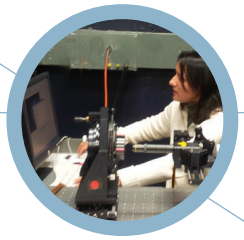
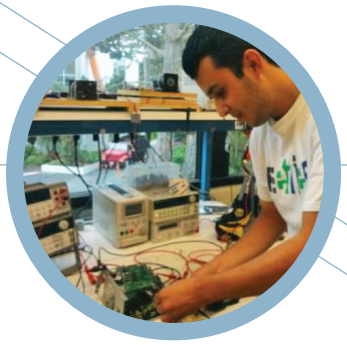
National Aeronautics and Space Administration

Curriculum Improvement Partnership Award for the Integration of Research (CIPAIR)

2012 Annual Performance Report

CIPAIR has two primary goals: (1) to help two-year and four-year minority institutions strengthen their institutional capacity building through curriculum development and faculty and students engaged in NASA R&D efforts, and (2) to attract more students into STEM-based academic programs, retain those students, and prepare them for success when they take the next steps in their education or in their careers.





CIPAIR Advancing National STEM Policies

This report shows how CIPAIR institutions have continued to promote a number of the "Elements of Successful STEM Education Programs," which are described in the latest report from the President's Council of Advisors on Science and Technology, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics (STEM)*. The major *Engage to Excel* recommendations include the following:

- Advocate and provide support for replacing standard laboratory courses with discovery-based research courses.
- Improve the first two years of STEM education in college.
- Encourage partnerships among stakeholders to diversify pathways to STEM careers.

In responding to these recommendations, successful CIPAIR-supported projects have incorporated several strategies for institutional and research capacity building, including but not limited to the following:

- Involving CIPAIR students and faculty in NASA-related STEM research at NASA Centers.
- Building alliances/partnerships between community colleges and research universities to enhance the availability of research experiences to CIPAIR students at community colleges and ease their potential transitions from two- to four-year institutions.
- Providing mentoring through role models of diverse backgrounds to inspire students and help them excel in STEM subjects.
- Providing CIPAIR faculty with professional development and training to teach STEM courses—through summer institutes and programs organized by professional societies and organizations.

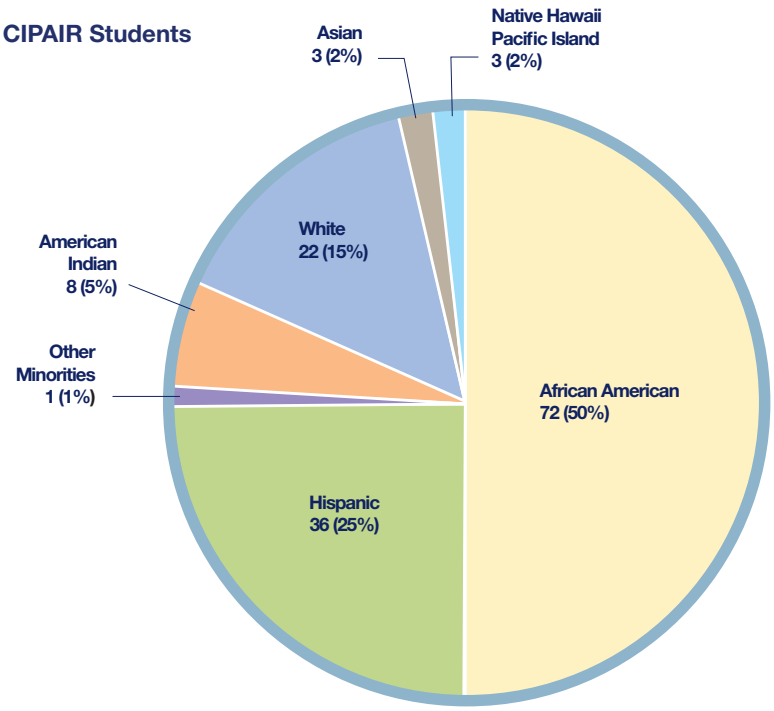
While no new awards were given due to budget constraints, the following accomplishments were noteworthy in 2012:

