS awarded	College Students	Underrep. Minorities in STEM	10.5%	Annually
HE	Fund	GRAs funded	UND SpSt Graduate Students	UND SpSt Graduate Students	3	Annually
HE	Involve	# Involved in NASA student competitions	Affiliate Institutions	≥ 1 team from non-research Institutions	5	Annually
HE	Fund	# of SFF awarded	Affiliate Institution Faculty	Non-research Institutions Faculty	5 (2)	FY15 (FY16, FY17)
HE	Provide	# of students attending pre-service workshops	College students	Education students at affiliate colleges	200	Annually
HE	Fund	# of STEM Ambassadors	College Students	STEM passionate college students	8 (5)	FY15 (FY16, FY17)
HE	Provide	# of teachers at in-service workshop	In-service teachers	In-service teachers	15	Annually
HE	Fund	# of travel grants	College students	≥ 1 from non-research affiliate institution	5 (3)	FY15 (FY16, FY17)
RI	Participate	# of RFAs funded	Affiliate Institutions	Faculty, Students	3	3 years
RI	Participate	# HSFL activities funded	Non-research affiliate colleges	Faculty, Students	1	FY15
P-C	Participate	# of HAB “mega-launches”	8 th grade classes	Rural or Tribal community school	3	3 years
P-C	Participate	# of classroom visits	K-12 classrooms	Rural or Tribal community school	3	3 years
P-C	Fund	# of FIRST Robotics Teams	High School students	Rural or Tribal community school	5	Annually
P-C	Participate	# of NSBC teams	Students grades 6-12	Rural or Tribal community schools	6	Annually
P-C	Participate	# of Space Camp attendees	Students grades K-8	Rural or Tribal community students	15	FY15
IE	Participate	# of participants at outreach events	ND general public	Especially rural and Tribal community	1000	Annually