Minority University Research and Education Programs (MUREP)
Science, Technology, Engineering and Math (STEM)
Engagement (MSE) Activity
2014 Annual Report

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Activity Manager: Theresa Martinez
theresa.c.martinez@nasa.gov
MUREP STEM Engagement (MSE) Description
NASA provides financial assistance (grants and cooperative agreements) to the Nation’s Historically Black Colleges and Universities (HBCUs), Hispanic Serving Institutions (HSIs), Asian American and Native American Pacific Islander-Serving Institutions (AANAPISIs), Tribal Colleges and Universities (TCUs), American Indian and Alaskan Native Serving Institutions (AIANISIs), Predominantly Black Institutions (PBIs) and eligible community colleges. The Administration recognizes the valuable role that these institutions play in educating our citizens, as reflected in the five Minority-Serving Institutions (MSI) focused Executive Orders signed by the President.

NASA’s Minority University Research and Education Activity (MUREP) investments enhance the research, academic, and technology capabilities of MSIs through multi-year awards. Awards assist faculty and students in research and provide authentic STEM engagement related to NASA missions. These competitive awards provide NASA specific knowledge and skills to learners who have been historically underrepresented and underserved in STEM. MUREP investments also assist NASA in meeting the goal of a diverse workforce through student participation in internships, scholarships, and fellowships at NASA Centers and JPL.

MUREP Small Projects (MSP) was consolidated into MUREP STEM Engagement (MSE). There is an overlap of activities funded by MSP, which are now part of the MSE portfolio of activities.

As funding is available (based on HQ budget and existing MSE portfolio of activities), MSE will release solicitations targeting specific MUREP portfolio needs. The proposals will be evaluated and funded based on how effectively they meet these objectives while leveraging other existing NASA education activities, external funding sources or external partnerships. Recurring funding of grants may be limited to grants meeting critical Agency needs, and with exemplary performance assessment.

MSE Goals
MSE’s goal is to increase the retention and completion rates of undergraduate degrees awarded from MSIs in NASA-related STEM disciplines. The MSE objective is to increase the number of NASA-focused STEM experiences that engage underrepresented groups in active learning to improve retention of information and critical thinking skills. STEM Engagement includes STEM challenges, which are creative applications of NASA-related science, technology, engineering, mathematics, and cross-cutting concepts. These STEM design challenges are research- or technology-based competitive experiential exploration, aeronautics, technology, science and/or interdisciplinary activities. Challenges use creative application of NASA-related science, technology, engineering, mathematics, and crosscutting concepts. MSE focuses on recruiting underrepresented and underserved students in STEM disciplines through completion of undergraduate or graduate degrees in support of their entry into the scientific and technical workforce.
MSE Benefit To FY2014 Performance Goals:
Annual Performance Indicators (APIs) and Co-Stem Priorities
All MSE goals and objectives are designed to support the Agency’s Strategic Plan and the NASA Education goals. MSE focuses on the following NASA Strategic Objective:

• Goal 2: Advance understanding of earth and develop technologies to improve the quality of life on our home planet.
  
  o Objective 2.4: Advance the Nation’s STEM education and workforce pipeline by working collaboratively with other agencies to engage students, teachers, and faculty in NASA’s missions and unique assets.

MSE supports the following NASA Education Multi-Year Performance Goal:

• FY 2014 2.4.1: Assure that students participating in NASA higher education projects are representative of the diversity of the Nation.

and supports the following NASA Education Annual Performance Indicator:

• FY 2014 ED-15-1: Provide significant, direct student awards in higher education to (1) students across all institutional categories and types (as defined by the US Department of Education); (2) racially or ethnically underrepresented students, (3) females, (4) persons with disabilities, and (5) veterans at percentages that exceed the national percentages for these populations, as determined by the most recent, publicly available data.

In addition, MSE is consistent with national priorities for STEM education, which are established by the National Science and Technology Council (NSTC) Committee on STEM Education (CoSTEM) 5-Year Strategic Plan. Specifically, MSE addresses the following priorities:

• Enhance STEM Experience of Undergraduate Students:
  
  o Identify and broaden implementation of evidence-based instructional practices and innovations to improve undergraduate learning and retention in STEM and develop national architecture to improve empirical understanding of how these changes relate to key student outcomes.
  
  o Support the development of university-industry partnerships, and partnerships with Federally supported entities, to provide relevant and authentic STEM learning and research experiences for undergraduate students, particularly in their first two years.

• Better Serve Groups Historically Underrepresented in STEM fields:
  
  o Invest in efforts to create campus climates that are effective in improving success for students from underrepresented groups through mentorship, technical assistance, and other innovative practices.
**MSE Accomplishments**

**Navajo Technical University (NTU): Laser Scanning for Digital Manufacturing**

Rapid prototyping skills are needed by the engineering directorate at several NASA facilities and internship opportunities were required at Marshall Space Flight Center (MSFC), specifically in the National Center for Advanced Manufacturing’s Rapid Prototyping Lab.

