

North Dakota Space Grant Consortium
University of North Dakota
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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 North Dakota Space Grant Consortium is a Capability Enhancement Consortium funded at a base level of \$430,000 for fiscal year 2012.

PROGRAM GOALS

North Dakota Space Grant stated the following goals in its FY 2012 proposal and budget:

1. Fund five research proposals worth up to a total of \$50,000 from non-research affiliate institutions. Five Research Focus Areas (RFAs) have been defined (astronomy/planetary science research, planetary space suit research, Earth science research, materials science research and small satellite design and development) but meritorious, NASA-relevant projects in other areas may also be approved;
2. Fund six Summer Faculty Fellowships, each worth \$5,000, that allow faculty to revise or create a NASA-relevant STEM course;
3. Provide partial or full funding for up to four North Dakota students to attend NASA Space Centers for summer internships for a total of \$25,000 plus travel;
4. Provide travel funding of \$10,000 to support North Dakota BalloonSat and HASP participants;
5. Provide funding for up to six FIRST Robotics teams to attend regional or national competitions for a total of \$25,000;
6. Provide \$2,000 in funding for travel to present pre-service workshops at affiliate colleges around the state.
7. Base funding for scholarships/fellowships will provide \$130,000 to undergraduate and graduate students from across North Dakota. All

applications will be submitted through the Consortium website and evaluated for eligibility. Fellowships per semester are now \$3,500 for undergraduate students, \$4,500 for masters students and \$6,000 for Ph.D. students and can be awarded to the same student up to two semesters. Students must submit a NASA-relevant research proposal that includes collaboration and oversight with a faculty mentor. Scholarship amounts will be determined based on recommendations of each affiliate college but it is expected that all amounts will be less than \$5,000 per student.

Below is the percentage of students who have taken their next step and have been successfully tracked through their next step versus last year of Space Grant support:

50% for 2006

60% for 2007

96% for 2008

90% for 2009

100% for 2010

100% for 2011

n/a for 2012- all participants still enrolled.

83% for 2006-2012

91% of students significantly supported went onto next steps in STEM disciplines.

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

For FY 2012, Space Grant provided a total of thirteen (13) research fellowships and one hundred and nine (109) scholarships in North Dakota.

Aligning with NASA education Outcome 1, Special American Indian Scholarships of \$2,500 each were awarded at each of the five tribal colleges in the state. These scholarships are given to exceptional students who plan to transfer to a four year college in North Dakota after receiving their associate degrees at their respective tribal college. This past fiscal year, through prudent budgeting, we were able to increase the overall scholarship money available by \$1,500 to each of the five tribal colleges. This resulted in an additional \$7,500 allocation to the tribal colleges for scholarships.

Aligning with NASA education Outcome 3, the North Dakota Historical Society is an affiliate of Space Grant. Planning is continuing for Space Grant to be involved in developing displays for the new "Modern Era" gallery at the Heritage Center which will open in the fall of 2013. Space Grant will provide expertise and funding for a display of a replica of the NDX-1 space suit developed at the University of North Dakota (UND).

Aligning with NASA education Outcome 1, Space Grant continues to provide funding for SPACE.EDU, a master's degree program in Space Studies, and a newly started doctoral program in Aerospace Sciences at UND. Each of these is offered on campus and via distance education. Enrollment has continued to grow in the master's degree program, and the 2012-2013 school year is the first year of the doctoral program, and we already have more applicants for next school year. The investments made by Space Grant in this effort are paying off exceptionally well.

PROGRAM ACCOMPLISHMENTS

Outcome 1 programs

Undergraduate scholarships/fellowships: The North Dakota Space Grant Consortium (NDSGC) provided 109 undergraduate scholarships to our affiliate institutions. Fifty-three (53) were given to male students and fifty-six (56) were given to female students. Thirty-six (36) of those students were American Indian. Any scholarship of \$2,500 or more is considered to be “significant” by the NDSGC. A total of nine (9) scholarships were significant with five (5) being given to American Indians and five (5) being given to female students.

