

Maine Space Grant Consortium  
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## 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 Maine Space Grant Consortium is a Capability Enhancement Consortium funded at a level of \$430,000 for fiscal year 2013.

## PROGRAM GOALS

The mission of the Maine Space Grant Consortium (MSGC) is to (a) Improve our Affiliates research infrastructure in areas of mutual interest to NASA and the state of Maine; (b) Encourage more students to consider careers in fields of science, technology, engineering, and mathematics (STEM); and (c) Enhance NASA's presence throughout the State of Maine.

### **A. Goals and Objectives Relevant to NASA Education Outcome 1:**

The MSGC's Research Infrastructure, Scholarships and Fellowships, Higher Education and Workforce Development goals are in alignment with activities to achieve Outcome 1. These goals are to: (a) strengthen the Affiliates' STEM research capacity in areas mutually beneficial to NASA and Maine (Research Infrastructure); and (b) to increase participation of Maine undergraduate and graduate students in STEM research conducted by the Affiliates and NASA Field Centers (Scholarships and Fellowships, Higher Education and Workforce Development).

To achieve these goals in a manner that will yield results consistent with Outcome 1, we support the following objectives:

- a. Support Research Infrastructure Seed Grants for faculty and researchers that include undergraduate and graduate student research experiences.
- b. Support a Minority Serving Institution Collaboration Program

- c. Support scholarships and fellowships for undergraduate and graduate students at Maine's graduate institutions to conduct STEM related research.
- d. Support scholarships for Maine undergraduate students matriculating at Maine's primary undergraduate institutions to conduct STEM related research.
- e. Increase STEM student enrollment at the University of Maine, University of Southern Maine and the College of the Atlantic by augmenting institutional scholarships to attract highly qualified high school seniors.
- f. Provide undergraduate students with a 10-week research experience at NASA field centers.
- g. Support new STEM course offerings.

## **B. Goals and Objectives Relevant to NASA Education Outcome 2**

The MSGC's Higher Education and Pre-College goals are in alignment with activities to achieve Outcome 2. These goals are to: (a) to increase participation of Maine undergraduate and graduate students in science and engineering research conducted by the Affiliates and NASA Field Centers (Higher Education); and (b) increase participation of Maine K-12 teachers and high school students in STEM activities through professional development activities for in-service and pre-service educators, curriculum development, teacher workshops and student-based programs (Pre-College). To achieve these goals in a manner that will yield results consistent with Outcome 2, we support the following objectives:

- Support STEM research experiences for High School Juniors
- Support a pre-college Professional and Curriculum Development program
- Support existing programs designed to help teachers and school districts acquire and utilize NASA and NASA related educational programs and resources.
- Develop partnerships to leverage and expand K-12 initiatives that connect schools to science and engineering research and educations strengths of the Affiliates

## **C. Goals and Objectives Relevant to NASA Education Outcome 3**

The MSGC's Informal Education goal is in alignment with activities to achieve Outcome 3. The goal is to increase the public's awareness of STEM research, education and activities that are associated with NASA and the Affiliates. To achieve this goal in a manner that will yield results consistent with Outcome 3, we support the following objective:

- Support one innovative educational project that uses NASA themes and contents.

## **PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, & 3)**

### **Outcome 1:**

Tony C. participated in our Maine Aerospace Workforce Development program where we send undergraduate students to NASA Field Centers for a 10-week research experience. Tony participated at the Marshall Space Flight Center in 2013 in a project titled "Using Satellite Imagery to Identify Tornado Damage Tracks and Recovery from the April 27, 2011 Severe Weather Outbreak". The project abstract is below:

Emergency response to natural disasters requires coordination between multiple local, state, and federal agencies. Moderate and high resolution satellite imagery can support these efforts by providing a high-level view of the affected areas. Satellite imagery could then be used to target areas for immediate survey or to monitor recovery following a severe weather event. In this study, the feasibility of using satellite imagery to identify tornado damage tracks was determined by comparing the characteristics of tracks observed from low-earth orbit to tracks assessed during the official NWS storm survey process. Of the 68 surveyed tornado damage tracks, this study was able to distinguish 24 (35.3%) tracks from other surface features using satellite imagery. Comparison of length and width characteristics lent  $R^2$  values of 0.93 and 0.49, respectively.

During the 10 week experience at NASA, students are required to submit weekly email reports briefly informing us about their project goals, their individual work and progress and their results. Students also share their experiences working in, as well as outside of NASA.