In order to create simulations of the manufacturing process, the MSFC team needed as-built models of facilities which are most efficiently and accurately captured by laser scanning, which MSFC does not currently have the capability to create. The NTU grant was initiated with goals of integrating the capturing and processing of the digitally captured data as a part of coursework, which will allow students to gain the hands-on knowledge highly valued by NASA. NTU has revised numerous courses (greater scope than anticipated) to incorporate rapid prototyping and laser scanning technology, improving the ability to provide NASA with the current level of skills needed by the NASA digital manufacturing team. The courses have a relationship to digital manufacturing, manufacturing engineering, quality control, statistical comparison, engineering and design.

The NASA MSE Grant has been an incredible boost to Navajo Technical University (formerly Navajo Technical College and before that it was Crownpoint Institute of Technology at the time of award). NTU has experienced incredible growth not only in the school but specifically in the STEM Programs. The Crownpoint Institute of Technology, with a total enrollment of ~340 students in 2006, evolved into Navajo Technical College in 2010 and increased enrollment to nearly 1,000 students including the enrollment at a new educational site in Chinle, AZ, and now has once again evolved into the Navajo Technical University with an enrollment of nearly 2,000 students and another educational site in Teec Nos Pos in northern Navajo Nation. All three sites lie within the borders of the Navajo Nation and NTU has seen unprecedented growth in student enrollment as well as educational programs.

NTU added a new Bachelor of Science Program, an IT Program with three distinct tracks, Computer Science, Digital Manufacturing, and New Media; Bachelors of Science degrees in Industrial Engineering, Computer Science/Engineering, and Environmental Science; Bachelors of Fine Arts in New Media and Creative Writing; Bachelors of Arts in Dine’ Studies and a Masters Degree in Dine’ Studies. All programs are accredited by the North Central Accreditation, the accreditation bureau for their region. (See table below with specific STEM enrollment figures.)
As stated by the Principle Investigator: “2009 and the receipt of the MUREP Grant can be identified as the jumping off point for Navajo Technical University to become what it is today – offering engineering and advanced degrees on the Navajo Nation – incredible!!!” NTU is now recognized as a leader of laser scanning within New Mexico and receives many calls for consulting in the technology.

Student interest and retention in the program has increased dramatically because of the internships, hands-on-projects, and student support available by NASA funded opportunities. By the end of the MSE grant period, enrollment at NTC as a whole increased by phenomenal 600%. As a community college, NTC was ranked in the top 120 community colleges in nation by Aspen Institute, one of only three tribal colleges to receive that distinguished ranking.

The success of the NASA funding also led directly to the award of a $2 Million grant from the National Science Foundation. This grant will continue to provide the support needed for the Navajo Tech Center for Digital Technologies (CDT). Recent leaps in success from the Navajo Tech CDT have come directly in large part from the MSE grant, which was designed to expand the CDT’s capacity in serving NASA and its subcontractors laser scanning and digital manufacturing needs. When the college’s president, Dr. Elmer Guy, announced the plans to pursue university status, the CDT ramped into high gear with a long range vision and accompanying plans to support the planning and implementation of the first Navajo University. The synergies that now exist between the various NTU colleges are due in large part to the leadership and success of the CDT, with its NASA support. Today the CDT aims to serve the education and economic development needs of the Navajo Nation, while also supporting laser scanning and rapid prototyping for business and government needs. Current efforts envision a
center for education and research on-campus, as well as an off-campus site for larger contracts and student internships.

A NASA CIPAIR grant was also awarded that will lend further support towards developing the full educational program. Curriculum development that supports integrating entrepreneurship into classroom activities by linking student projects to real-life industry needs is underway. Currently, the following outreach activities are underway:

- Student recruiting and retention will remain top priorities through dual enrollment to engage high school students in CAD and the fundamentals of engineering to recruit for the 4 year digital manufacturing program offered at NTC.
- A strong effort through visiting high schools will be made to let the Navajo Nation High Schools and the Navajo Nation know what NTC has to offer in STEM opportunities.
- Presentations on Laser Scanning have been made to middle school students at Fort Defiance and to high school students at Crownpoint High School.

As quoted in the NTU final report: “It is important to remember that this funding from MUREP allowed NTU to create new engineering programs, new four-year programs and gave the impetus to grow into a university. Without the infrastructure and internships this grant allowed NTU to create and develop, the eyes of the rest of the faculty would not have been opened to the possibilities of what can occur with a little funding and a lot of commitment. The faculty and students all got a boost in inspiration from this grant and the intangibles provided by this grant are immeasurable. Although the numbers may look small, NTU’s success is well known with the Department of Education (Sect. Duncan visited), the Tribal College community, Department of Energy (Dr. Dimitri Kusnezov, Senior Advisor to the Secretary US Department of Energy visited). Although the current four-year graduates have been few, the infrastructure is set up to help facilitate the graduation of more STEM students in the next couple of years; NTU’s first Industrial Engineering student should graduate May 2014. Immediate numbers don’t always tell the whole story of the impact a grant has on an institution and to the community but when students are standing around talking amongst themselves and it is overheard AND it is about a calculus test!!! Stand up and take notice. Hope has been given to these students!!!!”
New Mexico State University (NMSU): Promoting Access, Retention, & Interest in Astronomy

New Mexico State University (NMSU) is one of the two primary universities in New Mexico and its branch campuses serve fifty percent of the 62,000 undergraduates state wide. NMSU is also a Hispanic-Serving institution, therefore meeting the needs of underrepresented students. NMSU student body is 55% female and about 50% percent ethnic minority therefore resulting in a customer base that is 78% historically underrepresented and underserved students.

