Utah Space Grant Consortium
Lead Institution: University of Utah
Director: Dr. Joseph Orr
Telephone Number: (801) 573-2091
Consortium URL: http://www.utahspacegrant.com/
Grant Number: NNX15A124H
Lines of Business (LOBs): NASA Internships, Fellowships, and Scholarships; Stem Engagement; Institutional Engagement; Educator Professional Development

A. 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 Utah Space Grant Consortium is a Designated Consortium funded at a level of $760,000 for fiscal year 2016.

B. PROGRAM GOALS

Goal 1: In alignment with the NASA Internships, Fellowships, and Scholarships (NIFS) Line of Business, advertise and award Space Grant fellowships, scholarships, and internship awards to students enrolled in Utah institutions of higher education, thereby contributing to our Nation's future workforce and fuel an increased interest in STEM disciplines.

SMART Objective 1: In 2015-16 we plan to award 12 fellowships at the graduate student level. In 2016-17 & 2017-18 we plan to award 8 fellowships at the graduate student level. All of these awards will be above $5,000 and therefore will be longitudinally tracked.

SMART Objective 1A: In 2016-17 & 2017-18 (with augmentation funds) we plan to award an additional 8 fellowships each year (16 total per year) at the graduate student level. All of these awards will be above $5,000 and therefore will be longitudinally tracked.

SMART Objective 2: In 2015-2016 we plan to award 18 scholarships at the undergraduate level. In 2016-17 & 2017-18 we plan to award 15 scholarships at the undergraduate level. These scholarship awards will be below the $5,000 tracking level and therefore, not considered significant.

SMART Objective 2A: In 2016-17 & 2017-18 (with augmentation funds) we plan to award an additional 3 scholarships (18 total per year) each year at the undergraduate level. These scholarship awards will be below the $5,000 tracking level and therefore, not considered significant.

SMART Objective 3: Award student internships at NASA Centers and/or industry each year at a stipend level consistent with standard NASA internship stipend funding levels. In 2015-16 we plan to award four internships and in 2016-17 & 2017-18 we plan to award two internships per year.

SMART Objective 3A: In 2016-17 & 2017-18 (with augmentation funds) we plan to award an additional 2 internships each year (4 total per year) at NASA Centers and/or industry at a stipend level consistent with standard NASA internship stipend funding levels.

SMART Objective 4: Maintain 100% STEM retention of all fellowship/scholarship/internship awardees receiving $5,000 or more significant awards through graduation.

Goal 2: In alignment with the NASA STEM Engagement Line of Business, provide higher education opportunities in STEM education through new or revised courses, long and short duration workshops, hands-on student activities and competitions, and other relevant higher education opportunities. These opportunities will enable learners to acquire knowledge, understand what they have learned, and apply that knowledge through inquiry-based and project-based activities.

SMART Objective 5: During 2015-18, conduct an average of 15 higher education projects annually through Space Grant academic affiliates across the state of Utah. All faculty and student participants will be in the STEM fields.

SMART Objective 4A: Annually advertise and award competitive higher education minigrant opportunities for faculty members of our Consortium to benefit faculty/student teams at their institutions. We plan to award 4 higher education minigrant projects (with augmentation funding) to faculty/student teams in 2016-17 & 2017-18.

SMART Objective 5A: During 2016-18 (with augmentation funds), conduct 10 new higher education projects and augment 12 existing higher education projects annually through Space Grant academic affiliates across the state of Utah. All faculty and student participants will be in the STEM fields.

Goal 3: In alignment with the NASA Institutional Line of Business, build and develop capacity of institutions for sustained STEM capabilities in topical areas of interest to NASA through research infrastructure opportunities within the Utah Space Grant Consortium. These research infrastructure opportunities will promote interaction with NASA Centers, other education institutions, and enhance competitiveness to perform STEM research and development. Research infrastructure activities will also enable early career faculty to focus their research toward NASA priorities.

