

North Dakota Space Grant Consortium
University of North Dakota
Dr. Santhosh Seelan
701-777-2355
ndspacegrant.und.edu
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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 2013.

PROGRAM GOALS

North Dakota Space Grant stated the following goals in its 2010 base 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

100% for 2012

n/a for 2013- all participants still enrolled.

83% for 2006-2012

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

For FY 2012, Space Grant provided a total of eight (8) research fellowships and one hundred and fifty nine (159) 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 1, we were also able to increase the scholarship funding at each of our public two and four year affiliate institutions by \$3500, allowing for more direct funding for North Dakota students studying STEM disciplines.

Aligning with NASA education Outcome 3, work is continuing with the State Historical Society of North Dakota to bring NASA-relevant, student-built research equipment into a new exhibit. Space Grant is involved in developing displays for the new "Modern Era" gallery at the Heritage Center, a part of their expansion project which is scheduled to open later in 2014. Space Grant has provided expertise and funding for a display of a replica of the NDX-1 space suit developed at the University of North Dakota (UND), and

an Unmanned Aerial Vehicle (UAV) also used at UND, to aid farmers in detecting changes in their fields.

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. Support is given to the distance program via Space Grant. Enrollment has continued to grow in the master's degree program, with the 2012-2013 school year as the first year of the doctoral program, applicants in this program are increasing each year as well. The investments made by Space Grant in this effort are paying off exceptionally well, as can be seen by the summer 2013 NASA award for the Space Studies Department, the "Johnson Space Center Certificate of Appreciation," given for 25 years of outstanding leadership in university education in space studies, aerospace workforce development, and for accomplishments in interdisciplinary aerospace research.

PROGRAM ACCOMPLISHMENTS

Outcome 1 programs

Undergraduate scholarships/fellowships: The North Dakota Space Grant Consortium (NDSGC) provided 159 undergraduate scholarships to our affiliate institutions. Seventy eight (78) were given to male students and eighty one (81) were given to female students. Forty four (44) of those students were underrepresented minorities in STEM. Any scholarship of \$2,500 or more is considered to be "significant" by the NDSGC. A total of eight (8) scholarships were significant with six (6) being given to American Indians and six (6) being given to female students.

"My North Dakota Space Grant scholarship contributed to paying a part of my flight training, which allowed me to place more focus on my academics and career goal of becoming a Pilot." (Submitted by David Kim, University of North Dakota, continuing education scholarship recipient transfer from Lake Region State College in 2013)

In addition, eight (8) research fellowships were given to students at the University of North Dakota and North Dakota State University. Eight (8) of those students were male. One (1) of these students was an underrepresented minority in STEM. Any fellowship of \$2,500 or more is considered "significant" by the NDSGC. All (8) of these research fellowships were significant awards. Five (5) of the students were enrolled at the graduate level and three (3) were undergraduates.

Research Focus Area (RFA) Projects: (Some of these projects were approved in FY 2011 or FY2012 but the research and funding continued into FY 2013.)

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. This team of students attended the NASA Great Moonbuggy Race in Huntsville to compete with their improved design, and performed well. They had a 4th place finish out of 48 university teams and also received the College Rookie Award for the fastest course completion by a new race team.

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 an additional flight took place during the summer of 2013, using another small aircraft called Telemaster.

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, and has continued into FY2013.

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. In FY2012, 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 finished the Preliminary Design Review for this small satellite in 2013. Student and faculty work continued on this project through FY2013.

Dr. Wayne Barkhouse of UND received continued RFA funding through the summer of 2013 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.

Joseph Martinetti of United Tribes Technical College (UTTC) received RFA funding starting in the summer of 2013 for a project titled, “Watershed Impact Analysis Using AVIRIS and Field Data.” This research is working to create a procedure to monitor the environmental impacts that the recently expanding oilfield in Western North Dakota (one of the largest “oil booms” in US history) may have on the wetlands over the long term and on a large scale. Engaging students in field and laboratory research through a combination of AVIRIS (Airborne Visible/Infrared Imaging Spectrometer) data collection of the area of interest and greenhouse studies with mass spectrometer analysis of soil contaminants is currently taking place. Part of this project is has also complimented the development of a new course on remote sensing at UTTC as well.

Summer Faculty Fellowships: Seven (7) summer faculty fellowships were given in FY2013 for faculty at affiliate institutions to create or improve an existing higher education course in STEM fields. Faculty were from Dickinson State University, Dakota College at Bottineau, Minot State University, Lake Region State College, North Dakota State College of Science, United Tribes Technical College, and Valley City State University. Courses improved or newly developed included a freshman experience combining astronomy and mythology, undergraduate research in STEM, geology, chemistry, biology, planetary sciences, a new precision agriculture program, and advanced photogrammetry and remote sensing.

