COLORADO SPACE GRANT CONSORTIUM

Our Plan for the Future
2013 - 2017
When I was two years old (1972), events were happening in space that had an enormous impact on me later in my life and ultimately set before me a path to follow with my career. Those events revolved around the Moon and the Earth with NASA’s Apollo and Skylab programs (also Star Wars released when I was 7 years old). These events, and many others, inspired me to find a way to be involved and engaged in making science fiction non-fiction.

When I entered college in 1988, as an Aerospace Engineering major, I began looking for ways to plug into the “real world” of space. One evening, Elaine Hansen, COSGC’s founding Director, gave a talk about the program to students with free pizza. I, along with many other students, went for the free pizza. As Elaine took the stage, stuffed students began to sneak out but I decided to stay and that was one of the best decisions I ever made. During her talk, Elaine opened my eyes to all that Space Grant had to offer students like myself who were willing to get involved and over the next six years, I was.

I worked on a sounding rocket mission and two Space Shuttle Get-Away-Special missions, all of which launched while I was a student. I even went to graduate school while working on these projects. I attended integration and testing trips at NASA’s Goddard Space Flight Center and Kennedy Space Center. I sat at Mission Control at NASA’s Johnson Space Center during the shuttle flights. I presented papers and results at conferences and NASA functions. I also worked on proposals for new spacecraft to low Earth Orbit and beyond with Elaine and local aerospace companies. These experiences helped me stand out among the crowd of applicants when applying for employment at Lockheed Martin (where I worked for six years). Without these experiences, my life and my career would not be what it is today. This is my Space Grant Story and what drives me to keep the Colorado Space Grant Consortium alive and relevant for current and future students.

Since becoming Director in November 2004, I, along with my staff, affiliate directors, and countless students, have built upon the foundation that Elaine created to do just that. The Consortium now consists of 17 members and additional funding through competitive grants has allowed us to increase the funding level for many of them. The number of hands-on programs we offer statewide each year has substantially increased with our BalloonSat, Robotics, and Sounding Rocket programs. All this equates to more students having their own Space Grant experience, allowing them to write their own Space Grant Story. The students exiting our program are highly skilled, experienced, and valuable additions to the workforce. This is due in part to the student but also to our dedicated affiliate directors and the programs that they have created for their students.

The new five-year plan you are about to read is our plan for maintaining and expanding the Colorado Space Grant program. It builds upon the aspect of our program that was successful in the previous five-year plan (hands-on programs) and addresses the area that was not (diverse student participation). In addition, the plan provides a path that will allow the program to be less susceptible to the ups and downs of funding from NASA (partnerships). I am thrilled to be the Colorado Space Grant Director and I, like my staff, have chosen to dedicate my career to seeing this program succeed. In late 2017, when we will reflect on how far we traveled down the path laid out in this plan, I confident we will have been successful in giving hundreds, if not thousands, of students a chance to write their Space Grant Story.

Chris Koehler, Director
Colorado Space Grant Consortium
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A Space Grant Story...
The Colorado Space Grant Consortium (COSGC) is a state-wide program and is part of a national program funded by NASA that was formed in 1988. There is a Space Grant Consortium in every state plus Washington, D.C. and Puerto Rico. The 52 Space Grant Consortia support undergraduate and graduate students in over 700 higher education institutions in the areas of research, hands-on engineering, teaching, and public outreach.

COSGC consists of 16 higher education institutions and the Space Foundation. Through our hands-on programs, we engage over 500 post-secondary students state-wide each year providing them with experiences that will aid them in their future academic courses and careers.

We partner with industry, NASA, and faculty in Colorado and across the country to provide mentorship and project ideas to our students. These partners include Analytical Graphics Inc., Sierra Nevada Corp., Parallax Inc., SparkFun Electronics, Composite Technology Development, Edge of Space Sciences, Lockheed Martin, Ball Aerospace, FirstRF, Digital Globe and many others. We also work with many NASA centers, utilizing the expertise of their engineers and scientists. These include: the Jet Propulsion Laboratory, Kennedy Space Center, Goddard Space Flight Center, Wallops Flight Facility, Marshall Space Center, and NASA Headquarters.

COSGC enriches students’ higher education with real-world, hands-on projects and space-focused courses. Projects include observatory and robotics projects, balloon projects, sounding rocket payloads, and orbiting satellite missions, in addition to space-focused faculty and student research. “Gateway” courses expose students to the field of Aerospace and Space Science. Workshops enable educators and students from around the state and the Nation to start their own programs. We also facilitate workshops and hands-on programs for K-12 pre-service and in-service teachers. We have numerous astronomy and robotics programs that blend both the space connection with research through a hands-on method.