“Because of this opportunity, I was able to use theoretical and technical skills gained in the classroom for a real-world application. I was able to contribute to a project which had real implications and could help decision makers during their daily activities. Furthermore, the dedication and motivation I was able to demonstrate through this project is directly responsible for my graduate funding. Without MSGC, I would not have been able to pursue such a degree with the ease of mind that comes with full funding. The connections I have been able to make through NASA and other agencies will certainly improve my chances of gaining future employment with one of these organizations.”

Tony is now attending the University of Alabama, Huntsville in an M.S. program in Earth System Science and received a Graduate Research Assistantship with full tuition waiver. Tony, along with his NASA mentor, is an author of a paper to be published in the National Weather Association, Electronic Journal of Operational Meteorology (publication date is pending at this time).

### **Outcome 1:**

Terence C. from St. Josephs College of Maine participated in our scholarship and fellowship program. St. Joseph’s College is one of our newest affiliate members. Terence worked with Nicholas Benfaremo on a project titled “Synthesis and Properties of Siloles” in the Chemistry Department.

“As a result of my participation in the program, I am putting together a report to be published within the next several months. This report will entail a plethora of organic synthetic routes that I employed while working in the lab to acquire several desired organic compounds known as siloles. Without the support from MSGC, I would never have been able to explore and appreciate the vast array of synthetic routes leading up to some extraordinary organic compounds. My involvement in this program has allowed me to substantially increase my laboratory techniques. It has also allowed me to develop an appreciation for the beauty that is involved in creating new organic compounds. With that said, it has deepened my knowledge in regards to organic chemistry as a whole. Whether it was maintaining a descriptive laboratory notebook, brushing up

on my stoichiometry, or attempting to develop several new synthetic routes towards obtaining a desired organic compound, I was always employing my critical thinking skills. This experience has provided me with a taste of how critical thinking skills are employed within the laboratory. It has taught me that there is much more to science than just reading out of a textbook.

Additionally, this experience has been eye opening in regards to how much is still unknown in the science world. Therefore, this program has not only furthered my laboratory skills, but also wet my appetite for further research.”

### **Outcome 2:**

MSGC supported two K-12 teachers to attend the Northeast Region Space Grant Collaborative PreCollege Professional Development Workshop at Tufts University in Massachusetts during the summer 2013. These teachers have been using the skills and knowledge learned by coaching robotic teams in their school districts in Maine. Both teachers are leading their teams to robotic competitions to be held in May, 2014

The workshop focused on LEGO Robotics and Engineering using LEGO kits. LEGO NXT and LabVIEW software are powerful and engaging tools for teaching engineering, technology, science, and math. Tufts University's CEEO Summer LEGO Engineering Institute gave teachers the background they needed to make effective use of these tools in their classrooms. Through hands-on, open-ended design projects, participants learned engineering concepts, LEGO hardware & software, and associated pedagogy/educational theory.

The workshop was geared towards high school and middle school teachers. Participants:

- Learned Engineering Design Process
- Learned LEGO NXT building techniques
- Explored gearing and gear ratios
- Learned to use and program the LEGO NXT
- Learned LabVIEW for LEGO Mindstorms programming logic, control, and sensor input
- Explored the educational pedagogy and theory of using hands-on engineering projects
- Investigated how to teach other content (math, science, reading) through engineering based projects
- Discuss and develop classroom management strategies
- Took home a collection of classroom tested LEGO activities
- Took home an introduction to LEGO related resources
- Took home a written plan for implementation in your educational setting
- Took home a workbook of building & programming resources

A representative from NASA came to the workshop to observe and encourage participants along the way. Both teachers spoke very highly of the workshop and found it to be beneficial, both technically and in lessons learned. Below are a few quotes from our two sponsored teachers:

### **Chris Newcomb:**

After he returned from the workshop, summer 2013:

“One of the great things about a workshop like this is that as a teacher you wear two hats at all times. First you are a student, and secondly you are a teacher observing yourself and the other teachers as students and the instructor as the teacher. It is a fantastic way to learn.” “All in all, it was a great experience. I am thankful for the scholarship I received to attend the workshop. I feel certain that as a result of this workshop I will be able to help my students take on more challenging projects than previously.

