

Arizona Space Grant Consortium
The University Arizona, Lead Institution
Timothy D. Swindle, Acting Director
520-621-4128
URL: Spacegrant.arizona.edu
Grant Number: NNX10AI41H

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 Arizona Space Grant Consortium is Designated Consortium funded at a level of \$575,000 for fiscal year 2011.

PROGRAM GOALS

The AZSGC mission is to expand opportunities for Americans to learn about and participate in NASA's aeronautics and space programs by supporting and enhancing science and engineering education, research, and outreach programs that integrate research with education to help build a diverse, scientifically literate citizenry and a well-prepared science, engineering and technology workforce. Our vision is to extend the arms of NASA--expanding our universities' capacity to conduct research and doing it in such a way that educates the next generation of scientists and engineers, all in direct partnership with industry and NASA demanding new talent and the latest innovations.

- AZSGC Management goals: Engage prominent and diverse partners to lead high quality education, research and outreach programs that provide Arizonans opportunities to learn about and engage in NASA's mission and research, while benefitting our state's research enterprise and educating America's future STEM workforce.
- AZSGC Fellowship goals: Expand representation among active scientists and engineers, of our nation's diverse population. Design programs to be accessible to students from a variety of backgrounds, including those in non-technical disciplines and to improve and inform graduate and undergraduate education by providing experiences for a substantial number of students which will contribute in a number of ways, including fostering some students toward professional careers in aerospace

science and technology, while also fostering understanding, appreciation and sensitivity to space science and engineering as important national endeavors.

- AZSGC Research Infrastructure goal: Sponsor innovative programs in space science/engineering focused research and design, with associated opportunities to apply classroom knowledge to real-world, NASA-focused problems.
- Higher Education goals: Recruit and support a diverse group of participants, promote initiatives to develop interdisciplinary courses/curriculum and teacher training, sponsor group educational activities for Interns, Fellows and others to complement and enhance student learning, to foster a sense of community by building linkages and promoting networking among students, faculty, researchers, industry professionals and the public, and to provide a diverse group of students opportunities for educational/professional growth and promotion.
- Precollege goals: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers and faculty with special focus on training STEM educators—not only to excite and inspire P-12 students—but to excite and inspire while instilling basic competencies to insure that AZ students are prepared and able to study science in college.
- Public Programs goals: Engage members of the public from traditionally underrepresented groups, bridge the gap between Earth systems science research, geospatial technology and societal needs in Arizona, leverage funding to extend the reach of Space Grant beyond direct investment, support science education needs in underserved areas of our state, engage our students in informal education initiatives and track impacts and evaluate programs success via quantitative and qualitative methods (plus longitudinal tracking of graduate fellow/undergraduate intern participants) to insure continuous process improvement.

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

AZSGC has become a catalyst for synergy between NASA, industry, and Arizona's education/research efforts. Programs extend the arms of NASA—expanding our universities' capacity to conduct research and doing it in a way that educates our next generation of scientists and engineers directly contributing to Outcome 1. We use our presence at universities and partnerships with Arizona research organizations, federal research labs, and industry, to integrate smart, motivated students into current research programs and missions, which serve as ideal "classrooms" for training the next generation of aerospace professionals, and then leveraging student research into outreach designed to promote the understanding of space related research to precollege audiences and the public (Outcomes 2 and 3). Simultaneously, researchers get student workers at a minimal cost, which in turn extends research program capabilities, learning and accomplishments.

Integrating students into leading-edge research programs serves as a springboard into our nation's STEM workforce and top graduate programs (Outcome 1). Select FY 2011 examples (representing many more) are:

- FY 2011 Intern Michael Schaffner, was selected one of 74 students from over 850 applicants across the nation to present his Space Grant research on Capitol Hill. Michael exhibited a poster, “Water on the Moon: Remote Sensing from the Lunar Reconnaissance Orbiter”, detailing his work with Dr. William Boynton from the Lunar & Planetary Laboratory at the Council on Undergraduate Research (CUR) Posters on the Hill 2012 event April 24, 2012. He will begin graduate school in 2012 at Carnegie Mellon, working towards a graduate degree in Robotics. To quote Michael, “My Space Grant Internship enhanced my competency as a researcher, my contacts in industry, and my confidence in interviews and other projects. It is easily the best, most impactful experience of my undergrad career.”
- Aaron Goldstein clearly represents the NASA Space Grant pipeline concept. He founded the Sun Devil Satellite Lab (SDSL) at ASU, enabling students to participate in design competitions and gain experience designing and creating satellites. He currently leads a team working on Sun Devil Satellite 1 (SDS-1) with NASA Goddard Space Flight Center, and has taken SDS-1 through spacecraft Preliminary and Critical Design Reviews. Due to the success of SDSL in its design of spacecraft and involvement in the ASU engineering community, Aaron received the UBM Electronics Annual Creativity in Electronics (ACE) Student of the Year award, and will go to work for Orbital Sciences Corporation, an AZSGC Affiliate Partner, when he graduates in May 2012.
- FY 2010 Interns and FY 2011 Intern Advisors Alexandria Stanton (Native) and Dimuth Kulasinghe (Pacific Islander) had their first experiences with research, followed by opportunities to develop and hone leadership skills through participation in the AZ Undergraduate Research Internship Program. Both recently learned of their acceptance to their top pick graduate schools (Stanford and University of Illinois Urbana-Champaign) and were informed that they received full NSF Graduate Fellowships based on their impressive NASA Space Grant-generated research credentials.

PROGRAM ACCOMPLISHMENTS

Fellowships Programs: In FY 2011, AZSGC sponsored 7 Fellowship programs directed to Outcome 1, with select Internship and all Graduate Fellowship projects also contributing to Outcomes 2 and 3. Programs are designed to address Fellowships goals (above); 2011 accomplishments are measured against SMART objectives below:

1. **Support ≥ 87 students:** 133 (Fellowships/Scholarships were awarded to 121 undergraduates and 12 graduate students).
2. **Support a diverse group of students with at least 24% from underrepresented groups:** 43 (34%) of the total awards went to students from underrepresented minorities.
3. **Support 45% women:** 59 (46%) of awardees were females.
4. **Support students from diverse academic backgrounds representing >30 majors:** 2011 students reported 49 distinct academic majors.
5. **Promote quality outreach and community service programs with contributing partner organizations:** 12 Graduate Fellows designed and implemented programs delivered through precollege, higher education and

- informal education components, which gave many others opportunities to participate in NASA's science, engineering and education (Outcomes 1, 2, 3).
6. **Support mentored (NASA-focused), Undergraduate Research Internships with Arizona, NASA and industry researchers:** 121 Undergraduate Research Interns from UA, ASU, NAU, ERAU, and Pima Community College (PCC) from a variety of backgrounds and technical and non-technical disciplines, received mentored, hands-on professional work experiences on university campuses, in local industry and at NASA Centers, focusing on science/engineering, education, journalism and science policy (Outcomes 1 and 2).
 7. **Program participants and their research will generate >10 professional publications and presentations:** Science writing interns wrote 25 articles for two major AZ newspapers; an additional 22 articles were written by two Space Grant science writing interns for the UA Office of Public Information, with articles picked up by Science, MSNBC, Fox News, Le Figaro, GIT Laboratory Journal, Phys.Org, Science Daily, Earthsky.org, the National Library of Australia (Trove), Futurity.org, Algae Industry Magazine, Western Farm Press, Arizona State Parks: Kartchner Caverns, Biosphere 2 News, TheBioenergySite, Machines Like Us, Elankovan Sundararajan, Space Daily, Midwest Geological Sequestration Consortium: The Carbon Capture Report, Mendeley, News-About-Space.org, Accidentally Green, Rose Law Group, The Galaxy Today, weSRCH, American Space Drive, NASA Microgravity University, ACM Tech News, abitofscience.com, Evernote, HighBeam, redorbit.com, sazhightechconnect.com, mefeedia.com and other sources. 45 AZSGC authors published research results supported by Space Grant Fellowship efforts. In addition, 28 invited and self-submitted papers were delivered at professional conferences.
 8. **Evaluate programs' success via quantitative and qualitative methods to insure continuous process improvement:** Participants completed written program evaluations, Graduate Fellows made formal outreach program review presentations to steering committee members and interested members of the university community, and student tracking records were generated and updated for all program awardees.
 9. **85% of program graduates will pursue advanced degrees in NASA-related STEM fields, and/or join the nation's STEM workforce:** 94% 2006-2011 awardees who have taken "next steps" after graduation, are now employed in STEM fields or are pursuing additional STEM degrees (see Tracking below).
 10. **Leverage program funding:** AZ/NASA Space Grant Fellowships funds (\$263,752) are highly leveraged with Arizona dollars (\$214,882), and approximately (\$61,303) of other federal cost sharing.