- Current CIPAIR projects include 24 Minority Serving Institutions (MSIs) that have obtained little or no prior NASA funding.
- Of the 24 MSIs, 8 are HBCUs (33 percent); 8 are HSIs (33 percent); 4 are TCIs (17 percent); and 4 include other MSIs (17 percent).
- Representation of 15 community colleges or two-year institutions (63 percent of total CIPAIR MIs).
- 145 CIPAIR students engaged in NASA-related research (163 percent increase from FY2011): 119 or 82 percent were Underrepresented Minority Students, including 72 African Americans, 36 Hispanics/Latinos; 3 Native Hawaiian Pacific Islanders, and 8 American Indian/Alaska Natives. Females were 34 percent of the total CIPAIR students engaged in NASA-related research.
- 31 CIPAIR PIs, Co-PIs, and Office of Sponsored Research staff participated in the 3nd Annual Orientation and Procurement Workshop, which was held at NASA Goddard Research Center in Greenbelt, MD, on November 1–3, 2012.

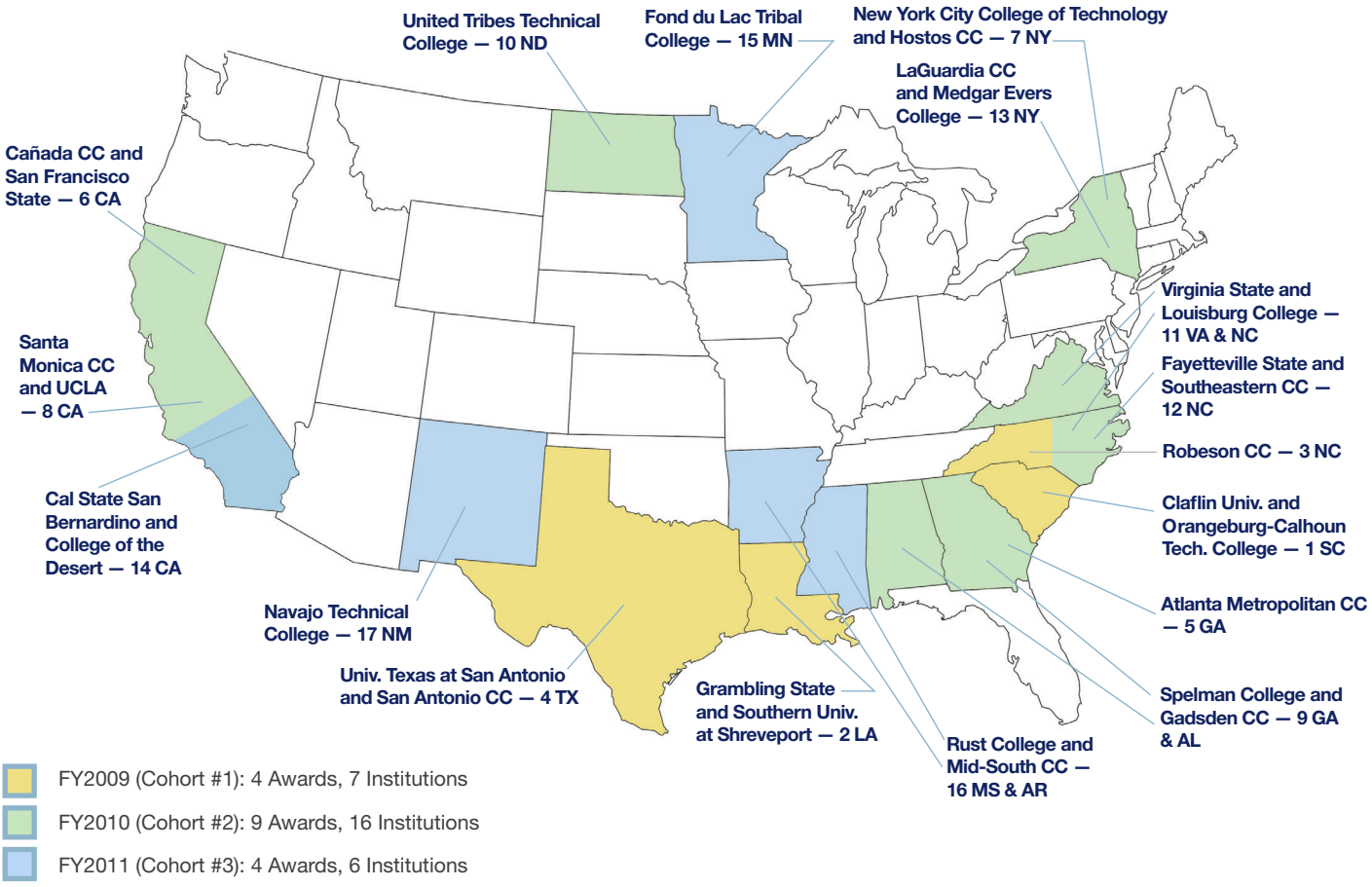
These outcomes address the following Annual Performance Goals (APGs) measures:

APG 5.1.2.1:ED-12.1:	**Achieve 40 percent participation of underrepresented and underserved (in race and/or ethnicity) in NASA higher education projects.**
APG 5.1.2.1:ED-12.2:	**Achieve 40 percent participation of women in NASA higher education projects.**
APG 6.1.1.1:ED12-3:	**35,000 educators participate in NASA education programs.**
APG 6.1.2.1:ED-12-4:	**20,000 undergraduate and graduate students participate in NASA education opportunities.**

CIPAIR Students



CIPAIR Institutions



Note: No awards were given in FY2012 due to budget constraints.

CIPAIR PI Orientation

Each year, the CIPAIR Orientation and Procurement Workshop rotates to a different NASA Center; in 2012 it was held at NASA Goddard. The 3rd Annual CIPAIR PI Orientation and Procurement Workshop provided professional development opportunities such as a “speed dating” session to connect CIPAIR faculty with NASA Goddard scientists and engineers. Faculty and staff were actively engaged in discussions related to their NASA-related research projects for the CIPAIR faculty and student teams.

CIPAIR Partnerships

Mid-South Community College and Rust College

Rust College and its partner institution, Mid-South Community College, hosted a successful two-day Center for Astronomy Education (CAE) workshop on May 19–20, 2012, in Holly Springs, MS (Rust Campus). The overarching goal of this two-day workshop was for participants to become familiar with research-validated active engagement teaching strategies and assessment materials and learn to implement them through role-playing, modeling, practice, and more. A total of 40 participants from eight states participated in the STEM professional development activity.

- Alabama
- Arkansas
- Connecticut
- Kentucky
- Louisiana
- Mississippi
- North Carolina
- Tennessee

CIPAIR Institution Spotlight

Two institutions demonstrated significant accomplishments in terms of institutional capacity building through curricular development:

- **Cañada Community College (Dr. Amelito Enriquez, PI)**
- **San Francisco State University (Dr. Hamid Shahnasser, Co-PI)**

NASA Ames Research Center Orientation for 2012 Student Interns

First row: Xenia Leon, Dr. Amelito Enriquez (Cañada College CIPAIR Principal Investigator), Dr. Hamid Shahnasser (San Francisco State Co-Principal Investigator), and Paul Grams (NASA Ames CIPAIR Research Mentor).

Second row: Hector Prado-Guererro, Alam Salguero, Elaine Talle, and John Paullino.

Third row: Agustin Robles, Jose Carrillo, Enrique Raygoza, Jesus Garcia, Jose Valdovinos, Joshua Lohse, John DeAndreis, and Peter Moala.