As of March, 2014 – after using the information through the academic year (to date)

“I have used the information I learned at Tufts a lot this year. First of all, I was able to share lots of great building tips with my kids, and because of the confidence I gained in building a successful walking robot of my own design, I have been able to help them solve a variety of building and design problems that I found more difficult if not impossible to do before the workshop.” “... I continue to help them (students) in taking one step forward at a time, seeing the big picture, but then taking care of the detail that is right before their eyes.”

Chris teaches an after school program. Most of the students he works with are in the Special Education program. These students may struggle with regular academics, but if you give them some legos they can design and build all sorts of great machines! Chris’s team is currently working towards the Maine Robot Track Meet in May, 2014. His team consists of seven students, 6th through 8th grade (1-female, 6-males)

### **Hope Tray:**

After she returned from the workshop, summer 2013:

“I benefited much from the conference in terms of learning how to program the LEGO mindstorm kits and the many and varying possibilities of what the robots could do. It is truly incredible and such a valuable resource for our students! I feel very grateful that my own children are involved in a program such as this, where they get to create and improve on their robots. I also benefited as a teacher. It helped me to reflect on myself as a learner and relate that to what some of my own students may feel at times in my classroom. In that sense, this experience has made me a better teacher. Thank you for the opportunity!”

As of March, 2014 – after using the information through the academic year (to date)

“Another lesson I took from the conference is that genuine learning and the application of that knowledge and skills takes time. In our effort to push STEM throughout our educational system I think that it is important to remember this. Many school districts, including my own, have cut science time. The process of engineering takes time and patience. Using Lego Robotics, a genuine learning experience with practical, real world applications can be replicated. I love this aspect and in working with the Lego Robotics team in Windham, it was fascinating to watch the kids work together to solve a problem. Not one kid gave up and with each small change the robot improved and then faltered, only to improve again. This took hours, but what an incredible lesson. I wish all students could experience this type of learning and think it would benefit each

and everyone- not just our future engineers and scientists. The pride they felt for their product was also evident. The team also went on to win their event in the local robotics meet!”

Hope coaches a team of students in Windham, ages 9-12 through the Southern Maine Gearbots. The team meets once a week for two hours through the beginning of April. Some team members have the option of going on to the state robotics meet in May. Hope’s team consisted of three fourth graders and two sixth graders. Students were offered different roles each week. Each participant was able to build, contribute to the final product and do some programming.

“Much of Tufts workshop was about building and programing robots to meet different challenges. Teachers also shared how they used Lego Robotics in their classrooms. I was able to use this with the Southern Maine Gearbots group by offering questions to the kids to help them to create a robot to meet their chosen challenge as well as put together a web site of resources for the volunteers who chose to coach a SMGearbots team. The SMGearbots had 24 "seniors" teams this year, from a variety of towns. Each team had between 4-6 participants”

## PROGRAM ACCOMPLISHMENTS

**Outcome 1:** *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA’s strategic goals:*

**MSGC Goal for Scholarships and Fellowships:** Increase the participation of Maine undergraduate and graduate students in STEM research conducted by the Affiliates and NASA Field Centers.

The purpose of this program is to provide research opportunities to graduate, undergraduate and community college students in Aerospace-related and STEM fields.

MSGC supports three umbrella scholarship and fellowship programs. 1: Scholarships and Fellowships for Graduate-degree granting institutions (University of Maine, University of Southern Maine, University of New England and Maine Maritime Academy). 2: Scholarships and Fellowships for undergraduate institutions and community colleges (Bowdoin College, College of the Atlantic, St. Joseph’s College of Maine, Southern Maine Community College and York County Community College) and Scholarships for in-coming Freshman (targets the University of Maine, University of Southern Maine and College of the Atlantic)

Our graduate and undergraduate programs support students in NASA-related research projects. Students work and are mentored in their respective academic institutions by faculty members. Students are also strongly encouraged to reach out to a NASA mentor for guidance when applicable. The incoming freshman program targets underrepresented students and in-state residents.

Participating institutions run in-house competitions based on the same cohesive guidelines that the Consortium established for all participating institutions. Following the consortium guidelines, each institution tailors its program to reflect the individual needs of its institution, faculty and students.

## Objectives:

1. On an annual basis, at least 38 undergraduate and graduate students (31 tracked and 7 non-tracked) will receive scholarships and fellowships to participate in NASA-related STEM research conducted by the Affiliates and NASA field centers.