SMART Objective 6: Annually advertise and award research infrastructure awards for junior faculty members of our Consortium as an investment in their space-related research and career development. All research funded will involve student participants. We plan to award three research infrastructure projects in 2015-16 and two research infrastructure projects in 2016-17 & 2017-18.

SMART Objective 6A: Augment the existing program to annually advertise and award research infrastructure awards for junior faculty members of our Consortium as an investment in their space-related research and career development. All research funded will involve student participants. We plan to award an additional 2 (with augmentation funds) research infrastructure projects in 2016-17 & 2017-18.

SMART Objective 7: All faculty receiving funding for research infrastructure awards will produce at least one publication or presentation for their results.

SMART Objective 8: In 2015-2018 we plan to target an average of 30 publications/ presentations per year from Space Grant supported students and faculty.

Goal 4: Assure that students and faculty participating in Utah Space Grant Consortium projects and activities are representative of the diversity of the State of Utah.

SMART Objective 9: Target the following percentages for diversity in fellowship and scholarship awards to students in our state: 40% awards to females and 30% awards to minorities annually.

Goal 5: In alignment with the NASA Educator Professional Development Line of Business, Utah Space Grant Consortium will attract and retain teachers and students in the STEM disciplines who have a solid understanding of the subject material.

SMART Objective 10: Annually conduct 12 workshops for teacher career development at the UNSGC HQ level involving the Outreach Administrator as the coordinator of these workshops.

SMART Objective 11: Annually conduct and participate in an additional 6 precollege projects at affiliate members of the UNSGC. These precollege projects will target K-12 teachers and students.

Goal 6: The Utah Space Grant Consortium will aim to increase the use of NASA-related materials in classroom instruction, increase the comfort level of elementary-level educators in teaching STEM subjects, and increase proficiency in NASA-related STEM subjects for middle and high school educators.

SMART Objective 12: Develop relationships with 2 new schools each year where we implement NASA-related material into the classrooms at these schools.

SMART Objective 7A: Annually advertise and award competitive precollege minigrant awards for members of our Consortium to carry out precollege projects. We plan to award 3 precollege minigrant projects in 2016-17 & 2017-18.

SMART Objective 8A: Annually conduct and participate in 2 additional precollege projects (with augmentation funds) at affiliate members of the UNSGC. These precollege projects will target K-12 teachers and students.

Goal 7: The Utah Space Grant Consortium will provide organized educational activities outside of the established formal school system through the planetarium, museums and science centers located in the State of Utah. This will increase exposure to and knowledge of NASA-related content.

SMART Objective 13: Annually develop 3 sets of informal education standards-based STEM materials or displays to enrich visual and activity experiences by informal education providers. All UNSGC public service/informal education activities must support science, technology, engineering, and mathematics (STEM) literacy and education.

SMART Objective 9A: Annually develop one additional set (with augmentation funds) of informal education standards-based STEM materials or displays to enrich visual and activity experiences by informal education providers. All UNSGC public service/informal education activities must support science, technology, engineering, and mathematics (STEM) literacy and education.

C. PROGRAM/PROJECT BENEFITS TO PROGRAM AREAS

1) HIGHER EDUCATION –The Utah Robotic Mining Project was funded by the UNSGC higher education projects competitive opportunity which was introduced as a new program in FY 16 with augmentation funds. The Utah Robotic Mining Project is a student-led project at the University of Utah that provides support to several undergraduate and graduate students with their capstone projects leading to graduation. While competing at the NASA Robotic Mining Competition at the Kennedy Space Center each year, these students get hands-on experience and participate in real-world engineering projects that can scarcely be replicated in the classroom. The project incorporates the most cutting-edge research into autonomous robotics as its very foundation, and new novel approaches to space mining have been fully realized including new mechanical design innovations, winning the team The Judge's Innovation Award in the 2016 competition. Higher education funding from Utah Space Grant is supporting the 2016-17 Robotic Mining Team to prepare and compete in the May 2017 NASA Robotic Mining Competition at Kennedy Space Center.