Since 1989, COSGC students have completed numerous research projects, launched over 1,400 BalloonSats, 25 sounding rocket payloads, three Space Shuttle payloads, three low Earth orbiting satellites, and demonstrated over 60 ground-based autonomous robotic designs. Additionally, Colorado students have flown on NASA’s microgravity flights and participated in NASA and industry internships.

“I think I absorbed more from Space Grant projects than from any other single aspect of my education. It gave me context to my education and showed me the vast distance there is between theory and practice.

Matthew Bird, Metropolitan State University of Denver (2012)
Our Students

COSGC is interdisciplinary, engaging students from various disciplines including: Physics, Electrical Engineering, Mathematics, Astrophysics, Aerospace Engineering, Biology, Mechanical Engineering, Computer Science, Chemical Engineering, and more. The students who participate in our programs gain valuable experience through hands-on, real-world student space missions. These experienced students are ready to contribute to the workforce upon graduation. The chart below shows where COSGC students take their next step.

Where We Are Going

COSGC will focus on three main goals, each designed to work in concert enhancing the overall student experience and better equipping each student for their next step - whether it be the space industry, advanced degrees, or teaching in a K-12 STEM classroom.

1. Engage an inclusive and diverse student population
2. Space focused research and hands-on programs for students and K-12 teachers
3. Develop more NASA, industry, and faculty partnerships

This symbol to the right represents a cross-section of both our program throughout our Consortium and goals of this plan. Our hands-on programs are enabled and enhanced by engaging an inclusive and diverse population of students through partnerships with NASA Centers, Industry, and Faculty. Looking at this symbol with that in mind, you can see that it forms our pipeline in Colorado.
Goal 1: Engage an Inclusive & Diverse Student Population

Basis:
A diverse community is a stronger community. A diverse student program creates a more complete student experience. The Colorado Space Grant Consortium understands the value and need for a diverse student community. Through the implementation of this goal, the needs of our student participants, our affiliate institutions, and our NASA, industry and faculty partnerships will be aligned, training the diverse workforce of the future. The lead institution will continue the implementation of the COSGC’s Community College Transfer Scholarship Program (CCTSP), where current and former students engaged in one of COSGC’s two year affiliates, can apply for a scholarship to attend one of COSGC’s four year affiliates. Each student will receive a scholarship for three years as well involvement in a COSGC project at that institution. The lead institution will continue to maintain and grow the Elaine Hansen Space Grant Internship (EHSGI). This Internship, named in honor of the COSGC’s founding Director, is open to any female student actively engaged in a COSGC affiliate program and places the student directly into a NASA summer internship.

Strategy:
Recruit, retain and engage an inclusive & diverse population of students in COSGC programs.

Performance Measures:
COSGC Institutions:
- Student participation shall meet each institution’s demographic STEM enrollment percentages by the end of 2015.

COSGC Leadership:
- Track and report on trend ultimately to reach a minimum of 40% female and 20% underrepresented minority students by 2017. Improvements expected each year.
- Support three students transferring from two year institutions to four year institutions in 2013 and six by end of 2017.
- Support one female student in a NASA internship each year through 2015 and two by end of 2017.

Action Plan:
COSGC Institutions:
- Determine the institution’s student demographics and develop a plan for recruiting, engaging, and retaining students.
  - Plans and results submitted annually in proposals and reporting cycle.
  - Participate in telecons to share best practices and keep the effort moving forward.

COSGC Leadership:
- Community College Transfer Program (CCTP)
- Elaine Hansen Space Grant Internship (EHSGI)
- Facilitate opportunities for COSGC faculty and staff to discuss successes, failures, frustrations, and share best practices.
- Update reporting process to include required data and continue to gather and report project, student and demographic information to NASA.

“Working for Space Grant helped me stand out from other applicants, I would even say that NASA Space Grant is probably the main reason I have my job now.”
Nathan Kowall, Western State Colorado University (2012)

“Because of Space Grant I realized I wanted to become a scientist. In this way, Space Grant influenced my decision to continue on in higher education toward an advanced degree before heading into the workforce.”
Jaime Corchado, Community College of Aurora/Colorado School of Mines (2012)
Goal 2: Space Focused Research & Hands-On Projects

Basis:
Education is enhanced and enriched by hands-on programs. Hands-on programs can help attract students to STEM and aid in the retention of those students. Hands-on programs, tied to real-world, space-related research and activities has been and continues to be a focus of our efforts at COSGC. Providing students with varying levels of projects is another way to retain student involved with COSGC. Students involved in COSGC’s hands-on programs are better prepared to enter the workforce upon graduation.