Accomplishments: 48 undergraduates and graduate students (38 tracked and 10 non-tracked) have received scholarships and fellowships.

Students are enrolled in the following institutions: Seven students from Bowdoin College, 16 students from College of the Atlantic, two students from Saint Joseph's College, eight students from the University of Maine, ten students from the University of Southern Maine and five students from the University of New England. ***NOTE: We are still waiting for data from the Maine Maritime Academy and York Community College. Southern Maine Community College chose not to participate in the scholarship program this year.***

**MSGC Goal for Research Infrastructure:** Strengthen the Affiliates science and engineering research capacity in areas mutually beneficial to Maine and NASA.

MSGC conducts two Research Infrastructure Programs, a Research Seed Grant Program and a Minority Serving Institution Collaboration.

## Programs:

*Research Seed Grant Program:* One Seed Grant has been awarded under our Research Seed Grant Program to the University of Southern Maine (USM), Department of Environmental Sciences titled "Stellar Outflows from Oxygen-Rich Stars: Application of Nucleation Models".

This project seeks to apply a theoretical condensation model known as scaled nucleation theory to improve the simulation of silicate grain formation from the stellar outflows of oxygen-rich asymptotic giant branch stars, as well as to develop the capability at USM for continued collaboration with NASA Goddard after the seed funding ends. Building on the PI's PhD work on nucleation theory, the PI will further develop a methodology for modeling the condensation of high temperature metallic elements and compounds relevant to stellar chemistry. The PI will assist in testing an existing Goddard stellar outflow model, as well as build capability to assist in future additional refinement of computer code. Phase I of this project is to communicate with Goddard staff to share and gather relevant information for applying scaled nucleation theory to systems of interest. Phase II will be to visit Goddard staff and learn the outflow code and create a methodology for calculating the nucleation and growth of clusters based on Phase I. Phase III will be to integrate the results into the outflow code and test results under variable conditions. This project represents a new direction for the PI as it relates to stellar outflow modeling; however, the PI has significant experimental and theoretical experience in nucleation phenomena. The PI will work closely with Goddard staff on this one-year project. It is expected that this project will result in a number of measureable outcomes, including publication(s), a fortified relationship with Goddard, and opportunities for undergraduate research

*Minority Serving Institution Collaboration Program:* One Minority Serving Institution Collaboration was awarded to Dr. John Wise from the University of Southern Maine to develop his collaboration with Dr. Michael Heithaus, Professor and Director, School of Environment, Arts and Society at the Florida International University (FIU).

In this project, Dr. Wise and two USM faculty are leveraging is ongoing collaboration with NASA to establish a program for monitoring and evaluating the genotoxic impact of climate change and chemical exposures on the environmental health of Kennedy Space Center (KSC). When complete, this program can be applied to other NASA centers and resources, adjusting it for their specific needs. For KSC's needs and environmental context, Dr. Wise's short-term objective focuses on the American alligator as a sentinel species for human health and the impacts of climate change. This proposed project will expand the use of aquatic reptiles as environmental sensors and develop sea turtles as a companion model system to compare with the reptiles from KSC. This proposal will also take the first steps and draw on Dr. Heithaus' sea turtle expertise and the Wise Laboratory's reptile cell culture and genotoxicity expertise to begin to develop a comparative site for KSC. In addition to Dr. Wise, two USM faculty participating in this project are Dr. Laura Savery and Dr. Hong Xie. Undergraduate students will be selected from the Department Applied Medical Sciences. MSGC funds are not supporting Dr. Heithaus participation in the project. We are in discussion with the Florida Space Grant Consortium to provide support to the FIU undergraduate and graduate students.

#### **Objectives:**

1. On an annual basis, two research collaborations between affiliates and NASA Centers will be seeded.
  - a. Accomplishments: **2 research collaborations** between affiliates and NASA centers have been seeded. The collaborations are with USM and NASA Goddard Space Flight Center through our Research Seed Grant Program and with USM and the NASA Kennedy Space Center through our Minority-Serving Institution Collaboration Program.
2. On an annual basis, four faculty will be supported in research collaborations between affiliates and NASA centers.
  - a. Accomplishments: **Two faculty** are being supported in research collaborations between affiliates and NASA centers. Two male faculty members at USM, are supported through the Research Seed Grant Program. We are not counting the faculty who are being supported under our Minority-Serving Institution Collaboration Program here, as they are being counted in Objective five below.
3. On an annual basis, four undergraduates and graduate students (two tracked and two not-tracked) will participate in NASA-related STEM research conducted by affiliates.
  - a. Accomplishments: **10 undergraduate and graduate students** (two tracked, six not-tracked) are participating in NASA-related STEM research conducted by affiliates through the Seed Research Grant Program.