The purpose of NMSU grant is to develop a set of critical resources for use in traditional and distance learning undergraduate introductory astronomy courses. The NMSU online interactive astronomy material provides students the opportunity to develop their science skills in a private, non-threatening, self-directed learning environment. The new astronomy materials will address two key needs in increasing success for underrepresented students in New Mexico: providing a mechanism for students to review basic math and science and allowing students to explore current astronomy topics at a pace commensurate with their skills. The new materials will also allow students whose work and family commitments limit their ability to attend in-class sessions to successfully pursue an accredited laboratory-based science course and mandatory graduation requirements.

The new materials being implemented will directly improve the scientific training for pre-service teachers, who comprise 40% of class membership thus improving the K-12 educational experience in the local underrepresented and underserved population. These new materials will improve retention rates for students with limited math and science backgrounds. The statewide science credit requirement recently doubled, so increasing access to laboratory science courses in a 24/7 mode removes a major barrier to completion of a college degree. The new online materials will also include an instructor analysis tool for reviewing student self-review work, containing trends with topic and time for individuals and groups.

NMSU received additional university funds in FY10, and was therefore able to increase the complexity of the computer simulations and usage of NASA images and spectroscopy in the lab exercises, while reducing their request for FY11 funds. They have also increased the number of lecture modules to be created. Students with English as a second language have cited the database as a productive tool for strengthening their background knowledge of the sciences, which is a critical need in New Mexico.

The database contains instructor analysis tools for reviewing student self-review work, trend data for individuals and groups, and records of each exercise completed by every student. This allows instructors to monitor individual and group progress, tracking every facet of student action including incorrect answers, as well as the global response to individual topics of study. The program contains four components, based on 26 lecture modules starting with exploration of the solar system and ending with the cosmology of the early universe, in conjunction with online text, and over 5,000 images derived primarily from existing NASA astronomy and space exploration missions. Over 88% of lecture modules contain NASA data, while the remaining 12% of lectures develop basic material congruent with NASA education goals. Seven platform-independent web applications have been constructed for dissemination and use of the materials.
The response to the pilot form was extremely favorable, with a total of 7,012 quizzes taken by 169 students. This corresponds to an average of 42 quizzes per student (versus five in-class, hand-graded quizzes each semester). Therefore, for year two, they began to increase the total number of questions per lecture to a minimum of 85, and the number of analysis questions per lecture to 12. By Year Three, they exceeded that goal with a minimum of 110 questions per lecture and at least 30 analysis questions per lecture. The mean values for the updated lectures are 55 unique questions, 224 multiple choice questions, 253 numerical questions, and 476 total questions per lecture, which vastly exceeds target goals for the grant. For the 26 lecture modules, there is a total database of 12385 questions.

Students cited the immediate feedback (24/7), the detailed solutions for all math problems, the ability to focus repeatedly on a single difficult concept, the wide breadth of topics covered, and the navigational ease as extremely helpful aspects. Over 50% spontaneously recommended the library as almost productive learning tool they had used to date, and requested similar assistance for other classes, in comments attached to course evaluations. By the time of the final exam virtually all students were fully engaged in the library (92% of women and 91% of men), having perceived its utility in the aftermath of the midterm exam.

The success of the course led directly into the creation of a full distance education mode for the course, due to the now very high demand for the course. The demand for these distance education courses is unprecedented, far higher than that for any other astronomy course at the university. All spaces were claimed within two hours of the beginning of general enrollment, and the instructor has been besieged by a steady stream of plaintive requests for over-rides ever since over each summer season. There were 25 undergraduate participants in Fall 2012, all distance learning students using the materials in a general education astronomy course to fulfill requirements for a B.S. degree. Of the Fall 2012 students, 59% were under-represented or under-served and 60% were female. Another 26 distance learning undergraduate participants are participating in Fall 2013. In contrast, in-class versions of the course remain open from May through August, with the last spaces not being taken until the first week of Fall classes. It is clear that with these courses we are creating an educational opportunity for students, which is in great demand, and of great utility to them.

Several students self-reported that English was a second language for them, as in Year One, and that they had difficulty in acquiring the academic vocabulary in English required in college-level courses. They cited the self-review library as a productive tool for strengthening their background knowledge of the sciences.

A Monte Carlo analysis of the results indicated, in agreement with Year One, that the fraction of student whose answers were distributed randomly (with an accuracy no better than random guessing) decreased from a terrifying 40% to a heartening 3% from the beginning to the end of the course, with an overall gain of 67% in accuracy for the entire cohort.

