

South Dakota Space Grant Consortium
South Dakota School of Mines & Technology
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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 South Dakota Space Grant Consortium is a Capability Enhancement Consortium funded at a level of \$590,000 for fiscal year 2009.

PROGRAM GOALS

Consortium Management: To ensure quality and fairness in all Consortium programs and alignment with the needs of NASA, the member and affiliate organizations, and the state of South Dakota.

Fellowship/Scholarship: To administer a fellowship/scholarship program that offers educational and research opportunities to students from diverse backgrounds who are pursuing degrees in fields of science, technology, engineering, and mathematics (STEM) that align with NASA's mission and those of SDSGC members and affiliates.

Research Infrastructure: To promote the improvement of research programs and capabilities of Consortium members with an emphasis on the fields of aerospace, earth science, and supporting STEM disciplines.

Higher Education: To build interdisciplinary programs related to NASA's mission and goals at the state's institutions of higher education and to support related programs that serve to strengthen STEM education in South Dakota.

Diversity of Participants: To model diversity in all Consortium programs and activities, with an emphasis on Native Americans, which make up the state's largest minority group.

Workforce Development: To use the Consortium's statewide network of scientists, engineers, and educators to provide talented students with a pathway to careers that will contribute to a highly-trained and diverse workforce for NASA and expand the nation's research and development capacity.

Longitudinal Tracking: To acquire and maintain accurate longitudinal data on all students and faculty who have received significant support from SDSGC in order to assess the impact of the support on their education, career, and professional development.

Minority Serving Institutions: To ensure that Minority-Serving Institutions in South Dakota, which are exclusively Tribal Colleges and Universities, are represented in the planning and implementation of all Consortium programs.

Precollege: To increase student awareness and access to education and career opportunities in aerospace, earth science, and supporting STEM disciplines.

Public Service: To enhance public scientific literacy in aerospace and earth science, to complement community efforts in STEM education, and to inspire citizens of diverse backgrounds through the excitement of scientific exploration and discovery.

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

As an example of Outcome 1 impacts, “*Contribute to the development of the STEM workforce in disciplines needed to achieve NASA’s strategic goals,*” Michael Barth, a May 2009 Civil Engineering graduate of South Dakota School of Mines & Technology (SDSM&T) conducted a summer 2008 co-op at NASA Kennedy Space Center that led to full-time employment with NASA at Kennedy Space Center’s Facilities Division. Currently, Michael is a Project Manager and Lead Design Engineer on a number of facility and infrastructure projects. During FY2009, he worked on KSC’s “greenest building” called the “Propellants North Administrative and Maintenance Building” scheduled to open in December 2010.

Additional examples of Outcome 1 impacts include the following:

Adam Dell, FY2009 Space Grant Fellow and Interdisciplinary Science student at SDSM&T, was awarded the Leadership Award at the national American Indian Science and Engineering Society (AISES) Leadership Conference in Albuquerque, NM in February 2010. Dell is President of SDSM&T’s chapter of AISES. The Leadership Award recipient is selected from among the conference attendees and is awarded to an individual that has most demonstrated the qualities of a leader including communication skills, respect, integrity, vision, and goals.

Helene Gaddie, a Native American Space Grant undergraduate Fellow at Oglala Lakota College wrote to SDSGC during FY2009 and indicated that Space Grant helped fund her education and allowed her to purchase the scientific instruments necessary for field research required for her senior class research project titled “The Geology of Ghost Canyon.” Through her research, she learned the importance of GIS/GPS and other geospatial data, and learned the importance of satellite imagery in the field of geology. Helene presented her findings at the Rocky Mountain Geological Society of America conference in Rapid City in April 2010, as well as at the NSF JAM and AISES national conferences in 2009. Helene wrote: “*The SD Space Grant especially helped build my confidence and gave me the inspiration to continue my education beyond undergraduate school. I am currently taking graduate courses at Oglala Lakota College and I plan to apply to Earth Science graduate programs.*”

Lilly Jones, Native American female student and 2008/2009 Space Grant Fellow from Oglala Lakota College wrote that her Space Grant funding has “*allowed me to mentor students interested in STEM education and careers through a group called ‘I Could Be’*,”

to complete my own education, and it has educated me as to the NASA programs, materials and services available to secondary teachers.”