4. On an annual basis, one new research collaboration between an Affiliate and Minority Serving Institution will be seeded.
  - a. Accomplishments: **One collaboration** was seeded between faculty at USM and the Florida International University (FIU) (see above for details)
5. On an annual basis, two faculty will be supported in the research collaborative between an affiliate and a Minority Serving Institution.
  - a. Accomplishments: **Three faculty** supported, one male and two female at USM.
6. On an annual basis, three undergraduate and graduate students will participate in a collaboration with a Minority Serving Institution *at least one student will be tracked*.
  - a. Accomplishments: **Four student participants**, one male and three female in this collaboration with a Minority Serving Institution, one female student is being tracked.

**MSGC Goal for Higher Education:** Increase participation of Maine undergraduate and graduate students in science and engineering research conducted by the affiliates and NASA Centers

Programs under Higher Education include 1) Our Maine Aerospace Workforce Development Program where we fund undergraduate students with a 10-week research experience at a NASA field center, 2) Maine Student High Altitude Platform (MeSHAP) Program which includes High-Altitude Ballooning and Rocketry projects, and 3) a Higher Education Other program which allows us to fund projects that don't align well in the first two projects, but are important to both NASA and Maine. Projects/activities that fit into this category include (but are not limited to) senior design courses, new course development or revisions.

**Programs:**

*Maine Aerospace Workforce Development Program:* MSGC is conducting another year of its Maine Aerospace Workforce Development program where we fund undergraduates students attending a Maine college or university with a ten week research experience at a NASA field center. We are currently in the middle of placing students at this time, therefore we do not have complete data on student participants. To date, two male undergraduates, one from the University of Maine and one from Colby College have been accepted to participate both at the Goddard Space Flight Center.

*MeSHAP (Maine Student High Altitude Program):* MSGC continued its MeSHAP program at the University of Maine, University of Southern Maine and Maine Maritime Academy. These projects are still on-going and participant data has not yet been reported at this time.

*MSGC Higher Education Program:* In addition to the Maine Aerospace Workforce Development and MeSHAP programs, MSGC funded four additional Higher Education projects as follows:

The first project at the University of Maine, Department of Physics and Astronomy titled “Physics and Optics Applications of Uninhabited Remote-Controlled Light Aircraft”. This project goal is to measure atmospheric conditions including wind, weather conditions, and electromagnetic emissions as a function of altitude, including gamma radiation levels, infrared emissions, polarized and non-polarized visible light. A high level of undergraduate and graduate student participation is planned. Student participants will receive instruction in radiation and optical instrumentation, photography, aerodynamics, flight controls, flight safety and legislation, and privacy ethics. Student involvement will include Capstone projects relating to interdisciplinary research in physics, aeronautics, electrical and mechanical engineering. Appropriate permissions from the FAA will be obtained before any flight above 400’ above ground level (AGL) or whenever otherwise required. This project relates to the existing NASA programs involving uninhabited aerial vehicles (UAVs).

The second project at the University of Southern Maine, Department of Biological Sciences titled “Steroid Hormone Research Education Web Site”. An interactive website education resource will be developed to bring the applicant’s NASA-funded research program into multiple classroom settings where students will engage in evidence-based, experiential learning activities. The research activities will specifically focus on feedback regulation of steroid hormone synthesis by endocrine glands during animal life cycles. The proposed work will achieve six overlapping objectives: 1) create a web-based undergraduate education module to enhance an existing laboratory course thereby facilitating recruitment and retention of undergraduate STEM majors, 2) provide preliminary evidence for a collaborative NSF proposal that will include creation of a web-based undergraduate lab education module focused on a research project studying mouse kidney embryogenesis, 3) strengthen existing connections between the applicant’s research program and high school science teachers and their students as well as supporting STEM teacher preparation, 4) introduce high school and undergraduate students to information about STEM research opportunities , 5) improve STEM training education within the applicant’s research group, and 6) build science education collaborations between postsecondary science instructors in Maine.