Back on earth, the project is seeing real progress towards autonomous mining which will allow for safer and more efficient mining operations around the world. Local outreach efforts in Utah have impacted over 2,000 K-12 students and multiple presentations at The Utah Mining Association has led to collaboration with Utah companies such as Rio Tinto Kennecott, CAT, and Millcreek Engineering to better the possibilities of mining in space, and hopefully lead to a safer future for mining across the globe.

2) RESEARCH INFRASTRUCTURE – John Armstrong of Weber State University received a research infrastructure project award for 2016-17 entitled "Geospatial Analysis of Mars Imagery in the Tracey Hall Computational Research Laboratory." With the construction of the Tracy Hall Science Center on Weber State University's Ogden Campus, it has been an excellent opportunity to combine resources for planetary science research with Weber's geospatial analysis lab. Combined with funding from NASA's Exoplanet System Science (NExSS) team, faculty and students at Weber State University were able to equip a geospatial and image analysis lab with 20 workstations featuring the latest GIS and analysis software. Funding from Utah NASA Space Grant allowed two faculty members to travel to the United States Geological Survey (USGS) Flagstaff Science Campus to train on GIS data products for NASA's Mars missions. Utah Space Grant funding was also used to support ten undergraduate students to work on an analysis for 1,000 southern polar craters on Mars in search for subsurface water ice. This project is still in process and faculty and students at Weber State University plan to complete the survey in April of 2017.

3) PRECOLLEGE – The Leonardo received funding in FY 16 through the new UNSGC precollege competitive opportunity program. The Leonardo has been working closely with experts Wendi and James Laurence, to develop "Flight!" curricula. The Leonardo has developed three curricula and piloted these programs and they are beginning implementation of the professional development. The three curricula include: (1) Flight 101: This lesson provides an introduction to teaching flight and how it can be integrated across the elementary and middle school curriculum. Topics include the forces of flight, experiments that allow students to engage in the 3 dimensions of the new SEEd expectations and how to connect the Flight! exhibit. A workshop presented by Leonardo experts will be provided February 4, 2017 for local educators and museum educators (who later on will be able to lead this teacher workshop). (2) Flight - Shifting Perspectives: This lesson demonstrate how flight has changed our view of the earth. Computer technologies are used to access data from airplane, ISS and satellite images to create visual representations of earth-based features. A workshop presented by Leonardo experts will be provided May 2017 for local educators and museum educators (who later on will be able to lead this teacher workshop). (3) Wings: This lesson integrates the Flight! exhibit wing focus, the scientific principles of lift and the design of airplane wings. A training presented by Leonardo experts will be provided March 24, 2017 for museum educators so they will know how to do this lesson with K-8 and PREP students during fieldtrips at the museum.

D. PROGRAM ACCOMPLISHMENTS

- NASA Internships, Fellowships, and Scholarships (NIFS):

SMART Objectives:

1&1A. During FY 2016-17, we awarded 25 fellowships to graduate students, exceeding our goal of 16 fellowship awards with base and augmentation funding. All 25 fellowship awards were significant awards and have been entered into the longitudinal tracking database.

2&2A. During FY 2016-17, we awarded 19 scholarships to undergraduate students with base and augmentation funding which exceeded our target of 18 scholarship awards.

None of these scholarship awards are at the significant level and will not be longitudinally tracked.

3&3A. We have been advertising opportunities to students for upcoming summer 2017 internships at NASA Centers and industry. We plan to fund our target of 4 students with base and augmentation funding at the $6,000 stipend-level this summer. We plan to fund two students at NASA Centers and two students in Utah industry (one at Orbital ATK and one at Space Dynamics Laboratory). We plan to review applications in OSSI after the deadline and work with industrial members to select interns. We will allocate our $24,000 budget for internships by April 2017 to student stipends for the internship awards.