In total, AZ Fellowship programs directly addressed NASA Education Outcomes 1, 2 and 3. Outcomes 2 and 3 are addressed through Intern community service, and through major Graduate Fellowship outreach programs conducted with a wide variety of cost-sharing stakeholders and educational partners. NASA priorities and current areas of emphasis, and all goals and SMART objectives were met.

Research: In FY 2011, 176 students participated in 11 AZSGC sponsored Research programs directed to Education Outcome 1. In addition, several programs have Precollege and Public Program outreach components contributing to Education Outcomes 2 and 3 (ASU Robotics, Daedalus Astronautics, etc.). Programs are designed to address the Research goals (above) and 2011 accomplishments are measured against the SMART objectives below:

1. **Support 30% diversity:** 41 participants (23%) are from underrepresented groups and 26% of funded students are underrepresented.
2. **Support 50% women:** 52 students (30%) are women.
3. **Sponsor >6 multi-disciplinary, student led and directed team engineering programs:** In FY 2011 AZSGC supported 1) Cubesat development (ERAU), 2) Lunabotics (ERAU), 3) Unmanned Vehicle Systems development (ERAU), 4) Two NASA Reduced Gravity teams (UA); 5) A senior design team's prototype development/testing of the NASA JSC RISA camera (UA), 6) SunDevil Sat 1 development (ASU), 7) Robotics team (ASU), 8) Daedalus Astronautics (Rocketry) team (ASU), and 9) AZSGC statewide balloon satellite program ASCEND! (UA, ASU, ERAU, PCC, SMCC, GCC and Diné).
4. **Build relations with NASA and aerospace industry:** Research and design programs 2, 4, 5, 6, 7, 8 and 9 (Objective 3 above) were conducted in direct partnership with NASA centers and aerospace industry.
5. **Grow ERAU and ASU R&D programs by 2:** ASU and ERAU each supported one new team engineering program in 2011, programs 3 and 6 (Objective 3 above).
6. **Support at least 5 teams in a statewide balloon sat program:** 6 teams and 7 colleges/universities (including 3 MSIs) participated in ASCEND!, our statewide balloon satellite program in 2011. The base budget funded one successful training workshop, launch/recovery, and opportunities to experience the full design-build-fly-operate-analyze cycle of space missions. 37 participants presented the results of their flight experiments in a dedicated "ASCEND!" session at our statewide symposium (see Higher Education).
7. **Promote NASA-focused astronomy learning, hands-on education and research through the National Undergraduate Research Observatory consortium (NURO):** NAU SG supported 30 students from NURO to travel with mentors to Arizona, and observe on a 31-inch telescope owned by Lowell Observatory/administered by NAU; as a result, 12 scientific articles were published in 2011.
8. **Leverage program funding:** AZ/NASA Space Grant Research funds (\$37,000) are leveraged with Arizona dollars, bringing an additional \$7,750 to these workforce development programs in 2011 (funding for some student participants is reported in Fellowships above), directly contributing to NASA Education Outcomes 1, and 2.

Cumulatively, programs helped foster relations with NASA centers and aerospace industry, while addressing several NASA Education priorities (see NASA Education Priorities below) directed at current areas of emphasis. All programs met the AZSGC Research goal of providing authentic, hands-on student (team engineering, research, and

design) experiences rooted in NASA-related topics and incorporating real-life problem-solving and needs. All program area SMART objectives were met with the exception of objectives 1 and 2; we did not achieve the desired levels of ethnic and gender diversity of participants.