Component	2012 Project Outcomes
Curriculum Development Integration of NASA-related content into and Student Involvement in the MI curriculum development	• **14 Revised and 1 New NASA-Related STEM Courses for 2012** **Cañada Community College** Math 130 (Trigonometry-Electricity Consumption; Coronal Mass Ejections and NASA STEREO Spacecraft) Math 222 (Precalculus); Math 251 (Calculus 1-Solar Wind Phenomenon) Math 252 (Calculus 2); CIS 250 (C++ Programming) ENGR 100 (Intro to Engineering); ENGR 210 (Graphics); ENGR 215 (MATLAB) ENGR 230 (Statistics); ENGR 260/261 (Circuits and Devices Lecture and Lab-Circuits Principles and Robotics using the BOEBOT) ENGR 695 (Intro to Robotics – New Course) **San Francisco State University** ENGR 323 (Structural Analysis); ENGR 301 (Microelectronics-Printed Circuit Board Design of Sensors for NASA Missions) ENGR 461 (Mechanical and Structural Vibrations) ENGR 844 (Embedded Systems)
Strengthening MI Faculty and Students Relationships with NASA Centers Research and Training Opportunities for MI Faculty and Students	• **Leveraged CIPAIR funding resulting in increased CIPAIR student internships** Two CIPAIR Faculty and 12 CIPAIR students completed 10-week research internships at NASA Ames Research Center — San Francisco State Univ.
Institutionalization and Sustainability Commitment of the MI Administration to Long-term Sustainability	• **100 percent retention rate and 92 percent of CIPAIR students planning to pursue graduate education** Of the 20 Cañada Community College students who received financial support over the past two years, 8 are currently enrolled at Cañada and 12 are enrolled in STEM disciplines at select universities including the following: UC Berkeley, UCLA, UC San Diego, UC Irvine, UC Davis, UC Santa Cruz, Cal Poly San Luis Obispo, San Jose State Univ, and San Francisco State Univ. • **Secured $6 M (Hispanic Institution — STEM grant) from the U.S. Department of Education**

CIPAIR National and Regional STEM Research Conferences Participation

Approximately 80 CIPAIR faculty and students published and presented their research at various STEM-related professional conferences. As shown below, several CIPAIR faculty and students participated in the American Society of Engineering Education National Conference in San Antonio, TX, June 9–12, 2012. In addition, eight Cañada Community College CIPAIR students research papers and poster presentations were finalists at the Society of Hispanic Professional Engineers (SHPE) National Conference.

CIPAIR Institution	Selected 2012 STEM Research Conference	CIPAIR Participants	
		Faculty	Students
New York City College of Technology (CUNY), Hostos Community College, Cañada Community College, San Francisco State University, and Virginia State University	The American Society of Engineering Education (ASEE) National Conference, San Antonio, TX, June 9–12, 2012	10	2
Cañada Community College and San Francisco State University	The American Society of Engineering Education Pacific Southwest Section (ASEE PSW) Conference, San Luis Obispo, CA, April 19–21, 2012	5	12
New York City College of Technology (CUNY) and Hostos Community College	The American Society of Engineering Education Mid-Atlantic Conference, Delaware University, DE, April 18–19, 2012	3	3
Atlanta Metropolitan State College	The 7th University of Puerto Rico, Humacao McNair Research Symposium, Humacao, PR, April 25–27, 2012	1	2
Hostos Community College	The 20th Annual Collegiate Science and Technology Entry Program (CSTEP) Statewide Student Conference, Bolton Landing, NY, April 13–15, 2012	1	1
California State University San Bernardino and College of the Desert	3rd North American Materials Education Symposium, San Luis Obispo, CA, March 29–30, 2012	4	0
Atlanta Metropolitan State College	The 89th Annual Meeting of the Georgia Academy of Science, Kennesaw, GA, March 22–24, 2012	2	1
New York City College of Technology (CUNY)	The Louis Stokes Alliance for Minority Participation (LSAMP) Conference, San Juan, PR. March 17, 2012	1	1
California State University San Bernardino and College of the Desert	National Conference for McNair Scholars and Undergraduate Research, University of Maryland, College Park, MD, March 16, 2012	1	4
Atlanta Metropolitan State College, Grambling State University, Southern University at Shreveport, Louisiana and New York City College of Technology (CUNY)	The Emerging Scholars Conference in STEM, Atlanta, GA, February 23–25, 2012	2	3

Note: Total does not equal 80; does not include all 2012 STEM conferences.

CIPAIR Summer Interns at NASA Centers

A total of 145 CIPAIR students and 35 CIPAIR faculty were engaged in NASA-related STEM research at the 24 CIPAIR partner institutions. Of the 145 CIPAIR students, 49 (34 percent) were engaged in research at nine NASA Centers in 2012. Twelve students are profiled on pages 6–8.