By offering a variety of resources the course serves a student body with multiple learning strategies. Students with a learning goal orientation can conduct self-review after every lecture, in pursuit of full understanding and a sense of mastery; while performance oriented students can use the self-review library as a study tool before exams. (Morris et al., 2003, suggest that this
dichotomy in learning styles is especially sharp between nontraditional [older] students, who tend to be learning-driven, and traditional [18- to 25-year-old] students, who trend to be performance-driven.) Additionally, a student with a particular difficulty – or a particular interest – in a specific concept can drill on the relevant lecture module, without repeating review questions. During pilot studies, for example, one student took 200 quizzes on atomic structure to “really understand why and how atoms absorb and emit photons.”

Short Films Highlighting Diverse Members of the Underrepresented STEM Workforce:
Research has shown that members of underrepresented groups are negatively affected in pursuing STEM fields by their lack of representation, and also by the perception that they are not normal (appropriate) STEM field members (e.g., for gender studies showing women lack role models in the sciences see deWelde et al., 2007 and Etkowitz et al., 1994; for evidence of stereotype threat see Steele & Aronson, 1995, for self-handicapping see Stroessner & Good, 2009; for the importance of showing young people scientists who are not necessarily white, male, and middle class see Times Higher Education, 2003). To combat these debilitating perceptions and promote inclusiveness, they are developing a set of short films showcasing the work of selected STEM professionals, chosen to highlight dynamic members of underrepresented groups.

In addition, they create a five-page discussion guide for each STEM film, filled with background information and sample discussion questions. These are being used by instructors (K-12 as well as college-level) and outreach coordinators to guide discussions and inform writing assignments based around the films. The public response to initial showings of the films has been extremely positive. The NRAO has asked to showcase the films in high-definition format at their national visitor’s center, and to provide them online through the NRAO website. The film series has developed into a much more sophisticated, and far-reaching, program than originally envisioned.

SUSTAINABILITY
NMSU, a land-grant university serving a large, sparsely populated state, is committed to distance learning initiatives. The development of a fully-online distance education science course with a lab component will be of great long-term value to NMSU’s College of Extended Learning. The course design allows the addition of new instructors trivially.

The self-review library and short films will be hosted by the NMSU astronomy department, but can be accessed worldwide. They are fully prepared to commit resources to building collaborations with and supporting external instructors, and have already begun to establish connections with selected educators interested in our program.

NMSU’s five campuses work with every county in New Mexico, and distance education partnerships with ENIPC tribal colleges create yet another pipeline for dissemination to populations statewide. The self-contained, non-proprietary, fully self-explanatory online materials can be used by external instructors without significantly increasing upkeep.

DISSEMINATION
A program description will be published, emphasizing the technological and rhetorical methods used to make the self-review library and laboratories fully accessible to students, in the
Astronomy Education Review and/or the American Journal of Distance Education, and the program will be promoted at the NASA Center for Astronomy Education (CAE) and American Astronomy Society (AAS) meetings. Dissemination efforts continue with presentation at annual ASP meeting and invited colloquium at Central Michigan University and publication presenting resources and offering collaborative usage through publication of journal paper in the American Journal of Distance Education. Laboratory exercise resources can be accessed freely online, from the website http://astronomy.nmsu.edu/geas/labs.

In Fall 2011, Fall 2012, and Fall 2013, a professor at New Mexico State University and a professor at Humboldt State University used the materials to teach their own undergraduate astronomy courses. In Spring 2013, professors at the Northern Virginia Community Colleges and Frederick Community College used the materials to teach their own undergraduate astronomy courses, in distance education mode. They have also fielded inquiries from interested instructors at several additional universities throughout the United States (including Creighton University, Lafayette College, the College of San Mateo, Dona Ana College, Pima Community College, the College of Southern Nevada, and New Mexico Tech), and in Canada (Waterloo University). The New Mexico Space Museum has also asked to utilize the laboratory exercise materials as a part of their outreach efforts.

NMSU is seeking funds to expand this program to include the general public, via educational applications and the creation of courses specifically to meet the needs of Pre-Service Teachers.
North Carolina Agricultural and Technical State University (NCA&TSU): Integrating NASA Science, Technology and Research in Undergraduate Curriculum and Training (INSTRUCT)

The mission of NASA requires STEM content that includes the bio-chemical sciences, physical sciences (earth and atmospheric sciences), engineering and mathematics. This grant will develop, implement, evaluate and disseminate innovative pedagogical concepts for integrating the associated NASA STEM content into the related courses at NCA&TSU. NCA&TSU is the number one producer of African-American BS and PhD graduates in engineering, and ranks number five nationally in the percentage of women awarded Bachelor’s degrees in engineering. The courses that have been chosen for inclusion in the grant are large enrollment courses that are critical to undergraduate STEM student success and provide opportunities to incorporate NASA content to motivate student engagement and success. An interdisciplinary team of faculty members are leading and coordinating the integration efforts, impacting the undergraduate curriculum in the fields of Biology, Physics, Chemistry, Mathematics and Engineering. The primary targeted audiences are undergraduate students in these disciplines, with the ultimate goal of increasing interest through real world data and examples and thereby increasing the retention of these students in STEM fields. These courses are large enrollment courses that are critical to undergraduate STEM student success.

