



# **FY2010 PROGRAM PLAN**

**January 29, 2010**

**SOUTH DAKOTA SPACE GRANT CONSORTIUM**

**[www.sd.spacegrant.org](http://www.sd.spacegrant.org)**

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Edward F. Duke, Ph.D.  
Director

South Dakota Space Grant Consortium  
South Dakota School of Mines and Technology  
501 E. St. Joseph Street  
Rapid City, SD 57701-3995

Phone: (605) 394-2388  
Fax: (605) 394-5360  
Email: [Edward.Duke@sdsmt.edu](mailto:Edward.Duke@sdsmt.edu)

**\* NOTE: Individual Subaward Plans were submitted to NASA, but are not included in this on-line version**

## Consortium Concurrence

1. By their signatures below, the Director of the SD Space Grant Consortium and affiliate representatives indicate their agreement with the contents of the FY2010 proposal.  
*(Signatures were included in the hard copy document submitted to NASA via Fed-Ex.)*

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Edward F. Duke, Ph.D. – Director, SDSGC  
SD School of Mines & Technology (Lead Inst.)

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Gregg Johnson – Program Manager, \*ASRC  
Research & Tech. Solutions, EROS Contractor

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Kevin Dalsted – Assoc. Director, SDSGC  
SD State University

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Daniel Swets, Ph.D. – Assoc. Director, SDSGC  
Augustana College

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Kristie Maher – Assoc. Director, SDSGC  
Exec. Director, SD Discovery Center

---

Ray Summers – Executive Director  
The Journey Museum

---

Subodh Singh  
Sinte Gleska University

---

Left Organization (Replacement being sought)  
Chris Rossing, Director  
Kirby Science Discovery Center

---

Brennan Jordan  
University of South Dakota

---

Ron Dyvig – Director  
Badlands Observatory

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Frank Belinsky – President  
Black Hills Astronomical Society

---

Andy Johnson, Ph.D. – Assoc. Dir., Center for the  
Adv. of Math & Science Ed., Black Hills State Univ

---

William Figg, Ph.D., Associate Professor  
Dakota State University

---

Greg Klein, Aviation Instructor  
Lake Area Technical Institute

---

(Unavailable for signature approval)  
Sheryl Scott, President  
Lower Brule Community College

---

Charles (Jason) Tinant, Math & Science Program  
Manager, Oglala Lakota College

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Thomas Zeller, President  
RESPEC

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(Unavailable for signature approval)  
Mark West, President and Chief Engineer  
Aerostar International, Inc. (Raven Industries)

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Margaret Norris  
Sanford Underground Science & Engineering Laboratory at Homestake

\* SAIC representative prior to 2008. ASRC initiated a separate EROS contract in 2008.

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## **B. ABSTRACT**

The vision of the South Dakota Space Grant Consortium (SDSGC) is to expand opportunities for all South Dakotans through education, research, and public service in the fields of aerospace, earth science, and supporting STEM disciplines. We specifically seek to include women, Native Americans, and other underrepresented groups in all programs and activities supported by SDSGC. At both the higher education and precollege level, student participants in SDSGC programs are provided hands-on research and learning experiences that emphasize interdisciplinary problem-solving skills that are directly relevant to NASA mission challenges.

In the course of the previous five-year grant period, SDSGC implemented key adjustments to improve the impact of its programs. Inactive affiliates were dropped and strategic new partnerships were established, resulting in a smaller but more engaged network. The fellowship/scholarship program has become increasingly competitive and more focused on state and NASA research priorities. Close coordination with the state NASA EPSCoR program has advanced targeted research collaborations in support of the Exploration Systems and Science Mission Directorates, most notably with NASA projects at the Ames and Glenn Research Centers. Consortium management has responded to supplementary opportunities from the Office of Education, allowing SDSGC to expand its programs and increase participation. These include successful competitions in NASA EPSCoR, several ESMD Space Grant programs, two Consortium Development Competitions, INSPIRE Collegiate Experience (Tier 2A), Competitive Programs for Science Museums and Planetariums, as well as separate STEM education grants from NSF and other sources. The consortium has increasingly shifted precollege and public service programs to partnerships with its informal education affiliates and NASA's Aerospace Education Services Program (AESP), allowing greater resource allocation for Outcome 1 activities without sacrificing critical components of the state's STEM pipeline. These programs include two highly successful precollege STEM summer programs on college campuses. Finally, SDSGC has shown a commitment to implementing evidence-based assessment of all of its programs including retention of an independent evaluation specialist.

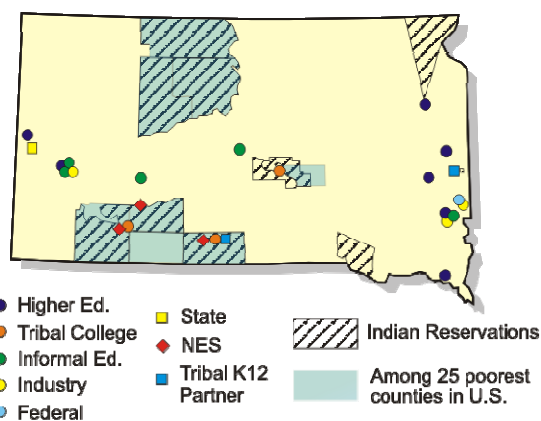
The management structure of SDSGC has demonstrated the ability to respond to the changing needs of the state and evolving NASA priorities. During the next five-year grant period, SDSGC will continue to serve as a model for innovative state-based public/private education initiatives featuring strong interagency partnerships. Unique new opportunities exist for partnerships with aerospace companies that have recently begun operations in the state. SDSGC will continue to advance NASA science priorities at the state's two major research facilities, the USGS Center for Earth Resources Observation and Science (EROS) and the Deep Underground Science and Engineering Laboratory (DUSEL).