The Third project at the University of Southern Maine, Program in Geography-Anthropology, titled “Geotechnology Learning Collaborative (GLC): Disseminating NASA’s Imaging technology and knowhow to middle and high school STEM & Social Studies Teachers”. This project uses Maine Space Grant/NASA funds to engage middle and high school teachers in a GeoTechnology Learning Collaborative (GLC) through intensive remote sensing and NASA satellite image analysis training and lesson plan development for use in southern Maine middle and high schools. The training will take place in the form of two half day professional development workshops at the University of Southern Maine’s GIS Laboratory and structured and moderated online collaborations where participants will have the opportunity to develop lesson plans based on the training they receive. USM will work closely with faculty from the University of Maine Farmington and the Maine Geographic Alliance to develop and execute all stages of this project. The workshop will especially target STEM and social science educators in

area schools and will enhance the knowledge capacity of teachers and educators in NASA remote sensing technology, satellite image interpretation and its applications. Providing educator training in this technology will directly support national and state goals of building a knowledge-based economy through STEM training and education, and NASA efforts in inspiring the future cohort of scientists, explorers and educators. The current middle and high school students of today will be the college graduates and workforce of tomorrow. Through this project we build strong and sustained linkages with area schools, teachers and their classrooms. Moreover, through early and exciting experiential learning opportunities with geotechnology, we have the potential to engage in the recruitment of these high school graduates to universities for degrees in higher education

The fourth project was part of our mid-course improvement plan to recruit and involve more minority students in MSGC and NASA program. MSGC, in partnership with the University of Maine, held an information session event to show and tell engineering students the various aerospace research activities underway at the institution and aerospace career opportunities at NASA and other sectors. The primary purpose of this event was to increase awareness of engineering students, primarily minority students, of funding opportunities for research and internships at the University and NASA. This awareness would result in minority students applying for space grant research fellowships and internships in the next academic year. Twenty-three students attended the event; five or 22% were minority students. Prior to tours of two NASA EPSCoR-supported laboratories, presentations were provided by Drs. Shehata and Abedi (Associate Professor of Electrical Engineering), and by Mechanical Engineering Ph.D. candidate Radic Glasier. Dr. Shehata discussed NASA research and internship opportunities. Dr. Abedi discussed flight opportunities with the International Space Station, nano satellite and rocket launches, and the NASA EPSCoR-funded Lunar Habitat. Mr. Glasier discussed inflatable structures. Following these presentations, Dr. Abedi gave the students a tour of the lunar habitat. The event was concluded by a presentation on an inflatable atmospheric decelerator device for spacecraft re-entry and a tour of the NASA EPSCoR supported work being done on this futuristic technology at the Advanced Structures and Composites Center. Dr. William Davids, John C. Bridge Professor of Civil and Environmental Engineering led this presentation.

### **Objectives:**

1. On an annual basis, at least five undergraduate and graduate students (three tracked and two not-tracked) will participate in NASA-related STEM research conducted by the affiliates.
  - a. Accomplishments: **42 students participated** (0 tracked, 42 not-tracked) in NASA-related STEM research conducted by affiliates. This data includes participating students in the four higher education projects noted above at the University of Maine and the University of Southern Maine. Participant data on the MeSHAP program will be included in our next report
2. On an annual basis, at least two courses that integrate NASA-related resources into STEM disciplines will be developed or improved.

- a. Accomplishments: **One course** has been revised/improved. This course is the result of one of the higher education projects listed above, titled “Steroid Hormone Research Education Web Site”
3. On an annual basis, at least four undergraduate students (all tracked) will participate in summer research experiences in NASA-related STEM research conducted at Maine Technology-based companies and/or NASA Field Centers.
- a. Accomplishments: **(To Date) two student participants** (2 tracked, 0 non-tracked) have been placed in research experiences at NASA Field Centers through our Maine Aerospace Workforce Development Program. Two male students have been accepted to NASA Goddard Space Flight Center. The students are enrolled at Colby College, and UMaine. *As mentioned above, we are in the process of placing students at NASA centers and do not have complete participant data.*

Outcome 2: “Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers and faculty”

**MSGC Goal for Pre-College:** Increase participation of Maine K-12 teachers and high school students in STEM activities:

Our programs that correspond with these goals and objectives for this year are our Maine Research Internships for Teachers and Students (MERITS), K-12 Professional and Curriculum Development Program, Space Day Maine, and a K-12 Other program that incorporates activities that are important to NASA and the State of Maine, but don't fit in the above projects.