Number of CIPAIR Summer Interns (N = 49)

CIPAIR Select Summer Interns at NASA Centers

Cheyenne Bolanos

College of the Desert Community College

Major: **Biology**

Faculty Mentors:
Dr. Carl Farmer
Dr. Alec Sim

NASA Research Mentor:
Dr. Miriam Rodón-Naveira
Dryden Flight Research Center

Desert Tortoise and Burrowing Owl Environmental Observation

The objective was to support several environmental activities for the Fish and Wildlife Service 1994 Desert Tortoise (*Gopherus agassizii*) Mojave Population Recovery Plan, as well as to monitor the Desert Burrowing Owl (*Athene cunicularia*). The project focused on learning about the desert tortoise and burrowing owl as "threatened and protected species," and on studying their habitats and current conservation and tracking techniques. The first part of the project consisted of literature search/studies on these two species to better understand their particular characteristics and habitat. The project also included field work for the identification of the species' natural environment and monitoring of the current Dryden populations.

Leandra Carter

Hostos Community College of CUNY

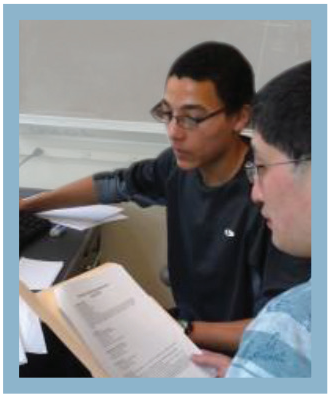
Major: **Mathematics**

Faculty Mentor:
Dr. Nieves Angulo

NASA Research Mentor:
Dr. Miriam Rodón-Naveira
Marshall Space Flight Center

Space Launch System (SLS) Ground Power Disconnect Breakout Box (BOB)

The SLS BOB was designed to simulate the umbilical disconnect by providing an externally controlled power disconnect switch to remove ground power from the SLS vehicle avionics and then to provide voltage and current monitoring via internal electronics and external BOB provisions. We will use the BOB in the Systems Integration Laboratory and the Systems Integration and Test Facility for software simulation and hardware-in-the-loop testing. Prior to launch, the SLS vehicle operates off +28 Vdc ground system power provided via the umbilical connections between the vehicle and the launch pad. Just before take-off, the vehicle switches from ground system power to onboard battery power. Once the switch-over takes place, ground system power is removed. The BOB enables the removal of ground system power without physically disconnecting an umbilical.



John Maxwell DeAndreis

Cañada Community College

Major: **Civil Engineering**

Faculty Mentors:
Dr. Amelito Enriquez
Dr. Cheng Chen

NASA Research Mentor:
Mr. Paul Grams
Ames Research Center

Seismic Analysis of Special Moment-Resisting Frames

This project involves designing a five-story steel moment–resisting frame structure in the earthquake-prone San Francisco Bay Area location of Fremont, California, near the Hayward fault. The structural engineer's main priority is safety; buildings must be designed with an infrastructure strong enough to withstand high-magnitude earthquakes. The objective of this research is to understand how to implement today's technologies of seismic design into the infrastructure of a building to construct a cost-efficient and environmentally friendly structure. Computer-aided analysis programs such as SAP2000 (Structural Analysis Program) and MS Excel are used to simulate and analyze the structure. This research internship program allows for the development of project management, time management, and teamwork skills, all of which help strengthen students' knowledge of seismic design in civil engineering and enhance preparation for academic and professional practice.

Cedric Flemming II

Claflin University

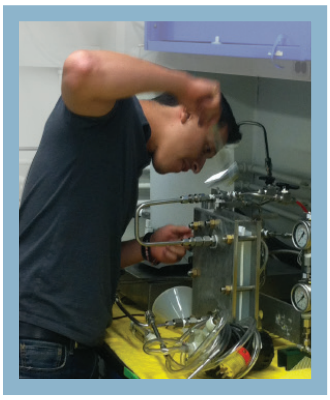
Major: **Mechanical Engineering/Applied Mathematics**