During the 2010-2014 period, SDSGC programs will contribute to the state of South Dakota by leveraging educational investments to sustain its unique STEM education pipeline, spanning elementary through graduate levels. SDSGC programs will contribute to NASA by providing a responsive and flexible in-state network that connects NASA research and development needs with talented students and teachers and strengthens the nation's STEM workforce. Despite its small population and limited research infrastructure, South Dakota institutions will continue to support NASA through science and engineering research programs and through the advancement of Native American student in STEM fields. The 2010 Program Plan that follows demonstrates that SDSGC programs will make significant contributions to NASA's PART measures in higher education and elementary/secondary education.

### C. CONSORTIUM PROFILE

In recent years, SDSGC and other state organizations have fostered significant advances in STEM capabilities of South Dakota, including progress toward the goals of the Governor's *Research 2010 Initiative*. Still South Dakota faces many challenges in efforts to develop a competitive and sustainable science and engineering infrastructure. The state ranks 47<sup>th</sup> in population and has the fifth lowest population density. Population sparsity hinders access to STEM education resources for the state's rural students and teachers. In addition, South Dakota has five of the seven poorest counties in the nation, all of which are located on or adjoining the state's nine Indian reservations. With respect to key science and engineering (S&E) indicators, South Dakota ranks between 49 and 51 in the following:<sup>1</sup> federal R&D (51); industry R&D (49); academic R&D (51); S&E doctorates awarded (50); science, engineering and health (SEH) post-docs in doctorate-granting institutions (50); and employed SEH doctorate holders (51). Enrollment at the state's six public universities for fall 2009 was 33,779 of which only 3,709 were in graduate programs. There are no degree programs in aeronautics or aerospace, and until recently, there have been no aerospace-related industries with operations in the state.

In response to these challenges, and in order to improve STEM education, research, and economic activity, SDSGC maintains a statewide network of 20 organizations representing public, private, and tribal universities, a technical institute, informal education centers, technology-based industry, a state science and technology authority which operates DUSEL, and a federal research facility (EROS) that supports NASA missions (see adjacent map). In keeping with SDSGC's status as a Capability Enhancement Program, emphasis is on NASA Education Outcome 1, especially in the areas of undergraduate and graduate student support, student involvement in interdisciplinary engineering design teams and summer internships, targeted programs at Tribal Colleges, and higher education curriculum enhancement including robotics programs that are integrated with precollege robotics activities. Support of NASA Education Outcomes 2 and 3 includes an internal network of informal education providers across the state, educator professional development in collaboration with NASA's Aerospace Education Services Program (AESP), and targeted teacher and student involvement programs at tribal schools including three NASA Explorer Schools.



Unlike other capability enhancement programs in the state (e.g., NSF EPSCoR), Space Grant is in a unique position to have a comprehensive impact across all educational levels and across all sectors – public, private, tribal, government. SDSGC uses this opportunity to advance two major themes across its programs: development of the state's STEM workforce, and improving educational and research opportunities for the state's Native American population. SDSGC will continue focusing on statewide development of robotics programs that link university faculty and students with precollege teachers, students, and community-based organizations such as 4-H. These efforts have directly contributed to the first state robotics competition in 2010 (30 teams) and to a new and unique M.S. program in Robotics and Intelligent Autonomous Systems.

<sup>1</sup> National Science Foundation, Science and Engineering State Profiles: 2006-2008, NSF 10-302, November 2009

## **D. PROGRAMMATIC ELEMENTS**

### **D.1. NASA Education Outcome 1**

#### **D.1.a. Diversity**

Based on latest data from the National Center of Education Statistics Digest (Fall 2007),<sup>2</sup> South Dakota's minority enrollment in degree-granting institutions is 10.8% (9.8% as adjusted for Asian students) of which 7.1% are Native American. With regard to student awards through SDSGC's Fellowship/Scholarship, Higher Education, and Research Infrastructure programs, awards to minorities and women will equal or exceed targets of 10% to minorities and 40% to females.

Diversity remains a cross-cutting theme with strategic objectives in all five program areas as well as Management strategies that are designed to recruit and support women and underrepresented minorities. SDSGC's Strategic goal for Diversity is "To model diversity in all Consortium programs and activities, with an emphasis on Native Americans, which make up the state's largest minority group." The goal for Minority Serving Institutions is "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." Specific objectives, strategies and outcome indicators for these goals are provided in the Consortium's *2010 Strategic Plan* (Appendix. G.1). Special efforts will continue to be made by Consortium staff to place minority and female students funded by SDSGC's higher education programs at NASA Centers to conduct internships and related research projects, as well as to facilitate employment at NASA upon graduation. Two female Space Grant graduates in recent years are now employed by NASA at KSC and JSC.

The Consortium's Management Team will continue to work with the Space Grant contacts at SDSGC's 10 academic affiliates (three of which are Tribal Colleges or Minority-focused institutions), three Informal Education affiliates, and two K-12 Tribal Partner Schools to improve recruitment of qualified female and minority students. Recruitment strategies include support of the following precollege and college bridge programs: Women in Science Conferences, Flandreau Indian School Success Academy held on the campus of South Dakota State University (SDSU), St. Francis Indian School, Native American South Dakota GEAR UP Program held on the campus of South Dakota School of Mines and Technology (SDSM&T), NASA Explorer Schools, and South Dakota Space Days. Strategies to maintain and support participation include targeting women and minorities in the Fellowship/Scholarship announcement, a 2007 Consortium Development Competition grant that targets women and Native Americans (one Native American and one Hispanic student have been recruited into STEM MS programs at SDSM&T), support for remote sensing research test sites located near Tribal Colleges, and support for Native American student members of the American Indian Science and Engineering Society. SDSGC is currently developing a Summer of Innovation proposal that would offer a summer residential STEM experience for Native American middle-school students.

