FY 2018 Year 4 Extension Annual Performance Document

Florida Space Grant Consortium
Lead Institution: University of Central Florida
Director: Dr. Jaydeep Mukherjee
Telephone Number: 407-823-6177
Consortium URL: www.floridaspacegrant.org
Grant Number: NNX15AI10H
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 Florida Space Grant Consortium is a **Designated** Consortium funded at a level of $**760,000** for fiscal year 2018.

B. PROGRAM GOALS

FELLOWSHIPS, SCHOLARSHIPS, & INTERNSHIPS

1. Enable students to pursue careers in the space program – whether through graduate, undergraduate, or Community College technical training.
    a. SMART Objective – On an annual basis, at least 15 undergraduate scholarships, 5 internships, and 10 graduate fellowships will be competitively awarded to students who wish to pursue space/aerospace/aeronautics training. At least 10 of these awards will be offered to minority candidates and at least 10 to female students. At least 70% of awardees will continue to the next step in their chosen STEM disciplines (academia/NASA/industry).

RESEARCH INFRASTRUCTURE

1. Support NASA related interdisciplinary research projects emphasizing work-force development with undergraduate and graduate students.
    a. SMART Objective – On an annual basis, at least 10 research projects will be competitively awarded. At least three of these research project awards will be awarded to a minority serving institution and/or include minority participation. At least 10 undergraduate or graduate students will be supported by the projects, including at least 2 women and 2 under-represented minorities.

2. Foster collaboration among NASA engineers, Florida university faculty and industry partners.
    a. SMART Objective – By March 2018, facilitate at least two Space-Related Research Symposia within the State of Florida that specifically target NASA engineers, Florida university faculty and industry partners.

HIGHER EDUCATION

1. Provide undergraduate students with opportunities for interdisciplinary hands-on experiences in team-based student launch activities and student pay-load development programs to better understand STEM concepts as they relate to space exploration.
    a. SMART Objective – On an annual basis, involve at least 100 students, representing a minimum of five Florida-based higher education institutions, including at least two minority serving institution, in collaborative space-based interactive learning experiences.

PRE-COLLEGE EDUCATION

Contribute space-related resources and training to help increase the number of K-12 teachers who:

1. Use space-related curricula resources to motivate more students to pursue math and science courses
    a. SMART Objective – On an annual basis, conduct and/or facilitate space-related pre-service and in-service teacher training opportunities for middle school teachers focused on space-related math and/or science curricula. A minimum of 50 Florida teachers per year will attend this training.

INFORMAL EDUCATION

Contribute space-related resources to help increase the number of citizens who are aware of:

1. How the application of math and science enable or enhance common activities, NASA's contributions to our standard of living (beyond Velcro®), and NASA's mission.
    a. SMART Objective – On an annual basis, collaborate with Florida museums and/or science centers to facilitate/conduct engaging space-related learning events held in public venues. A minimum of two events per year will be held. At least 200 members of the public will attend one or more of these events per year.

C. PROGRAM/PROJECT BENEFITS TO PROGRAM AREAS

My participation in the Florida Space Grant allowed me to greatly expand my skill set and experience in aerospace engineering-related topics and work, and also allowed me to grow my professional network. This in turn has helped me to continue excelling in my university studies, as well as gain admittance into the Master of Science program at the University of Florida in aerospace engineering. (**Carlos Ojeda -, 2018 Space Grant Internship, University of Florida - Aerospace Sciences Lab Teaching Assistant**)

The Florida Space Grant has not only enabled me to continue my dissertation research, but it has also provided me with the opportunity to become involved in more outreach initiatives (eg. Pegasus Express STEM Mentoring Initiative) and educational/academic endeavors (eg. participation in a NASA grant panel in 2018) as I have become connected with people in my field and integrated into the periphery of the Aero/Space community. It's also been inspiring and informative as to my future career track, ideally with NASA Space Biology or a similar program. (**Madeline Vroom -, 2016 Space**

Grant Fellowship, 2017 Affiliate Scholarship Program, 2018 Space Grant Scholarship, University of Florida - Graduate Student Researcher)

I have acquired an interest in the field of materials through my work on this project; the project has given me a greater overall understanding of research design and techniques, and it has also allowed me to gain insight into how broad the field of materials is. This expansive range of potential applications is appealing to me, and was a key factor in my decision to choose a Mechanical Engineering minor with specialization in Materials Engineering as an undergrad, which ultimately led to my current studies in Chemical Engineering at Stanford University. (**Cecilia Luciano -, 2018 Space Grant Research Award**)

D. PROGRAM ACCOMPLISHMENTS

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

Fellowships:

(i) Dissertation and Thesis Improvement Fellowship Program

The program awards Master's Thesis and Doctoral Dissertation Improvement Fellowships in areas of space science and engineering. Proposals must align with the topics of interest to NASA. These grants provide partial support of Master's Thesis and Doctoral Dissertation research for improvement beyond the already existing project. Funds cannot be used for salaries. In 2018-19, FSGC supported 10 fellows from 5 universities. 3 of the fellows were women and 2 were under-represented minorities.