John Heiberger, SDSM&T graduate with a BS in Mechanical Engineering and 2008 Space Grant Fellow, wrote to SDSGC near the end of FY2009 program year and said *“I will begin employment with L-3 Communications in July 2010 and will be designing aeronautical components. The Space Grant stipend provided me with the opportunity to complete my undergraduate education without having to work a second job. This allowed me to focus on areas of interest in the aerospace field.”*

Similarly, Craig Oeding, 2009 Space Grant Fellow and graduate of SDSM&T with a BS in Electrical Engineering, wrote in April 2010: *“I will be starting my first job as a graduated Electrical Engineer in summer 2010 with Rockwell Collins designing communication systems for military aircraft. The Space Grant provided financial aid for supporting both me and my senior design project. It allowed me to spend more time focused on the project rather than working at a job.”*

PROGRAM ACCOMPLISHMENTS

NASA Education Outcome 1 Accomplishments

Fellowships/Scholarship

Seventy-eight (78) applications were received from students from six (6) of the Consortium’s universities in competition for the \$150,000 in NASA funding available through the FY2009 Fellowship/Scholarship Program. A total of \$511,400 was requested. Ten (10) of the 78 applicants were minority students (12.8%) and eight of those 10 were Native American. **Fifty-five (55) student awardees** were selected for funding from the base FY2009 Space Grant. Sixteen (16) of the 55 student awardees were graduate level (29%) and 39 undergraduate (71%). Seventeen (17) of the 55 awardees were female (31%), although females received 42% of the total funds awarded. All 10 of the minority applicants were awarded funding, representing 18.2% of the total awardees, almost doubling SDSGC’s target goal of 10% funding to minorities. Three of the eight Native Americans attend Tribal College affiliate Oglala Lakota College. Four students from three South Dakota universities (USD, SDSU, and SDSM&T) conducted **summer 2010 internships**, but three of them were funded with NASA ESMD stipends that are not included in the total fellowship funds awarded through the base FY2009 Space Grant reported here. Of the four summer 2010 internships, two were with industry (Rockwell Collins and Northern Plains Power Technology) and two were at NASA Langley Research Center through the NASA LARSS Program. In addition, five undergraduate students (4 female and one male) seeking STEM degrees were awarded a total of \$60,000 in non-federal matching scholarships (\$12,000 per scholarship) under Augustana College’s “Distinguished Scholar Competition”

Research Infrastructure

SDSGC awarded two Project Initiation Grants to promote research in NASA-related fields. The awards went to: 1) South Dakota State University (SDSU) and Sisseton Wahpeton College for a collaborative project titled *“Remote Sensing for Water Quality Monitoring and Watershed Assessment on Lake Traverse Reservation,”* and 2) the

Department of Chemistry and Chemical Engineering at SDSM&T for a project titled “*Thermal and Mechanical Properties of Cross-Linked Epoxy-Silicate Polymer Nanocomposites from Molecular Simulation.*” Of the \$66,000 in Project Innovation Grant funds awarded among four funded projects during FY2009, a total of \$56,000 were awarded to these two projects in the Research Infrastructure category.

Higher Education

SDSGC supported five **multi-disciplinary university student teams** to participate at national competitions in FY2009 including SDSM&T’s **Aero Design Team, Robotics Team, Mars Rock Retriever Team**, the ***Moonrockers Lunabotics*** lunar regolith excavator team, and the **Unmanned Aerial Vehicle Team**, two of which are highlighted below. A sixth SDSM&T senior design team was also significantly supported by Space Grant called the “**Autonomous Underwater Vehicle**” Team which designed and built a robotic submarine. SDSGC also funded a Higher Education Project Initiation Grant to affiliate Lake Area Technical Institute titled “*AQUILA – High Altitude Balloon Research Project*” which includes collaboration with industry affiliate Aerostar International, Inc. (a subsidiary of Raven Industries) and the Montana Space Grant Consortium.

