

Arizona Space Grant Consortium
The University Arizona, Lead Institution
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PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Arizona Space Grant Consortium is a Designated Consortium funded at a level of \$785,000 for fiscal year 2009. AZ/NASA Space Grant funds are highly leveraged with non-federal dollars, bringing an additional \$959,998 to Arizona student-directed programs in 2009.

PROGRAM GOALS

Our 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. These programs integrate research with education to help build a diverse, scientifically literate citizenry and a well-prepared science, engineering and technology workforce.

AZSGC Fellowship programs are geared to expand representation among active scientists and engineers, of our nation's diverse population. Programs are designed to be accessible to students from a variety of backgrounds, including those in non-technical disciplines. Programs 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.

The goal of the AZSGC Research Infrastructure component is to sponsor innovative programs in space science/engineering focused research and design, with associated opportunities to apply classroom knowledge to real-world problems. These programs "encourage cooperative programs among universities, aerospace industry and Federal, state and local governments" as articulated in the National SG Program objectives. Through team research, engineering and design programs, Space Grant students learn to

work as team members, to be held to industry standards for deliverables, to complete tasks on schedule, to communicate about technical work to professionals, peers, and the public through oral and written presentations, and to work side-by-side with science and engineering faculty, researchers, NASA, and industry professionals. These challenging programs impact student education, future employability in industry, and contribute to science and technology development.

AZSGC Higher Education program goals are to 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.

AZSGC Precollege programs are geared to 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. All AZSGC precollege programs are aligned with AZ and National Standards, leverage funding, are directed to underrepresented and underserved populations, and support NASA Education programs.

Public Programs actively engage members of the public from traditionally underrepresented groups, bridge the gap between Earth systems science research and geospatial technology and societal needs in Arizona; leverage funding to extend the reach of SG beyond direct investment, support science education needs in underserved areas of our state, engage SG 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.

That integrating students into leading-edge research serves as a springboard into our nation's STEM workforce and top graduate programs is documentable. Select FY09 examples (representing many more) are: (1) Pima Community College, Matthew Bunting, applied for and was awarded a FY2008 University of Arizona (UA)/NASA Space Grant Undergraduate Research Internship to help his transition into the large four year university. He successfully completed an internship working with AZSGC Affiliate Rincon Research and as an E/PO assistant with the NASA Phoenix Mars Mission. In FY09, Matt made front page news in the *Arizona Daily Star*, featured in an article written by fellow Space Grant Intern Otto Ross, about his innovative design of a "spiderlike robot that teaches itself to walk, can adapt when damaged and watches its maker as he moves around the room." Matt's robot created considerable industry buzz, got him an "A" in his cognitive robotics class, over 100,000 hits on YouTube and prompted an order from Intel for two robots that will demo the company's latest processor. Since that time, Matt has traveled to Germany to assist in the design of a robotics laboratory, has worked on another specialized robotic design program with his major professor in Malibu, CA, and will begin his first year of graduate studies in the fall of 2010, working toward a PhD in ECE at UA with a full departmental scholarship. (2) ERAU just hired Kyle Box, a Space Grant Intern and ASCEND! (balloon sat) program graduate, to work in their Space Systems Laboratory. Kyle, an ERAU FY08 graduate, recently completed his Masters degree in Astronautical Engineering from the University of Southern California. (3) FY09 NAU Space Grant science writing Intern at the *Arizona Daily Sun*, Eric Betz, was hired as a writer for the American Institute of Physics (AIP) in June 2010. He did an excellent job for the *Daily Sun* and his work there definitely assisted him in getting the prestigious AIP position. (4) In FY09 UA Intern Allison Strom graduated with honors and was awarded the highly competitive Gates Cambridge Scholarship for graduate studies in Astronomy. She follows fellow AZ Space Grant Intern Caitlin Casey, who is completing her PhD in Astronomy as a Gates fellow this month. Caitlin has recently been awarded a Hubble Postdoctoral Fellowship to continue her studies related to NASA Cosmic Origins in Hawaii this fall. (5) 2009 has been a BIG year for 2002 Space Grant Intern Jacob Lauser. Since graduating from UA in 2004, Jacob has worked to combine passions for space and law, graduating from VA Law School in May, 2009, and pursuing work in the American Bar Association's Air and Space Law Sections. As a licensed attorney in PN, he will soon be licensed to practice in Washington, D.C. and NE, and is starting work towards a Master of Law Degree in Space and Telecommunications Law from the University of NE. This will ultimately enable him to work for NASA's Office of the General Counsel or other space R&D organizations. (6) 2008 Intern Jason Dittmann was the student leader of his Space Grant Internship project at Steward Observatory. He graduated in FY09 and will enter the Harvard Astronomy PhD program this fall -- as the Clay fellow. The Space Grant program played a big role in helping Jason get admitted into the very best schools (he declined generous offers from MIT, Berkeley, and Caltech).

