

Colorado Space Grant Consortium
University of Colorado, Boulder
Chris Koehler
303/492-3141
<http://spacegrant.colorado.edu>

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 Colorado Space Grant Consortium is a Designated Program Consortium funded at a level of **\$785,000** for fiscal year 2009.

PROGRAM GOALS

The Colorado Space Grant Consortium had four primary goals for the year as part of a five-year strategic plan developed to enhance the overall student experience and better equip the student for the workforce.

These four primary goals were:

1. Increase diverse student participation in hands-on space hardware programs.
2. Sustain four stages of hands-on programs for COSGC students.
3. Create and support opportunities for COSGC students to work with engineers and scientists from Colorado aerospace companies.
4. Partner COSGC students and programs with faculty and industry experts and their research through space hardware missions, seed grants, and research grant opportunities.

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

Outcome 1:

- Space Grant at Colorado State University successfully initiated an innovative "DemoSat B-R" Sequence for CSU undergraduate students. [DemoSat B is balloon payloads and R is sounding rocket payloads.] The new model integrates NASA Space Grant objectives and DemoSat programs with CSU's education mission. Students are engaged in space-hardware projects in a progressive and sustained manner and leverage the management structure provided by the Mechanical Engineering Senior Design practicum. This effort has engaged new faculty, along with mentors from Marshall Space Flight Center. Students incrementally progress through DemoSat B, attend the RockOn! Workshop and

finish with a DemoSat R payload. In addition to the DemoSat B-R sequence, CSU implemented a beginning robotics project, which will serve as an entry level project to start students toward the DemoSat program.

- The Colorado CubeSat program was successful at winning a spot on NASA's ELaNa (Educational Launch of Nanosatellites) Launch and continues to work toward launch in fall 2010.
- Metropolitan State College of Denver student, Matthew Hanley received a full paid internship at Wallops Flight Facility, spring 2009. Mr. Hanley was then hired full time at Wallops following graduation.
- Celebrating the landing of the first lunar rover, Team Artemis (Steven Wilbur and Katelyn Sandoval, students from Colorado School of Mines) participated in the 16th Annual NASA Great Moonbuggy Competition, April 3-4, 2009. The team took 4 minutes off their race time by modifying the articulated joint in their buggy. The team finished 11 and won the Rookie of the Year award for their performance. They also won the Frank Joe Sexton Memorial Pit Crew Team Award and Spirit Award..
- Mesa State College Student, Chris Aquinto, successfully finished his degree at Mesa State and was accepted as a PhD student at the University of Colorado, Boulder. Chris participated in the balloon payload and robotics programs offered by Space Grant at Mesa State.
- The CSU RocketSat team was invited to present their project to the Colorado Space Business Roundtable (CSBR) on December 9th, 2009. The event was in its sixth year and has become a premier event to connect with the Aerospace community throughout Colorado. The students also wrote a proposal for the Next-Generation Suborbital Researchers Conference (NSRC) that involved theory behind their project and how sub orbital microgravity flights can be used for research and education. The team was selected as a finalist presented at the conference, on February 18th, 2010.
- Shawn Carroll (graduate student, Aerospace Engineering, University of Colorado) served as project manager for the new RockSat initiative. RockSat is a payload canister that provides a standard payload volume and weight for launch on a sounding rocket for a relatively low cost. The first RockSat launch included customers who had participated in the 2008 RockOn! Workshop, including students and faculty from 9 universities from across the United States.

Outcome 2:

- The Space Foundation's boldest STEM initiative is supporting the "Educate to Innovate" campaign in partnership with Colorado Springs School District 11. This effort is transforming a previously failing middle school into a highly focused STEM learning center – the Jack Swigert Aerospace Academy.

PROGRAM ACCOMPLISHMENTS

NASA Outcome 1:

COSGC Goal 1

- Colorado Space Grant was successful at winning a Minority Serving Institution Partnership Development grant. After a successful balloon payload project, the four community colleges

that participated in the program were unanimously voted in as full members of Colorado Space Grant Consortium at the COSGC Annual Meeting in September 2009.