Lunabotics Mining Competition Team – D’Ann Barker, an Electrical Engineering and Physics major at SDSM&T, received a Space Grant scholarship in 2010 and used it to help her “*Moonrockers*” team build a robotic lunar excavator to compete in the **First Annual Lunabotics Mining Competition at NASA Kennedy Space Center** in May 2010. The *Moonrockers* team consisted of six senior level students from SDSM&T’s Electrical Engineering, Mechanical Engineering, Computer Science, and Physics Departments. The goal of the competition was to deliver in excess of 10 kg of regolith simulant within 15 minutes as a means that NASA might use in an actual Lunar Regolith Excavator. Of the 22 university teams that competed, the SDSM&T *Moonrockers* took fourth place in regolith delivery and fourth place overall, which accounted for excavation/delivery, a systems engineering paper, a K-12 outreach paper, a slide presentation, team spirit, and multidisciplinary teaming. In addition to a grueling competition week for the *Moonrockers*, other trip highlights included observing the final historic landing of STS-132 Space Shuttle Atlantis, a tour of the SpaceX launch facility and Falcon 9 rocket, and an up-close look at a Delta IV rocket and its launch. Craig Jacobson, an SDSM&T alumnus working for NASA at KSC, was present at the competition and indicated what a terrific job the team did. The *Moonrockers* conducted two outreach activities to a local middle school.

Mars Rock Retriever Team – An SDSM&T multidisciplinary team of students placed second out of 28 teams during the American Society of Mechanical Engineers (ASME) District C Student Professional Development Conference held in Milwaukee, WI on April 16-18, 2009. The competition was aimed at simulating rock-retrieving vehicles on the Martian surface. The SDSM&T team completed all the tasks with only two seconds to spare. Only four of the 28 teams including SDSM&T were able to do this. SDSM&T’s second place finish made the team eligible to compete at the ASME International Congress in November 2009 in Orlando, FL where they placed eighth out of 15 teams. In addition to the competition and conference, the team met with, and was provided guest

passes to the Kennedy Space Center by two NASA engineers who are also SDSM&T Electrical Engineering alumni. Team member and Space Grant fellow Lisa Robinson graduated in December 2009 with a B.S. degree in Mechanical Engineering and in April 2010 she was selected for the District C ASME Charles T. Main Award. This is the most prestigious ASME award that can be conferred to an ASME member to recognize significant contributions to an ASME student section while a student member.

NASA Education Outcome 2 Accomplishments

Precollege

Three South Dakota Teachers Selected for Presidential Awards for Excellence – In July 2009, three educators from South Dakota were named by President Obama among more than 100 STEM teachers and mentors receiving Presidential Awards for Excellence. All three educators have received support from SDSGC in the past, a good indicator that a) high quality educators in South Dakota recognize the value of Space Grant resources, and b) Space Grant management selects well qualified teachers as Space Grant awardees.

Inaugural South Dakota FIRST LEGO® League (FLL) Robotics Tournament - Robotics continued to be a theme supported by SDSGC during FY2009. Seven \$5,000 Robotics Materials Awards were competitively awarded to teachers. SDSGC's two-day robotics teacher training workshops were held in Rapid City and Pierre and targeted middle school teachers. Teachers were trained by a NASA AESP specialist from JSC and were provided hands-on curriculum enhancement capabilities in the field of robotics. With assistance from SDSGC, the "South Dakota Robotics Association" comprised of educators, community members, the Washington Pavilion of Arts and Sciences, and the Sioux Falls-area Catholic and public schools was formed two years ago. In January 2010, the inaugural South Dakota FIRST LEGO® League (SD FLL) Tournament was held with students, coaches, and mentors from 30 middle and elementary school teams. The teams dedicated themselves to 16 weeks of work in which they embraced science and technology as accessible, fun, and rewarding. The number of students involved with the FLL activities in South Dakota has grown from 140 students in the 2008/09 season to 290 students in 2009/10, to an estimated 400 in the upcoming 2010/11 season. SDSGC's Associate Director at the SD Discovery Center plans to start a FIRST LEGO League Advisory Team with the goal of recruiting additional students, coaches, mentors and sponsors.