Graduate Research Assistantship/Tuition Waivers: Space Grant funded six (6) M.S. students in Space Studies with Graduate Research Assistantships for FY 2013. 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. Three (3) of these students have used this funding to aid in various practices in high-altitude ballooning, and two (2) of these students completed research on Near-Earth Object (NEO) operations.

Six (6) M.S. students in Space Studies received tuition waivers for the 2013-2014 school year, for a total of 37 credits. One (1) of these students was female.

“For the past two years, I have been able to work closely with the operation of high quality research telescopes at the UND Observatory. I was able to take skills I learned here and complete an internship in California conducting research on solar prominences, and then apply this knowledge to my master’s thesis. Space Grant provided funding that allowed me the hands-on experience I needed to gain expertise in operating telescope equipment and research in solar physics. I was also able to image a lot of pretty awesome deep space objects!” (Submitted by Jonathan Schiralli, University of North Dakota, Graduate Research Assistantship recipient in 2013).

Space Grant Sponsored Travel and Research:

Space grant provided travel stipends for seven (7) students whose papers or posters were accepted at regional or national conferences for presentation. These meetings included the Fall 2013 National Space Grant Meeting, Students for the Exploration and

Development of Space Conference, Lunar and Planetary Science Conference, Academic High Altitude Conference, and the Institute of Electrical and Electronics Engineers Conference.

Space Grant funding was also made available to the Lunabotics program, the High Altitude Student Payload (HASP) project, the Undergraduate Student Launch Initiative (USLI), the American Institute of Aeronautics and Astronautics, Design/Build/Fly student team competition, and the North Dakota High Altitude Ballooning activities. Support continues for the Human Spaceflight Laboratory and the Spaceflight Simulator Facility at UND.

NASA Space Center Internships: The NDSGC also supported four (4) students for internships at NASA Space Centers. Three (3) of these students were male. Two (2) were graduate students and two (2) were undergraduate students. All four (4) of the awards for internships were considered “significant.”

“My internship in the Microbiology Department at Johnson Space Center was invaluable, as I was able to work on projects involving the ISS, providing me with space life science experience and learning about many types of ongoing projects. I was also recently selected to participate in the Hawai’i Space Exploration Analog and Simulation (HI-SEAS) long duration Mars mission as a crewmember for four months starting in March 2014. As my long term goal is to become an astronaut one day, I attribute credit to Space Grant for being a significant part of this journey, funding my summer internship at JSC, which was a unique experience that I would recommend to anyone wanting to get into space life sciences.” (Submitted by Tiffany Swarmer, University of North Dakota, internship recipient in 2013)

Outcome 2 programs

FIRST Robotics: Three (3) teams from North Dakota high schools were supported for regional competitions in FY 2013. Those teams were from Cando, Northwood/Hatton, and a new team was supported this year from West Fargo. All of these teams performed very well at the regional competitions, and Space Grant will also support travel for one of the students from West Fargo who was invited to compete at the national competition later in 2014.

Pre-Service Workshops: Space Grant conducted pre-service workshops for two hundred thirty five (235) soon-to-be student teachers at the University of North Dakota, Valley City State University, Dakota College at Bottineau, North Dakota State University, and Turtle Mountain Community College. In-service workshops were also conducted for fifty (50) teachers in Rugby, ND, sessions led at the North Dakota Science Teachers Association Annual Meeting, and a two-day workshop focused on the Next Generation Science Standards and inquiry-based space science activities held at the University of North Dakota. These workshops included NASA resources and opportunities for students and teachers of K-12 classrooms and hands-on activities during the workshops.

Near-Space Balloon Competition: In 2013, Space Grant sponsored the second annual Near-Space Balloon Competition for students grades 6-12 in North Dakota. Three 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. In order to increase the participation of the Tribal communities in the state, this past year's launch took place from Four Winds Community High School in Fort Totten, ND. The winning team measured differences in bacterial growth in a near-space environment and ground samples, and received a trip to UND School of Aerospace Sciences to tour aviation and space facilities.

High Altitude Ballooning Middle School Initiative

In the fall of 2013, the entire 8th grade class of 126 students at Valley Middle School in Grand Forks participated in a high altitude balloon launch. The design of this launch had the same premise as the Near-Space Balloon Competition, but with the goal of significantly increasing participation in hands-on STEM initiatives. This initiative has expanded to include two other middle schools in Grand Forks, who are preparing their team payloads for launch in the spring of 2014.

Outcome 3 programs

Space Science Presentations to Young People: During FY 2013, Space Grant sponsored speakers (NDSGC coordinator, Space Studies faculty, both undergraduate and graduate students) to numerous elementary and middle school schools in the Grand Forks school district and across the state. Presentations were also given at two summer space camps. 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).

Community Events

A partnership with the Dakota Science Center in Grand Forks has been established and is invaluable in participation in community events such as science days at the Grand Forks Public Library, events at the local heritage center with hands-on activities for students, and other events throughout the area.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- Student Data and Longitudinal Tracking: Total awards = 178; Fellowship/Scholarship = 173; Higher Education/Research Infrastructure = 5; 44 of the total awards represent underrepresented minority funding.