*NASA Education Outcomes and PART Measures: SDSGC diversity efforts support Objectives 1.2 and 2.3, and contribute to the Outcome 1 PART Measure on underrepresented students*

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<sup>2</sup> [http://nces.ed.gov/Programs/digest/d08/tables/dt08\\_228.asp](http://nces.ed.gov/Programs/digest/d08/tables/dt08_228.asp)

### D.1.b. Fellowship/Scholarship

*Description* – The goal of the SDSGC Fellowship/Scholarship program is **“To administer a Fellowship/Scholarship program that offers educational and research opportunities to students from diverse backgrounds who are pursuing degrees in fields of STEM that align with NASA’s mission and those of SDSGC members and affiliates.”** The *2010 Strategic Plan* (Appendix G.1) identifies seven specific objectives for achieving this goal (box at right); associated with each objective are operational strategies and outcome indicators that the Consortium uses to measure the success of the program.

#### Fellowship/Scholarship Objectives

- B.1.1: Competitiveness
- B.1.2: NASA & EROS ties
- B.1.3: Industry ties
- B.1.4: Mentoring and professional development
- B.1.5: Diversity
- B.1.6: Long. tracking
- B.1.7: Evaluation

In order to track the next step that students take after Space Grant funding in terms of workforce or advanced education, SDSGC will continue to secure the services of the National Space Grant Foundation throughout FY2010 and beyond to provide longitudinal tracking of all students who receive significant support from Space Grant. In South Dakota, students receiving \$1,000 or more in a single award will be included in our longitudinal tracking surveys and respective database. Based on the fact that 55 students were selected from among six Consortium universities in 2009 to receive significant fellowship/scholarship funding, it is projected that a similar number of STEM degree seeking students will be selected and longitudinally tracked in 2010. This proposal for the first increment of FY2010 funding will provide \$110,000 in fellowship/scholarship awards with a higher amount anticipated in a projected proposal for a second increment. Because SDSGC does not award fellowship/scholarship awards less than \$1,000, there will be no funded students who are not tracked. Evaluation methods are discussed further in section E.1 Consortium Management.

*Competitiveness* – SDSGC invites applications from all undergraduate and graduate students of U.S. citizenship enrolled at any South Dakota institution of higher education who are engaged in the study of STEM disciplines that align with NASA’s mission and those of SDSGC affiliates. The Consortium specifically encourages applications from women, underrepresented and Tribal College students, and persons with disabilities. The announcement for the FY2010 Fellowship/Scholarship program will be released at the start of the fall 2010 semester. The announcement is distributed through the designated Space Grant representatives at each affiliate college, and where campus regulations permit, the announcement is sent directly to all student e-mail addresses. The announcement is also posted on the SDSGC website and the state NSF EPSCoR website along with links to other statewide STEM fellowship and internship opportunities.

Applications are reviewed by SDSGC’s Management Team and selections are made based on academic excellence, alignment with the goals of NASA and SDSGC, and an assessment of the applicant’s motivation toward an earth science, aerospace, or engineering career or research. Special consideration is given to applicants interested in internships at NASA Centers, EROS, or other federal or aerospace industry internships. As a result of broader promotion of the program and an increase in applications, the selection process has become more competitive. In 2006, 86% of the applicants who requested NASA funding received awards (36 awardees from 42 applicants), whereas that percentage dropped to 71% by 2009 (55 awardees from 78 applicants). During the past six years, the number of institutions receiving SDSGC Fellowship/Scholarship awards increased from three to eight including three Tribal College affiliates. In 2009, the Management Team restructured the funding strategy in the fellowship/scholarship program. A



small number of \$1000 awards are made to outstanding freshmen and sophomores in order to attract them into the cohort of Space Grant students and the NASA pipeline. Upper-level students who demonstrate continued interest and successful progress are eligible for \$2500 awards, and senior or graduate-level students proposing specific NASA-related research projects are awarded up to \$12,000.

*NASA Education Outcomes and PART Measures: SDSGC Fellowship/Scholarship programs support Objectives 1.1, 1.2, 1.3, and 1.5, and contribute to Outcome 1 PART Measures on employment, advanced education, and underrepresented students*

### D.1.c. Research Infrastructure

*Description* – The goal of the SDSGC Research Infrastructure Program is **“To promote the improvement of research programs and capabilities of institutional and affiliate members with an emphasis on the fields of aerospace, earth science, and supporting STEM disciplines.”** The 2010 *Strategic Plan* identifies seven specific objectives for achieving this goal (box at right); associated with each objective are operational strategies and outcome indicators that the Consortium uses to measure the success of the program.

#### Research Infrastructure Objectives

- B.2.1: Research proposals
- B.2.2: Research support
- B.2.3: Collaborations
- B.2.4: Facilities
- B.2.5: Integrate research & education
- B.2.6: Diversity
- B.2.7: Evaluation

Students awarded campus research funds and funds to assist with off-campus internships of >160 hours at NASA Centers and industry are awarded those funds through SDSGC’s Fellowship/Scholarship Program described above. Those students meet SDSGC’s longitudinal tracking threshold and are tracked under that program. So as to avoid duplicate counting, students receiving fellowship/scholarship funds are not counted under the Research Infrastructure program.