“The NASA Space Grant helped me throughout school to become involved in many issues surrounding our area. I consider myself fortunate to be able to participate in various ways of finding the problems and hopes of future solutions. Getting involved is the first step!” (Submitted by Ann Solano, Sitting Bull College, scholarship recipient in 2012)

“The grant I received has been a great help for me. I am a mother of 3 boys: 14, 12, and 9 and also working almost full time. With the grant money it helped cover my tuition so I could cut back on my hours at work and spend more time on my studies and with my boys. The grant has helped me very much in getting one step closer to my goal of finishing college and becoming a nurse.” (Submitted by Amber Gill, Sitting Bull College, scholarship recipient in 2012)

In addition, thirteen (13) research fellowships were given to students at the University of North Dakota and North Dakota State University. Nine (9) of those students were male and four (4) were female. One (1) of these students is American Indian. Any fellowship of \$2,500 or more is considered “significant” by the NDSGC. All (13) of these research fellowships were significant awards. Ten (10) of the students were at the graduate level and three (3) were undergraduates.

Research Focus Area (RFA) Projects: (Several of these projects were approved in FY 2011 but the research and funding continued into FY 2012.)

Dr. Santhosh Seelan and Alex Nikle of UND, received continued RFA funding for their project titled, “UAS Based Remote Sensing for Precision Agriculture.” This project works with farmers in the region to detect changes in the agricultural fields due to damage caused by insects, fungus, water, hail, wind, etc. Through the use of small unmanned aerial systems, this project aims to put the power of collecting remote sensing information immediately into the hands of farmers themselves, rather than depending on satellite data providers. Several experimental flights using CropCam, an unmanned aircraft, were conducted during the summer of 2012, and there are more flights scheduled for the summer of 2013, using another small aircraft called Telemaster.

Dr. Ghodrat Karami of North Dakota State University (NDSU) received RFA funding to continue the design of a “Human Powered Vehicle (HPV).” The group of students at NDSU Mechanical Engineering conducted conceptual design, implemented their design in drawings, selected materials, and manufactured and assembled the vehicle. They examined and challenged the vehicle under loading and in practice. The next stage of the job was the optimization and data collection during practice on the vehicle in order to be able to compete at the national level. The group attended the 2012 Human Powered Vehicle Challenge (HPVC) competition sponsored by ASME. This team of students will also be attending the NASA Great Moonbuggy Race in Huntsville to compete with their improved design.

Dr. Kerry Hartman of the Fort Berthold Community College, an institution tribally chartered by the Three Affiliated Tribes of the Mandan, Hidasta and Arikara Nations, received continued RFA funding for the project “Utilizing Remote Sensing to Investigate the Surface Impacts of Oil Development on the Fort Berthold Indian Reservation.” Student interest in the first RFA project of 2011 was so high that the faculty advisor applied for funding for a second RFA project so that the students could continue with the research. The project which involves students from the college and USGS scientists from EROS Data Center, aims to create a baseline database of information regarding the environmental impacts of surface activities of oil development on the Fort Berthold Indian Reservation. This research has been extremely successful at getting students at Fort Berthold Community College interested in hands-on STEM initiatives.

Dr. Ronald Fevig of UND received RFA funding for the “North Dakota Inter-Institutional Space Robotics Program.” This funding provided start-up money to initiate a small spacecraft development program that is supporting the design, build, delivery, and operation of a CubeSat small satellite. This past year a team of students made progress toward designing and building an engineering prototype for a small satellite to fly on a high-altitude balloon in order to test the mission concept for the eventual CubeSat mission. Another team of students is developing the CubeSat mission architecture, and plans to finish the Preliminary Design Review for this small satellite in spring 2013.