Of the AZSGC 2006-2009 awardees who have completed (award) degree programs, 264 (93%) are now employed in STEM fields or are pursuing additional STEM degrees. AZSGC sponsored science journalism internships at two major state newspapers, the *Arizona Daily Star* and the *Arizona Daily Sun*, resulted in 88 bylines, contributing directly to the development of the STEM workforce (Outcome 1), while promoting

STEM literacy and awareness of NASA's mission to the general public (Outcome 3). Science-writing interns play an increasingly important role in helping newspapers provide informative and important science stories to readers as they deal with harsh economic realities and declining revenues. (3) AZSGC partners with Orbital Sciences Corp. and BAE Systems, Inc. to sponsor robotics programs that epitomizes the NASA pipeline at work directly contributing to NASA Education Outcomes 1 and 2. SG Mentor Shea Ferring (AZSGC alum and Orbital Sciences steering committee representative) works with SG Undergrad Interns to mentor high school FIRST Robotics teams. Upon graduation, FIRST students are encouraged to enroll at ASU and join the (college level) ASU Underwater Robotics team—also led by Mentor Ferring and SG Interns. This concerted effort uses robotics to create a pathway from high school to college while training and inspiring America's future engineers.

PROGRAM ACCOMPLISHMENTS

Fellowships Programs: In FY09 AZSGC sponsored 7 programs that awarded 155 Fellowships/Scholarships to 143 undergraduates and 12 graduate students. 31 (20%) of the total awards went to students from underrepresented minorities, and 55 (35.5%) of awards were to females. All Graduate Fellows designed and implemented programs delivered through our precollege, higher education and informal education components, that gave many others opportunities to participate in NASA's science, engineering and education (Outcomes 1, 2, 3). 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 a mentored, 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). 17 AZSGC authors published results supported by Space Grant Fellowship work in 2009. AZ/NASA Space Grant Fellowships funds (\$321,872) are highly leveraged with Arizona dollars, bringing an additional \$263,545 to these workforce development programs in 2009.

Research: In FY09, AZSGC Research programs directly served 113 students and 52 faculty and other participants. Highlights include ASCEND!, a statewide balloon satellite development/launch program, that provided teams of students from UA, ASU, ERAU, PCC, SMCC, and their mentors, two successful launches/recoveries, and opportunities to experience the full design, build, fly, operate, analyze cycle of space missions. Student teams at ERAU constructed CanSats for the national competition, flew an experiment in the NASA Reduced Gravity Student Flight Opportunities Program (RGSFO), and worked collaboratively with personnel from several ERAU departments and students and mentors from PCC (MSI) to develop HASP payloads, systems and operations; the payload is currently being integrated for launch. Students from ASU collaborated with mentors from Orbital Science Corporation (the lead industry mentor is an AZSGC program graduate and our affiliate representative) to design and build robots to compete in national underwater robotics competitions. The AZSGC Robotics team placed 2nd in the NATO Undersea Research Centre (*NURC*) AUV competition, and 6th in the Explorer category for the International Remotely Operated Vehicle (ROV)

competition in June 2009. Another ASU student team worked to design and build UAVs (low-cost autonomous unmanned aerial vehicles) for aerial surveillance and other research-based tasks, while others participated in Daedalus Astronautics, a student run organization dedicated to the design, manufacture, and launching of large high powered rockets and associated rocket paraphernalia. Daedalus members undertake self-driven advanced astronautical engineering projects to enhance their educations and develop professional skills. Daedalus members compete in conferences and rocket competitions throughout the United States and have a very strong K-12 outreach component. In addition, NAU SG supported 34 students from the National Undergraduate Research Observatory Consortium (NURO) to travel to Arizona with mentors, and observe on a 31-inch telescope owned by Lowell Observatory/administered by NAU; 15 NURO participants published articles as a result. AZ/NASA Space Grant Research funds (\$80,984) are highly leveraged with Arizona dollars, bringing an additional \$44,892 to these workforce development programs in 2009.