As part of this goal, the high altitude balloon satellite programs (BalloonSats), ground-based robotic programs, numerous astronomy programs, Gateway to Space courses, and numerous hands-on research programs will continue. COSGC will continue the following statewide programs: DemoSat, the Robotics Challenge and the Colorado Undergraduate Space Research Symposium (CUSRS). COSGC will begin a new statewide program entitled CORE (COLORado Rocket Experience) and will be similar to the DemoSat program. Through CORE, affiliates that want to have a rocket-based hands-on program, will be able to fly their sounding rocket payloads each summer as part of an overall shared payload space in the RockSat-C and RockSat-X programs (managed by COSGC). CORE payloads should demonstrate technologies and/or concepts from NASA, industry, and/or academia. COSGC will continue support HASP payloads with this plan. The High Altitude Student Platform (HASP) provides students interested in doing more advanced high altitude ballooning experiments each year. Student-built HASP payloads are launched to 120,000 feet and stay aloft from 8 to 48 hours.

As part of this goal, COSGC will support various types of student research statewide. These research projects includes) ones in which the student is closely mentored and monitored by a peer supervisor, 2) projects requiring some autonomy and initiative on the part of the students, and 3) students creating and developing their own ideas and innovations that are tied directly to a NASA interest.

COSGC will continue to offer hands-on training workshops for affiliates and their partners in support of our statewide BalloonSat and Robotics programs as needed each year. Affiliates interested in implementing the Gateway to Space course at their campus will be offered training from COSGC leadership. COSGC plans to implement a new hands-on training workshop for affiliates called COSMOS (COLORado Students Making Orbiting Satellites) that will help affiliates begin their own orbital satellite. COSMOS will provide participants with enough hands-on training to build their own orbiting satellite. COSGC will help affiliates identify and propose for opportunities to get their satellites into orbit.

COSGC will continue to support national hands-on workshops and programs including the Student Hands-On Training (SHOT) for the Air Force (BalloonSats), RockOn! Workshop, RockSat-C and RockSat-X (Sounding Rocket Payloads), and the Starting Students Space Hardware Programs (BalloonSats) workshop. These workshops can be used for K-12 teacher training, impacting more students prior to them reaching the higher education level.

Symposium winners pose with industry sponsor (left); Trinidad State Junior College student teams engaged in hands-on robotics projects (middle) on TSJC campus; and Colorado Robotics Challenge at Great Sand Dunes National Park (right).

“[Space Grant] robotics program at TSJC helped my career path choice because it encompassed a variety of disciplines, like computer science, mechanics, and systems integration. This helped me figure out what I enjoyed doing the most and what area of engineering I wanted to pursue.”

Zach Scott, Trinidad State Junior College/University of Colorado at Boulder (2012)
**Strategy:**
Facilitate space-focused, hands-on projects, courses, and research of varied types and complexity for post-secondary students including pre- and in-service teachers. Provide state-wide workshops to support student project efforts in addition to opportunities to launch payloads, demonstrate capabilities, and present results.

**Performance Measures:**

**COSGC Institutions:**
- Facilitate at least one program/project 2013 - 2017.
- Offer at least two varying projects at four campuses by 2015.
- Offer at least three varying projects at eight campuses by 2017.

**COSGC Leadership:**
- Facilitate balloon payload and/or robotics workshops three times per year.
- Facilitate the DemoSat (balloon payload) program, with standardized reviews and three launch opportunities per year.
- Facilitate the Colorado Robotics Challenge (CRC) annually.
- Facilitate the Colorado Undergraduate Space Research Symposium (CUSRS) annually.
- Develop and facilitate the CORE (Colorado Rocket Experience) program by 2015.
- Develop and facilitate the COSMOS (CColorado Students Making Orbiting Satellites) program by 2017.

**Action Plan:**

**COSGC Institutions:**  **Each institution will engage in activities based on specific campus needs and affiliate director research focus.**
- Facilitate space-focused workshops for K-12 pre- and/or in-service teachers.
- Facilitate space-focused research, robotics, observatory, and/or space hardware missions for undergraduate and graduate students on COSGC campuses.
- Facilitate space-based courses.
- Participate in COSGC supported launch opportunities and expand student opportunities on home campuses.

**COSGC Leadership:**
- Facilitate balloon/robotics workshops, DemoSat-B, CRC, and CUSRS.
- Support programs that have implemented, or would like to implement a “Gateway to Space” course as part of their curriculum.
- Provide launch opportunities for balloon and sounding rocket payloads.
- Develop and facilitate the CORE and COSMOS programs, along with support workshops.