4. All fellowship and scholarship student awardees to-date have maintained 100% STEM retention. We will continue to track fellowship awards into the future to watch STEM retention. We plan to carefully review internship applications and select quality students who have goals for STEM careers and advanced degrees.

9. Of the total fellowship and scholarship awards for 2016-17, 61.3% were awarded to female students and 54.5% were awarded to minority students. These accomplishments exceed our targets for this year which were set at 40% to women and 30% to minorities.

- Higher Education projects:

SMART Objectives:

5&5A. For year 2 of this grant (2016-17), we funded 28 higher education projects with base and augmentation funds. These higher education projects were carried out at the following affiliate institutions: University of Utah, Brigham Young University, Utah State University, Weber State University, Southern Utah University, Utah Valley University, Snow College, Dixie State University, Salt Lake Community College, Westminster College, The Leonardo, and Utah College of Applied Technology. These projects included hands-on experiences for undergraduate and graduate students, student Olympiads, fairs and competitions, STEM education development performed by students, student research, curriculum development, research symposium, and developing new interactive displays. The faculty and student participants involved in each of the projects were all in STEM fields. The 28 total projects (18 base funding, 10 augmented programs that were already existing, and 10 new programs with augmentation funds) exceeds our target of 25 projects (25 new projects and 12 existing being augmented) in FY 2016.

4A. We awarded 4 higher education minigrant projects through the new competitive proposal opportunity (with augmentation funding) to faculty/student teams in 2016-17 as follows: 1) Spencer Wendel, STEM-Promoting Design/Build/Fly Competition, Utah State University; 2) Carl Sorensen, University Rover Challenge Capstone Project, Brigham Young University; 3) Ali Siahpush, Rocketry Club and Competition, Southern Utah University; and 4) John Robe, The Utah Robotic Mining Project, University of Utah. These 4 competitive awards met our goal to award 4 competitive awards per year.

- Research Infrastructure projects:

  SMART Objectives:
  6&6A. We awarded 3 research infrastructure minigrant projects (with base and augmentation funding) to faculty members in 2016-17 as follows: 1) John Armstrong, Geospatial Analysis of Mars Imagery in the Tracey Hall Computational Research Laboratory, Weber State University; 2) J.R. Dennison, Space Survivability Test Facility for CubeSats, Components and Spacecraft Materials, Utah State University; and 3) Douglas Hunsaker, Improvement of a Modern Lifting-Line Algorithm for Swept Wings, Utah State University. These 3 awards were less than our objective stating we would fund a total of 4 projects in 2016-17 due to our decision to fund the 3 awards at a higher level of funding each with additional augmentation funds.

  7. All 3 faculty members who received research infrastructure funding in 2016-17 have produced at least one publication or presentation each from their work and they are continuing to work on additional publications that will be reported at the end of the funding period in OEPM.

  8. During 2016-17, Space Grant supported students and faculty have produced a total of 34 publications to-date and we plan another 32 publications at our annual Fellowship Symposium coming up later this spring. Therefore, the total number of Space Grant publications will exceed our goal of 30 publications/presentations per year in FY 2016. We plan to report all publications in detail in the OEPM report at the end of the funding period.

- Precollege projects:

  SMART Objectives:
  10. We have conducted 9 teacher career development workshops and plan an additional 3 teacher workshops using 2016-17 precollege funds making a total of 12 teacher workshops in FY 2016. These workshops were planned and conducted by the Outreach Administrator, namely John Vanderford, of the Utah Space Grant Consortium. The workshops were held or are being planned at the following school locations (SD=School District): 1) Adams Elementary, Logan SD; 2) Birch Creek Elementary, Cache SD; 3) Weber SD; 4) Spring Creek Middle School, Cache SD; 5) Granite Elementary (involved 8 total schools), Granite SD; 6) Jordan Elementary (involved 7 total schools), Jordan SD; 7) Lincoln Elementary, Cache SD; 8) Ridgeline High School, Cache SD; 9) Salt Lake Elementary; Salt Lake SD (involved 4 total schools); 10) Canyon Elementary, Cache SD; 11) North Cache Center, Cache; and 12) South Cache Center, Cache SD. The 12 workshops that were or will be conducted in FY 2016 meets our target of 12 workshops.

