

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 \$660,000 for fiscal year 2010.

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 Education Outcome 1 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)

The following highlights reflect the impact of SDSGC programs in support of NASA Education Outcome 1: *“Contribute to the development of the STEM workforce in disciplines needed to achieve NASA’s strategic goals.”*

Stephen Boyte, 2009 MS graduate of SDSU and Space Grant Fellow in 2007 and 2009 wrote the following in 2010 about his role in the aerospace industry since graduation: *“I have been working at the USGS EROS Data Center as a scientist involved in researching, presenting, and writing about using satellite data to study ecosystem performance in multiple land cover types. I’m also studying the effects of climate change on ecosystem performance, and I use geospatial technologies daily.”*

Iseley Marshall, currently a senior Physics and Chemistry major at USD, conducted a summer 2010 internship through the NASA Langley Aerospace Research Summer Scholars (LARSS) Program and was accepted back for a second LARSS internship for summer 2011. Her summer 2010 internship included working with NASA’s Dr. Cheol Park in the Research and Technology Directorate and Dr. Jin Ho Kang on a project titled *“Solar/Thermal Radiation Control Materials for Thermoelectric Solar Cells.”*

Landon Luick of SDSM&T conducted a summer 2010 aerospace industry internship at SpaceX and is going back to SpaceX for part of summer 2011. Landon wrote of his first internship there: *“My experience with SpaceX was pretty cool. I’ve seen the fuel tanks of the 1st and 2nd stage of flight 3 from start to completion.”*

Kyle Weis, graduate of Dakota State University and previous Space Grant fellow and NASA intern indicated in 2010 that he gained employment with ASRC Aerospace at NASA Kennedy Space Center. Kyle wrote: *“My participation in the NASA Space Grant ESMD internship provided by the SD Space Grant helped me realize how much I enjoy working in a research environment. Since the end of my internship, I have taken a position working at the Kennedy Space Center on technology development. Several of the technologies under development are meant to further extra terrestrial exploration.”*

In February 2011, Patrick Davis, a senior Physics major at USD wrote of his 2009 and 2010 Space Grant scholarships: *“NASA Space Grant program has helped to shape my career entirely. At the moment I am applying for graduate school in engineering, and it is because of the research that the NASA Space Grant allowed me to do that helped me decide what it was I wanted to do with my career.”*

Connie Giroux is a previous Space Grant Fellow and Rosebud Sioux tribal member who conducted a summer internship at NASA JPL and graduated from SDSM&T with an M.S. in Technology Management. She now works at the Sanford Underground Science and Engineering Laboratory and during FY2010 was designated as the lab supervisor for the Majorana Demonstrator Experiment, which will be used to look for the signature of neutrino-less double-beta decay. Connie is also the laboratory supervisor for the surface lab where the Large Underground Xenon (LUX) Experiment is located and where a dark matter detector is currently being built to be filled with superchilled xenon and placed in a tank of purified water one-mile underground. Connie said *“Being a scientist, as well as an American Indian, I have a perspective on both the culture and benefits for science. The main cultural benefit is that the lab gives American Indian students the chance to be at the forefront of groundbreaking research. We are developing programs to benefit both our laboratory and Tribal colleges and universities. We also want to share the opportunities here with American Indian owned businesses or tribal enterprises if they have a product we can use at the laboratory.”*

In January 2011, SDSM&T graduate Michael Barth (B.S. Civil Engineering) and two of his colleagues at NASA KSC were selected as the U.S. Department of Energy's (DOE) 2011 Energy Champions as part of the Federal Energy Management Program's *You Have the Power* campaign. This DOE campaign is an initiative among 21 participating federal agencies to promote energy-efficient practices and products and to spread the word about saving energy, money, and resources among federal workers. In 2010, Michael wrote *“The SD Space Grant stipend enabled me to relocate to Florida to participate in the KSC Co-op Program. Also, the fact that I received the stipend probably was a contributing factor in my selection to take part in the Co-op program.”* Michael is now a full-time employee at NASA KSC.

Native American student Jessica Tsingine is currently a senior in Industrial Engineering at SDSM&T supported by Space Grant for the past three years. Her 2010 senior design project is working with REI Corporation (an electronic manufacturer) in Mission, SD on the Rosebud Indian Reservation. Her work assists the company in circuit board production, cable assembly, and research focused on tin-whiskers prevention in soldering.