Continued RFA funding was given to Dr. Mijia Yang from NDSU to study “Real Time In-situ Impact and Damage Identification in Aerospace Materials and Structures through Fiber Optic Sensors.” Polymer-matric and ceramic-matric composites have been increasingly used in aerospace structures such as the new Boeing 787 and the Airbus A380. These materials are lightweight with high stiffness and strength. However, they are easily damaged by the impact of flying objects due to their layered configuration. This proposal is working to develop a damage locating and growth monitoring system (structural health monitoring) which will be capable of acquiring and analyzing data in real-time in-situ fashion and indicating the damage status.

Dr. Yail Kim from NDSU was given continued RFA funding to study “An Intelligent Composite Material System for Real-time Stress Alleviation in Aircraft Structures.” Composite materials are widely accepted by the aircraft community. Despite the benefits of those new lightweight materials, composite elements need particular attention because

delamination and local failure usually govern their service life. Study was made of adequate and timely technical action to improve the longevity of structure members. Because Dr. Kim has since left NDSU, this project was terminated early, and the remaining funding will be used for future RFAs.

Dr. Mark Guy and Dr. Tim Young of UND received RFA funding for their project titled, "Exploring New Technology Tools to Enhance Astronomy Teaching and Learning in Grades 3-8 Classrooms." Due to K-12 students' declining performance in science understanding, these researchers are utilizing both a traveling GeoDome (inflatable planetarium) and Apple iPad tablets to aid in teaching abstract astronomy concepts interactively to elementary students. The unique aspect of this program is that the teachers teach their classrooms, rather than a trained astronomer, as is the case with most planetariums. Teachers participate in a workshop to develop their own two-week lesson plans which include a student-created final project using their iPads to communicate their learning. Participation in the project is increasing, and several revisions and improvements are being made for future iterations.

Dr. Wayne Barkhouse of UND received RFA funding for his project titled, "Quantifying Dark Energy Using Galaxy Clusters." This project is aimed at optimizing software tools for the detection and characterization of galaxy clusters. By minimizing the false-positive detection of galaxy clusters as a function of redshift and mass, their abundance can be used to map out the expansion history of the Universe and place important constraints on dark energy and its possible evolution.

Summer Faculty Fellowships: Three (3) summer faculty fellowships given for faculty to create or improve an existing higher education course in STEM were funded during the summer of 2012. Faculty were from the Mayville State University, North Dakota State College of Science, and Valley City University. Courses improved included an education course on Secondary Methods for Science, a series of Chemistry courses, and a course on Environmental Geology and Earth Science.

Graduate Research Assistantship/Tuition Waivers: Space Grant funded four (4) M.S. students in Space Studies with Graduate Research Assistantships for FY 2012. Each of these students attended the University of North Dakota, and two (2) were female. None were minorities. One (1) of these students was funded to assist with the operations and maintenance of the UND Observatory. Two (2) of these students have used this funding to develop their theses in solar research and educational practices in STEM-related competitions, respectively.

Five (5) M.S. students in Space Studies received tuition waivers for the 2012-2013 school year, for a total of 61 credits. Two (2) of these students were female, and one (1) student was American Indian.

"For the past two years, I have been involved with high altitude ballooning, an educational, fun, and rewarding activity. I had no experience with balloons before, and North Dakota Space Grant gave me this opportunity. I plan to go into education and

share my experience with other students.” (Submitted by Marissa Saad, University of North Dakota, Graduate Research Assistantship recipient in 2012).

Space Grant Sponsored Travel and Research:

Space grant provided travel stipends for five (5) students whose papers or posters were accepted at regional or national conferences for presentation.

Space Grant funding was made available to the Lunabotics program, the High Altitude Student Payload (HASP) project, the Undergraduate Student Launch Initiative (USLI), and the North Dakota High Altitude Balloon activities. The last listed was previously called *BallonSat*, but is now called the Near-Space Balloon Competition (NSBC). Support continues for the Human Spaceflight Laboratory and the Spaceflight Simulator Facility at UND.

NASA Space Center Internships: The NDSGC also supported seven (7) students for internships at NASA Space Centers. Six (6) of these students were male. Four (4) were graduate students and three (3) were undergraduate students. One (1) student was a minority. Six (6) of the awards for internships were considered “significant” as one was partial funding.