Aerospace Career and Education (ACE) Camp 2009 – Space Grant funding supported SDSU's 18th annual ACE Camp was held on July 12-15, 2009 with 24 high school students. Since ACE Camp's inception in 1992, 392 students have completed the program, averaging 22 students per year. The primary goal of the ACE Camp is to create an aviation-aware society that understands and respects the importance of aviation and aeronautics at the federal, state, and local level. ACE Camp was evaluated by the Consortium evaluator, Ms. Tracey McMahon, with a detailed final report submitted to SDSGC on Dec. 21, 2009.

Women in Science (WIS) Conferences – Through its subcontract and partnership with the SD Discovery Center, SDSGC continued to support four highly successful WIS conferences held throughout South Dakota. WIS conferences reached 1,450 girls in

FY2009, 150 of whom were Native American (10.3%), and 200 teachers and adult volunteers. Of the 1,450 girls, roughly 60% were in middle school and 40% in high school.

NASA SOLAR Institute – In September 2008, SDSGC applied to NASA for a NASA INSPIRE Collegiate Experience (Tier 2A) grant and was funded in the amount of \$50,000 for the first year of a three-year project that began in FY2009 titled “NASA SOLAR (Space Observation, Learning, and Research) Institute.” SDSGC was one of only three consortia nationwide to receive funding under this grant. During summer 2009, the project provided for a two-week, STEM-focused, residential, college-preparatory summer camp at SDSM&T for 37 high school students, 36 of whom were from out of state. The students were selected for participation by NASA. The goal of the camp was to increase the number of students interested in STEM careers and to encourage the students to apply such knowledge toward possible NASA careers. During the two-week camp, students were immersed in STEM coursework taught by SDSM&T instructors and SDSGC staff.

In addition to the precollege programs highlighted above, SDSGC headquarters staff provided an additional **14 precollege programs** at schools and museums during FY2009 reaching **1,158 students as direct participants** (575 elementary, 281 middle school, and 302 high school), 22% of whom are Native American.

NASA Education Outcome 3 Accomplishments

Informal Education Programs (Public Service)

SDSGC’s annual hallmark public service informal education event ***South Dakota Space Days 2009: A Journey into Space*** was held on October 1-2, 2009 at SDSM&T and was co-sponsored by SDSGC affiliate the Journey Museum. The event reached 953 middle and high school students, teachers, and parents with 20 separate and concurrent hands-on STEM educational activities (“missions”), each repeating up to 7 times per day, including presentations by experts in the fields of aerospace, earth science, physics, and engineering. Featured speakers included: a) Dr. Theodore Gull, NASA Goddard Space Flight Center Astrophysicist and Deputy Principal Investigator for the Hubble Space Telescope Imaging Spectrograph, b) Dr. Peggy Norris with the Sanford Underground Science and Engineering Laboratory, and c) Mr. Tom Durkin, SDSGC Deputy Director. South Dakota Space Days is subject to evaluation criteria under the NASA South Dakota Space Grant Consortium’s Strategic Plan. Formative and summative evaluations were used to assess the impact of Space Days 2009. Survey instruments were distributed to all 16 schools that attended South Dakota Space Days 2009. Pre- and post-event surveys were provided to teachers and students. Of the 16 attending institutions, 7 were public schools, 5 were Native American institutions, and 4 were home educators. Many of the teachers indicated that the hands-on activities of the missions were one of the most valuable aspects of Space Days 2009. One teacher wrote “*It was such a great day of learning and has provided my students with so many ideas. I have had students talk to me about how they could "get into" those kinds of jobs and study. THAT is amazing! Thank you so much!!*” Of the Space Days 2009 student survey respondents, 27% were self-reported Native Americans and 60% were female. Of the 953 attendees of Space Days 2009, 864 were students and 97% of them were middle school students (3% high