Eric Musil, SDSM&T Mechanical Engineering graduate student and Space Grant Fellow was one of 15 students statewide who were invited to present their research to lawmakers and the public at the 2011 Student Research Poster Session held in the rotunda of the State Capitol Building on Feb. 24, 2011. Eric's research has been funded by SDSGC and involves applying Friction Stir Processing technology to the landing gear system of an RC aircraft designed and built by SDSM&T's multi-disciplinary AeroDesign Team. The process was found to increase the damping or energy absorbing capability of the aluminum landing gear, improving the landing capability and crashworthiness of the aircraft. This work has led to further investigation under a mechanical engineering MS thesis which explores potential commercialization strategies for this technology to develop new job opportunities in the state of South Dakota.

PROGRAM ACCOMPLISHMENTS

During FY2010, SDSGC support resulted in the following accomplishments. The performance *Goals* for Fellowship, Research Infrastructure, Higher Education, Precollege, and Informal Education are listed above under “Program Goals”. The specific *Performance Objectives* clipped from Table G.3 “Summarized Table of Consortium Goals and SMART Objectives” included in SDSGC’s FY2010 Program Plan that are applicable to the accomplishments listed below are given in *italics* at the start of each accomplishment.

NASA Education Outcome 1 Accomplishments

Fellowships/Scholarship

Annual Performance Objective: Statewide competition offered at all 10 higher education affiliates including three Tribal Colleges; emphasis on internships with NASA, aerospace industry, DUSEL, and EROS. [At least 55 awards (\$1,000-\$12,000); all awardees enter longitudinal tracking system; at least 10% minority and 40% female; at least three NASA interns and five EROS interns]

One-hundred eleven (111) applications were received in October 2010 from students from seven of the Consortium’s universities in competition for \$230,000 in NASA funding made available through the FY2010 Fellowship/Scholarship Stipend Program (\$180,000) and remaining funds (\$50,000) from a combination of: A) ESMD Space Grant student internship funds, and B) remaining fellowship/scholarship funds from the previous five-year Space Grant cycle. SDSGC’s Management Team reviewed the applications and in November 2010 offered \$230,000 in student funding to 89 high-achieving college students representing seven institutions. Thirty-two (32) of the 89 student awardees were graduate level (36%) and 57 undergraduate (64%). The Consortium exceeded its targeted goal of 10% of its awards to minorities in both number of awards and amount of funding. Of the 89 students funded through the SDSGC Fellowship/Scholarship program in FY2010 with regular Space Grant funds, 14 (16%) are minority students, 7 of which are Native American. Thirty-four percent (34%) of the total number and the total dollar amount of awards were provided to female students, which did not meet the targeted goal of 40% of awards to female students.

Research Infrastructure

Annual Performance Objective – Statewide competition for Program Initiation Grants for research development offered at all 10 higher education affiliates including three Tribal Colleges; emphasis on interdisciplinary research focused on NASA, DUSEL, or EROS priorities. [At least two awards for research (\$5,000-\$20,000)]

In January 2011, ten applications were submitted by SDSGC affiliates in competition for \$80,000 made available during FY2010 for meritorious Project Innovation Grants. Three of the ten applications were in the research infrastructure program area. The others were in the areas of Higher Education and Precollege. In February 2011, \$60,000 in Project Innovation Grant funds were awarded among five projects selected for funding. Of the five funded projects, \$18,600 was awarded to the following SDSM&T project to specifically promote research in NASA-related fields: “*Vacuum Assisted Resin Transfer Molding (VARTM) Process Simulation for Compressible Preform Materials.*”

Annual Performance Objective – Support collaborative research proposals in NASA areas. [At least one collaborative proposal submitted]

In June 2010 SDSGC supported a proposal submitted by Sinte Gleska University under NASA's Tribal Colleges and Universities Project (TCUP) to conduct research into carbon sequestration in grasslands on Tribal lands.

Among 15 students selected to present their research findings at the 2011 Student Research Poster Session held in the rotunda of the State Capitol Building on Feb. 24, 2011, three were from Sisseton Wahpeton College. They presented their research results on “*Remote Sensing for Water Quality Monitoring and Watershed Assessment on Lake Traverse Reservation*”; a research project funded by last year's (FY2009) Space Grant.

Beau White, Native American junior and Space Grant Fellow at SDSM&T (and previous two-time NASA robotics intern at JSC) was a participant who worked on friction stir welding during the 2010 NSF Research Experiences for Undergraduates (REU) program hosted at SDSM&T during summer 2010. Dubbed “Back to the Future”, the focus of the 2010 REU program was research into Materials/Metallurgical Engineering projects that have historical and cultural significance. Twelve exceptional undergraduate students from SDSM&T, University of Dallas, University of Tennessee-Knoxville, Michigan Tech University, and University of Nebraska-Lincoln participated in the program. SDSGC staff provided students with the history of NASA's Apollo missions to the Moon.