“Without a doubt Space Grant molded me into the engineer I am today. Without it, I would not have developed the necessary hardware, project management, teamwork, rapid project development, and lean scheduling skills that are truly critical in the aerospace industry.”

David Ferguson, University of Colorado at Boulder (2010, SpaceX)
Goal 3: NASA, Industry, and Faculty Partnerships (NIFP)

Basis:
Many COSGC hands-on projects require assistance with mission or design. Every one can benefit from mentors and advisors. NIFPs connect students with research being done on their campuses, at NASA and in industry. Partnerships provide student teams with a customer and connect them with mentors. Partners gain an opportunity to low-cost access to space that will benefit their grant writing. Ultimately, NIFPs may enable funding opportunities that benefit COSGC programs and students.

Strategy:
Partner with NASA, industry, and/or faculty and their research through solicitation of experiments, space flights, internships, and seed grants.

Performance Measures:
- One NIFP at each COSGC affiliate by end of 2013.
- Two NIFPs at 50% of the COSGC affiliates by end of 2015.
- Three NIFPs at 75% of the COSGC affiliates by end of 2017.
- Through NIFPs, each COSGC affiliates shall generate funding 60% or greater of their annual COSGC funding by 2017.

Action Plan:
COSGC Institutions:
- Affiliate Directors will actively pursue collaborations with NASA Centers, supporting industry or faculty on their home campuses.

COSGC Leadership:
- Provide assistance to affiliate directors who request help making connections with NASA Centers and/or industry partners.
- Continue to diversify funding with the goal of reinstating Seed Grants/supplemental grant proposal opportunities for affiliate institutions.

“I would like to thank the Colorado Space Grant Consortium for the insight and direction that I received from the program. Without the help of the program I would not be where I am today. I fully believe that the future of aerospace in Colorado depends on programs like the Colorado Space Grant Consortium.”
Bruce Keller, University of Northern Colorado (2005, Lockheed Martin)
Below is the summary schedule for Goals 1, 2, and 3. R = Rocket, H = HASP, “3” = number of students or affiliates, and W = Workshop.

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Colorado Mesa University students working on autonomous robots (left); Colorado State University students perform emergency repairs on their robot at the Colorado Robotics Challenge (middle); and pose with their rocket payload (right).

“I had a course called “math clinic,” where we met with a team from United Launch Alliance that needed to optimize electrical box placement on a launch vehicle. Space Grant prepared me for working on a team to solve this kind of very specific applied problems.”

Chris Aquinto, Colorado Mesa University (2012)

“My involvement with RocketSat was always the centerpiece of discussion while interviewing for jobs. I firmly believe that my involvement with the Colorado Space Grant is what ultimately led to multiple job offers.”

Ryan Sullenberger, Colorado State University (2010)
**Funding**

Current funding through the base NASA award covers the cost of continuing student programs at all COSGC institutions at their current capacity as of the publishing of this document (September 2013). This current funding level is $575K each year. NASA funding for COSGC is expected to remain flat through the end of our current 5-year grant which ends on May 2015. COSGC plans to propose for augmentation opportunities that may become available through the national program. The cost of expanding programs to encompass new student programs that take advantage of the CORE and COSMOS opportunities and/or support new endeavors with NASA, industry and academic partners will be dependent on fundraising at each COSGC institution. It is expected that leveraging resources created by new partnerships will enable expansion of student opportunities. In addition, as the lead institution works toward diversifying income to support programs currently funded by the base NASA award, more funding may become available to support new programs, or supplemental grant opportunities to expand COSGC programs at affiliate institutions. Expanded programs in this 2013-2017 plan require additional funding for full implementation. The paragraphs and table below detail these funding requirements.

**Goal 1 - Engage and Inclusive and Diverse Student Population**

As each COSGC Affiliate will be embedding the fundamentals of this goal into their overall programs, the costs associated with the implementation of this goal are for the **Community College Transfer Scholarship Program (CCTSP)** and the **Elaine Hansen Space Grant Internship (EHSGI)**. CCTSP will cost $6K ($3K in scholarships and $3K in engagement funds) per student for the three years that they are in the program. 3 students in 2013 and 2014, will cost $36K ($6K * 3 students * 2 award years). 4 students in 2015 and 2016 will cost $48K ($6K * 4 students * 2 award years). 6 students in 2017 (but award spans to 2019) will cost $36K ($6K * 6 students * 1 award year). Currently, COSGC has $12K available to support this aspect of the goal. To fully support this aspect of Goal 1 will cost $120K minus the $12K already available leaves an additional $108K that is needed. Each EHSGI student award will cost $7K per year. To meet this aspect of Goal 1, $28K will be needed for awards given in 2014 – 2017 and encompasses the total cost implementing the EHSGI effort. COSGC currently has $0K available for EHSGI. To fully achieve these aspects of Goal 1, $136K ($108K + $28K) is needed. Fundraising will be required to secure these funds.