Faculty Mentor:
Dr. Nesan Sriskanda

NASA Research Mentor:
Dr. Gioia Massa
John F. Kennedy Space Center

From the Kennedy to Beyond: Growing Plants in Space

Astronauts cannot have their cake and eat it too, but what about growing a salad and eating it? As NASA continues to push the envelope on space exploration and inhabitance, the need for a constant food source becomes vital. The Life Support team at NASA is developing a system, the VEGGIE, which is capable of growing plants in space. The introduction of plants provides astronauts a means of independently growing supplying food as well as recreation, oxygen replenishing, and psychological benefits. The plants were grown in "pillows," a system used for growing plants within the VEGGIE. The test included four types of media mixtures composed of clay-based media known as Arcilite and Fafard. Currently, three types of cultivar are being grown in four mixtures of media. Tests are being conducted to see which form of media has the ratio of best growth and the least amount of harmful microbes.



Stefan Garza

University of Texas at San Antonio

Major: **Mechanical Engineering**

Faculty Mentor:
Dr. Hatim Sharif

NASA Research Mentor:
Mr. Michael Flynn
Ames Research Center

Pressure Retarded Forward Osmosis (PRO)

The NASA Pressure Retarded Forward Osmosis process converts hydraulic pressure into electrical energy. The hydraulic pressure is generated from the water flux across a forward-osmosis system. In forward osmosis, fresh water and saltwater are placed on opposite sides of a semi-permeable membrane; the osmotic pressure difference between the two causes water to transfer from the fresh water side to the saltwater side. This continues until there is no longer a difference in osmotic pressure on both sides of the membrane. This water flux across the membrane increases the pressure on the saltwater side. The pressure output can be harvested as hydraulic power. In this research, we will rebuild and test the PRO system in the water lab in the bio-engineering branch. In addition, the system will be built according to specifications to meet pressure safety requirements.

Isaac J. Morris

Santa Monica College

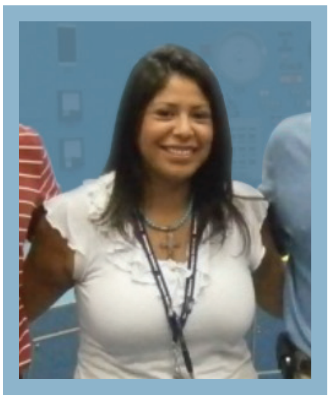
Major: **Environmental Engineering**

Faculty Mentor:
Richard Lavallee

NASA Research Mentor:
Mr. Wayne W. Schubert
Jet Propulsion Laboratory

Embedded Bioburden Quantification

Current assessments of bioburden embedded in spacecraft materials are based on work performed in the Viking era (1970s); microbes can become entrained in spacecraft materials during manufacture. To assess new materials that cannot be decontaminated with dry-heat sterilization, due to sensitivity to this process, we are working to establish cryogenic grinding as a physical release of spores to determine the recovery and survival of bacterial spores encapsulated in spacecraft-qualified polymer materials. This will help quantify the bioburden of new materials used in current and future construction of spacecraft. Concentrations of bacillus atrophies spores were embedded in various two-part epoxies and Flame Master paint. These materials were then themselves embedded into like materials, with a percentage saved for comparison. After curing, a cryogenic freezer/mill was used to pulverize the embedded materials and then serial dilutions to direct agar plating and colonies counted. This was compared to the direct agar plating of the embedded and non-pulverized inoculated samples.



Isabell Piña

San Antonio College

Major: **Mechanical Engineering**

Faculty Mentors:
Dr. Dan Dimitriu
Dr. Hatim Sharif

NASA Research Mentor:
Mr. Dana Valish
Johnson Space Center

Z-series Interfaces: Donning Stand and PLSS Line Routing

NASA's first planetary suit prototype has been created and the Agency will begin testing an advanced Extravehicular Mobility Unit (EMU) suit in expected planetary conditions. The Z-1 suit will be subject to microgravity and extreme terrain environments. The research was performed under the guidance of engineers, technicians, and designers from the Crew and Thermal Systems Division, which designs, tests, and develops technology for environmental control/life support systems and active thermal control systems for spacecraft and extravehicular crew members, as well as crew equipment and spacesuits for extravehicular activity and other hazardous environments. The research contributed to the CTSD projects: Z-1 prototype spacesuit donning stand modification and stress analysis; EMU suit stand modification for use as a Z-1 donning stand; and advanced suit series Portable Life Support System line routing and advanced suit series donning stand interfaces. The Z-1 donning stand modifications were completed three working days before the scheduled reduced gravity flight on the zero-G plane. The testing of the line routing design will take place using the demonstration box as a model test.