COSGC Goal 2

- Students from the Colorado School of Mines participated in habitation research. These students focused on designs for support systems: 1) astronaut rescue and 2) astronaut observation.
- Approximately 100 first-year design teams at the Colorado School of Mines have focused this semester on designing a satellite to measure the Earth's white and black albedo. There is significant amount of energy available from these reflected sources to help power vehicles operating in the Stratosphere at 60,000 to 80,000 ft. Lockheed-Martin wants to better assess the potential of additional solar energy from these reflected sources. Those teams winning bids will fly their satellite experiments as part of the Colorado Space Grant Consortium (COSGC) DemoSat program.
- University of Northern Colorado (UNC) had one successful balloon-launched payload in April 2009. This project investigated three ways of producing energy in flight: solar cells, the Peltier Effect and magnetic induction. COSGC funds were used for supplies for building the boxes and for the purchase of the hardware. This project involved three students.
- Students and faculty at UNC the developed an introductory robotics course. A subsection of this effort was to create a larger more capable rover with the capacity to bring robotics to schools around the country and world. The large robot "Odin" has an onboard computer that is connected to the internet via a wireless network. The program in robotics combines many aspects of robotics an presents them to undergraduate students at an affordable cost.
- Mesa State College moved into new lab facilities in 2009 to support student robotics efforts. In addition, the Space Grant program at Mesa State was able to host two NASA speakers on campus – one from the Jet Propulsion Laboratory and the other from Johnson Space Center. Both of these efforts have improved student interest to Space Grant programs.
- Students at University of Colorado, Colorado Springs continued to make progress on the "Space Sling" – a laboratory demonstration of a space transportation system.
- The Space Grant program at Fort Lewis College (FLC) provided support for three students to complete observatory research. This research included a project to increase duration of exposures to enable research-quality imaging of fainter objects.
- Three FLC students designed, built, tested and launched a balloon payload as part of the state-wide DemoSat program. They were successfully designed a technology validation for new structure and microprocessor systems and were also able to conduct a sound speed experiment.
- Pikes Peak Community College was able to expand tutoring services to include astronomy tutoring in addition to biology and chemistry.
- At Colorado State University (CSU), two student teams developed balloon payloads as part of the DemoSat statewide program. One team designed a jumping rover vehicle and the other measured solar cell efficiency during balloon ascent and deployed cells upon landing.
- The CSU RocketSat team developed a fiber-optic interferometer fuel gage for operation in zero-mass conditions. This effort is with NASA Marshall Space Flight Center, Dr. Polzin.

- CSU-Pueblo students designed, built and tested two autonomous rovers, continued work on a biosphere experiment, and demonstrated oxygen creation using plants grown in a closed (tightly sealed) environment.
- A team of all freshman students at University of Colorado, Boulder (CU) students proposed and won a mission to develop a payload through the High Altitude Science Platform (HASP) program at Louisiana State University. Working with scientists and engineers from the Southwest Research Institute and Dartmouth College, a small team designed, built, tested, and launched the HASP payload in September 2009 to great success.
- Undergraduate students at CU successfully designed, built, tested, and integrated the RocketSats V payload with mentors from NOAA. Launch took place in June 2009. Preliminary design for the RocketSat VI payload began at the end of 2008, following analysis of data from the RocketSat V payload.
- The CU CubeSat (CO³Sat) mission progressed working toward a 2010 launch.
- CU students and staff facilitated the second annual RockOn! Workshop in conjunction with NASA's Wallops Flight Facility, NASA Education, and the Virginia Space Grant Consortium. The second RockOn! workshop took place June 21-26, 2009 for 45 faculty members and college students from across the country.
- The CU student team continued to build and test the DANDE spacecraft (low-Earth orbiting satellite) working toward a 2011 launch secured by a 1st place win of the AFOSR's University Nanosatellite Competition.
- CU students continued working to design and implement ground station capabilities in the Mission Operations Control Center on the CU campus and in an off-campus location, to support S-band communications for the CO³Sat mission and future Colorado Space Grant missions.
- Dr. Randy Emmons at Adams State College organized the third annual Colorado Robot Challenge at the Great Sand Dunes National Park. Undergraduate students from across the state demonstrated autonomous robots in the harsh environment of the Dunes. In addition to organizing the Challenge, Dr. Emmons traveled to affiliate institutions and hosted workshops for undergraduate students to learn the basics of robotics as they began their projects.

COSGC Goal 3

- CU continued the EduSourcing partnership with Lockheed Martin and placed students in Lockheed Martin internships during the summer and academic semesters.

COSGC Goal 4

- Students at Colorado State University – Pueblo (CSU-Pueblo) worked with faculty to build and calibrate a three-point testing device to determine the modulus of elasticity of very small specimens. Using the device, the team is seeking to demonstrate if certain diet could help stop or reduce bone strength loss in weightless (space) environments.
- CSU Space Grant awarded four grants to junior faculty (as seed money designed to generate future external funding). Part of the award includes engaging students in the faculty research projects. A total of six students were engaged in faculty research through this program.
- CU partnered with Lockheed Martin to begin a new cubesat program called ALL-STAR (Agile Low-cost Laboratory for Space Technology Acceleration and Research).