Annual Performance Objective – Support Tribal College research roundtable in conjunction with NASA EPSCoR. [At least one Tribal College research roundtable]

In spring 2010, SD NASA EPSCoR RID funds were used to facilitate a meeting of representatives of six SDSGC affiliates aimed at recruitment of Native American students into research programs in earth science and physics that are being conducted at the Deep Underground Science and Engineering Laboratory (DUSEL) in Lead, SD. Specifically, the meeting attendees were members of the 2009–2010 SDSGC CDC project titled “*NASA-DUSEL Research Center for Probing the Earth's Interior.*” In early 2011, the SD NASA EPSCoR Steering Committee selected a joint proposal from SDSGC affiliates USD and Sinte Gleska University titled “*Development of a Nanocomposite Research Program at Sinte Gleska University using 3D Simulation and Visualization as an Education and Research-Recruitment Tool*” for funding during the period March 2011–May 2012.

Higher Education

Annual Performance Objective – Statewide competition for Program Initiation Grants for course development offered at all 10 higher education affiliates including three Tribal Colleges; emphasis on NASA disciplines. [At least one award for course development (\$5,000-\$20,000)]

Six of the ten applications mentioned above in competition for \$60,000 provided through SDSGC's FY2010 Project Innovation Grants program were in the Higher Education program area. The others were in the areas of Research Infrastructure and Precollege. Of

the \$60,000 awarded among five selected projects, a total of \$40,500 went to the following four Higher Education projects (three at SDSM&T and one at Augustana College): 1) *Restoration of Students for the Exploration and Development of Space (SEDS)*, 2) *Design and Development of a Cooperative UGV/UAV Team*, 3) *The Design and Fabrication of a Search For Life Autonomous Underwater Vehicle and Its Satellite Relay Simulator*, and 4) *Aviation at Augustana College*.

Annual Performance Objective – Support interdisciplinary student engineering design teams in NASA priority areas. [At least three engineering design teams]

SDSGC supported six multi-disciplinary university student teams to participate at national competitions in FY2010 including SDSM&T's Aero Design Team, Robotics Team, Programming Team, the *Moonrockers* Lunabotics lunar regolith excavator team, Unmanned Aerial Vehicle Team, and Autonomous Underwater Vehicle Team.

Annual Performance Objective – Support summer STEM programs for precollege students on college campuses with emphasis on Native American students. [At least four summer STEM precollege programs]

For the 18th consecutive summer, the “South Dakota Gaining Early Awareness and Readiness for Undergraduate Programs” (SD GEAR UP) Honors Program was held on the campus of SDSM&T. This six-week, summer residential, college-preparatory program hosted 220 high school students from 24 Tribal schools in South Dakota that are members of the Oceti Sakowin Education Consortium. All nine tribes in South Dakota are represented. About 85% of the students are Native American and 67% are female. Most of these students would be first-generation college students. Students apply as 8th graders to enter the program and are selected based on academic achievement and teacher recommendations. A middle school component of 6th - 8th graders and their parents visit for a few days to tour campus and learn about the programs available to them once they get into high school and become eligible for the full six weeks. Peggy Norris of SDSGC affiliate Sanford Underground Science and Engineering Laboratory worked with the GEAR UP students for three of the six weeks during the 2010 summer camp offering: 1) lectures on the birth and death of stars using NASA educational materials, nuclear science, water treatment, and chemistry curriculum, 2) labs on nuclear forensics and polymers, and 3) tours of the Sanford Lab included the hoist room, science building, and water treatment plant. SDSGC's Deputy Director Tom Durkin provided additional NASA content to the curriculum including a Uniview Planetarium program at the Journey Museum to 140 of the GEAR UP students. Of the students who graduate from the program, virtually 100% also graduate from high school and 85% attend college. Three other summer STEM programs for precollege students held on college campuses include SDSU's Aerospace Career and Education (ACE) Camp 2010 and SDSM&T's NASA SOLAR Institute (both described under the Precollege accomplishments section below) and SDSU's Flandreau Indian School (FIS) Success Academy.