Higher Education: In FY 2011, AZSGC sponsored 9 higher education programs directed to Education Outcome 1, with 2794 direct student participants. Programs are designed to address the Higher Education goals (above) and accomplishments are measured against the SMART objectives below:

1. **Support 30% diversity:** 573 participants (21%) are from underrepresented groups (100% of directly-funded students are underrepresented).
2. **Support 50% women:** 573 students (25%) are women.
3. Include 4 minority serving institutions/initiatives: PCC, SMCC, TOCC and Diné participated in programs.
4. **Support ≥ 5 multidisciplinary group activities:** Supported activities are: 1) SEDS research, promotion, preschool and community outreach (UA); 2) Statewide Symposium (UA, ASU, NAU, ERAU, SMCC, PCCC); 3) Multidisciplinary courses (UA, SMCC, PCC, TOCC); 4) Student travel to present research at professional meetings (UA, ERAU, ASU); 5) Four brown-bag lunch events with guest speakers, and one science writers focus group (UA); 6) Abstract and PowerPoint presentation development training workshops (UA, ASU, NAU, PCC); 7) Campus STEM outreach and program promotion events (ASU); 8) Space Grant Alumni Night (ASU).
5. **Host a statewide Undergraduate Research Internship Symposium:** In April 2011, the Twentieth Annual Arizona/NASA Statewide Undergraduate Research Internship Program Symposium featured 130 students presented on year-long research projects relevant to all NASA Mission Directorates.
6. **ASU outreach for recruiting:** 25 Space Grant Interns showcased their research and design projects, providing hands-on demonstrations of robotic arms, rockets and more at the School of Earth and Space Exploration (SESE) Earth and Space Exploration Day (Objective 4 project 7).
7. **Support multidisciplinary course development:** 4 (revised) courses were offered at The University of Arizona, (MSI) Pima Community College (PCC), and (MSI) South Mountain Community College (SMCC), and Tohono O'odham Tribal College (TOCC). The TOCC course, "Atmospheric Science, Weather and Climate with a Native Science Perspective", (Objective 4 project 3), was developed and delivered by a (Native) Graduate Fellow and contains associated higher education and reservation community outreach, that address NASA Education Outcomes 1, 2, and 3.
8. **Develop/support opportunities to network and promote linkages between Space Grant students, faculty, researchers, industry and NASA professionals to foster workforce development, and educational/professional growth and promotion:** Higher Education programs 1-8 (Objective 4 above) promoted linkages, networking and enhanced student workforce development, educational/professional growth and promotion.

9. **Leverage program funding:** AZ/NASA Space Grant Higher Education funds (\$107,381) are highly leveraged with Arizona dollars, bringing an additional \$64,387 to these workforce development programs in 2011.

These activities and others, contribute directly to AZSGC Higher Education goals and objectives, to several NASA Education current areas of emphasis (see NASA Education Priorities below), and to NASA Education Outcomes 1, 2 and 3. All program area SMART objectives were met with the exception of objectives 1 and 2; we did not achieve the desired levels of ethnic and gender diversity of participants.

Precollege: In FY 2011, AZSGC sponsored 8 Precollege programs, the majority conducted in collaboration with partners to leverage funding and to extend program reach; several programs were designed and delivered by Space Grant Graduate Fellows. Most programs address multiple AZSGC goals/objectives, and all contribute to NASA Education Outcome 2 (Educate and Engage). Programs are designed to address the Precollege goals (above) and accomplishments are measured against the SMART objectives below:

1. **Programs align with Arizona and National Standards:** All supported programs align with state and national standards.
2. **Direct programs to underrepresented/underserved groups and areas of greatest need:** Native Americans are severely underrepresented in college STEM enrollment. Four NASA-focused precollege programs--two designed and led by Graduate Fellows--are directed to Native schools/communities in Northern California and Arizona. Programs are: 1) "Promoting Science, and Bridging Gaps in Native American Science Education" a summer GPS and GIS 6-12 grade training class delivered at the Klamath River Early College of the Redwoods in Northern California, and at Tohono O'odham Ha:san Preparatory and Leadership School (Ha:san) in Tucson (UA); 2) "Incorporating spatial technology and inquiry-based learning into ecological research" a summer field program with academic year follow-on activities, conducted in partnership with the Mt. Graham International Observatory's Summer Youth Program, Ft. Thomas High School serving the San Carlos and Bylas Apache communities, and Ha:san. 154 Native students engaged in program activities to date in FY2011. (UA); 3) The "Navajo-Hopi Outreach program" with affiliate partner Lowell Observatory that delivers hands-on NASA space science content, related educational activities, field trips and guest presenters to 3 Navajo reservation middle school teachers and 75 students (NAU); and 4) The "American Indian Mobile Education Resource (AIMER)" science classroom and educators, that delivered NASA Space Science educational resources, lessons, and activities to 389 students at rural reservation schools and 31 teachers including (17 underrepresented females) in FY 2011; and 5) A "5th Grade Rocket Outreach Program at the Navajo Elementary School in Gilbert, Arizona" (a school with 39% underrepresented enrollment), engages and educates middle school students and teachers in exciting space-related activities (ASU).

3. **Programs support NASA Education:** All Native American and underserved-directed programs 1-5 (Outcome 2 above) focus on NASA research topics, and incorporate NASA curricular materials and expertise. In addition, 6) Space Grant Interns and Fellows led a wide variety of NASA-focused precollege classes, activities and training sessions through the ASU Mars Education Center and at various local schools, including mentoring FIRST Lego League and FIRST Robotics teams that engaged 6,581 precollege participants (ASU); 7) “Changes in Altitudes” a statewide precollege balloon satellite program originally funded by NASA’s Phoenix Mars Lander Mission’s E/PO, provided real “space mission” experiences for seven Arizona middle and high school teachers and 35 students (NAU); and 8) AZSGC supported two GEMS Space Science Teacher Training workshops attended by 19 middle school teachers, designed to give grades 6-8 teachers opportunities to explore the Sun-Earth-Moon system while being trained in core science/math curriculum, using NASA-produced materials.
4. **Programs engage middle school teachers in hands-on curriculum enhancement:** “NASA Technologies in Service of Authentic Learning” is under development in partnership with the Arizona Sonora Desert Museum and 4H to create curriculum plus lesson plans for in-class use for the Museum’s Summer Earth Camp for Middle School Teachers (UA). An inquiry based, standards-aligned middle and high school hydrology curriculum, developed, evaluated and tested with local middle school teachers and scientists, will become a cornerstone for the B2 precollege visitation program, exposing visitors to the interdisciplinary nature of Earth systems science.
5. **NASA education and outreach provided to remote reservation schools via AIMER:** The mobile AIMER classroom and educators delivered NASA Space Science educational resources, lessons, and activities to 389 students and 31 teachers at rural reservation schools.
6. **Leverage program funding:** FY 2011 AZ/NASA Space Grant Precollege funds (\$38,500) are highly leveraged with Arizona (\$20,223) cost sharing dollars.

These and other Precollege activities contribute directly to AZSGC goals and objectives and to NASA Education Outcomes 1, 2 and 3. In addition programs address several NASA Education priorities directed at current areas of emphasis (see NASA Education Priorities below). All program area SMART objectives were met.

Informal Education: In FY 2011, AZSGC sponsored 7 Informal Education programs, most in collaboration with partnering organizations to leverage resources and to extend reach. Our flagship effort is the Earth Grant Geospatial Extension Program, led by the UA Space Grant Associate Director at no charge to our grant with a cadre of Graduate Fellows, Undergraduate Research Interns and representatives from partnering programs and agencies who work together to address shared program goals and sponsor a variety of activities focused on bridging the gap between NASA Earth systems science and technology and the needs of the public. The program focuses on capacity building, scientific literacy and STEM learning. FY 2011 projects land in three general categories: (1) technology transfer, (2) precollege afterschool programs that want to use NASA science and technology for STEM learning, youth empowerment, civic engagement and

the promotion of healthy life styles, and (3) knowledge transfer associated with the science behind desertification and its control. Earth Grant and other Informal Education programs, address multiple AZSGC goals/objectives and NASA Outcomes 2 and 3. Programs are designed to address the Informal Education goals (above) and accomplishments are measured against the SMART objectives below:

1. **30% diversity of participants:** Demographic data is only routinely collected for programs conducted under the Geospatial Extension Earth Grant Program: Overall the Earth Grant activities this year have directly engaged 3828 participants (47% traditionally underrepresented in STEM).
2. **50% female participation:** Gender diversity data is only routinely collected for programs conducted under the Geospatial Extension Earth Grant Program: Overall the Earth Grant activities this year have directly engaged 47% female participants.
3. **Serve >38 communities with Geospatial Extension programs:** Programs and activities were conducted in 34 Arizona communities in 2011.
4. **Train AZSGC students to help deliver >4 NASA Earth science focused topical training sessions:** Overall the Earth Grant activities this year have directly engaged participants in 221 field days, meetings, presentations, workshops and training events involving 12,613 contact hours.
5. **Build strategic partnerships with formal and informal STEM education providers:** All Earth Grant programs are conducted in partnership with Cooperative Extension, and also involve partnerships with numerous community organizations, schools, tribal groups, government agencies and businesses. The “Gardenroots” citizen science program was conducted in partnership with the town of Dewey-Humboldt, Arizona, the Arizona Department of Environmental Quality, EPA and Yavapai County Cooperative Extension; “Kid’s Club”, a monthly math, science and aerospace club for 3rd grade through middle school students, is conducted in partnership with AIAA (UA); The “Gardenroots: Dewey-Humboldt Project” was conducted in partnership with the town of Dewey-Humboldt, Arizona, the Arizona Department of Environmental Quality, the US EPA and Yavapai County Cooperative Extension; “STEM Sisters”, a middle school science club for girls, is a collaboration with Mt. Elden Middle School (NAU); The annual “Flagstaff Festival of Science” is a large, university-sponsored community event that benefits from Space Grant involvement and support (NAU); “Space Grant Intern and Fellow Community Outreach” involves participation in a variety of community events that in total, served 7,388 participants in 2011 including (Earth and Space Exploration Day, the Arizona SciTech Festival, and more.) Each event represents collaborations between many partners including ASU’s School of Earth and Space Exploration (SESE) and members of the greater Phoenix community (ASU).
6. **Support NASA Applied Science:** All Geospatial Extension programs support NASA Applied Science. In FY 2011 1) Map@Syst (an online peer-reviewed system developed collaboratively by Geospatial Extension Specialists across the country), reached 88 community of practice members and experienced 164,161 page views. Website users learn basic knowledge and skills related to

- investigating satellite imagery, remote sensing opportunities and careers, and how earth observation solves real-world problems; 2) The knowledge transfer program focused on desertification, now involves sites in 12 countries testing a participatory environmental evaluation protocol (that includes indicators derived from NASA satellite imagery). The design created, based on problem-based learning theory, was delivered to software developers, and is expected to launch in FY 2012. Related efforts at the global scale were presented at the Tenth Conference of the Parties of the United National Convention to Combat Desertification (UNCCD) held in Changwon, Korea.
7. **Programs support NASA Education programs:** FY 2011 Earth Grant precollege-directed Informal Education efforts involved engaging 13 youth interns, and SG Interns and Fellows in the co-development an application suite that brings learning opportunities to youth (aged 12-18) exploiting mobile communication and location-based technologies.
 8. **Evaluation programs success via quantitative and qualitative methods (plus longitudinal tracking of graduate fellow/undergraduate intern participants) insure continuous process improvement:** All Earth Grant programs undergo quantitative and qualitative evaluation and review.
 1. **Programs leverage NASA funding by >50%:** A NASA base budget investment of only \$1,000 is highly leveraged with Geospatial Specialist Barron Orr committing 10% FTE (\$11,551) to programs at no charge to our grant. Other efforts are staffed by Space Grant Interns and Fellows with wages reported under Fellowships, and ASU Interns contribute community service hours as part of their Fellowship award obligations.