  11 & 8A. The affiliates of UNSGC have also conducted an additional 9 precollege projects in FY 2016 with base and augmentation funds, which exceeded our goal of 8 projects. These projects were carried out at affiliate members Clark Planetarium, Hill Aerospace Museum, Westminster College, The Leonardo, and Snow College and included teacher development workshops, demos and presentations for schools, hands-on

science traveling K-12 shows, science outreach, and precollege student training programs.

12. We have exceeded our goal and developed new relationships in 2016-17 with the following three schools where NASA-related materials have been implemented into their classrooms: (1) Beehive Charter School in Salt Lake City, Utah (August 2016); (2) Birch Creek Elementary School in Smithfield, Utah (May 2016); and (3) Ridgeline High School in Millville, Utah (December 2016).

7A. As part of a new thrust this year, we advertised a precollege competitive opportunity, reviewed proposals and funded 5 precollege minigrant projects as follows: 1) Bronson Nye, Snow College K-12 Science Teacher Workshops, Snow College; 2) Ed Galindo, STEM Opportunities for Native Americans in Rural Utah, NANRAEF; 3) Ali Siahpush, Two-Day Science Teacher Workshops at SUU, Southern Utah University; 4) Samuel Tobler, Teacher Workshops at DSU, Dixie State University; and 5) Shanna Futral, Take Flight!—Developing Aerospace-Focused, 3D Science Standards-Aligned K-8 Student and Educator Materials, The Leonardo. The five competitively-funded precollege minigrant projects exceeds our goal to support three competitively-funded precollege minigrant projects in 2016-17.

- Informal Education projects:

SMART Objectives:

13 & 9A. Four sets of informal education standards-based STEM materials/displays were developed to visually enrich experiences in STEM by informal education providers. These included: 1) Take Flight! Aerospace-focused, 3D science standards-aligned educator materials, The Leonardo; 2) Water Cycle, Energy Conservation and Solar Energy, Dixie State University; 3) Sun, Moon, Earth, Clark Planetarium; and 4) Portable Planetarium units, Snow College. All public service/informal education activities in FY 2016 supported science, technology, engineering and mathematics (STEM) literacy and education. The development of these four sets of materials met our target for FY 2016.

E. PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS

- **Diversity**: The Utah Space Grant Consortium has a goal to assure that students and faculty participating in Utah Space Grant Consortium projects and activities represent the diversity of the State of Utah. We have maintained objectives to support 40% females and 30% minorities when making student awards. During FY 2016 we issued 44 fellowship and scholarship awards. Twenty-seven of these were awarded to female students (61.3%) and 24 were awarded to minority students (54.5%). Utah's largest minority sub-population is Hispanic and we are working together with affiliates Salt Lake Community College and Utah Valley University to better reach this population of students.

- **Minority Serving Institution Collaborations**: Salt Lake Community College and Utah Valley University have large Hispanic student populations with whom we have joint activities. We are working with these institutions to reach out to their campuses and provide opportunities for the minority groups. We are working together with Utah State University-

Blanding campus to implement new outreach programs and provide opportunities for students on that campus. Their campus is made up of a high Native American population.