school). Approximately 69% of the student respondents indicated that Space Days informed them of the variety of careers available with NASA, and 20% of the respondents indicated that they would someday like to work for NASA. Other evaluative results are too extensive to summarize here, but a detailed, 22-page evaluation report titled “*South Dakota Space Days 2009: A Journey into Space - Evaluation Report*” was prepared by SDSGC Program Evaluator (in 2009) Ms. Tracey McMahon. The report is on file at SDSGC Headquarters.

SDSGC headquarters staff provided an additional **five NASA- and space-related informal education programs** to 631 members of the general public during FY2009. These programs included the opening debut of affiliate the Journey Museum’s Uniview Planetarium, Neutrino Day in Lead, SD, and three other public service events.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- Longitudinal Tracking: Total Fellowship/Scholarship awards in FY2009 = 55; 10 of the total awards were to underrepresented minority students. During the FY09 program year 20 students took their next step: 11 have accepted STEM positions in industry, 4 have accepted STEM positions with Aerospace Contractors, 3 students graduated and are pursuing advanced STEM degrees, 1 is employed at NASA, and 1 is working in a non-STEM field. For all students that were significantly supported in the period spanning FY06-FY09, 18 students accepted STEM positions in industry, 8 students graduated and are pursuing advanced STEM degrees, 7 have accepted STEM positions with Aerospace Contractors, 2 are employed by NASA, and 2 are working in non-STEM fields. The remaining students have not yet received the degree that they were pursuing while they received their Space Grant award.

- Course Development: 5 new courses and 1 new Masters Program. A new M.S. Program at SDSM&T in **Robotics and Intelligent Autonomous Systems (RIAS)** was planned and developed with support from SDSGC Program Initiation Grant funds during FY2007-2008 and was approved by the South Dakota Board of Regents in 2009. The new RIAS program including **five new courses** officially opened for business and began offering classes at SDSM&T during the Fall 2009 semester. The new program provides an interdisciplinary, research-oriented degree in an emerging technical area. The primary objective of the RIAS program is to give students a basic understanding of the mechanical, electrical and computing systems required to participate in advanced mobile intelligent robotics applications. The program covers the essentials of robotics, artificial intelligence, control, communications, sensors and signal processing. Upon graduation, students are able to participate in NASA, commercial, and military projects to design and build intelligent autonomous systems capable of interacting with the environment and performing complex tasks.

- Matching Funds:

NASA Funds	Fellow/Scholar	Match Required	Match Provided	Ratio
\$590,000	\$150,000	\$440,000	\$440,000	1:1

- **Minority-Serving Institutions:** Two Consortium members are **MSI Tribal Colleges** (Sinte Gleska University and Oglala Lakota College) and one is a **minority-focused Tribal College** (Lower Brule Community College). Subodh Singh took over the role of Space Grant representative at Sinte Gleska University from former representative James Rattling Leaf. In June 2010, with a letter of support from SDSGC, Sinte Gleska University submitted a proposal under NASA's Tribal Colleges and Universities Project (TCUP) to conduct research into carbon sequestration in grasslands on Tribal lands. SDSGC's partnership with Tribal College affiliate Oglala Lakota College continued throughout FY2009 through SDSGC's FY2007 multi-institution Consortium Development Competition (CDC) project to *"Increase Minority Participation in Higher Education in STEM Disciplines Responsive to NASA Needs"*. Similarly, in October 2009, SDSGC was awarded \$194,000 under the FY2009 CDC to foster increased involvement of NASA in Deep Underground Science and Engineering Laboratory (DUSEL) research and with SDSGC affiliates including Oglala Lakota College. Specifically this was accomplished through establishment of a *"NASA-DUSEL Research Center for Probing the Earth's Interior."* The focus of the one-year project was a 10-week summer research experience for 15 undergraduate students at DUSEL and six collaborating SDSGC institutions. The students worked on three related research projects and were mentored by faculty, postdoctoral researchers, and graduate students from the following six participating universities: USD, SDSM&T, Black Hills State University, Oglala Lakota College, Augustana College, and Dakota State University. The project allowed for 1) the development of new techniques for geo-neutrino detection, 2) construction of a geological/geochemical model for the Earth's crust at DUSEL, and 3) research into the use of atomic interferometry based subterranean gravimetry at DUSEL. On April 16-17, 2010, a workshop including the 15 student interns, project faculty, and the Director of SDSGC was held in Chamberlain, SD and the student team then traveled to a meeting at NASA JPL in July.