These and other Informal Education activities contribute directly to AZSGC goals and objectives and to NASA Education Outcomes 1, 2 and 3. In addition programs address several NASA Education priorities directed at current areas of emphasis (see NASA Education Priorities below). All program area SMART objectives were met with the exception of objective 3: programs reach extended to four fewer Arizona communities than was our target.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- **Student Data and Longitudinal Tracking:** Of 726 (total) AZSGC 2006-2011 Fellowship/Scholarship awardees (all significant award students are reported here), 535 have completed degree programs. 478 (94%) of these are now employed in STEM fields or are pursuing additional STEM degrees: 133 are employed by NASA, aerospace contractors, universities, and other educational institutions, 127 are employed in STEM non-aerospace positions, 218 (see note below) are pursuing advanced STEM degree programs. 157 AZSGC 2006-2011 awardees are from underrepresented groups; 103 have completed degree programs; 11 of these are seeking STEM employment. 88 (96%) of the underrepresented graduates are pursuing advanced STEM degrees or are employed in STEM fields. In addition, 32 undergraduate students pursued advanced STEM degrees PLUS entered the STEM workforce. To comply with NASA reporting requirements and not double count

students, these 32 undergraduate students (16 women and 16 men, 6 from underrepresented groups) were not counted in the “pursuing advanced STEM degree” category. 27 program grads are currently seeking STEM employment.

- **Diversity:** AZSGC involves Arizona’s four, four-year research universities as members, working with 26 affiliate partners: community colleges (four of these MSIs), federal research organizations, private industry, and for- and not-for-profit research enterprises. The state management team consists of ten members, (50% women, one from an underrepresented minority group) representing 9 diverse NASA and education fields. 77 researchers/faculty members from across Arizona from 44 diverse, NASA-related, research disciplines serve as research mentors to Space Grant Undergraduate Research Interns. To further grow our nation’s STEM workforce, Space Grant Fellowship awards are not restricted to STEM students. In our experience, non-STEM awardees frequently become passionate about Space Grant work and change to STEM majors. We meet or exceeded ethnic and gender student participant diversity goals in all program areas except research and higher education, where participant numbers reflect the composition of university/college classes, student clubs, etc. Space Grant *funded* students diversity however, meets or exceeds goals in Fellowships and Higher Education program areas; the average percentage of awards to underrepresented minority students across all higher education program areas is 33.5%. Precollege and public programs are directed to underrepresented, underserved populations across Arizona.
- **Minority-Serving Institutions:** AZSGC includes four minority-serving institutions: Pima Community College (PCC), South Mountain Community College (SMCC), Dine Tribal College and Tohono O’odham (Tribal) Community College (TOCC). New avenues for collaboration were established in 2011 including: 1) funding the first TOCC students to participate in NASA-focused research and outreach under the mentorship of a UA (Native) Space Grant Graduate Fellow/TOCC instructor; 2) funding a Diné mentor to work alongside the UA ASCEND! team, so she can engage a Native student team to join our statewide balloon sat (Research) program in 2012; and 3) enlisting our SMCC Space Grant representative to invite students and faculty from Glendale Community College (GCC) to work alongside the SMCC balloon sat team with a goal to establish a stand-alone team to be funded with Space Grant Augmentation funds.
- **NASA Education Priorities:**
 - **Authentic hands-on student experiences in science and engineering disciplines rooted in NASA related, STEM-focused questions and issues; incorporation of real life problem-solving and needs as the context for activities:** This priority is addressed through 1) all 121 mentored research internships (Fellowships); 2) All 12 Graduate Fellowship NASA research-based outreach programs (see Fellowships, Higher Education, Precollege and Informal Education); and 3) all Research programs.