Lunabotics Mining Competition Team – After taking 4th place overall and 4th place in regolith delivery at last year's May 2010 inaugural Lunabotics Mining Competition at NASA KSC with support from SDSGC, SDSM&T's multi-disciplinary *Moonrockers* team will again compete in the 2nd annual competition to be held in May 2011. Team

members are comprised of ten undergraduate students at the freshman through senior level from the computer science, computer, electrical, and mechanical engineering programs at SDSM&T. Along with the primary objective of redesigning the collection and delivery system, the team continues to provide outreach activities to local schools. *Moonrockers* advisor Jason Ash said the 2011 team is “*extremely grateful for support provided by the NASA South Dakota Space Grant Consortium and Space Exploration Technologies (SpaceX).*”

SDSM&T’s five Programming Teams totaling 15 students competed in the North Central North America Regional Association for Computing Machinery (ACM) International Collegiate Programming Contest on Nov. 6, 2010 among 223 university teams representing 63 colleges and universities. Teams from five SDSGC affiliate colleges and universities participated in the competition (SDSM&T, USD, SDSU, DSU, and Augustana College). SDSM&T’s five teams took 3rd, 5th, 7th, 13th, and 14th place among the 223 teams. “*It’s pretty amazing to realize that any one of the five teams would have placed in the top ten in the region if no other SDSM&T teams had been entered*”, coach Ed Corwin said. Four of the 15 SDSM&T students are 2010 SD Space Grant Fellows and two of them were on the top SDSM&T team that took 3rd place overall in the Regional competition. The 223 teams that competed in the North Central Regional event competed for the right to go to the World Finals originally scheduled in Sharm El-Sheikh, Egypt for February 2011, but due to unrest in Egypt, the finals were later reorganized and will be held in Orlando, Florida from May 27-31, 2011. The World Finals are limited to only 100 teams. More than 8,700 teams including over 26,000 students from 86 countries vied at regional competitions for the 100 slots at the finals. One of SDSM&T’s five teams including two SDSGC fellows qualified for the World Finals. They were one of only 16 teams that qualified from the U.S. including Carnegie Mellon, Duke, MIT, Princeton, University of Maryland, University of Chicago, University of Michigan, and others.

SDSGC’s Lead Institution, SDSM&T, honored Dr. Steven Squyres, Goldwin Smith Professor of Astronomy at Cornell University and Principal Investigator for the science payload on NASA’s Mars Exploration Rover Project, with the prestigious “2010 Mines Medal Award.” SDSM&T launched the Mines Medal Award Program in 2009 to honor engineers, scientists, and researchers who have demonstrated exceptional leadership and innovation. The award also highlights the significant role these individuals play in society helping to ensure our global preeminence in engineering and science.

The Space Grant Internet Telescope Network (SGITN) was again supported in 2010 for the fourth consecutive year with \$5,000 in funding from SDSGC. The SGITN program began operations in North and South Dakota in August 2007. It is a partnership of online astronomical observatories whose goal is to facilitate undergraduate, graduate, and faculty research and education in astronomy. SDSGC-affiliate Badlands Observatory with its high-quality, research-grade 26 inch f4.8 Newtonian Telescope is a primary participant along with internet telescopes at the University of North Dakota Observatory, Sierra Stars Observatory in California, Tzec Maun Observatory in New Mexico, Bareket Observatory in Israel, and the Astronomical Research Institute in Illinois. The following

publication in the Minor Planet Bulletin by a graduate student resulted during FY2010: (846) Lipperta: A Very Slow Rotator; a paper on the lightcurve study of asteroid 846 Lipperta. To participate in the Network, the user must be an undergraduate or graduate student or faculty member at a college or university affiliate of a Space Grant Consortium that is participating in the Network.

NASA Space Science Student Ambassador Daniel Johnson, student at Augustana College, was selected in 2010 as South Dakota's NASA Space Science Ambassador. Mr. Johnson was also one of two student ambassadors selected in 2009 for the International Year of Astronomy Student Ambassador Program.

NASA Education Outcome 2 Accomplishments

Precollege

Annual Performance Objective – Support statewide precollege robotics programs, including resources, teacher training workshops, and state competition. [At least 30 teams participate in SD FLL robotics state competition (400 students)]

The 2nd Annual South Dakota FIRST LEGO® League (FLL) Robotics Tournament was held in Sioux Falls, SD on January 15, 2011 with \$10,000 in support from SDSGC and major efforts from SDSGC Associate Director Dr. Dan Swets at Augustana College. Students, coaches, and mentors from 56 middle and elementary school teams participated in the event. This was up from 30 teams the first year. 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 410 students during the 2010/11 season. SDSGC's Associate Director Kristie Maher at the SD Discovery Center (SDDC) recruited six teams from Pierre, SD to participate in the January 2011 SD FLL tournament. SDDC also hosted a pre-tournament robotics scrimmage in November 2010 among 50 students.