IMPROVEMENTS MADE IN THE PAST YEAR

SDSGC lent support to affiliate the Journey Museum in submitting a proposal under NASA's Competitive Program for Science Museums and Planetariums during FY2008 to build a permanent planetarium dome that would host Uniview Planetarium educational programs. Although the FY2008 proposal was not funded, those efforts proved successful in securing a private gift in July 2009 from a community member to the Journey Museum to purchase the Uniview software and establish **South Dakota's first "flat screen" planetarium**. The public debut of Uniview was given by SDSGC's Deputy Director Tom Durkin and Journey Museum Director Ray Summers to two sold-out shows (320 people) on the evening of August 21, 2009. High quality astronomy programming provided via the Uniview planetarium platform is now under development. One such program already in operation began in the fall of 2009 titled "Cosmic Journey: A Solar System Adventure". Because a permanent planetarium was established in South Dakota, the Journey Museum submitted another proposal in September 2009 titled "Journey into Space" under NASA's 2009 Competitive Program for Science Museums and Planetariums to develop additional educational programming. In January 2010, this proposal was selected by NASA for full funding (\$492,778) for three years (2010-2013).

It also allows for purchase of a portable “ExploraDome” that, starting in September 2010, will take programming to Tribal, public, and private schools throughout the state.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

SDSGC is a statewide network of 20 organizations from education, industry and government. The Consortium’s eight-member Management Team consists of representatives of a cross section of the membership including SDSM&T (the Lead organization), SDSU, Augustana College, USGS Earth Resources Observation and Science (EROS) Center, South Dakota Discovery Center, the Journey Museum, and an ex-officio member of the South Dakota Board of Regents. The full membership consists of the following educational, industrial, and government affiliates.

Educational Affiliates

- SD School of Mines and Technology (Lead Institution, state university BS-PhD, science and engineering)
- SD State University (state university BS-PhD, agricultural and STEM institution)
- Augustana College (four-year private liberal arts and professional college)
- SD Discovery Center and Aquarium (science center)
- Black Hills State University and Center for the Advancement of Mathematics and Science Education (four-year, state liberal arts institution)
- The University of SD (state university BS-PhD, medicine, law, fine arts, business)
- Dakota State University (state university, Associates-PhD, computer management)
- Badlands Observatory (private observatory, astronomical research/education)
- Black Hills Astronomical Society (astronomical society)
- Kirby Science Discovery Center (science center and museum)
- The Journey Museum (museum)
- Lower Brule Community College (minority-serving, two-year college)
- Oglala Lakota College (Tribal College, AA-MS with STEM majors)
- Sinte Gleska University (Tribal College, four-year institution)
- Lake Area Technical Institute (technical institute, Associates of Applied Science degrees, programs in robotics and aviation maintenance)

State and Federal Government Affiliates

- Sanford Underground Science & Engineering Laboratory at Homestake (a state organization under the management of the SD Science & Technology Authority)
- USGS Earth Resources Observation and Science “EROS” Center (data management, systems development, and research field center; Land Processes Distributed Active Archive Center for NASA’s Earth Observing System)

Industrial Affiliates

- Raven Industries (engineered films, high-altitude balloons, GPS products)
- RESPEC (consulting & services: engineering, IT, water & natural resources)
- Science Applications International Corporation “SAIC” (scientific, engineering, and technology applications company)