This grant has developed and implemented innovative pedagogical concepts of integrating the associated NASA STEM content into the related courses at NCA&TSU. In the second year of the grant, the courses that were chosen for inclusion in the grant were large enrollment courses that were critical to undergraduate STEM student success and provided opportunities to incorporate NASA content to motivate student engagement and success. The third year effort focused on the replicability and sustainability within NCA&TSU of the selected sections of specific undergraduate courses taught by an interdisciplinary team of faculty investigators during the first and second year.

During the fourth year of the grant, the following contributions were made:

- Number of new or revised courses targeted at STEM skills needed by NASA that are developed with NASA support: Six (6) in first and second year, Four (4) in third year. Out of these courses Six (6) revised courses have become permanent part of the A&T curriculum. These courses are from various STEM areas including biology, chemistry, mathematics, engineering and energy and environment.
- In the fourth year, the number of under-represented and under-served students participating in NASA education programs, i.e. courses, seminars, and course module development: in excess of 340 undergraduate students.
- Out of 14 students receiving significant support:
  - Number of student participants employed by NASA, aerospace contractors, universities, and other educational institutions – Two (2)
  - Number of undergraduate students who move on to advanced education in NASA related disciplines –Three (3)
  - Only two students left the university, the remaining students are still enrolled in STEM related majors.
Following are some of the innovations that were achieved during the third and fourth year of the grant:

- All modules that were developed and implemented were based upon STEM education research and best practices were implemented in various undergraduate courses during the third year.
- Interdisciplinary team approach was utilized that allowed NASA content to be incorporated into biology, physics, chemistry, mathematics, atmospheric science, and engineering courses.
- Biochemistry module was implemented in undergraduate curriculum.
- Continued use of modern educational technologies (virtual self-study modules and exercises, web based tutorials, other techniques such as Magic Planet presentations) were used to communicate NASA research data.
- Continued working in the area of space radiation shielding in collaboration with National Institute for Aerospace (NIA), Hampton, Virginia and NASA Langley Research Center.
- NASA-INSTRUCT program was leveraged to get funding from various federal agencies and private industries. The total funding of NASA INSTRUCT participating faculty generated funding in the excess of 3 Million dollars.
Florida A & M University (FAMU): Minority Innovation Challenges Institute

MICI, operated by FAMU, mentors students at MSIs across the country by providing technical sessions to generate participants in the STEM technical competitions sponsored by NASA. Unfortunately, the trend has been that there is little participation by MSIs in most of the NASA challenges. In less than 2 years, FAMU significantly changed this trend. MICI is delivered in the format of a year-round virtual conference. Registration is free and open to any student currently enrolled in a STEM major. The virtual conference features live video presentations from technical speakers, powerpoint presentations, Q&A sessions, a discussion board, exhibit booths, and the ability to view archived content. MICI focuses on a different NASA technical opportunity each month. During the third year of the grant, students who participated in MICI were invited to participate in a virtual job fair hosted within the existing virtual conference infrastructure. NASA, along with NASA contractors, were invited to make presentations, occupy a virtual expo booth, and connect with these future workforce candidates via video, audio, or text chat.

FAMU launched its first broadcast on May 24, 2010. Since then, as of summer 2013, 1314 students and 269 faculty members have registered in MICI. Faculty registration has been the cornerstone of MICI success. Student registration in MICI is approximately 65% underrepresented and underserved. These students are comprised of 876 underserved and underrepresented. The remaining students are comprised of 132 Asian Americans, 249 White students, 54 students who opted not to disclose their race or ethnicity, and 12 Other. These students represent a total of 425 different colleges/universities including 126. In this reporting period of FY 13, MICI had 308 AAPI students registered from 42 AAPI institutions, which is 28% of the AAPI institutions across the nation.

FAMU Student Stipends
During the period of October 1, 2012 - June 30, 2013, FAMU provided a total of $9,750.00 in stipends to the following undergraduate students to assist in the management of MICI.

MICI has produced over 70 content sessions, including a video message from NASA Administrator, Charles Bolden, NASA internships, and grants for technical competitions. To date, MICI has provided more than 70 hours of content on the:

- NASA Lunabotics Mining Competition
- Great Moonbuggy Race
- University Student Launch Initiative
- eXploration Habitat Academic Innovation Challenge
- Intercollegiate Rocket Competition
- Space Elevator Contest
- Strong Tether Contest
- Green Aviation Engineering Challenge
- SpaceTech Engineering Design Challenge
- ESMD Systems Engineering Paper Contest

FAMU created a one hour course for a team of FAMU students recruited to participate in the University Student Launch Initiative (USLI) in Huntsville, AL, April 2012. In 2011, the team also participated in USLI, but they were not eligible to launch their rocket during the competition.
because their recovery system did not work. However, in 2012, they received the award for Closest to Altitude.