Annual Performance Objective – Sponsor statewide competition for precollege STEM teacher grant. [At least one precollege teacher grant (\$5,000)]

Kelly Lane Earth & Space Science Grant – This annual \$5,000 grant is awarded by SDSGC to science or math teachers in South Dakota in recognition and support of outstanding teaching and innovative educational programs at the pre-college level in the fields of STEM. Five applications were received for FY2010 and two winners were selected including Amber Stout of Jefferson Elementary School in Pierre, SD for her project titled “*Incubation in the Classroom*” and Jessica Krueger and Robin Anderson of Liberty Elementary School in Harrisburg, SD for their project titled “*Great Mistakes*” focusing on physics, architecture, design, and STEM disciplines.

SDSGC received six (6) applications from precollege educators to its FY2010 Robotics Materials Award program. This annual \$5,000 award is open to South Dakota educators who either have taken robotics training provided by NASA SGSGC or who have sustained robotics programs or curriculum at their schools. Linda Foos, Principal of Koch Elementary School within the Milbank School District was selected for the award in January 2011. She had previously been a teacher at another school in South Dakota where she was trained by SDSGC in robotics. She was so impressed with the program in

teaching STEM concepts at that school that she is implementing it in her new school as principal.

Annual Performance Objective – Support collaborative proposals for innovations in precollege STEM education. [At least one collaborative proposal]

SDSGC affiliate SD Discovery Center led a collaborative proposal submitted in February 2011 to NASA's Summer of Innovation program.

Aerospace Career and Education (ACE) Camp 2010 - SDSU's 19th annual ACE camp was held July 11-14, 2010 with SDSGC support. Since ACE Camp's inception in 1992, 410 high school students have completed the program, averaging 22 students per year and 18 this year. The camp's attendance reached a high in 1995 with 36 students attending the camp, and a low in 2008 with only 9 students. Since ACE Camp's inception, 126 females have completed the program, representing 31% of all ACE Camp participants. 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. A detailed 15-page ACE Camp 2010 Evaluation Report was prepared by SDSGC's Program Evaluator.

NASA SOLAR Institute – In 2009, SDSGC was awarded a three-year NASA INSPIRE Collegiate Experience (Tier 2A) grant for a NASA SOLAR (Space Observation, Learning, and Research) Institute designed to increase the number of high school juniors interested in NASA STEM careers. The summer 2010 SOLAR Institute at SDSM&T hosted 19 juniors selected by NASA. In addition to the intensive two-week STEM curriculum, students were provided with presentations by NASA's Linda Smith, Program Manager of NASA Aerospace Scholars and INSPIRE at JSC. SDSGC affiliate Black Hills Astronomical Society also provided telescopic observing opportunities for the students. The students were from among the following states: VA, NE, OH, SD, PA, OR, TN, CA, NV, FL, and IL. All of them are enrolled in STEM-focused degree tracks and many plan to work for NASA in the future.

Women in Science (WIS) “*Expanding your Horizons*” Conferences – Through its subcontract with the SD Discovery Center, SDSGC continued to support six highly successful WIS conferences held throughout South Dakota. WIS conferences reached 1,400 girls in FY2010, 210 (15%) of whom are minority students and, of those, 154 are Native American (11% of the total). Teachers and adult volunteers numbered 281. Of the 1,400 female participants, 69% were in middle school and 31% in high school. The six WIS conferences were held in 1) Pierre (on 3/22/11), 2) Aberdeen (3/8/11), 3) Rapid City (3/8/11), 4) Sioux Falls (3/9/11), 5) Watertown, and 6) Yankton (the last two held in the fall of 2010).

In addition to the precollege programs highlighted above, SDSGC headquarters staff provided an additional ten (10) precollege programs at schools and museums during FY2010 reaching 945 students as direct participants (78 elementary, 489 middle school, and 378 high school), 21% of whom are Native American.

On June 15-16, 2010 Mary O'Neill of SDSU's Office of Remote Sensing hosted two GPS training sessions for six high school students attending SDSU's Youth Engineering Adventure summer camp and five Native American students and one instructor from St. Joseph Indian School in Chamberlain, SD.