SDSGC Research Infrastructure programs include: (1) A statewide competition for Program Initiation Grants for research development offered at all 10 higher education affiliates including three Tribal Colleges; emphasis is on interdisciplinary research focused on NASA, DUSEL, or EROS priorities. (2) Support for collaborative research proposals in NASA areas. (3) Support for Tribal College research roundtables in conjunction with NASA EPSCoR. In recent years, SDSGC has partnered with its tribal college affiliates on two NSF TCUP (Tribal College and Universities Program) proposals and an NSF proposal for a Pre-engineering Education Collaborative (PEEC). The annual number of participants is estimated to be about 65 during FY2010.

*Interdisciplinary* – Students and faculty supported through the Research Infrastructure, Higher Education, and Fellowship/Scholarship programs represent more than 35 disciplines. The Consortium prioritizes support of interdisciplinary projects, including engineering design teams (Aero Design Team, Unmanned Aerial Vehicle Team, IEEE Robotics Team, Mars ASME Mars Rock Retriever, Autonomous Underwater Vehicle, and ESMD Lunabotics). Since its inception, SDSGC has promoted research in support of NASA’s Earth Observing System, especially through cooperative programs with the Land Processes DAAC at EROS. EROS is a key partner in the nation’s efforts to monitor global climate and environmental change. EROS is staffed by approximately 600 USGS and private sector employees, some of whom are deployed at NASA Goddard. EROS employees also maintain offices on the campuses of SDSGC



affiliates. Research collaborations with EROS are inherently interdisciplinary in nature, bringing together specialists in remote sensing, geography, geology, hydrology, atmospheric science, physics, plant science, agronomy, computer science and engineering, and electrical engineering. For example, the Augustana College “Remote Sensing Pipeline Project” is in partnership with EROS and SDSU to provide quality undergraduate students from a wide range of disciplines who upon graduation from Augustana, enter graduate school at SDSU and conduct meaningful research in the SDSU/EROS Remote Sensing Center of Excellence. SDSGC supports students conducting interdisciplinary research at the Deep Underground Science and Engineering Laboratory (DUSEL) at the site of the former Homestake mine in the Black Hills mentioned earlier and discussed in more detail below. For example, six students provided with stipends through the FY2009 Fellowship/Scholarship program are members of an interdisciplinary research senior design team that is constructing an Autonomous Underwater Vehicle (AUV) robotic submarine to be field tested at DUSEL. An additional \$10,000 was made available to the AUV project.

The DUSEL concept initially started as a SDSGC initiative in 2001 through collaboration with the University of Pennsylvania. Today, DUSEL is unquestionably the state’s number one research and development priority. In 2007, NSF selected the site from among seven sites as the preferred location for a national and international deep science facility, and more than 50 scientists from across the U.S. and abroad are actively involved in the project. State, private and federal funds of \$85 million are now committed to the project to develop an interim lab at the 4,850-foot level, near the site of measurements of solar neutrino flux by Ray Davis that lead to the 2002 Nobel Prize in Physics. Currently, a faculty member from the lead institution, along with a physicist from UC-Berkeley/Lawrence Berkeley National Laboratory, is a Principal Investigator on a \$15 million NSF grant to develop the final science and engineering plans for a deeper laboratory at the 7,400-foot level. The project will next be submitted as an NSF Major Research Equipment expenditure, which would pave the way for \$300 million in federal funds to develop the infrastructure down to the 7,400-foot level. Once fully operational, DUSEL will be a multi-disciplinary facility with research in neutrino physics, particle physics, dark matter, nuclear astrophysics, nucleosynthesis, microgravity, geomicrobiology, hydrology, and geology, as well as the site of a comprehensive Education and Outreach center that will be managed by an SDSGC affiliate. Science and engineering experiments will be funded primarily by DOE and NSF, but research in astrophysics and dark matter may also attract NASA funding. The lead institution is already working with NASA Ames researchers on possible experiments and student internships. Faculty from all eight of the Consortium’s four-year universities (including two Tribal Colleges) are involved in research, education, or outreach components of the DUSEL project, and SDSGC will continue to invite and fund Program Initiation Grant applications related to DUSEL research. In 2009, SDSGC was awarded a Consortium Development Competition grant that supports six affiliate institutions in development of a “NASA-DUSEL Research Center for Probing the Earth’s Interior.” Furthermore, several DUSEL research projects have been funded by SD NASA EPSCoR seed grants, and a NASA EPSCoR Major Research proposal will be submitted in February 2010 involving laser pulsed cold atom interferometry (AI) in collaboration with NASA Ames and Stanford University.

Building on the national visibility of DUSEL, a new joint Ph.D. degree program in Physics was approved by the SD Board of Regents in December 2009. Under this new physics program, each of three state universities and members of the Consortium (SDSM&T, USD, and SDSU)

will have individual authority to award the PhD. Faculty from two other Consortium universities will also assist in teaching courses and serving on dissertation committees.

*NASA Education Outcomes and PART Measures: SDSGC Research Infrastructure programs support Objectives 1.1, 1.2, and 1.5, and contribute to Outcome 1 PART Measures on underrepresented students and institutions in EPSCoR state*

#### D.1.d. Higher Education

*Description* – The goal of the SDSGC Higher Education Program is **“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.”** The 2010 Strategic Plan identifies six specific objectives for achieving this

goal (box at right); associated with each objective are operational strategies and outcome indicators that the Consortium uses to measure the success of the program.

##### Higher Education Objectives

- B.3.1: Curriculum and NASA content
- B.3.2: NASA and EROS ties
- B.3.3: State government
- B.3.4: Industry involvement
- B.3.5: Diversity
- B.3.6: Evaluation

Students awarded funds for participation in higher education experiences of >160 hours are awarded those funds through SDSGC’s Fellowship/Scholarship Program described above. Those students meet SDSGC’s longitudinal tracking threshold and are tracked under that program. So as to avoid duplicate counting, students receiving fellowship/scholarship funds are not counted under the Research Infrastructure program.