Higher Education: 776 AZSGC students and 313 faculty and others participated in 11 higher education programs in FY09. Activities resulted in four (revised) courses (at South Mountain and Pima Community Colleges (MSIs), Tohono O’odham Tribal College and at The University of Arizona). In November 2009, the University of Arizona SEDS organization hosted SpaceVision 2009, the national SEDS conference (AZSGC is the SEDS sponsoring organization.) “SpaceVision is the largest fully student-fun space conference in the nation, dedicated to facilitating networking between college students, professionals, and the public, furthering the development of SEDS-USA, and allowing the sharing of ideas through professional speakers and workshops. In April, 2009, the Eighteenth Annual Symposium featured presentations by over 124 students about their year-long research on topics relevant to all NASA Mission Directorates, and was attended by audiences of peers, mentors, dignitaries, family, friends and others. NASA's Chief Scientist, Dr. Paul Hertz was the featured keynote speaker. AZ/NASA Space Grant Higher Education funds (\$163,952) are highly leveraged with Arizona dollars, bringing an additional \$161,840 to these workforce development programs in 2009. These and other Higher Education activities contribute directly to AZSGC goals and objectives and to NASA Education Outcomes 1, 2 and 3.

Informal Education: Over the past year our Informal Education Programs, led by the Earth Grant Geospatial Extension Program, engaged 4881 participants in 263 educational events involving 6515 contact hours. Audiences served were diverse and involved those traditionally underrepresented in science and technology (52.1% women and 45.3.0% minorities). Students, trained to provide educational outreach as a form of public service reached another 4,000 people through community public service events. We launched a new initiative in collaboration with the Department of East Asian Studies at the University of Arizona and a similar department at University of Tsukuba in Japan to introduce geospatial technology, and in particular, the use of dynamic satellite imagery, to create a context for informal language learning. UA Graduate Fellows led outreach included promoting solar energy/photovoltaics through tours at the Tucson Electric Power Company’s Solar Test Yard, curriculum implementation in schools, teacher training and other public presentations. They also trained promotoras (Hispanic lay

health workers) on environmental issues such as solid waste, recycling, wastewater and air quality to educate others in their primarily Hispanic community of South Tucson that faces extreme challenges as an EPA Superfund site. NAU Space Grant helped implement the annual week-long Festival of Science in Flagstaff. These activities on top of Geospatial Extension efforts, served an additional 1733 participants at 85 separate educational events. AZ/NASA Space Grant funds (\$30,500) are highly leveraged Arizona dollars, bringing an additional \$209,015 to Informal Education programs serving citizens across our state in 2009. Results of these activities contribute directly to NASA Education Outcomes 1, 2 and 3.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- **Longitudinal Tracking:** Of the AZSGC 2006-2009 awardees who have completed (award) degree programs, 264 (93%) are now employed in STEM fields or are pursuing additional STEM degrees. 55 of the AZSGC 2006-2009 awardees who have completed (award) degree programs are from underrepresented groups. Of these 49 (89%) are pursuing advanced STEM degrees or are employed in STEM fields. Only 4 have accepted employment in non STEM areas (2 are seeking STEM employment).
- **Course Development:** AZSGC supported four (revised) courses in 2009, conducted at South Mountain and Pima Community Colleges (MSIs), Tohono O'odham Tribal College and at The University of Arizona).
- **Matching Funds:** Arizona/NASA Space Grant funds are highly leveraged with funds from state and other federal sources: NASA SG (\$785,000-37%), Arizona (\$959,998-45%) and Other Federal (\$395,632-18%).
- **Minority-Serving Institutions:** AZSGC includes four minority-serving institutions: Pima Community College, South Mountain Community College, Dine Tribal College and Tohono O'odham (Tribal) Community College.

IMPROVEMENTS MADE IN THE PAST YEAR

Several improvements were implemented across AZSGC in 2009. UA added an Associate Director to help meet program goals, mitigate workload and to bring a federal research organization perspective to program management. ASU added an Intern Advisor Program, implemented an alumni night and an ASU Space grant campus poster session. NAU added new affiliate members Coconino Community College and Lowell Observatory. ERAU grew its Space Grant steering committee and instituted a (local) annual report to keep members better informed of programs and progress.

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: Lowry Computer Products
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: International Dark-Sky (NPO)
Outreach Affiliate: Wide Ruins Community School
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)