In FY13, MICI generated the participation of 8 Minority Serving Institutions (MSIs) in three different NASA competitions. MICI sponsored and conducted a competition for mini-grants providing $4,000 for each institution as a mini-grant, for a total of $32,000. These MSIs were recruited through MICI, and were first time competitors in these NASA challenges last year. The list represents Hispanic Serving Institutions (HSIs), Historically Black Colleges and Universities (HBCUs), and Tribal Colleges and Universities (TCUs). A total of 76 students participated on these teams in a technical challenge.

Each selected team faculty was also required to develop either a Senior Design or Special Projects Course for the student team members. Participation was as follows:

- **NASA Lunabotics Mining Competition** - Morgan State University; Texas A&M University Corpus Christi; University of Texas - Pan American

- **University Student Launch Initiative** - Alabama A&M University; California State Polytechnic University, Pomona; New Mexico State University; Northwest Indian College

- **Intercollegiate Rocket Engineering Competition** - Haskell Indian Nations University; Virginia State University

**Virtual Career Fair**

As part of another new initiative during FY 13, MICI hosted 2 different Virtual Career Fairs. In addition to delivering online presentations, the MICI platform was also designed to host interactive “expo” style events. This capability allowed MICI to host a virtual career fair for NASA’s Lunabotics program in January, 2013. Students competing in the Lunabotics were invited to attend this event and had the ability to meet one-on-one via web-cam with different NASA contractors and NASA organizations. Students began the experience by entering a “Virtual Expo Hall” where they could view the booths of several different companies. Once a student selected a booth, they could introduce themselves via text to the person from that company who was staffing the booth. The staff person could then engage the student face-to-face by clicking on a button to connect webcams. In total, more than 60 students and 10 different exhibitors participated in the event. The event proved to be a very effective way to connect students with several different major companies and NASA all within the span of a few hours, from the comfort of their dorm room or home. In addition, NASA incurred $0 in travel expenses for its participation, since the entire event was virtual. A second event for the entire MICI audience was planned for June.

The outcomes for both are:

**2013 NASA Virtual Career Fair, January 22, 2013**


62 Students from 22 Colleges/Universities across the US Attended.
27 Students from 22 Colleges/Universities across the US Attended.

Feedback from the NASA center representatives was excellent. MSFC stated: “After the career fair, I was highly impressed with the 3D virtual environment capability during my participation in the Lunabotics career fair a couple of weeks ago. I'm now looking at ways to utilize this capability as a part of my overall recruiting strategy for MSFC. I see this as a great tool to complement our current strategy in that it broadens our access to include many student markets that we would normally miss due to limited time and travel budgets. It also provides an opportunity for students to get engaged in NASA recruiting events that they normally would not have access to based on proximity to their universities.”

KSC stated: “Attached is the report that we received from [MICI]. This report alone shows how thorough they are with any activity they are involved in, especially considering the fact that we have attended many career fairs where this type of information is not readily available after an event. [The MICI] team have truly been a delight to work with through both this Career Fair and through our previous virtual briefings. The virtual career fair was very well coordinated and allowed for us to reach students in an environment that was cost and time effective. Our team truly believes that technologically advanced opportunities like this really showcase NASA’s ability to be innovative on all fronts, including recruitment and student programs. The virtual briefings that we have done previously allowed us to communicate the Pathways Programs to a broad audience of students attending minority serving institutions. The more opportunities we have to share information with students and the more we remain connected with students throughout their matriculation, the better situated NASA will be once these students begin to consider employment options. Thank you for keeping us involved in these opportunities and we look forward to hearing more about programs/events/opportunities supported through this organization!”
Three Hispanic-Serving Institutions (HSI) in Puerto Rico, namely Universidad del Turabo (UT), the lead institution, Universidad Interamericana-Bayamon (UIAPR), and Universidad Politecnica de Puerto Rico (UPPR), have collaborated with Michigan Technological University (MTU) to develop Systems Engineering based multi-disciplinary capstone design courses. This grant was initially planned to impact a minimum of twelve engineering programs (four per institution), incorporating NASA sponsored research and projects.

The grant leverages expertise from an existing NASA Exploration Systems Mission Directorate (ESMD) funded senior design course developed by MTU and addresses a key NASA need for engineering graduates with design knowledge and experience using a systems engineering approach. The main goal of the grant is to develop new capstone design curricula that better prepares students to be successful in multi-disciplinary teams performing complex systems design projects.

The systems engineering approach and the capstone design class are becoming fundamental to senior students to improve their potential of a successful engineering career. The new capstone design curriculum will enable students at each institution a richer design experience that better prepares them for the systems-based design teams employed by NASA and the aerospace industry. The grant targets students in many departments at these HSIs with nearly 100% underrepresented and underserved Hispanic students in STEM disciplines. The program will be initially developed at the three HSIs, and then results will be disseminated to MSIs nationwide.

