

Colorado Space Grant Consortium  
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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 Colorado Space Grant Consortium is a Designated Program Consortium funded at a level of **\$730,000** for fiscal year 2008.

## PROGRAM GOALS

### *Goal 1: Increase Diverse Student Participation in Hands-On Space Hardware Programs*

**Targets:** The student population working in COSGC programs will be 17.7% underrepresented minority and 27% women.

### *Goal 2: Staged Hands-On Programs (SHOP)*

**Purpose:** Create and sustain four stages of hands-on programs for the Colorado Space Grant Consortium students.

### *Goal 3: EduSourcing*

**Purpose:** Create and support opportunities for COSGC students to work with engineers and scientists from Colorado Aerospace companies. The students will work with industry mentors to develop, design, and demonstrate each company's technologies, concepts, and ideas.

### *Goal 4: Research Faculty and Industry Partnerships (RFIP)*

**Purpose:** Partner our students and their programs with faculty and industry experts and their research at each of the COSGC campuses through solicitation of experiments, space flights, seed grants, and research grant opportunities.

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

### **Outcome 1:**

- COSGC implemented two stages of the Student Hands-On Program state-wide: *Walk* – students from all COSGC institutions are engaged in “walk” level projects which include BalloonSats, observatory research, and other space hardware research with faculty mentors. *Run* – The RocketSat program has now been implemented at 4 COSGC institutions. Students design and build payloads that are launched on sounding rockets. *Jump* – The Colorado CubeSat program was successful at winning a NASA launch for the CO<sup>3</sup>Sat Payload. *Fly* – The low earth orbiting DANDE satellite team successfully completed their Flight Competition Review and won a 2011 launch. Students have from two COSGC institutions have been a part of the mission.
- The student designed and built satellite, DANDE (Drag and Atmospheric Neutral Density Explorer) won the University Nanosatellite V competition sponsored by AFRL/AFOSR. Students from CU and UNC have worked on the mission which now has a guaranteed launch in 2011. The DANDE mission engaged over 60 students in FY 2008. Work is scheduled to continue through launch and mission operations in 2011. Students are mentored by engineers and scientists from industry and academia.
- Shawn Carroll, University of Colorado at Boulder (CU) Aerospace Engineering junior, served as project manager for the RocketSat mission at CU. His experience and expertise led to him being recruited as the project manager for the new RockSat nationwide-initiative and the Colorado state-wide RocketSat and BalloonSat programs – which have him coordinating payloads for 15 faculty and 60 students.

- Students at the Colorado School of Mines (CSM), designed a mobile lunar habitat, an exploration vehicle (EV) rather than a recreational vehicle (RV), for extended trips from the permanent base site. The focus for the design of the Highly Adaptive Lunar Transport (HALT) provided space for living, sleeping and researching. It facilitated transportation from the lunar base to various research sites at distance from the base. To help understand the challenges of travel on the lunar surface, teams have designed and built a moon buggy to compete in the NASA Moon Buggy Competition schedule for April.

**Outcome 2:**

- The Space Foundation (SF) promoted and gave space STEM curricula to educators through the Space Discovery Institute and Teacher workshops and provided scholarships for in-service teachers to attend. 54% of the scholarship recipients worked in schools with 50% or more free or reduced lunch.

## **PROGRAM ACCOMPLISHMENTS**

**Outcome 1:**

COSGC Goal 1:

- COSGC partnered with the CU Multicultural Engineering Program (MEP) and Women In Engineering Program (WIEP) to design and teach a 1 credit Journey into Space course designed to go beyond the popular Gateway to Space course and provide more detail about spacecraft design, sponsored by a grant from Lockheed Martin. The course recruited students from MEP and WIEP into the CubeSat (CO<sup>3</sup>Sat) mission, thereby raising the number of underrepresented students involved in Space Grant student space hardware missions. Ten students were awarded fellowships to work on CO<sup>3</sup>Sat in the summer of 2008.
- Students at UNC are working with a faculty member on an introductory robotics course designed to engage students from underrepresented populations.

COSGC Goal 2:

- A team of four undergraduate Mechanical Engineering and Space Science students at Colorado State University (CSU) executed a successful BalloonSat mission, including defining objectives, managing a fixed budget, developing and manufacturing and testing the payload, and successful mission and launch (in July 2008).
- An undergraduate team of five students from CSU has started work on the CSU RocketSat program targeted at a launch from the NASA's Wallops Flight Facility in June 2009. The team recently completed their Critical Design Review.
- One CSU undergraduate student worked on the optical modeling of a laser ignition system.
- One CSU graduate student worked on erosion of electric propulsion thrusters.
- Two CSU students were supported for participation in the 2008 RockOn Workshop (at NASA's Wallops Flight Facility in June 2008).
- Three Fort Lewis College (FLC) students completed astronomy research with the FLC observatory facility including color image processing with wide- and narrow-band filters, and light curves and photometry for an eclipsing binary star system
- Two FLC students completed a BalloonSat mission. Their mission included an active-control camera pointing system using a student-designed and built reaction wheel; this was successful, and is a first for the state program.
- FLC affiliate director Craig Tyler finished the publication process for *Your Cosmic Context*, a cosmology textbook he has been co-authoring for the last several years; it is now available from Addison-Wesley.
- The student team Titan, at the CSM, with the help of Ball Aerospace, developed and presented its asteroid chaser to the 3<sup>rd</sup> Space Exploration Conference in Denver, Colorado. The system was design to carry a transponder safely to the surface of a near-Earth object (NEO).
- The CSM student team Lunar Knights researched materials to create a radiation shield for the lunar habitat. The team proposed a permanent radiation shield utilizing titanium dioxide (TiO<sub>2</sub>) deposits embedded in the volcanic glass at the Aristarchus Plateau.
- In an effort to creatively and interactively document the activities of the astronauts, CSM students designed DOG, a communications rover, which follows an astronaut around the lunar surface. Ultimately, the rover camera will be controlled from Earth allowing middle and high school students to observe the surface and areas of interest associated with the astronaut's activities.

- A team of all freshman students from the CU 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 2008 to great success.
- Undergraduate students at CU successfully designed, built, tested, and integrated the RocketSats IV payload with mentors from NOAA. Launch took place in June 2008. Preliminary design for the RocketSat V payload began at the end of 2008, following analysis of data from the RocketSat IV payload.
- The CU CubeSat (CO<sup>3</sup>Sat) mission progressed working toward a 2009 launch. Students were selected for a launch on a late 2009 NASA flight.
- CU students and staff completed the development of the RockOn! workshop in conjunction with NASA's Wallops Flight Facility, NASA Education, and the Virginia Space Grant Consortium. COSGC led the first annual RockOn! workshop which took place June 23-27, 2008 for 60 faculty members and college students from across the country.
- The CU student team continued to build and test the DANDE spacecraft working in preparation for a Flight Competition Review in January 2009. On January 20, 2009 the DANDE team won the competition which includes follow-on funding and a guaranteed launch for the student-built DANDE satellite.
- Students from the CU DANDE team won a flight with the Reduced Gravity Flight Opportunities Program at Johnson Space Center that took place March 2008 where they tested the separation system for the DANDE mission.
- CU students continued working to design and implement ground station capabilities in the Mission Operations Control Center on the CU campus to support S-band communications for the CO<sup>3</sup>Sat mission and future Space Grant missions.
- CU is leading a new national effort called RockSat – a result of the RockOn! workshop. The RockSat effort is creating a new standard for launching payloads on sounding rockets. As the lead of the RockSat initiative, CU is working closely with NASA's Wallops Flight Facility and coordinating payload integration for 11 universities from across the country.
- Students at Colorado State University-Pueblo (CSU-Pueblo) designed and built a rover and a lander. The lander project was demonstrated at the COSGC Undergraduate Space Research Symposium on April 19, 2008. Work on the rover continues and is expected to be a part of the Colorado Robot Challenge on April 4, 2009.
- CSU-Pueblo students began several new projects. These include: the effect of weightlessness on bone strength, a biosphere experiment, and fuel production experiment (in-situ) for Mars return trip.
- Mesa State College (Mesa) students built an autonomous robot vehicle that was able to navigate a simulated Martian environment. It was the only successful vehicle at the COSGC's 2008 Colorado Robot Challenge.
- Students at UCCS made significant progress on the “Space Sling” – a laboratory demonstration of a space transportation system that could someday be based on the Moon. A tether reel assembly and a tether angle sensor were designed and built in house by undergraduate students. Progress was also made on the data acquisition and control system. These efforts are getting us very close to a control deployment and spin-up of the tether launch device. Significant analytic progress was also made on the modeling and control algorithm development. Results will be presented at the national AIAA Spaceflight Mechanics conference.
- UNC students helping develop an introductory robotics course successful designed a large rover designed to be used in the classroom via the internet.
- Students at MSC initiated involvement in the RocketSat project. The MSC RocketSat program represents the next level of learning for workforce development programs for MSC students.
- MSC implemented a three hour Intro to Space Technology course. This course has no pre-requisites and is meant as an introduction to space and aerospace careers. Student teams completed the course by building a mini satellite for a balloon launch.
- MSC began plans for an annual COSGC conference, the first of which will occur in May 2009. This conference will allow our students to present their results from participation in our various space hardware projects completed and will also serve as a recruitment tool to broaden the scope of potential participants.