John Rodriguez

Claflin University

Major: **Civil Engineering/ Applied Mathematics**

Faculty Mentor:
Dr. Nesan Sriskanda

NASA Research Mentor:
Dr. Oscar Monje
John F. Kennedy Space Center

Developing a Biological System to Grow Plants in Space

Cabin air can accumulate volatile organic compounds (VOCs) to toxic levels if not removed. The objective is to design a CO_2 concentrating bed for biological systems that can remove CO_2 from spacecraft cabin air. Biological systems would remove and process CO_2 from cabin air but operate more efficiently at higher CO_2 concentrations. Typical methods used to concentrate CO_2 from cabin air use packed sorbent beds to adsorb CO_2 followed by regeneration at high temperatures. A temperature-swing absorption compressor is composed of a bed in which the adsorbent is housed and a heating module along with sensors to measure CO_2 concentration, air flow, moisture, and temperature. Important factors to consider during CO_2 removal by biological systems are that sorbents also adsorb H_2O and VOCs such as NH_3, which may impact the purity of CO_2 supply and affect biological process efficiency. In order to approach the problem, the CO_2 concentration system may require silica gel for moisture removal and activated carbon for NH_3 removal.

S. Aicha Seck

Atlanta Metropolitan State College

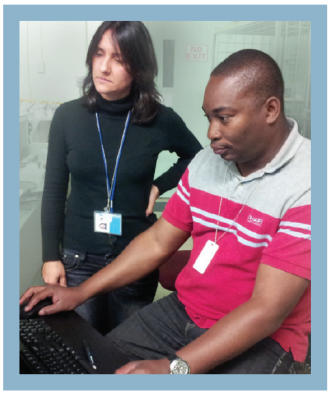
Major: **Biology**

Faculty Mentors:
Prof. Bryan O. Mitchell
Dr. Margaret Lowder

NASA Research Mentors:
Ms. Mary Hummerick
Dr. Raymond Wheeler
John F. Kennedy Space Center

Microbial Characterization of Solid Waste and Wastewater

The Heat Melt Compactor (HMC) is a candidate technology being tested at Ames Research Center for the reduction of solid waste volume and water recovery. The heating process should result in a biologically stable disk that could be eventually used as a radiation shielding material. In this study, we analyze the microbial load of surfaces within the HMC hardware, the efficiency of the HMC process in killing microorganisms from the space trash when creating the disks, and if the disks themselves showed any evidence of contamination after various incubation periods. Prior to creating the disks, simulated space trash bundles were created using a "recipe" based on the contents of ISS/shuttle trash. Each bundle was weighed at approximately 500 grams and was inoculated with the two contaminants most commonly found in real space trash: *bacillus amiloliquefaciens* and *rhodaturula mucilaginosa*.



Agossa Segla

New York City College of Technology

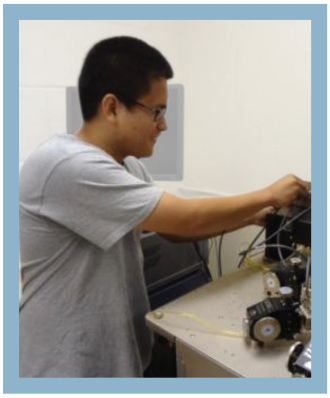
Major: **Telecommunications Engineering Technology**

Faculty Mentor:
Viviana Vladutescu

NASA Research Mentors:
Dr. Raymond Ohl, Mr. Phillip Coulter, Mr. Theo Hadjimichael
Goddard Space Flight Center

Modern Optical Metrology Techniques Used in James Webb Space Telescope Segment Optics and Space Instruments

Deep space studies have been of high interest for a wide range of space investigations. The James Webb Space Telescope (JWST), the follow-on to Hubble, will be launched in 2018 with the goal of exploring the universe and improving our understanding of processes such as the assembly and evolution of galaxies, star birth, first light, reionization, and the formation of planets orbiting other stars as well as objects in our solar system. The JWST collects light from distant stars and galaxies with sensors that convert that light into digital images and spectra. The presented work involves non-contact measurements of mechanical and optical system components on JWST. In the first stage, the Laser Unequal Path Interferometer (LUPI) has been calibrated and used in conjunction with laser radar for a charge-coupled device calibration. The calibration of the LUPI was performed by comparing the fringes obtained from the uncalibrated interferometer with the ones from an existing calibrated LUPI.