The grant entails a multi-prong approach, including the implementation of a NASA course in systems engineering-based, multi-disciplinary, capstone design; a summer program to develop student project team leaders; support for NASA capstone projects as one way to achieve the goals of ABET-accredited capstone design programs; advocating and supporting proposals for NASA summer opportunities for students as a means to gain real world experience; the development of university cohorts to gain efficiencies in curricular planning and faculty training, as well as to foster long term collaboration across the universities; and the development and dissemination of a capstone design assessment process that is grounded in best practices.

According to the current enrollment figures, this program was expected to impact between 150 and 200 senior students per year during the final two years of implementation. The first year was used for development of curriculum. Students selected for Michigan Tech summer research internships spend eight weeks working within existing research groups and existing research projects that match well with their abilities. Student activity includes the following:

- A total of 63 students participated in the Leadership Workshops at Michigan Tech
- Additionally, students participated in summer internships at NASA, MTU, and Federal Government agencies, such as Los Alamos National Lab, US Army, industries like Pfizer and Trane de Puerto Rico, and other universities like South Florida University, Institute for Economic Analysis (IAE) in Barcelona, Spain.
- Grant funds sponsored student participation in three commercial design team competitions for FY12
- ABET program outcomes were used in the grant’s assessment of student learning
• Assessment tools were developed and are used to evaluate the students’ capstone projects

Faculty workshops training faculty to deliver these classes has exceeded all expectations. Initially planned for 12 faculty members, the workshops had to be expanded to meet the demand, at no additional cost to NASA.

• A total of 48 faculty members completed the Systems-based, multi-disciplinary Capstone Design workshop offered by Dr. Gershenson, Michigan Tech University
• At least one faculty member per program is working on course syllabus development
• Faculty are also trained in designing, implementing, and assessing these courses

In FY12, materials developed for this grant were posted on a dedicated project web site. The website, www.systemsengi.org was developed in order to help sustain the project in the future.

Highlights of the three years of the grant:
• 20 capstone courses were developed including this design methodology
• 48 faculty members were trained in SE to develop new capstone courses,
• 63 students took a Leadership Workshop which focused on SE and went to summer
• 327 students were impacted during the grant as they learned this new design approach.

The grant not only achieved all the goals, but the numbers far exceeded the goals. The results obtained in the first assessment were presented at ASEE 2012 Summer Conference in San Antonio, TX.
Achieving Competence in Computing, Engineering, and Space Science (ACCESS):
A 1990 study by the AAAS Project on Science, Technology, and Disability study found that students with disabilities were earning engineering degrees but did not have a track record of getting jobs in technical fields. The NASA ACCESS grant created internship opportunities for students with disabilities to showcase their skills and talents needed by a professional workforce. Beginning in 1996, the Goddard Space Flight Center worked with AAAS to design a program offering research, data collection, or laboratory-based internship assignments that would prepare students with disabilities for entry into the STEM workforce. Following the Goddard model, ACCESS was expanded in 1997 to include all NASA sites except Headquarters, which joined the program in 2001.

ACCESS provides students a 10-week paid internship at NASA centers around the United States. It is designed for undergraduate and graduate students with disabilities who have strong backgrounds in science and a desire to pursue technical careers. Undergraduate students are provided a stipend of $6,000 and the graduate student stipend is $7,500. There is a provision for assistive technology and other reasonable accommodations. Since 1996 AAAS referrals to ACCESS have resulted in 297 students being hired as NASA interns. Ninety of those students have earned or are pursuing a graduate degree in their major and 76 students are currently pursuing undergraduate degrees. More than 120 student interns have secured full employment in a technical field.

In FY13, thirty-four students with disabilities, studying at 32 colleges and universities, were placed in 10 NASA sites. The students were diverse in race, ethnicity, culture, disability, gender, geography, and academic majors. Of the 34 students, there were:

- Twenty-nine (29) undergraduate and five (5) graduate students
- Eight (8) women and twenty-six (26) men
- Nine (9) identified as underrepresented minorities
  - African American (3)
  - Asian (1)
  - Latino/Hispanic (4)
  - Native American (1)

Outstanding Accomplishments for the 2013 NASA ACCESS Interns:

- Aaron Ashley and Ethan Greene, interns at Marshall, were nominated to be NASA Ambassadors.
- Caitlin Bailey and Michael Finch, interns at Goddard, were selected as a John Mather Nobel Scholars. This award will provide them with a travel allowance award towards the cost of presenting their research at a professional conference.
- Joe Benassi, Gregory Bennett, Jefferson Brand, Adam Broderius, Michael Finch, Juergen Nittner and Sawyer Rosenstein, all interns at Goddard, were nominated to be NASA Ambassadors.
- Andrew Huber was the recipient of Goddard Space Center’s Poster Award for best Computer Science presentation. His poster discussed plant monitoring software.
- Johanna Lucht was featured in the 2013 Summer Intern Experience publication by Dryden Flight Research Center.

Updates for 2012 ACCESS students:

• Ivan Rivera (Marshall 2012) secured a 2013 internship at Glenn.
• Peter Rosado (Headquarters 2012) earned Masters of Business Administration from the Polytechnic University of Puerto Rico. Secured employment as a systems integration analyst at Accenture.
• Andrew Tsoi (Goddard 2012) is employed as a research associate at NASA Aeronautics Academy at Ames.