SDSGC Higher Education funding during FY2010 will support for: (1) A statewide competition for Program Initiation Grants for course development offered at all 10 higher education affiliates including three Tribal Colleges; emphasis is on NASA disciplines. (2) Interdisciplinary student engineering design teams in NASA priority areas. (3) Summer STEM “bridge” programs for precollege students on college campuses with emphasis on Native American students (see below and section D.2.a Precollege).

Higher education college-preparatory “bridge” programs will be provided to secondary students on college campuses through the continuation of SDSGC-supported programs such as the six-week, residential South Dakota GEAR UP program held on the campus of SDSM&T, and the Flandreau Indian School (FIS) Success Academy held on the campus of SDSU. Both the SD GEAR UP and FIS Success Academy are college-preparatory programs each involving over 200 Native American high school students from Tribal schools on reservations within South Dakota who express interest in science and engineering. An objective of these two programs is increased enrollment in STEM disciplines and interest in STEM careers. The two programs use tracking and evaluation tools to assess interest in STEM disciplines.

About 85% of the participants in the SD GEAR UP program are Native American students and two-thirds are female. Over the six-week period, faculty, campus researchers, and administrators offer daily seminars on technology and career exploration to start the day. Students then attend classes throughout the day in math, science, English, computers, and life sciences. Mini-courses are provided in a wide variety of science and engineering subjects with a hands-on, engaging approach including tours of the many campus laboratories, a science fair, and professional development training. SDSGC personnel provide NASA content to the

curriculum and explain Space Grant-funded opportunities that the students can access when they enter college. Over the 17 years that the SD GEAR UP program has been offered, statistics show that of those students who graduate from the program, virtually 100% graduate from high school and 87% attend college. The director of SD GEAR UP is a former SDSGC student and NASA USRP intern. In January 2010, he was awarded the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring at the White House. Planning for the Summer of Innovation proposal focuses on extending the reach of SD GEAR UP to add additional programs for middle-school students and additional NASA content.

Based on metrics from recent years, it is estimated that about 720 college and university students will participate in the Consortium's Higher Education programs during FY2010. An estimated 400 of the 720 students consist of Native American precollege students participating in the SD GEAR UP and Flandreau Indian School (FIS) Success Academy programs held on the campuses of SDSM&T and SDSU where many of them will take college courses for credit. Because SD GEAR UP and FIS Success Academy are college-preparatory programs, the 400 Native American precollege students are considered "other participants" in the area of higher education. Pursuant to NASA guidance, those 400 students are included in SDSGC's PART Measure total number of underrepresented students participating in NASA higher education programs rather than in precollege (see Appendix G.4).

*Interdisciplinary* – As emphasized above in the Higher Education program goal, SDSGC focuses on interdisciplinary experiences for individual students or design teams such as the following that provide hands-on, engineering programs that integrate a wide variety of STEM fields: 1) Aero Design Team, 2) Unmanned Aerial Vehicle Team, 3) interdisciplinary robotics teams such as IEEE Robotics, ASME Mars Rock Retriever, and AUV Robotic Submarine Teams. Additionally, a combined team representing SDSM&T and Oglala Lakota College is among 25 qualifiers for the May 2010 Lunabotics Mining Competition. These activities are focused around challenging engineering design problems, but also incorporate real-world, systems-engineering aspects, such as logistics, planning, resource development, and deadlines, that prepare students for the STEM workforce. Four students from affiliate Oglala Lakota College were among 16 tribal college students selected for a six-week NASA-AIHEC (American Indian Higher Education Consortium) summer robotics program at Southwest Indian Polytechnical Institute in Albuquerque, capped by a week-long program at Johnson Space Center.

The Interdisciplinary Robotics Initiative (IRI) began at SDSM&T three years ago through an SDSGC Project Initiation Grant and has seeded additional growth in robotics education at both the university and precollege level. The IRI project is aimed at increasing the number of graduates in computer science and engineering and promoting careers in science and technology. Furthermore, the IRI activity sparked a fundamental change in SDSM&T's Computer Science graduate program in that a new M.S. program was developed with NASA support and approved by the SD Board of Regents in April 2009. SDSM&T formally converted its M.S. in Computer Science from a broad survey degree to an interdisciplinary program in Robotics and Intelligent Autonomous Systems (RIAS). The RIAS program covers the essentials of robotics, artificial intelligence, control, communications, sensors and signal processing. It is one of fewer than a dozen graduate programs in the U.S. providing this kind of educational opportunity. Students will have the opportunity to gain advanced knowledge in focus areas such as pattern recognition, computer vision, nonlinear control, digital signal processing, and communications. The new

program promotes additional growth in robotics education at both the university and precollege level and will increase the number of graduates in computer science and engineering that go on to pursue STEM careers. Faculty in the RIAS program are actively engaged in the development of the statewide South Dakota Robotics Association and the integration of advanced robotic designs into precollege robotics programs.

In February 2010, Dr. Jennifer Karlin of SDSM&T's Industrial Engineering will represent SDSGC in NASA's Education Forum entitled "*STEM Education Research: Current Findings and Needs*" at Kennedy Space Center. Dr. Karlin leads SDSM&T's Taskforce on STEM Education Research.