(i) Space Grant Masters Fellowship

In 2018, the Masters Fellow received an Academic Year 2017-2018 fellowship stipend of $10,000 for full-time masters students. The award cannot be renewed. In 2018-19, FSGC awarded 2 Masters fellowships, one from Embry Riddle Aeronautical University and the other from the University of Central Florida. Both the fellows were men.1 of them is an under-represented minority.

Scholarships:

Bethune-Cookman Presidential Scholarships

The Presidential Scholarship is offered to student who will complete high school the spring prior to enrolling into Bethune Cookman (HBCU) in the subsequent Fall Semester. The FSGC scholarship covers university expenses not covered by federal and/or state financial aid and other non-institutional scholarship. Students must earn and maintain a 3.50 cumulative grade point average to renew the award. In 2018-19, 32 scholars were supported by FSGC under this program. of the students were women and were under-represented minorities. FSGC also supported 5 scholars at the University of West Florida. Among these 5 scholars, 1 was a woman and 1 was an under-represented minority.

Internships:

FSGC will be supporting interns during the Summer of 2019. Details will be provided in the OEPM report.

In summary, we supported 49 fellows and scholars. Among them were 36 minorities (80%) and 21 were women (47%). All of them were directly funded. This is in agreement with our SMART goals for NIFS.

- Higher Education projects:
  The goal of our Higher Education projects is to provide students the opportunities to engage in hands-on activities that requires working in a group and in inter-disciplinary topics. We achieve this by supporting senior design projects and student groups taking part in NASA Competitions like Robotic Mining Competition, Student Launch Initiative, RASC-AL ROBO-OPS Student Competition and Microgravity University. In addition, FSGC runs the Hybrid Rocket Competition for Florida students. Details of our higher education programs are as follows:

  Hybrid Rocket Competition
  76 students in 9 teams from 7 universities are taking part in this competition. The objective of the competition is to build and launch a hybrid powered rocket. There are two categories in the competition. This competition is a stepping stone for students to participate in the University Student Launch Initiative competition. This project is sponsored by FSGC. Final launch is scheduled for March 17, 2019.

  NASA Competitions: FSGC is supporting 5 teams from 5 universities in NASA competitions like Robotic Mining, Student Launch Initiative and the NASA Micro-g NExT 2019 Challenge.

  Senior design: FSGC is supporting3 teams from FIT, FSU, and UCF on senior design projects.

  Star Trek Academy
  In this program, 16 college students from 9 universities participated as one large team, with smaller technical units to successfully launch and retrieve a weather balloon, with a payload that travels up to 100,000 feet. Students learned about subjects such as meteorology, telemetry and how NASA takes different variables into account to perform missions, very similar to these. They also learned about payload integration and how to plan and efficiently carry out a balloon launch. The flight computer was be designed to interact with 3 PODS (portable experiment computers) that can be programmed to connect with 10 sensors each.
  Over a period of 4 days, the group designed and constructed 4 different experiments to make observations in the upper atmosphere and the throughout the flight of the weather balloon. This projected was managed by the Atlantis Educational Services, located at the Kennedy Space Center Visitor Complex and sponsored by FSGC. The dates were Dec 11-14, 2018.

  Travel Grants
  Travel Grants totaling $11,784 were provided to 2 faculty and 6 students to travel to conferences to present papers and also to go to CA for launch of their cubesat.

  Centaur Exploration Workshop: The Roots of Activity
  This workshop will be held in April 2019 at the University of Central Florida (Orlando, FL), under the auspices of the Florida Space Institute and the Center for Lunar and

Asteroid Surface Science (SSERVI team). The workshop's impetus is two-fold: Advance our understanding of how small bodies originate, evolve and become active beyond Jupiter's orbit; Planning of exploration strategies – Both Earth-based observations and Space-based measurements – aimed at a representative object of the Centaur population. The former serves as our science rationale and context, while the latter will help focus our workshop discussions and deliverables on future remote and in-situ characterization of a single target. he final outcome of this meeting will be a White Paper, which will summarize the prioritized knowledge gaps, their broader scientific context and suggested characterization and exploration pathways. In addition, we will formulate a comprehensive multi-wavelength observing campaign to provide important observational constraints to test origin and evolution models. We will solicit and actively encourage the participation of early career researchers (including graduate students and postdoctoral researchers).