“My summer internship at the Jet Propulsion Lab was probably the best learning experience I have ever had. The opportunity to work on the next generation of space exploration rovers exposed me to an entirely new approach to engineering. It was truly cutting edge research with the most brilliant and driven people I have ever met who taught me how to solve design problems that had never been encountered before. My experience at JPL showed me firsthand the extraordinary achievements that we are capable of through science and engineering and I am sincerely grateful for being given the chance to participate!” (Submitted by Paul Johnson, North Dakota State University, internship recipient in 2012)

Outcome 2 programs

FIRST Robotics: Two teams from North Dakota high schools were supported for regional competitions in FY 2012. Those teams were from Cando and Northwood/Hatton. While none of our teams qualified for the national competition they each did very well at the regionals.

Pre-Service Workshops: Space Grant conducted pre-service workshops for 80 soon-to-be student teachers at the University of North Dakota, Valley City State University, and Mayville State University. The reason that this number has decreased significantly from last year is due to the Deputy Director of the NDSGC having broken her hip in the fall of 2012, so she was out of work during the time period when most of the pre-service workshops are normally conducted.

Near-Space Balloon Competition: In 2012, Space Grant sponsored the Near-Space Balloon Competition for students grades 6-12 in North Dakota. Four teams competed,

developing scientific payloads at their respective schools, and payloads were launched attached to the high-altitude balloon at the end of the school year. The winning team measured temperature, relative humidity, solar panel voltage, and dew point at different altitudes while concurrently taking pictures, and received a trip to UND School of Aerospace Sciences to tour aviation and space facilities.

STEM Center Visit: A new middle school (*STEM Center*) focused primarily on STEM education, opened recently in West Fargo, and Space Grant is currently working to build collaborations with the school. The STEM Center is aimed at helping students to use creativity and innovation to inspire problem solving using the Engineering Design Process, and to communicate their ideas effectively. One hundred (100) STEM Center students visited the UND School of Aerospace Sciences in February 2012 to tour Aviation and Space Studies facilities. These students are also designing their own payloads to be launched on a high-altitude balloon in the spring of 2013. This will be the first Space Grant sponsored launch focused on a single school, with the end-goal of giving these teachers the tools to be able to eventually conduct regular launches themselves.

Outcome 3 programs

North Dakota Historical Society: Space Grant is providing funding for the Heritage Center (the state's official museum) to develop educational trunks that will be available for K-8 classrooms across the state. The trunk topics center on aurorae, meteorites and direct connections between North Dakota and NASA. The trunks are stocked with objects that can be handled by students and have been sent to classrooms for the first time this school year. The Heritage Center has expanded this project to include stand-alone space themed displays that can be taken to conferences, shopping centers, etc. Next on the agenda for the Heritage Center and Space Grant is the development of permanent space science displays for the "Modern Era" gallery in the new addition to the Heritage Center.

Space Science Presentations to Young People: During FY 2012, Space Grant sponsored speakers (Space Studies faculty and graduate students) to numerous elementary and middle school schools in the Grand Forks school district. Presentations were also given at a summer space camp. Space Grant frequently gave tours and presentations to school groups who came to UND to visit the Human Spaceflight Laboratory and the Spaceflight Simulator Facility (both of which are funded by Space Grant).

Mars Curiosity Landing: To celebrate the landing of Mars Curiosity in 2012, Space Grant sponsored an outreach event open to the public at UND which involved talks by Space Studies faculty and graduate students, distance-scale solar system models to demonstrate the trajectory and overall distance traveled by Curiosity, and of course viewing of the actual landing. The UND NDX-1 Space Suit was also on display. Sixty (60) people attended the event.