*NASA Education Outcomes and PART Measures: SDSGC Higher Education programs support Objectives 1.2, 1.3, 1.4, and 1.5, and contribute to Outcome 1 PART Measures on employment, underrepresented students, course development, and institutions in EPSCoR states*

## **D.2. NASA Education Outcome 2**

### **D.2.a. Precollege Education**

*Description* – The goal of the SDSGC Precollege Education Program is **“To increase student awareness and access to educational and career opportunities in aerospace, earth science, and supporting STEM disciplines.”** The 2010 Strategic Plan identifies seven

specific objectives for achieving this goal (box at right); associated with each objective are operational strategies and outcome indicators that the Consortium uses to measure the success of the program. In keeping with the focus of a capability enhancement consortium, SDSGC allots only about 13% of its budget to precollege education programs so the focus remains on NASA Education Outcome 1 objectives. Leverage of outside funding such as from SDSGC affiliates will be sought as a means of augmenting the Consortium's precollege programs. SDSGC maintains targeted e-mail distribution lists for special interest groups in precollege education and participates in the annual state science and math teachers conference and the annual technology in education conference. An estimated 590 teachers and 3,400 students will directly participate in SDSGC's FY2010 precollege programs. Major precollege efforts are summarized here.

#### **Precollege Objectives**

- D.1.1: NASA dissemination
- D.1.2: Partnerships
- D.1.3: In-service teacher training
- D.1.4: Science & education events
- D.1.5: State standards
- D.1.6: Diversity
- D.1.7: Evaluation

➤ SDSGC will continue to sponsor statewide competition for a precollege STEM teacher grant. The \$5,000 Kelly Lane Earth and Space Science grant is awarded annually to a select science or math teacher in South Dakota to recognize and support outstanding teachers and innovative educational programs at the precollege level.

➤ SDSGC will continue to support teacher training workshops in NASA priority areas. A major emphasis will continue to be SDSGC's two-day robotics training workshops, which will be targeted at the middle school level during FY2010. Teachers will be trained by a NASA AESP specialist from JSC and provided hands-on curriculum enhancement capabilities in the field of robotics. Workshops will continue to be held at three SDSGC affiliate locations and will involve direct support of consortium affiliate staff. With assistance from SDSGC (specifically through the Consortium's Associate Director at Augustana College), the “South Dakota

Robotics Association” was formed two years ago. In January 2010, the inaugural South Dakota FIRST LEGO® League (SD FLL) Tournament was held, with children, coaches, and mentors from 30 middle and elementary school teams. 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 for the League.

➤ Through its partnership with affiliate SD Discovery Center (SDDC), SDSGC will continue to financially support and participate in six Women in Science (WIS) conferences held throughout South Dakota in 2010. An estimated 1,200 middle and high school girls will participate. SDDC will also provide “Great Explorations in Math & Science” (GEMS) training and “Advancing Teacher Learning in Space Science” (ATLaSS) workshops for precollege teachers. Ken Graupmann, retired teacher from Kadoka NES school and currently on contract to do space-related informal education program at SDDC, was accepted by NASA to the Solar System Educator Program. He will receive SSEP training in early 2010 and train well over 100 precollege teachers annually in South Dakota.

➤ SDSGC will continue to use its higher education and precollege network to coordinate collaborative proposals for innovations in precollege STEM education with an emphasis on programs that improve STEM opportunities for Native American youth. The consortium is currently consulting with a multi-institution team representing public, private, and tribal groups regarding its response to the Summer of Innovation opportunity. Successful past collaborations include the NSF Opportunities for Enhancing Diversity in the Geosciences, and NASA grants for the INSPIRE Collegiate Experience (Tier 2A) and the Competitive Programs for Science Museums and Planetariums.

➤ SDSGC has a long and successful history of supporting summer STEM programs for precollege students on college campuses, especially those with an emphasis on Native American students. In addition to the summer college-preparatory programs of SD GEAR UP and FIS Success Academy described above under Higher Education, summer opportunities will also be provided to precollege students on college campuses through the continuation of the following SDSGC-supported programs: (1) the Aerospace Career and Education (ACE) Camp held at SDSU, (2) the Space Adventures Camp held at SDSM&T, and (3) the NASA INSPIRE Collegiate Experience (Tier 2A) program at SDSM&T. All of these programs seek to increase enrollment in STEM disciplines and interest in STEM careers, and all programs use tracking and evaluation tools to assess interest in STEM disciplines. Data collected from SDSGC Fellowship/Scholarship applications indicates that former participants in summer precollege programs are now entering the higher education part of the STEM pipeline.

➤ SDSGC will continue to support precollege educators by sharing NASA educational resources and providing appropriate training. These include portable StarLabs, robotic kits, and telescopes. SDSGC affiliate the Journey Museum received notification from NASA in January 2010 that it will be the recipient of a \$492,778 Competitive Programs for Science Museums and Planetariums grant for their proposal entitled “Journey Into Space,” which was submitted in fall 2009 with Consortium support. The grant covers costs for a Uniview Geodome (an inflatable and portable dome with state-of-the-art Uniview planetarium software for space science programming). The grant also covers the salary for a science teacher who will conduct a space science outreach program to schools within South Dakota and neighboring states, stipends for

annual teachers' workshops, and support for additional space science programming and events to be created and conducted by the Journey Museum with assistance from Consortium personnel.

*NASA Education Outcomes and PART Measures: SDSGC Precollege programs support Objectives 2.1, 2.2, 2.3., and 2.4, and contribute to the Outcome 2/3 PART Measures on educator development, student interest, and student numbers*

### **D.3. NASA Education Outcome 3**

#### **D.3.a. Informal Education**

*Description* – The goal of the SDSGC Informal Education (Public Service) Program is **“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.”** The

*2010 Strategic Plan* identifies four specific objectives for achieving this goal (box above); associated with each objective are operational strategies and outcome indicators that the Consortium uses to measure the success of the program. In keeping with the focus of a capability enhancement consortium, SDSGC allots less than 3% of its budget to informal education programs. SDSGC maintains targeted e-mail distribution lists for special interest groups in informal education.