Astronomy Society Balloon Project (UCF)
The goal is to inspire and improve THE Astronomy Society members' understanding of the various disciplines involved in spaceflight, including programming, electrical engineering, physics, and physical chemistry. We will be launching an 800g weather balloon to 75,000-100,000 feet for near space photography and to take measurements of various atmospheric data such as pressure, CO2 ppm, and ozone ppb. We are still considering the addition of more sensors. We will have several launch sites ready for the launch, due to meteorological variability in air currents. One of the flight calculators that will be used is the CUSF Landing Predictor 2.5 from Cambridge University, which is used to get a general flight prediction to avoid hazards such as airports and cities. Once a launch site is chosen, we will fill the balloon with helium until reaching a lift force of 4.386kg, which can be determined inexpensively by tying the balloon and payload to a water jug filled with the same mass of water, then filling the balloon until it begins to lift the water. This will provide an estimated 5 m/s ascent rate. The balloon will be sealed with twists and zipties, which will be covered with electrical tape to protect the balloon from the sharp ziptie edges. After launch, we will track the balloon using a microcontroller called Tracksoar, which utilizes ham radio to provide latitude, longitude, and altitude, until landing. We have several options for payload retrieval prepared: a canoe for a water landing, and a certified tree climber in case the payload gets stuck in a tree.

In summary, so far 175 students participated in higher education projects. 40 of them were women (23%) while 29 were under-represented minorities (17%). These students were not directly funded. This is just below our higher education goals. We still have a couple of projects in the next 2 months and will make it a point to ensure more participation by women and under-represented minorities.

- Research Infrastructure projects:
  Florida Space Research Program: In 2018-19, FSGC has funded 11 space research and education grants under the Florida Space Research Program (FSRP) totaling of $267K which includes $100K from Space Florida. Matching funds totaled $276K. The program is comprised of three categories – The Space Education & Training Program, Space

Exploration & Spaceport Technical Development, and Space-Based Research and Payload Development. The State of Florida and Space Florida have been significant contributors to the Florida Space Research Program for five years. The FSRP 2018 awardees are from 7 Florida universities. A total of 49 proposals were received under this program. Each submission was independently evaluated by a team of experienced professionals from Kennedy Space Center and other universities and NASA centers. Some of the interesting projects being funded this year includes ". In 2018-19, 13 students were directly funded through research grants. 4 students were under-represented minorities and 5 were women. Please note that some of the awards were made a few months ago. The information on the students is incomplete. We will have all the required information before the OEPM submission date

<u>FSGC and NASA Kennedy Space Center Technology Development and Commercialization Program</u>

KSC innovators have developed many new technologies and made many scientific breakthroughs over the years. While all have been developed for NASA's space exploration mission, some KSC technologies have the potential to provide benefit here on Earth in commercial applications. As a result, the KSC Technology Transfer Office (TTO) patents these technologies and makes them available to private sector companies for commercialization through the NASA Technology Transfer Program. However, many of these patented technologies are early stage and require additional development to better determine the strength of their commercial viability and their use to NASA. In some cases, KSC laboratories lack the NASA funds to advance these technologies and private sector companies cannot risk the investment in needed development. Because of this, these technologies have stopped in their development despite their possible commercial benefit here on Earth and use to NASA.

In response, FSGC and the KSC TTO have partnered to establish this pilot program. This program seeks to provide Florida universities with a competitive opportunity to further develop KSC patented technologies for potential commercial applications and for NASA space applications if the specific technology has "dual use" potential. To initiate the pilot, FSGC and the KSC TTO worked collaboratively to identify two early stage KSC patented technologies that fit the profile for this program.

(i) Damage Detection System for Flat Surfaces and
(ii) Adaptive Thermal Management System

FSGC awarded $25K each to the Florida International University and University of Central Florida to further develop the 2 technologies. The matching funds totaled $50K.

In summary, so far13 students participated in research projects. 6 of them were women (46%) while 4 were under-represented minorities (31%). These students were directly funded. This is in agreement with our Research Infrastructure goals

- Precollege projects:
  <u>Challenger Learning Center</u>

This project provides an eight-hour professional development workshops for fifteen (15) middle school teachers; curriculum for classroom instruction; and student engagement challenges for the students of the teachers attending the workshops to demonstrate their new knowledge and excitement for space exploration by conducting a simulated NASA space mission or other hands-on minds-on STEM activities. Teachers will utilize skills, lessons and curriculum from the workshops to train and prepare up to thirty (60) of their students to attend hands-on, critical thinking activities at the Challenger Learning Center of Tallahassee.