#### COSGC Goal 3:

- A total of **20** students were placed in EduSourcing industry internships. Three students were hired as a direct result of their participation in EduSourcing. Michitaka Onizuka, Ponphet Homchanh, and Mark Gefreh were hired at MicroSat Systems, and James Hilverding was hired at Lockheed Martin.
- One grant proposal was submitted for State workforce development funding in partnership with an EduSourcing Industry Partner to expand the program.
- Funding with Lockheed Martin for the EduSourcing program was renewed for 2009.

#### COSGC Goal 4:

- CU partnered with Aerospace and Electrical and Computer Engineering faculty on several Senior Design projects.
- Space Grant programs and students were the focal point of two Colorado Space Business Roundtable annual meetings held at the Denver Museum of Nature and Science.
- Space Grant at CSU supported junior faculty with seed grants as follows: 1) Dr. Xianghong Qian, Asst. Prof., Dept. Mechanical Engineering, “Magnetically Activated Self-Cleaning Membranes for Waste Water Treatment”; 2) Dr. Tiffany Weir, Asst. Prof., Dept. of Horticulture, “Examining Effects of Microgravity on Bacterial Quorum-Sensing”; and 3) Dr. Rebecca Atadero, Asst. Prof., Dept. of Civil and Environmental Engineering, “Predictive models and mechanics of adaptive solid open-cell foams”
- CSU supported undergraduate students to work with faculty on all the above seed grant supported research projects.

### **Outcome 2:**

#### COSGC Goal 1:

- The Space Foundation works to attract minority and “high risk” K-12 teachers through the Space Discovery Institute and/or Teacher workshops. Scholarships and attendance were awarded to 11 K-12 educators. Six of the scholarship recipients work in schools with 50% or more free or reduced lunch.

#### COSGC Goal 2:

- Space Grant at the Space Foundation promoted and gave space STEM curricula to educators through the Space Discovery Institute and Teacher workshops.
- Adams State College (ASC) student, Shelly Grandel, integrated her experience with the ASC Planetarium outreach services with her teacher education classes, exposing her cohort of future teachers to space and science. While still within the teacher education setting, Shelly was successful in showing the other Master Degree students how to construct hands-on science activities, engage students in those activities and find additional resources to expand the potential activities.

## **PROGRAM CONTRIBUTIONS TO PART MEASURES**

- **Longitudinal Tracking:** Total 2008 awards = 132, all of which were categorized as Fellowship/Scholarship awards. 11 of the total awards represent underrepresented minority F/S funding. 13 students have accepted STEM positions in an aerospace industry, while 12 have graduated and are pursuing advanced STEM degrees.
- **Course Development:** 4 – CU’s Journey to Space; Metro State’s Intro to Space Technology; UNC’s Robotics; Mesa State’s Intro to Space Science
- **Matching Funds Ratio:** 1:1
- **Minority-Serving Institutions:** COSGC is privileged to have two MSI’s in the consortium – Adams State College and Colorado State University – Pueblo. The leadership at both of these institutions has worked toward providing resources for their unique populations through the COSGC network, and has, for the most part, done so successfully. However, this has largely been done autonomously and separate from the COSGC lead institution and administration. The Director and Associate Director visited each of these institutions in summer 2008 and discussed plans for expanded and new programs at the institutions that can reach more students and provide appropriate resources to students. The COSGC Director has provided support to the Affiliate Director at Adams State College during the development and implementation of the Colorado Robot Challenge, which has been led by Randall

Emmons, Affiliate Director at Adams State College. COSGC is submitting a proposal that would fund collaboration with 4 addition HSI Community Colleges to start BalloonSat programs at their institutions.

## **IMPROVEMENTS MADE IN THE PAST YEAR**

Implemented several processes to better support COSGC member institutions including:

- Regulated annual progress reporting, CMIS, budget, and proposal processes to take place at the same time every year, regardless of national timeline. This new process will ensure that member documents are in order so that funding may be awarded in full, immediately, thus avoiding detrimental effects of late or incremental funding.
- Recruited an undergraduate student to manage state-wide DemoSat B and R programs in order to restore lead institution oversight of program schedule and other parameters.
- After awarding two years of supplemental awards to COSGC member institutions that have proposed expansions of their workforce development programs, UNC's base funding was doubled to support their extended program. It is the first increase in base funding since the founding of COSGC. COSGC leadership plans to continue the supplemental funds program with the ultimate goal of increasing base funding for high achieving COSGC affiliate institutions.
- COSGC leadership conducted the face-to-face meetings with each affiliate director at all affiliate institutions.
- The RocketSat program was extended statewide with 4 COSGC institutions participating for the first time in 2008.

## **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 2 & 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): Minority Serving Institution; Facilitates 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
- 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.
- University of Colorado at Boulder (University through PhD) Facilitates student programs that contribute to Outcome 1.
- 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 & 2.