##### **Informal Education Objectives**

- E.1.1: NASA dissemination
- E.1.2: Science and education events
- E.1.3: Diversity
- E.1.4: Evaluation

Implementation of the informal education strategies has increasingly involved partnerships and linkages with the Consortium's three Informal Education affiliates and statewide organizations such as the StarBase Department of Defense Youth Program and 4-H. 4-H is especially effective at reaching rural populations through USDA County Extension educators. SDSGC informal education affiliates are members of the NASA Museum Alliance, and these organizations leverage outside staff and funding as a means of augmenting the Consortium's programs in this area. This has provided a significant pool of qualified presenters of NASA aerospace content who are now able to interact with large numbers of participants across the state. As with its precollege program, SDSGC also shares educational resources (robotics kits, StarLabs, etc.) across this network of informal education providers. It is estimated that 2,885 direct participants will be impacted by SDSGC's informal education programs during FY2010.

➤ SDSGC will continue to partner with informal education affiliates to disseminate NASA content, share NASA educational resources, and host major NASA science education events.

The largest program in this category is South Dakota Space Days, an event held in different communities each year designed to promote STEM literacy and awareness of NASA's mission to the general public. Thousands of students, teachers, and members of the general public from throughout the state participate in hands-on educational activities and visit with experts in aerospace, aeronautics, earth science, engineering, computer science, physics, and other disciplines about their field. Guest speakers with nationally recognized credentials such as NASA astronauts, scientists, and managers present programs and meet with the public. News coverage and interviews with NASA speakers are broadcast by local and statewide media. Numerous exhibits on space and earth science and technology are provided by NASA, SDSGC affiliates, and other organizations. Standards-based educational materials are provided and exhibits are staffed by qualified STEM professionals. Students and teachers are exposed to the

excitement and opportunities of various STEM careers and they learn firsthand about the impact that NASA has on their lives. SDSGC's program evaluator and Management Team continue to evaluate how Space Days events can be improved.

Through matching funds, SDSGC sponsors *StarDate*, heard twice daily on South Dakota Public Radio. NASA and SDSGC are acknowledged, and upcoming consortium events such as the fall Fellowship/Scholarship competition are advertised.

*NASA Education Outcomes and PART Measures: SDSGC Informal Education programs support Objectives 3.1, 3.2, and 3.3, and contribute to the Outcome 2/3 PART Measures on student interest and student numbers*



## E. CONSORTIUM MANAGEMENT

### **E.1. Consortium Management**

*Management structure* – SDSGC’s management structure, goals, and policies and procedures are clearly defined in two documents: (1) the *SDSGC Strategic Plan* (Appendix G.1) which is assessed and updated annually, and (2) the *SDSGC Roles and Responsibilities of Members* (Appendix G.1.a) which was adopted in July 2005 and clearly defines the Consortium’s decision-making process. The organizational structure of the Consortium consists of the Director and Deputy Director (Program Coordinator) at the lead institution, four Associate Directors, and designated Space Grant representatives at each of the remaining 15 affiliates.

The Consortium currently operates under an eight-member Management Team consisting of the Director, Deputy Director, four Associate Directors, one representative from another affiliate, and an ex-officio member of the SD Board of Regents. The Management Team meets on a monthly basis via teleconferences to a) conduct business, b) evaluate program success, c) make/revise policy, d) plan activities, e) develop the budget, and f) make selections of Fellowship/Scholarship and Program Initiation Grant awards. Quarterly meetings are open to all 20 affiliates; these are face-to-face meetings held at different venues in order to encourage participation of affiliates. The Consortium Program Evaluator is present at all meetings.

*Operational policies and procedures* –The *SDSGC Strategic Plan* lays out nine strategic objectives of management (see box at right). Associated with each objective are specific operational strategies and outcome targets to aid in implementation and assessment of the management goals and objectives.

#### **Management Objectives**

- A.1: Reporting
- A.2: National network
- A.3: Consortium network
- A.4: State government
- A.5: State industry
- A.6: Link to public
- A.7: Increase resources
- A.8: Diversity
- A.9: Evaluation

*Evaluation* – All South Dakota Space Grant Consortium (SDSGC) projects are required to build on both formal and informal learning research, practice, and prior work and then add to this knowledge base through evaluation. Summative evaluation procedures vary widely depending on the activity that is being evaluated given the diversity of deliverables. In terms of higher education, fellowship and scholarship program applications, educational programs, and research funding and collaboration, opportunities are announced to all higher education members and affiliates including Minority-Serving Institutions in South Dakota, which are exclusively Tribal Colleges and Universities. Applications are competitively reviewed to ensure the fair distribution of funds to member universities, educational affiliates, and to ensure funding for women, members of underrepresented minorities, and persons with disabilities. Before-and-after surveys are administered to faculty and students who have received significant support from SDSGC to assess the impact of the support on the individual’s education, career, and professional development. In addition SDSGC scholars and fellows are longitudinally tracked through the National Space Grant Foundation’s (NSGF) Longitudinal Tracking system to document, measure, and assess the impact of such programs. The NSGF report is reviewed annually by the SDSGC Management Team to assess the effectiveness of SDSGC programs and funding. After careful review of evaluation reports and the NSGF report by the SDSGC Management Team, adjustments are made to program activities to strengthen activities that are working and drop or improve activities that are not working.

A similar approach to evaluation is also undertaken for both elementary and secondary education and informal education. Before-and-after surveys are developed and administered to precollege program participants and informal education program participants to assess: (1) the impact of such programs on the individual's scientific literacy of aerospace, earth science, and supporting STEM disciplines; (2) their awareness of NASA's mission and educational and career opportunities in STEM disciplines; and (3) the ability of such programs to inspire participants of diverse backgrounds through the excitement of scientific exploration and discovery. After careful review of survey results and evaluation reports by the SDSGC Management Team, adjustments are made to program activities to strengthen activities that are working and drop or improve activities that are not working.