NASA Education Outcome 3 Accomplishments
Informal Education Programs (Public Service)

Annual Performance Objective – Partner with informal education affiliates to disseminate NASA content, share NASA educational resources, and host major NASA science education events. [15 informal education providers and 500 students share NASA resources; 150 teachers and 2,200 students participate in NASA science education events such as SD Space Days]

SDSGC's annual hallmark public service informal education event *South Dakota Space Days 2010: "Careers with a View"* was held during the week of October 4th, 2010 with the main event on October 7, 2010 at Riggs High School in Pierre, SD. Space Days 2010 was organized by affiliate SD Discovery Center. The event reached 3,745 direct participants consisting of middle and high school students, teachers, and parents with various hands-on STEM educational activities and presentations by experts in the fields of aerospace, earth science, physics, and engineering. That number of direct participants represents about ½ of one percent of the entire population of South Dakota; a significant accomplishment for a single Space Grant event. The featured speaker was former NASA Astronaut Col. Sam Gemar, a native of South Dakota, a three-time Space Shuttle Astronaut (STS-38, STS-48 and STS-62), and currently a test pilot with Bombardier Learjet. Tom Durkin, SDSGC Deputy Director, presented a 40th anniversary talk on the history of NASA's Apollo Missions. Planetarium programs were provided using the Journey Museum's new NASA-funded Uniview *ExploraDome* traveling planetarium and the SD Discovery Center's StarLab Planetarium. Paper rocket launching was a big hit with the students, as was the hands-on display about electromagnetic radiation. Corporate sponsorship was provided by 3M. SD Space Days is also an example of how SDSGC fulfilled one of its Annual Precollege Performance Objectives to "*Share NASA educational resources (StarLabs, robotic kits, Uniview Exploradome mobile planetarium, and telescopes to where at least 180 teachers and 250 students utilize NASA educational resources.*"

Evaluation of Space Days 2010 - Formative and summative evaluations were used to assess the impact of Space Days 2010. Pre- and post-event surveys were provided to teachers and students. Teacher survey instruments were designed to measure the relative importance of the factors used in considering whether or not to attend Space Days, whether the contents of the lectures and the hands-on activities met their educational objectives, their overall satisfaction with the event, and the perceived impact the event had on their students. Overall, the teachers found Space Day to be a well-organized and valuable experience which successfully demonstrated the interdisciplinary nature of NASA research and development. Student survey instruments were designed to measure the racial and gender distribution of the attending students, their satisfaction with the contents of the lectures and hands-on activities, the extent to which they better understand careers in aerospace, science, technology, engineering, and/or mathematics as a result of

the event, and the impact the event had on their future career goals. Approximately 69% of the student respondents indicated that Space Day informed them of the variety of careers available with NASA. One student wrote: *"I liked how the speakers interacted with the audience."* Another said: *"I liked the astronaut speaker from South Dakota, it was funny and kid friendly."* Yet another wrote: *"It was really, really fun. I want to go again."* Of the Space Days 2010 student survey respondents, 18% were self-reported Native Americans and 43% were female. Other evaluative results are too extensive to summarize here. A detailed 21-page evaluation report titled *"South Dakota Space Days 2010: Careers with a View - Evaluation Report"* on file at SDSGC Headquarters was prepared by SDSGC Program Evaluators Tyson Abbott and Anna Maday, graduate students enrolled in SDSU's Rural Sociology program.

SDSGC headquarters staff provided an additional three NASA space-related informal education programs to 185 members of the general public during FY2010. Presentations were given at Neutrino Day in Lead, SD (site of the Sanford Underground Science and Engineering Lab), the Black Hills Astronomical Society, and the Journey Museum's Final Frontier Friday science lecture series.

NASA 2010 Education Priority Accomplishments:

- **Hands-on student experiences in NASA-related STEM disciplines** that incorporate real-life problem-solving needs were provided to the following six multi-disciplinary university student teams at SDSM&T that participated in national competitions during FY2010 with Space Grant support, several of which are summarized above under Outcome 1 Higher Education: 1) Aero Design Team, 2) Robotics Team, 3) Programming Team, 4) *Moonrockers* Lunabotics lunar regolith excavator team, 5) Unmanned Aerial Vehicle Team, and 6) Autonomous Underwater Vehicle Team. Similarly, authentic experiences were provided to precollege students through significant direct support from Space Grant as summarized above under Outcome 2 Precollege: 1) 410 middle school students who benefited from participating in the 2nd Annual South Dakota FIRST LEGO® League (FLL) Robotics Tournament, and 2) 1,400 middle and high school girls who attended six Women in Science Conferences in South Dakota.