Venus Transit: At the UND Observatory in June of 2012, an outreach event was organized that was open to the public to view the Transit of Venus. Over three hundred

(300) people participated in telescope viewing, a distance-scale tour of the Solar System, space arts and crafts, and tours of the equipment and facilities. It was one of the biggest single outreach events sponsored by Space Grant, and involved Space Studies graduate students and faculty in planning and implementation. The event also increased public awareness of North Dakota's STEM research capabilities.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- Student Data and Longitudinal Tracking: Total awards = 128; Fellowship/Scholarship = 121; Higher Education/Research Infrastructure = 7; 38 of the total awards represent underrepresented minority funding.

Student Data and Longitudinal Tracking: Total "significant" awards of \$2500 or more= 29, Fellowships= 13, Scholarships= 9; Higher Education/Research Infrastructure= 7. During FY 2012, 7 of the total "significant" awards represent underrepresented minority F/S funding.

During FY2012 program year, 11 students are pursuing advanced degrees in STEM disciplines, 8 accepted STEM positions in industry, 1 accepted a STEM position in academia, and 4 went on to positions in non-STEM disciplines. The remaining students have not yet received the degree that they were pursuing while they received their Space Grant award.

- Diversity: The North Dakota Space Grant Consortium is composed of nineteen (19) affiliates. Of those affiliates, five are tribal colleges. They are Turtle Mountain Community College, Cankdeska Cikana Community College, Fort Berthold Community College, United Tribes Technical College, and Sitting Bull College. All of the tribal colleges are two year colleges although some of them do provide bachelor's degrees in a few specialized areas. The majority of our affiliate contacts at both tribal and non-tribal colleges are female. Of the one-hundred and nine (109) scholarships given last year, fifty-six (56) were awarded to female students and thirty-six (36) were awarded to American Indians. Of the thirteen (13) fellowships given, four (4) went to females and one (1) went to a minority.
- Minority-Serving Institutions: Five tribal colleges in North Dakota are affiliates of the North Dakota Space Grant Consortium. Each college participates in our scholarship program and has been of great assistance in finding applicants/recipients for the special American Indian Scholarships that were developed by Space Grant. Representatives from the tribal colleges are regular and contributing attendees at our annual meeting when we set priorities for the coming year. A faculty member at Fort Berthold Community College (FBCC) was the recipient of funding for a second Research Focus Area from Space Grant. He and his students are using remote sensing data to study the effects of oil development on the Fort Berthold Indian Reservation. We hope that this will serve as an example to other affiliates that are non-research institutions that they too can do research that is of a practical nature and of interest to NASA and can be funded by Space Grant.

- NASA Education Priorities: College students in North Dakota were involved in hands on experiences in science and engineering through the NDX-1 and NDX-2 projects, HASP, NSBC, Lunabotics, Near Space Recovery Project, and USLI. High school and middle school students were involved in hands-on experiences in science and engineering through rocketry, FIRST Robotics, and NSBC as well.

Through the revitalization of the NSBC program more teachers (and students) in North Dakota are being involved in science and engineering enhancement capabilities.

Space Grant is pleased that all five tribal colleges in the state are affiliate partners of Space Grant. Each tribal college participates at an activity level with which it feels comfortable. Space Grant is proud that it has a diversity of colleges and a diversity of faculty and student participants in its projects. (See Program Contributions in previous section.)

Two of the Research Focus Area Projects funded this year by Space Grant involve aeronautics research. Those projects are at NDSU, an affiliate of Space Grant.

Space Grant is continuing to involve its scholarship recipients in more active involvement in science using the Integrated Scholarships developed with and awarded at Lake Region State College as a model.

IMPROVEMENTS MADE IN THE PAST YEAR

Our annual meeting was held in May and was well attended. Presentations were given by both faculty and students who received funding for RFAs, fellowships, or internships. The 2012 meeting was held in Grand Forks, and affiliates were given a tour of the UND Aerospace facilities, including the Human Spaceflight Laboratory and the Spaceflight Simulator Facility (both of which are funded by Space Grant). It was the first time that the meeting was held outside of Bismarck, and we have decided to rotate the location of the meeting each year to be held at various affiliate institutions to allow affiliates to be more involved in Space Grant, and to show off this unique facilities. This year's May meeting will be held at the Dakota College at Bottineau.