## **E.2. Consortium Structure/Network (Internal)**

SDSGC's statewide network of 20 affiliate institutions including the lead organization consist of 10 public, private, and tribal universities (including one technical institute and one community college), three informal education centers, three technology-based industries, one private observatory that conducts astronomical research, one astronomical society that provides informal education, one state science and technology authority working to develop an underground science and engineering laboratory in the Black Hills, and one federal research facility that supports NASA missions. The map on page ii (Consortium Profile) shows the distribution of these 20 institutions plus five additional institutions consisting of three NASA Explorer Schools and two Tribal K-12 school partners that are not formal affiliates.

As referenced above, the *SDSGC Roles and Responsibilities of Members* (Appendix G.1.a) defines the Consortium's decision-making process. All decisions are made by a vote of a quorum of the Management Team. Most votes are subject to a simple majority, but some decisions, such as changes in membership, or change of Director or lead institution, require a two-thirds vote. Each of the 20 affiliates maintains contact with the Consortium Management Team through a designated Space Grant representative. Affiliate representatives are eligible to apply for a rotating two-year position on the Management Team. Affiliate members receive no regular Consortium funds, but they are eligible to apply for a variety of special programs, many of which provide funding to the organization or to individuals. All of the other roles and responsibilities of affiliate representatives can be found on pages 4-5 of Appendix G.1.a.

In recent years, the consortium's strategies to improve participation have resulted in significantly greater engagement of several affiliates (Oglala Lakota College, Sinte Gleska University, University of South Dakota, Dakota State University, Black Hills State University, and the Journey Museum). An important new affiliate was added in 2009, the South Dakota Science and Technology Authority, which manages research and education programs at DUSEL. Preliminary discussions are underway with three aerospace industries that have recently begun operations in the state: Northrop Grumman, General Atomics, and Lunar Trans LLC (competing for the Google Lunar X Prize).

## **E.3. Consortium Operations**

At the lead institution, the Director's staffing level is 0.26 FTE (10% NASA funds plus 16% match). The Deputy Director (Program Coordinator) is supported at 0.9 FTE NASA funds. Each receives additional support from the state's NASA EPSCoR funds which ensures alignment and collaboration between the two programs. Space Grant clerical support at the headquarters office increased from 0.1 to 0.15 FTE in FY2010 through cost-sharing input from SDSM&T.

The four Associate Directors at affiliate institutions are staffed at a combined total of 0.46 FTE through a combination of NASA and matching funds (0.28 FTE funded by NASA only). The total FY2010 NASA funds for the salaries of the Director, Deputy Director, and four Associate Directors is \$85,451. The fringe is \$21,946 and supplies are \$5,557 in NASA funding. As a whole, the allocation of management staff resources is approximately 70% for management and administrative tasks, 20% for resource development, and 10% for project implementation.

The composition, role and meeting frequency of SDSGC's Management Team is described above. The "internal" advisory/executive committee for SDSGC is the eight-member Management Team as described above (page 11) along with its meeting frequency. The "external" advisory/executive committee for SDSGC is the 29-member state "Research Excellence: A Critical Hallmark" (REACH) Committee which meets three times per year and provides the advisory function for both Space Grant and NASA EPSCoR as well as oversight of the state's other federal STEM capability enhancement programs. Starting in 2009, the Vice President for Research of the South Dakota Board of Regents has served in an ex-officio capacity on both the SDSGC Management Team and the SD NASA EPSCoR Steering Committee. This important addition has allowed SDSGC to achieve closer alignment with other statewide initiatives in research and education.

The policies for adding and removing members of the Consortium are specifically explained on pages 7-9 of Appendix G.1.a (*SDSGC Roles and Responsibilities of Members*) along with specific policies for change of Director and lead institution and change of Associate Director.

#### **E.4. Collaborations and Partnerships Outside the Consortium**

SDSGC has developed a number of collaborations and partnerships outside the membership of the consortium for the purpose of promoting STEM education and workforce initiatives.

*At the state level, these include:* (1) Through SDSGC-funded programs at Flandreau Indian School and St. Francis Indian School, approximately 700 Native American precollege students participate each year in specialized aerospace disciplines, earth science programs, and college-preparatory courses in order to increase training and recruitment of underrepresented minorities in STEM degrees and eventual careers. (2) SDSGC affiliates work very closely with the NASA AESP specialist for South Dakota, who typically assists with at least six workshops or other events each year. (3) SDSGC affiliates have been instrumental in establishing the first statewide robotics association and competition, and are planning to establish a 501(c)(3) organization for a multi-state, regional network. (4) SDSGC informal education affiliates work closely with the state's 4-H educators and the Department of Defense StarBase program to add robotics training and other NASA content to these programs. (5) Dr. Dan Swets, SDSGC Associate Director at Augustana College, serves as co-partner for SD FLL and serves on the Planning Committee responsible for overseeing and supporting the FLL activities in SD.

*With respect to the national Space Grant network, these include:* (1) SDSGC collaborates with several other state consortia to develop the Space Grant Internet Telescope Network program, which began operations in August 2007. (2) SDSGC Associate Director Kevin Dalsted at SDSU will serve on a technical review panel of fellowship applicants for the Indiana Space Grant Consortium. (3) Tribal college affiliate Sinte Gleska University is participating in the Wisconsin Space Grant Consortium's first National Tribal College Rocket Competition. (4) Affiliate Lake Area Technical Institute is participating in the Colorado Space Grant Consortium's Starting Student Space Hardware Programs Workshop.