John Paulino

Cañada College

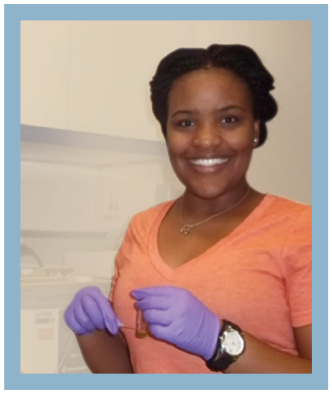
Major: **Mechanical Engineering**

Faculty Mentors:
Dr. Amelito Enriquez
Dr. Hamid Mahmoodi

NASA Research Mentor:
Mr. Paul Grams
Ames Research Center

Analysis of Performance Degradation of Integrated Circuits due to Transistor Aging Effects in Nano-Scale

Integrated Circuits, or ICs, work behind the scenes in refrigerators, dishwashers, and the most sophisticated computers to make people's lives better. IC performance has improved dramatically since their creation in the 1960s. However, with scaling of ICs to nano-scale, an ideal integrated circuit delivering reliable performance over its lifetime is impossible. All ICs experience degradation over time due to the aging of underlying transistors. In this research effort, analysis of transistor breakdown is performed through computer simulations using the Custom Designer SE tool to understand effects on circuit power and performance. To simulate the effect of transistor breakdown, a ring oscillator circuit is utilized. This breakdown is modeled by resistors placed between the transistor terminals.



Treetenia Williams

Rust College

Major: **Biology**

Faculty Mentor:
Dr. Rhonda Kuykindoll

NASA Research Mentor:
Oana Marcu
Ames Research Center

Stress Responses in the Unicellular Alga *Chlamydomonas reinhardtii*

The unicellular green alga, *chlamydomonas reinhardtii*, is widely used as a model for research for various topics including cell motility, photosynthetic pathways, and responses to environmental stimuli. Responses to certain stimuli such as extreme temperatures include the use of intracellular pathways that produce reactive oxygen species (ROS). The space environment of high UV radiation and extreme temperatures also affects intracellular oxidation. Stress responses of algae in space are essential for understanding key biological effects, as well as providing a platform for life support, in situ resource utilization, and synthetic biology for NASA. While ROS are commonly known for damaging cellular components, studies have shown that *C. reinhardtii* is capable of strongly acclimating to singlet oxygen after being pretreated with sublethal level of the ROS. Such data is significant because it proves that specific genes are responsible for the resistance of the damaging outcome of ROS.

For more information

CIPAIR Website

www.nasa.gov/offices/education/programs/descriptions/Curriculum_Improvements_Partnership_Award.html

CIPAIR Interns at Goddard Space Flight Center

http://svs.gsfc.nasa.gov/vis/a010000/a011100/a011100/

CIPAIR Project at Cañada Community College

http://www.youtube.com/watch?v=x3BuoF5Oi8w&feature=youtu.be

CUNY Summer STEM Research Symposium, held at New York City College of Technology's Great Hall, August 2, 2012.

(Left to right) Hostos student Thaelis Suriel; Dr. Leland D. Melvin, NASA Associate Administrator for Education; Hostos student Somdat Bhola; Hostos professor Dr. Nieves Angulo, CIPAIR Co-PI; and Dr. Lenell Allen, CIPAIR National Project Manager.

National Project Manager and Editor: Lenell Allen, Ph.D., Jet Propulsion Laboratory (JPL). CIPAIR is managed for NASA by JPL in Pasadena, California.

National Aeronautics and Space Administration

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