Longitudinal data indicate that 90% of ACCESS alums have pursued graduate studies and/or have found full employment in science, technology, engineering, or mathematics (STEM) fields. The most recent data shows that, since 1996:

• 297 students have participated in ACCESS internships.
• 73 ACCESS alumni identified as African American, Indian, Native American, Hispanic, and Asian.
• 81 ACCESS alumni have returned to NASA for multiple internships.
• 17 ACCESS alumni have been hired at NASA.
• 12 ACCESS alumni have done co-ops at NASA.
• 3 ACCESS alumni have worked for NASA contractors.
• 90 ACCESS alumni are pursuing Master’s or Ph.D. in a technical field.
• 76 ACCESS alumni are pursuing undergraduate degrees.
• More than 12 ACCESS alumni have reported they are working in STEM-related fields, and
• Only 12 ACCESS alumni have reported they are working in non-STEM fields.
MSE Significant Accomplishments and Improvements

- All MSE activities are on budget and on schedule; some have increased scope with no additional funds request.

- A total of six innovative grants were funded and managed by the MSE manager.

- NTU is phenomenally above scope with a 600% increase in enrollment for the courses directly impacted by the end of the third year, and an overall 600% increase in NTC enrollment. This is directly due to MSE funds, which initiated the change from a 2 year college to a 4 year university. In addition, Navajo Tech Center for Digital Technologies was created, generating the development of economic funds through contract work.

- ACCESS placed 34 student interns at NASA centers in FY13. Longitudinal data indicates a 90% retention rate in STEM careers or STEM graduate studies. Additionally, at least 20 students were hired by NASA or NASA contractors since the inception of the grant.

- FAMU MICI went above scope at no additional cost during FY13 by supporting various NASA initiatives, and hosting two virtual career fairs. These sessions were all extremely successful, both in direct results to the grants, and in drawing in new registrants for MICI.

- The use of a mini-grant competition for FAMU MICI continues to exceed expectations, having generated brand new MSIs participating in NASA challenges for the first time. Eight of these new MSI participants competed again in FY13. There has historically been little participation by MSIs in the NASA challenges.

- NMSU secured additional funding from the university, enabling them to increase the scope of the grant. The incredible success of the curriculum led directly to a full online class being developed, at no additional cost to NASA. A partnership with another university has clearly shown the scalability of the grant. In addition, a series of 13 short films highlighting astronomy-related STEM fields are being created, reinforcing a message of inclusion for underrepresented students, with requests for use of the films by external partners.

- SUAGM is performing above scope at no additional cost to NASA. This includes the training of more faculty than anticipated, more course revisions than expected, and funds availability for student competitions to reinforce the concepts learned in the classroom. In addition, improvements made to UIAPR’s capstone courses helped the UIAPR’s engineering programs during ABET accreditation.
MSE Partners and Role of Partners in Activity Execution

The following is a list of partners in the implementation of the MSE activities in this reporting year:

- **ACCESS**: Principle Investigator: The American Association for the Advancement of Science (AAAS), responsible for student recruitment, selection, reasonable accommodations and stipend payment.

- For Navajo Technical College (NTC), partnerships have been created with Marshall Space Flight Center (MSFC) and Ames Research Center (ARC). Advisory Board members include National Center for Advanced Manufacturing – Louisiana Partnership (NCAM-LP); Navajo Tribal Utility Authority; Sandia National Labs; SPAR Point Group, Diversified Business Communications, SPAR, LLC; WHPacific, Inc. NTC is also working closely with the National Institute for Standards and Technology (NIST), to implement the development of the CAD Center as a center for non-destructive evaluation with optical measurements and advanced digital manufacturing. To ensure sustainability through economic opportunities, a variety of partners (Boeing, Sandia National Laboratories, and NIST) have become involved with the education, the projects, and the research.

- **FAMU MICI**: Secor Strategies, LLC, managing day to day operations for grant implementation. FAMU has developed working relationships with many NASA centers in support of the technical sessions for MICI, as well as industry for the career fairs.

- **SUAGM**: Michigan Technological University (MTU) was previously funded to develop a Capstone Senior Design course for the Exploration Systems Mission Directorate. SUAGM is leveraging this experience and utilizing it for the development of their capstone courses. In addition, plans for dissemination include the National Space Grant Consortium, which will also be facilitated by MTU. Final grant metrics greatly exceeded anticipated goals, by approximately 200%.

- **NMSU** developed a partnership with Humboldt State University, who is using the NMSU astronomy coursework. The series of 13 short films highlighting members of underrepresented groups with productive careers in astronomy-related STEM fields are also being requested for use at the National Radio Astronomy Observatory (NRAO) website and the visitor center at Arecibo Observatory in Puerto Rico, with Spanish subtitles.

- **NCA&TSU** has secured additional funds from the state of North Carolina, for an additional $100K per year, for every year of NASA funding.