The workshops will increase teachers' content knowledge regarding space exploration, physical and earth/space science. The purpose of the simulated NASA space mission and STEM student challenges is for students to participate and immerse themselves in STEM pedagogy while increasing excitement for the subject matter. Pre and post tests will be administered to teachers and students to determine efficacy of curriculum and training.

The goal of this program is to increase STEM content knowledge of pedagogically strong teachers so that they can inspire their students to pursue higher education and careers in the STEM subject areas, specifically those relevant to the space industry. In order to accomplish this task for their students, these teachers must have a working knowledge of current and future space missions; science principles behind the missions; tools and resources to provide these lessons to their students, as well as a platform to engage student imagination and excitement of their students…this project provides all of that. FSGC provided $12.5K for this project and was matched by the Challenger Center ($12.5K)

Florida Engineering Education Conference (FEEC)

The Florida Engineering Education Conference (FEEC) has been hosted by the College of Engineering and Computer Sciences (CECS) at the University of Central Florida since its beginnings in 2005. In 2013, the event was transitioned to the Center for Initiatives in STEM (iSTEM), a collaborative effort between the Colleges of Education and Human Performance, Engineering and Computer Science, and Sciences focused on coordinating STEM initiatives across the university and surrounding community. An event that has been described as unique in the state of Florida, the FEEC strives in bridging the engineering workforce and the academic sector, through a series of workshops, hands on activities, and networking sessions. In 2014, the topic was broadened beyond the typical engineering disciplines to address a more comprehensive STEM agenda. The 2019 conference follows on from the success of all previous FEEC events, and continues to adhere to the original goals of the program: (1) to highlight the importance of articulating pre-college STEM education with the "day to day" workforce applications; (2) to showcase both formal and informal STEM education models or programs; (3) and to serve as an information hub for educators, administrators, and industry partners alike. We hope that these three goals will make an impact in the pedagogy of STEM curricula. The 14th annual FEEC will be held at the UCF Student Union on March 1, 2019. The FEEC website will be put in place to serve as the epicenter for all activities related to the event (i.e. agenda, updates, and registration). The 2019 FEEC will remain a single day event with the agenda addressing topics in STEM education. Furthermore, the event is open

statewide to K-12 STEM teachers, administrators, practicing professionals, and other (informal) educators who are interested in attending. FSGC is providing $2100 t0 partially support this project.

Student SpaceFlight Experiment Program
Hillsborough County Public Schools (HCPS) proposed to participate in the Student Spaceflight Experiments Program (SSEP) Mission 13 to the International Space Station (ISS). They proposed to fully
immerse a minimum of 4,200 8th grade students in real microgravity experiment design and proposal writing. They expect a minimum of 541 flight experimental proposals to be formally submitted by our student teams, with one selected for flight to the International Space Station in 2019. Mission 13 is viewed as our next step with the full intention to engage all HCPS elementary and middle schools in future SSEP flight opportunities. We are projecting 20 plus elementary schools, 5 plus middle schools, 85 classroom teachers involved and supporting the project. FSGC provided $2500 for this project with matching of $21K from the Hillsborough County Public Schools.

- Informal Education projects:
  Orlando Science Center:
  Over the past four years, Orlando Science Center has created seven strategically placed interactive exhibits throughout the museum that bring each exhibit hall to life in a way that encourages hands-on, playful learning and competition. Building off their experience designing, prototyping, fabricating, and testing these seven experiences, they proposed three additional STEM Design Challenge exhibits that when completed, will deliver engaging STEM content, awareness and literacy to visitors from ages five through adulthood helping us effectively support Florida's citizenry and the school districts we serve. Utilizing these exhibits OSC will be serving approximately 6,000 students annually in classrooms located in Orange, Seminole, Osceola, Lake, Volusia, and Polk counties. They will evaluate the activities by conducting pre- & post-tests which measure outcomes, as well as collecting evaluations from participating teachers.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE GOALS

Include summary data for the bulleted list below:

- **Diversity**:
  Awards have been given to 62 students from 9 institutions, including 2 minority serving institutions. 27 of the directly funded students are women (47%) and 40 are under-represented (69%). In addition, 175 students from 12 institutions including 2 minority serving institution and 3 4-year colleges are participating in hands-on collaborative projects. 40 of them were women (23%) while 29 were under-represented minorities (17%). These students were not directly funded.