- **Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise:** See Precollege program 8 (Objective 3), and Objective 4 programs.
- **Summer opportunities for secondary students on college campuses to increase enrollment in STEM disciplines or interest in STEM careers:** Mt. Graham field course for Apache students, Precollege program 2 (Objective 2).
- **Aeronautics research:** ERAU has its roots as an aeronautical university with an emphasis on aviation and aeronautical engineering. ERAU Space Grant supports basic and applied research in aeronautics. The projects range from basic low-speed aerodynamics studies up to applied research in unmanned aerial systems integration into the national air space. In 2011, 12 AZSGC Undergraduate Research Interns from UA, ASU and ERAU participated in mentored research on aeronautics topics.
- **Environmental Science and Global Climate Change--research and activities to better understand Earth's environment:** 31 Undergraduate Research Interns worked with Arizona researchers on Environmental Science/Global Climate Change research in 2011. An entire topical session at the Statewide Space Grant Symposium was dedicated to these topics. Five Graduate Fellows led significant outreach programs focused on environmental science/global change (see Higher Education, Preschool and Informal Education), and many projects subsumed under the Earth Grant program are directed to these topics, especially to the effects of desertification.
- **Diversity of institutions, faculty, and student participants:** See Diversity (above).
- **Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities:** When Internship project proposals are received from researchers starting to build research programs, we waive split-funding requirements (see Fellowships). Participation in our statewide balloon sat program (see Research) has positively impacted the research infrastructures at two (MSI) community college affiliates: According to Dr. Tim Frank at SMCC, "Because of ASCEND!, I realized that I could get my students to work harder and learn more if I modified...courses to include more real-world projects. Consequently...modifying my introduction to engineering courses to include more "real-world" design projects [has helped grow] enrollment in our engineering courses by 46%, and most original ASCEND! class participants "...went on to transfer to ASU and major in engineering." MSI PCC's participation in the AZSGC balloon sat program, is showcased on PCC's homepage and helped the college win funding for a new 47,000-square-foot sciences, technology, engineering and math building slated to open in 2013.

IMPROVEMENTS MADE IN THE PAST YEAR

1. A concerted statewide effort increased Fellowships programs diversity from 18% in 2010, to 34% in 2011.

2. We established new contacts and started collaborations with Departments of Education; the “NASA Technologies in Service of Authentic Learning” project (see Objective 4, Precollege) was co-funded by the UA College of Education.
3. We are working to build and hone relationships with new and existing affiliate partners, adding three science center affiliates (Flandrau Planetarium, Mt. Lemmon Sky Center and Biosphere 2), establishing new Space Grant representatives at National Optical Astronomy Observatory (NOAO), the *Arizona Daily Star*, Dine Tribal College, and Tohono O’odham Tribal College, and deleted one inactive affiliate (Vieria-Lowry Computer Systems).
4. We continued to upgrade and improve statewide and member university websites, and added Facebook and Twitter feeds to <http://spacegrant.arizona.edu>, the AZSGC statewide website to better advertise AZSGC and NASA opportunities.
5. An online symposium abstract submission/rsvp form with a reviewers interface was completed and piloted in 2011. It effectively allows all participating college and university Space Grant managers to review their students’ abstracts, make speaking order and topical session assignments, and more.
6. We convened our first “Science Writing Focus Group”, bringing scientists, professional journalists, and student science writers together to discuss strategies and best practices.
7. We utilized a “train the trainer” model, employing community college balloon sat teams/mentors, to mentor and train new community college teams for future participation (See MSI Collaborations above).

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Members:

University of Arizona (Lead): State University
 Arizona State University State University
 Northern Arizona University State University
 Embry-Riddle Aeronautical University

Affiliate Partners:

Higher Education Program Partner: Coconino CC
 Higher Education Program Partner: Dine College (Tribal)
 Higher Education Program Partner: Nat'l Undergrad Research Observatory
 Higher Education Program Partner: South Mountain CC (MSI)
 Higher Education Program Partner: Pima CC (Hispanic)
 Higher Education Program Partner: Tohono O’odham CC (Tribal)
 Industry Affiliate: AZ Near Space Research
 Industry Affiliate: Iridium Satellite LLC
 Industry Affiliate: Orbital Sciences Corp
 Industry Affiliate: Paragon Space Development Corp
 Industry Affiliate: PM & AM Research
 Industry Affiliate: Raytheon Corp
 Industry Affiliate: Rincon Research

Outreach Affiliate: AZ Daily Star
Outreach Affiliate: AZ Daily Sun
Outreach Affiliate: Biosphere 2
Outreach Affiliate: Flandrau Science Center
Outreach Affiliate: International Dark-Sky (NPO)
Outreach Affiliate: Mt. Lemmon Sky Center
Outreach Affiliate: Prescott Astronomy Club
Research Partner: Jet Propulsion Laboratory
Research Partner: Lowell Observatory
Research Partner: National Optical Astronomy Observatories (Federal)
Research Partner: Planetary Science Inst (NPO)
Research Partner: USDA SWRC (Federal)
Research Partner: USGS, Flagstaff, Tucson (Federal)