Student Data and Longitudinal Tracking: Total "significant" awards of \$2500 or more = 27, Fellowships = 8, Scholarships = 8; Higher Education/Research Infrastructure = 11. During FY 2013, 7 of the total "significant" awards represent underrepresented minority F/S funding, and 10 of the total "significant" awards represent female F/S funding.

During FY2013 program year, seven (7) students have taken the next step in pursuing positions in STEM.

- 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 fifty nine (159) scholarships given in FY2013, eighty one (81) were given to female students, and forty four (44) of those students were underrepresented minorities in STEM. Any scholarship of \$2,500 or more is considered to be "significant" by the NDSGC. A total of eight (8) scholarships were significant with six (6) being given to American Indians and six (6) being given to female students. Of the eight (8) fellowships given, one (1) went to an underrepresented minority. Of the six (6) graduate research assistantships given, two (2) were given to females.
- 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 United Tribes Technical College received funding during FY2013 for a research project titled, "Watershed Impact Analysis Using AVIRIS and Field Data." This continues to exemplify that affiliates at non-research institutions can also complete research that is of a practical nature and of interest to NASA and can be funded by Space Grant. Increased participation of Turtle Mountain Community College through pre-service educator workshops also took place during FY2013.
- 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, Lunabotics, Near Space Recovery Project, AIAA Design/Build/Fly, general high altitude ballooning, 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. (In our base 2010 proposal goals, NSBC is referred to as *BalloonSat*.)

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.)

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 (LRSC) as a model. This includes two new scholarships during FY2013 for students who transferred from LRSC to UND to continue their education toward a four year degree in a STEM field.

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 2013 meeting was held at Dakota College at Bottineau (DCB), one of the affiliate institutions of Space Grant. This was an outcome of the decision 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 showcase their unique facilities. This included a tour of the greenhouses at DCB in 2013. This year's May meeting will be held in Bismarck at the Heritage Center.

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. The success of the Human Spaceflight Laboratory can be seen in the culmination of the research projects into an integrated system of NDX-2 space suits, inflatable lunar habitat, and pressurized electric rover during FY2013. In the fall of 2013, three UND graduate students lived inside the habitat for ten consecutive days as "astronauts" which ended as a successful initial test of the components, a precursor to a thirty day mission to take place later in 2014. The students recorded their experiences at <http://spacesuitlab.blogspot.com/>.

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. The most exciting improvement in high altitude ballooning this past year has been the involvement of entire 8th grade classes at local middle schools, with the plan of hopefully incorporating groups of these students to participate in next year's NSBC. The goal of this is to also expand these "mega-launches" outside of the Grand Forks area in years to come, especially through the summer 2014 Academic High Altitude Conference, which will be held at UND and include a workshop on high altitude ballooning for K-12 educators.

Space Grant's newsletter, *The Aurora*, highlights each of these activities.
http://webadmin.aero.und.edu/newsImgs/2014_aurora_2014-02-24_09-43-10-AM.pdf

There has been a significantly increased presence of Space Grant in K-12 classrooms. This has in part been as a result of in-service workshops at the North Dakota Science Teachers' Association Meeting, and speaking at the North Dakota Council of Math Teachers meeting. These classroom visits have expanded beyond the Grand Forks community and to other areas in the state. For example, a new partnership with the national Junior Achievement Program allowed for five sessions of economics-based lessons in a second grade classroom, all focused on NASA. Funding a third team for the FIRST Robotics competition this year was also an expansion on K-12 initiatives.

The NDSGC has also put a focus on affiliate engagement. Angie Bartholomay of Dakota College at Bottineau (DCB) accompanied the coordinator to a workshop in Orlando, FL put on by the Astronomical Society of the Pacific in the fall of 2013 on the Next Generation Science Standards and incorporating astronomy investigations into the classroom. They conducted an in-service workshop in March 2014 as an outcome of this. Pre-service and in-service workshops, and K-12 visits also occurred in partnership with DCB and Turtle Mountain Community College and the surrounding rural areas with a NASA Discovery Dome for two months in the fall of 2013. The newfound partnership with the Dakota Science Center for community events (like star public parties) is also being examined as adding a potential affiliate. During the 2014 annual affiliates meeting, up for discussion will also be the potential inclusion of private schools as affiliates.

The NDSGC now readily participates extensively in social media outlets, including Facebook and Twitter, and a group on LinkedIn. These are updated with opportunities for students, teachers, faculty, and the public both nationally and locally, and NASA-relevant news. As an outcome of the recent national Space Grant meeting, a focus has also been put on fostering "community" through social media. This is part of an effort to increase awareness of and participation in Space Grant sponsored events throughout the state. The coordinator has also been trained on maintaining the Space Grant website and continuously adds electronic resources for teachers as follow-ups to workshops to ensure that participants include these new activities in their classrooms.

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, the Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.