Outcome 2:

COSGC Goal 1

- The Space Foundation engaged teachers of “high-risk” K-12 students through the Space Discovery Institute and Teacher Workshops.
- The Space Foundation’s effort to create an innovative STEM learning center is focused on transforming a school of 500+ students, where 71% are underrepresented minorities and 82% receive free or reduced lunch.

COSGC Goal 2

- The Space Foundation’s Space Grant program engaged in-service and pre-service teachers in the Space Discovery Institute.
- Space Grant at Adams State College provided ASC undergraduate students working toward education degrees with the opportunity to hone teaching skills and interact with K-12 students in hands-on science activities and planetarium presentation.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- **Longitudinal Tracking:** Total FY2009 awards = 129, all of which were categorized as Fellowship/Scholarship awards.
 - 7 awarded to minority students underrepresented in STEM fields.
 - 18 students are pursuing graduate studies
 - 2 have graduated and are seeking employment in STEM fields
 - 9 are employed in the aerospace industry
 - 17 are employed in STEM positions (non-aerospace industries)
 - 2 are employed at NASA
 - 4 are employed in K-12 academic field in STEM disciplines
 - 5 are employed in non-STEM fields
 - 112 students are still enrolled in their degree programs (includes students from 2006-2008 tracking who have not moved to next-step)
- **Course Development:** No new courses in 2009.
- **Matching Funds:** 1:1
- **Minority-Serving Institutions:** COSGC welcomed four new community colleges into the consortium as full members, three of which are categorized as Other MSIs – Trinidad State Junior College, Pueblo Community College, Community College of Denver. Each of these institutions implemented balloon payload programs in 2009 and will receive 2010 base funding as full COSGC members. They will have the opportunity to apply for supplemental grant funds and participate in all state-wide space hardware efforts. In addition to these four new members, Adams State College continues to be an active COSGC institution. Dr. Randy

Emmons at ASC has been integral at organizing the Colorado Robot Challenge and engaging students with embedded systems/robotics workshops across the state.

IMPROVEMENTS MADE IN THE PAST YEAR

- Addition of four community colleges into the Colorado Space Grant Consortium has extended COSGC resources to an important population of post-secondary students who previously were not engaged in COSGC programs. All four institutions have high enrollment of minority students from populations underrepresented in STEM disciplines.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

- Adams State College (4-year, Baccalaureate & Graduate): Minority Serving Institution; Facilitates student programs that contribute to Outcome 1 & 3.
- Colorado School of Mines (University through PhD): Facilitates student programs that contribute to Outcome 1
- Colorado State University (University through PhD): Facilitates student programs that contribute to Outcome 1
- Colorado State University – Pueblo (4-year Baccalaureate & Graduate): Facilitates student programs that contribute to Outcome 1
- Community College of Aurora (2-year college) Facilitates student programs that contribute to Outcome 1.
- Community College of Denver (2-year college) Minority Serving Institution. Facilitated student programs that contribute to Outcome 1.
- Fort Lewis College (4-year Baccalaureate) Facilitates student programs that contribute to Outcome 1
- Mesa State College (4-year Baccalaureate & Graduate) Facilitates student programs that contribute to Outcome 1
- Metropolitan State College of Denver (4-year Baccalaureate) Facilitates student programs that contribute to Outcome 1
- Pikes Peak Community College (2-year college) Facilitates student programs that contribute to Outcome 1
- Pueblo Community College (2-year college) Minority Serving Institution. Facilitates student programs that contribute to Outcome 1.
- The Space Foundation A nonprofit organization supporting space activities, space professionals and education. The Foundation's education programs have touched teachers in all 50 U.S. states and Germany. Facilitates student programs that contribute to Outcome 2.
- Trinidad State Junior College (2-year college) Minority Serving Institution. Facilitates student programs that contribute to Outcome 1.
- University of Colorado at Boulder (University through PhD) Facilitates student programs that contribute to Outcome 1 and 3.
- University of Colorado at Colorado Springs (University through PhD) Facilitates student programs that contribute to Outcome 1.

- University of Northern Colorado (University through PhD) Facilitates student programs that contribute to Outcome 1.
- Western State College (4-year Baccalaureate) Facilitates student programs that contribute to Outcomes 1.