Continued emphasis was put on funding research projects beyond the UND Observatory and the Human Spaceflight Laboratory. Both have been very successful so Space Grant continues efforts to enhance through funding, the development of ballooning and small satellite technologies and subsequent research projects.

Our ballooning program was revitalized by the willingness of graduate students in the Department of Space Studies at UND to serve as trackers after balloon launches. The enthusiasm of this new group of graduate students is making it possible for the continuation of the Near-Space Balloon Competition and for multiple HASP launches each year.

A partnership with the local *Space Aliens* restaurant chain was established, and UND Space Studies graduate students completed monthly outreach events coinciding with the restaurant's "Kids Night." Space Grant funded students designed educational activities for children to complete while waiting for their meals, and allowed children and their families to look through a telescope as well. Space Grant also provided educational materials to be handed out at each event, serving an average of seventy (70) children and their families at each of the nine (9) events. *Space Aliens* closed at the end of 2012, so new possibilities are being explored to continue these activities.

One summer student fellowship was awarded at UND to develop a lab curriculum for Space Studies 200, and to make this available to other colleges throughout North Dakota as a template for their labs, or to serve as their lab curriculum as well. These lab activities were designed to require minimal equipment, which would reduce the cost to each school and encourage participation in the course. These labs are currently being used at UND and Dakota College at Bottineau, as the lecture portion of the course is being broadcast via IVN (Interactive Video Network). Plans are to expand Space Studies 200 via IVN to more and more campuses in North Dakota over the coming years.

Space Grant's newsletter, *The Aurora*, highlights each of these activities.
<http://ndspacegrant.und.edu/uploads/aurora/Aurora2013.pdf>

A Space Grant funded student designed a two-week observational astronomy curriculum as a part of her master's thesis at UND and taught this course to high school students in the spring of 2012. This course involved a tour of the UND School of Aerospace facilities as well as the UND Observatory, and taught students how to conduct astronomy research. As this was the first iteration of this course, improvements are currently being made to the curriculum and the hope is that in the coming years, this will be made available to educators throughout the state, and high school students will get a chance to use the UND Observatory for research, using the telescopes remotely.

The enthusiasm of new graduate students also allowed public Star Parties at the UND Observatory to become regularly scheduled events. In North Dakota, the weather generally permits these events to be conducted biweekly from May through October. Due to the organization of more specialized outreach events, the visibility of the UND Observatory is increasing, as is the attendance at each of these events.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

The Space Grant affiliate members in North Dakota helped develop our strategic plan. Throughout the academic year, affiliate members provide input as to what degree of involvement the respective colleges and universities will have in various projects. An annual meeting of all affiliate representatives is held each spring; at that time discussion is held as to possible new projects and programs that could be sponsored by Space Grant.

Institutions that comprise the North Dakota Space Grant Consortium include the following:

Bismarck State College—two year community college
Cankdeska Cikana Community College—tribal college at Spirit Lake Indian Reservation
Dakota College at Bottineau—two year community college
Dickinson State University—public four year college
Fort Berthold Community College—tribal college at Fort Berthold Indian Reservation
Gateway to Science Center—children’s science museum in Bismarck
Grand Forks Herald—regional, daily newspaper
Lake Region State College—two year community college
Mayville State University—public four year college
Minot State University—public four year college
North Dakota Heritage Center—state history museum in Bismarck
North Dakota State College of Science—two year technical college in Wahpeton
North Dakota State University—doctoral research university in Fargo
Sitting Bull College—tribal college at Standing Rock Indian Reservation
Turtle Mountain Community College—tribal college at Turtle Mountain Indian Reservation
United Tribes Technical College—tribal college in Bismarck supported by all four Indian Reservations in the state
University of North Dakota—doctoral research institution in Grand Forks
Valley City State University—public four year college
Williston State College—two year community college

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