**Goal 2 - Space Focused Research & Hands-On Projects**

As with Goal 1, Goal 2 is expected to be embedded into each Affiliate’s program. However, at current funding levels, Affiliates will not be able to expand their programs to have multiple projects per year without additional funding. This additional funding will come from successful implementation of Goal 3 of this plan at each affiliate institution. Statewide aspects of Goal 2 like the DemoSat program, the Annual Symposium, and the annual Robotics Challenge are are part of the base funding at COSGC’s lead institution. The HASP, CORE, and COSMOS aspects of Goal 2 do not currently have funding support. Participation in these three programs is optional and will be implemented at the Affiliate level. Therefore costs associated with student compensation, hardware, and travel will be covered by the affiliates and the launch fee will be covered by the lead institution.

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**“The Space Grant program was extremely helpful in the interviewing, and hiring process. I felt that it gave me an edge when talking to potential employers, because I had accumulated experience in nearly every aspect of the engineering design process, as well as presenting my work to experienced professionals.”**

*Benjamin Gindl, Colorado State University (2011)*
The launch fee associated with CORE varies depending on the number of affiliates participating and the size of their payload. Assuming 2 affiliates participate in 2015 and 2016 ($14K each year) and 4 participate in 2017 ($28K for this year), the total funds needed for CORE program is $56K ($14K+$14K+$28K). The HASP and COSMOS programs do not have launch fees associated with them. The lead institution will provide training workshop for affiliates that wish to participate. Costs associated with HASP and CORE workshops are ~$4K per year (starting in 2014) for a total of $16K. In order to implement COSMOS, funds will be needed for developing and conducting the training workshop and distribution of ALL-STAR hardware. Assuming two affiliates participate in COSMOS in 2017, the funds needed are ~$80K ($20K workshop development, $10K for actual workshop and $50K for the ALL-STAR hardware provided to the affiliates). Total cost for implementing Goal 2, outside of the costs associated at the affiliate level, is $152K ($56K+$16K+$80K).

Goal 3 - NASA, Industry, and Faculty Partnerships (NIFP)
Goal 3 is a model that enables the full implementation of Goal 2. Primary funding from NASA Education is flat for the foreseeable future and the additional funds needed to grow the COSGC program must come from partnerships. This model has been successfully implemented at several of COSGC’s affiliates during the last Strategic Plan. Making connections with NASA’s Mission Directorates, local, statewide, and national companies in the Aerospace and general engineering industry, as well as research faculty can lead to partnerships that will support the research and flight programs that are set forth in Goal 2. The funds needed to implement Goal 3 are minimal however it is expected the time required to make the needed connections may be significant. Affiliates that wish to award Seed Grants to stimulate these partnerships will have to raise these funds locally.

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| Total Needed to Implement New Programs | $272,000 |

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Western State Colorado University successfully recover their BalloonSat (left); Colorado Mesa University students show off their rovers for the Robotics Challenge (middle); student participants in the hands-on Robotics workshop held on the Fort Lewis College campus.

“I my professional career I continue to draw upon the knowledge and skills acquired through my work in Space Grant, from machining parts and understanding how manufacturing practice and design are codependent to testing assemblies and product design.”

Scott Harder, University of Colorado, Colorado Springs (2012)
THE COLORADO SPACE GRANT TEAM

George Sellman, Assistant Professor
Adams State University

Steve Trageser, Associate Professor
University of Colorado, Colorado Springs

Cindy Clements, Professor
Trinidad State Junior College

Jaid Probert, Vice President
Space Foundation

Liz Coelho, Faculty
Pikes Peak Community College

Charlie Hakes, Assistant Professor
Fort Lewis College

Victor Andersen, Faculty
Community College of Aurora

Azer Yalin, Associate Professor
Colorado State University, Ft. Collins

Brian Sanders, Deputy Director
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Chris Koehler, COSGC Director

Bob Walch, Professor
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Suzanne Taylor, Assistant Professor
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Bill Hardwick, Instructor
Pueblo Community College

Aaron Brown, Associate Professor
Metropolitan State University of Denver

Steffanie Peterson, Assistant Instructor
Community College of Denver

Jude DePalma, Associate Professor
Colorado State University, Pueblo

Angel Abbud-Madrid
Colorado School of Mines

Warren MacEvoy, Professor
Colorado Mesa University

Bernadette Garcia Galvez,
COSGC Program Coordinator

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