- **Office of Education Annual Performance Indicators**:
  - API 2.4.1: ED-16-1 _____44__
  - API 2.4.2: ED-16-2 ____120__
  - API 2.4.4: ED-16-4 UNSGC has __4__ STEM education strategic partnerships with The Leonardo, Clark Planetarium, Hill Aerospace Museum, and the North American Native Research & Education Foundation. These affiliate partnerships in Utah offer unique NASA and STEM education content to inspire and educate.
  - API 2.4.5: ED-16-5 __35,000__

F. IMPROVEMENTS MADE IN THE PAST YEAR

With the addition of augmentation funding in year 2 (2016-17), our Consortium implemented a new program for affiliates to compete for additional funding in higher education and precollege components. We had already implemented this program in 2014 for research infrastructure funding in Utah. We developed internal solicitations as follows: (1) higher education component included student projects and competition, senior design projects, and curriculum development and (2) precollege component included K-12 teacher development and outreach projects. We received proposals for the competitive programs and evaluated to make awards to those in alignment with our stated goals and objectives. This program of competitive funding within our state has proven to be very valuable when it comes to reporting and gathering data as we have been able to expand the scope of our existing programs and add to the valuable annual data collection in Utah.

Beginning in May 2016, we re-structured the format of our annual meeting of affiliates/trustees and the annual Fellowship Symposium. We flipped the order of these events and now hold the fellowship symposium in the morning and the annual meeting of affiliates in the afternoon. This change resulted in positive results including (1) more representation from affiliates across state for the student presentations since this was being held before the annual meeting of trustees, and (2) that affiliates from further distances could travel in the morning to the meeting, saving time and funds for travel costs as they used to have to travel the night before and stay in a hotel.

This year we also implemented a method whereby we send out quarterly statements to each affiliate detailing all of their subcontract invoices received and paid to-date along with detailed matching funds to-date. This has helped the affiliates be more aware of their financial status and helped to improve the receipt of more timely invoices from them.

The Utah Space Grant Director office has improved their management of sponsored research consistent with NASA Space Grant and Federal policies. The program management guidelines have been audited by the University of Utah to confirm that we are in compliance with sponsor terms and conditions, applicable federal cost principles & administrative requirements and University policies. Additionally, the audit results confirmed that we have no compliance issues or weaknesses and internal controls and compliance are good. Our goal is to implement any new changes required by the NASA Space Grant to continue to maintain the strength of our program.

G. CURRENT AND PROJECTED CHALLENGES

A current and projected challenge for us is the cost of funding graduate students. The cost to successfully attract and retain graduate students has gone up while for the most part, our funding has remained steady. We were able to meet this challenge better with the augmentation funds that were awarded this year. When funding remains steady over time, it has resulted in us having to fund fewer students per year at higher levels.

The time to manage the National College & Fellowship Program Space Grant award and its associated awards has increased due to the additional specific grant reporting requirements. In the past, we used to have funding through Space Grant as well as augmentation and the reporting for these programs was usually combined. While the addition of specific-funded programs like the Community College-Technical Schools and USIP has been very beneficial to students and faculty in our State, the additional reporting requirements and additional deadlines has been a challenge for our staff in time and resources.

In Utah, we have always strived to waive IDC on all of our Space Grant-related funding so that all of the awarded funds can be used for the purpose of the grant, specifically for student training. As costs at our universities rise, it has become difficult to always secure the waiver of the IDC at our lead institution as well as affiliate institutions across the state. It is becoming increasingly important at our institutions to have the request for waived IDC be built into the NASA solicitations in order for them to agree to the waiver.

H. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

PhD Granting Research Universities: Fellowships, Scholarships, Internships, Higher Education and Research Infrastructure projects

(1) University of Utah; (2) Utah State University; (3) Brigham Young University

Industry: Aerospace, defense and commercial products industrial partner

(4) Orbital ATK

Education Institutions: Higher Education, Research Infrastructure, and Precollege projects

(5) Weber State University; (6) Southern Utah University; (7) Snow College; (8) Dixie State University; (9) Utah College of Applied Technology; (10) Salt Lake Community College; (11) Westminster College; (12) Utah Valley University

Government Centers: Government partners, internship opportunities

(13) Idaho National Laboratory; (14) Space Dynamics Laboratory; (15) Hill Air Force Base

Outreach Institutions: Precollege and informal education programs and projects

(16) Clark Planetarium; (17) Hill Aerospace Museum; (18) North American Native Research & Education Foundation; (19) The Leonardo.