- **Engaged middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise** – The SD Discovery Center (SDDC) used FY2010 Space Grant funding to support Ed Sobey "Global Evangelist for Creative Thinking" as a featured speaker at the Feb. 3-5, 2011 South Dakota Science and Math Teachers Conference in Huron. SDDC is reaching more teachers and building stronger networks with the SD Science and Math Teachers associations by providing Space Grant teacher workshop funds to annually host a major conference speaker. Sobey is author of the book Rocket-Powered Science: Invent To Learn! Create, Build & Test Rocket Designs. His rocket-building activities are designed to challenge students to work in teams like NASA engineers where they develop and test models as they measure and record data, and graph and report results. On Feb. 6-7, Sobey then conducted a two-day workshop for 25 teachers at the SDDC in Pierre, SD. In February 2011, SDDC also began providing GEMS

(Great Explorations in Math & Science) training to Sinte Gleska University pre-service teachers. SDSGC supports GEMS teacher-training workshops and provides funds for the kits as part of its precollege program.

In partial fulfillment of one of SDSGC's Annual Performance Objectives to *"Support teacher training workshops in NASA priority areas,"* NASA AESP-trained staff from the Journey Museum and SDSM&T provided Space Grant-funded after-school robotics training for middle school teachers in the form of a two-day workshop at North Middle School in Rapid City attended by 6 teachers. Likewise, Augustana College provided four middle school teacher-training workshops in robotics attended by 22 teachers.

- **Summer 2010 opportunities for secondary students on college campuses** with the objective of increased enrollment in STEM disciplines and interest in STEM careers included the following four camps, the first three of which are detailed above in this report: 1) the week-long 2010 Aerospace Career and Education (ACE) Camp held on the campus of SDSU with 18 high school students, 2) the two-week NASA SOLAR "Space Observation, Learning, and Research" Institute held on the campus of SDSM&T, 3) the six-week South Dakota GEAR-UP program held on the campus of SDSM&T with 220 high school students from Tribal schools (85% of whom are Native American), and 4) the Flandreau Indian School Success Academy held on the campus of SDSU which is an intensive STEM-focused college-preparatory program for over 200 Native American high school students. These four programs fulfilled one of SDSGC's Annual Precollege Performance Objectives to *"Support summer STEM programs for precollege students on college campuses with emphasis on Native American students. [At least four summer STEM precollege programs for 450 students.]"*
- **Community Colleges** – SDSGC continued working with two year college affiliate Lake Area Technical Institute on their Space Grant-funded Project Initiation Grant 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. SDSGC's relationship with affiliate Lower Brule Community College was maintained throughout FY2010, but no special projects were undertaken this year.
- **Aeronautics research** – Of the five meritorious Project Innovation Grant projects selected for SDSGC funding during FY2010, a project titled *Aviation at Augustana College* was selected for a \$10,000 grant to plan an aviation/aeronautics program at Augustana that would align with NASA's aeronautics mission directorate and augment similar existing programs underway in South Dakota such as ACE Camp at SDSU.
- **Environmental Science and Global Climate Change** – The Journey Museum was one of a national collaboration of planetariums, scientific institutes and community-based organizations selected for \$1.25 million in shared funding through NOAA

Department of Education's Environmental Literacy Grant Program. The three-year grant funds the development of innovative, planetarium-based ecological literacy programming in a project called the Worldviews Network. Participating institutions use a shared library of interactive visualizations that present basic concepts about cosmic, solar system, and global Earth systems science. The Network links participating planetariums and creates programming that educates audiences about global change issues such as biodiversity loss, climate change, and ocean acidification, using the planetariums' unique immersive visualization technology as a teaching tool. Each partner planetarium customizes its presentation about a regional issue with the help of the Network and local community partners. Planetariums are linked via "domecasting" technology which enables the Journey Museum audience to be in live communication with presenters in different cities and learn about a variety of environmental issues both locally and abroad. Numerous partners include NASA Goddard and Ames Research Center.

In June 2010 SDSGC supported a proposal submitted by Sinte Gleska University under NASA's Tribal Colleges and Universities Project (TCUP) to conduct research into carbon sequestration in grasslands on Tribal lands, but the project was not funded.