- **Minority Serving Institution Collaborations**:
  FSGC is collaboration with 3 of the 4 minority serving institutions in the state. It is supporting a scholarship program for students at the Bethune Cookman University (HBCU). FSGC has also supported a senior design team from FSU/FAMU College of Engineering. FAMU is an HBCU. In addition students from Bethune Cookman and FAMU

participated in the FSGC Academy program. A research award has also been given to a faculty from Florida International University (HIS) on a topic that was identified by the tech transfer group at the Kennedy Space Center as one with potential for commercialization.

On February 4, 2019, the lead university (University of Central Florida) was designated by the U.S Department of Education as a Hispanic Serving Institution.

- **Office of Education Annual Performance Indicators**:
  - API 3.3.3: STEM-18-1 _____62___
  - API 3.3.5: STEM-18-5 _____49___

E. IMPROVEMENTS MADE IN THE PAST YEAR

We have continued with our program to engage local women engineering professionals (in the space coast area) to mentor freshman and sophomore female engineering students and engage them in hands-on projects from their 1st semester in college. We think that this may increase the number of female students participating in hands-on projects.

F. CURRENT AND PROJECTED CHALLENGES

The challenge we faced this year and anticipate in the next couple of years is the relative low percentage of women and under-represented minorities taking part in engineering hands-on project. This is specially the case for women. As mentioned above, we are trying to engage freshman engineering students in their first 2 semesters in hands-on inter disciplinary projects. If it is successful, we will implement this program around other universities.

G. PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Listed below are all of FSGC's affiliates. Funds are not provided directly to affiliates for implementation of programs. FSGC awards are all competitive and awards are given to the respective PI's in their institution. The affiliate institution is responsible for sending final reports and all other relevant documentation to the FSGC offices. The only roles the affiliates have is to ensure that information from the FSGC office is being sent to all interested faculty and students and to ensure timely technical and financial reports to the FSGC office. In addition, the FSGC advisory Board, comprising of representatives from all 21 affiliates meet twice a year to approve the budget and FSGC programs.

Academic

Bethune-Cookman University (4-year historically black college awarding exclusively baccalaureate degrees): FSGC has a scholarship program with Bethune Cookman.
Broward College (4-year Hispanic college Bachelor of Science degrees in addition to their 2-year degree programs).
Embry-Riddle Aeronautical University (University awarding baccalaureate and master's degrees)

Eckerd College (Private, 4-year college awarding exclusively baccalaureate degrees)
Florida Atlantic University (University awarding degrees up through the Ph.D)
Eastern Florida State College (community college that is now a 4-year college)
Florida Gulf Coast University (4-year college awarding baccalaureate and graduate degrees)
Florida Institute of Technology (Private University awarding degrees up through the Ph.D)
Florida International University (University awarding baccalaureate and master's degrees, Hispanic Serving Institute)
Florida State University (University awarding degrees up through the Ph.D)
Florida A&M University (University awarding degrees up through the Ph.D.; Historically Black College or University)
Florida Polytechnic University (Engineering University awarding bachelors and Masters degrees)
University of Central Florida – Lead University: (University awarding degrees up through the Ph.D)
University of Florida: (University awarding degrees up through the Ph.D)
University of Miami (Private University awarding degrees up through the Ph.D)
University of North Florida: (University awarding baccalaureate and master's degrees)
University of South Florida: (University awarding degrees up through the Ph.D)
University of West Florida: (University awarding baccalaureate and master's degrees)

State Agency

Space Florida (State/Local Government): Space Florida was created by the Florida Legislature to sustain Florida's position as the global space leader. Space Florida provides $100K for the FSGC research program

Federal Agency

Kennedy Space Center (Federal Center): KSC is the NASA center of excellence for launch and payload processing systems. KSC is partnering with FSGC on the pilot Technology Development and Commercialization Program by providing potential topics for commercialization

Non-Profit

Astronauts Memorial Foundation (Private 501(c)(3) not-for-profit organization): The Astronauts Memorial Foundation honors and memorializes those astronauts who have sacrificed their lives for the nation and the space program by sponsoring the national Space Mirror Memorial, and by implementing innovative educational technology programs. AMF, through its Educator Resource Center, conducts teacher workshops.

Science Centers

Orlando Science Center (Science Museum): Orlando Science Center offers hands-on fun for all ages through engaging interactive exhibits, live programming, giant-screen films, school field trips and school-break camps. The science Center conducts the Informal Science program for FSGC