- **Diversity of institutions, faculty, and student participants** – SDSGC's Diversity goal *"to model diversity in all Consortium programs and activities, with an emphasis on Native Americans, which make up the state's largest minority group"* was met in terms of institutions and student participants. Three of the ten institutions of higher education that are members of the Consortium are Tribal colleges (Oglala Lakota College, Sinte Gleska University, and Lower Brule Community College). Sixteen percent of the university student fellowship awards were provided to minority students, exceeding SDSGC's target goal of 10%. Over 21% of the precollege students who participated in Space Grant programs are Native American.
- **Support of innovative research infrastructure activities to enable early career faculty to focus research toward NASA priorities** – Of the five meritorious Project Innovation Grant projects selected for SDSGC funding during FY2010, the research infrastructure project mentioned earlier titled *"Vacuum Assisted Resin Transfer Molding (VARTM) Process Simulation for Compressible Preform Materials"* was awarded to early career faculty member Dr. Marc Robinson of SDSM&T who received his Ph.D. in 2008.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- Longitudinal Tracking: Total Fellowship/Scholarship awards in FY2010 = 89; 14 of the total awards were to underrepresented minority students. During the FY2010 program year, 14 students (supported from FY06-FY10 funds) took their next step: 3 are pursuing advanced degrees in STEM disciplines, 3 accepted STEM positions at NASA contractors, 1 accepted a position at NASA, 4 accepted STEM positions in industry, 1 accepted a STEM position in K-12 academia, 1 accepted a STEM position

in academia, and 1 went on to a position in a non-STEM discipline. Of 52 students who were significantly supported and took their next step in the period spanning FY06-FY10, 11 are pursuing advanced degrees in STEM disciplines, 10 accepted STEM positions at NASA contractors, 3 accepted positions at NASA, 22 accepted STEM positions in industry, 1 accepted a STEM position in K-12 academia, 2 accepted STEM positions in academia, and 3 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.

Course Development: There were no new courses developed with Space Grant support during FY2010 that are targeted at the STEM skills needed by NASA. However, SDSM&T's relatively new M.S. program that began during FY2009 with Space Grant support titled Robotics and Intelligent Autonomous Systems (RIAS) with five new courses has proven successful in terms of student interest and enrollment in FY2010. 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. 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
\$660,000	\$180,000	\$480,000	\$480,000	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). In June 2010, SDSGC supported a proposal submitted by Sinte Gleska University under NASA's Tribal Colleges and Universities Project (TCUP) to conduct research into carbon sequestration in grasslands on Tribal lands. SDSGC and the Wisconsin Space Grant Consortium partnered to support four Native American students and one faculty member from Sinte Gleska University to attend a rocket workshop held in Wisconsin at the College of Menominee Nation's Green Bay campus in December 2010. Although the following project was reported in last year's APD report, the work was conducted during FY2010 and is therefore reported here. During summer 2010, 15 undergraduate students participated in a 10-week summer research experience at the Deep Underground Science and Engineering Laboratory (DUSEL) at the former Homestake gold mine in the Black Hills under funding from SDSGC's FY2009 CDC titled "*NASA-DUSEL Research Center for Probing the Earth's Interior.*" The project fosters increased involvement of NASA in underground science at DUSEL. Oglala Lakota College students participated in this multi-institutional project and were mentored by faculty, postdoctoral researchers, and graduate students from USD, SDSM&T, Black Hills State University, Oglala Lakota College, Augustana College, and Dakota State University. The participating student team then traveled to a meeting at NASA JPL in July 2010.

IMPROVEMENTS MADE IN THE PAST YEAR

In September 2010, with funding provided under the Journey Museum's successful 2009 NASA Competitive Program for Science Museums and Planetariums grant to develop educational programming, a portable "*ExploraDome*" Uniview planetarium was obtained. In its first six months, the planetarium has provided programming to 14 Tribal, public, and private schools throughout the state and has reached 1,250 students and 62 teachers as direct participants. Of the 1,250 students, 1,078 were elementary, 125 middle school, and 24 high school level. 228 (18.2%) of these students are Native American. Similarly during FY2010, the Journey Museum implemented a 21st Century Community Learning Center Program which consists of a four-session after-school program about stars for students in grades 2 – 5. The program reached 120 elementary participants and consists of visiting NASA's "Space Place Live" website, a flat-screen planetarium program, a lesson on lenses and telescopes, and a craft activity to build a star finder.

In January 2011, SDSGC took on a new two-year rotating member on the Consortium's Management Team from affiliate University of South Dakota (USD), which has resulted in increased engagement of USD.

During FY2010, SDSGC expanded its contract with the National Space Grant Foundation and implemented a new online proposal and review system. This system was used for SDSGC's Robotics Materials Award and Project Innovation Grant programs as a pilot test of the system. The online process and may be expanded during FY2011 to include student fellowship/scholarship applications and review.

Significant updates were made to SDSGC's competitive fellowship/scholarship program by A) going completely paperless, B) establishing four categories of awards (educational stipends, NASA and industry internship stipends, and undergraduate and graduate research stipends), and C) raising the dollar level of undergraduate and graduate research stipends.

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

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)