As stated in our mid-course improvement plan, we reinstated our pre-college K-12 Professional and Curriculum Development program, as described in our original 5-year proposal, to support middle school teachers and students. Second, we established a partnership with the Perloff Foundation. Although this partnership was not described in our mid-course improvement plan or in our original 5-year plan, we believed it would be beneficial to partner with the Foundation and subsequently impact many more teachers and students across the state. Moreover, the Foundation already has a grant-making process that substantially minimized our administrative requirements.

**Programs:**

*MERITS:* The MERITS Program provides summer research opportunities for highly motivated high school students who are interested in science, technology, engineering and mathematics (STEM) careers to experience ‘real-time’ applications of STEM in a research-focused work world at host institutions conducting research and technology development. By doing so, MSGC seeks to expose students to career opportunities in Maine and to provide a direct way by which Maine businesses and research communities can attract young people with high potential for possible future employment.

Clear expectations and mentored research lead to valued results for the students and the host institutions. Students learn and apply research protocols and processes to a project related to

research disciplines such as, but not limited to, information technology; semiconductor engineering; electrical engineering; environmental studies; molecular genetics; medical research; estuary and ocean science; marine biology; precision manufacturing; geology and soil science; and analytical chemistry. Participation in the MERITS Program will provide students with an increased understanding of the relevance of high school requirements as preparation for STEM opportunities.

The MERITS program is still ongoing at this time. Through a thorough review process, we have selected nine students participants, but we do not finalize and count participants until they have been officially accepted at a host institution. We are in the process of matching students to applicable host institutions at this time.

*MSGC's K-12 Professional and Curriculum Development Program:* Through this program, we are supporting the Maine Mathematics and Science Alliance project titled “Engineering Connections for K-8 Teachers”. Inclusion of engineering in the Next Generation Science Standards (NGSS) presents an opportunity for K-8 teachers to meaningfully integrate STEM concepts and practices by engaging in design challenges. Currently, only 4-6% of K-8 teachers feel confident teaching engineering and engineering is largely absent from teacher pre- and inservice preparation programs. In its original proposal, MMSA *proposed* to work with 45 teachers from throughout Maine to help them integrate this unfamiliar field into their classrooms— not by adding more to an already overflowing school curriculum, but rather by capitalizing on the connections between engineering and the math and science they are already teaching. This project is based on the premise that students engaged in integrated instruction, built around engineering challenges, will make significant gains in science and math content knowledge and practices. The initial goals of the MMSA project were to:

- Increase K-8 teachers’ understanding of engineering and its applications in developing students’ understanding of targeted science and mathematics content;
- Increase teachers’ understanding of the complementary nature of the practices outlined for engineering, mathematics, and science in the NGSS and Common Core State Standards for Mathematics (CCSSM), with an emphasis on the shared practices of modeling, collecting and analyzing data, and constructing and critiquing arguments;
- Prepare teachers to implement two weeks of instruction that uses an engineering design problem as the anchor for science and mathematics content and STEM practices;
- Establish a network of K-8 teachers, university professors, practicing engineers, and MMSA staff to support the integration of engineering instruction;
- Deepen students’ abilities to propose successful solutions to engineering problems through proficient use of targeted science, engineering and mathematical practices; and
- Increase students’ interest in and understanding of STEM careers by bringing engineers into classrooms to demonstrate their work.

The professional development component of the project included the following virtual and face-to-face involvement in Professional Learning Communities (PLCs):

- ongoing PLCs to meet regularly during the academic year, both in person and virtually. School-based groups of teachers work together to deepen their understanding of key science and math content related to an engineering problem. (10 hours per year);
- virtual book groups, co-led by project staff, professors, and practicing engineers, focused on high interest books such as *To Engineer is Human*. (5-15 hours per year);
- a summer workshop, where teachers engage in engineering design through a 3 day workshop at Maine Maritime Academy, which offers CEU credit. (3 days = 24 hrs.);
- a workshop where teachers learn to use research-based engineering curricula (*Engineering is Elementary*, middle school materials from Museum of Science); and
- support in planning and carrying out Family Engineering events and/or other out-of-school activities (*Engineering Adventures*, *Lego Robotics*, *Junior Solar Sprint*) that broaden opportunities for students to become interested and engaged in engineering.

To date, 61 K-8 teachers are participating in this program. Two of the teachers are using NASA contents in their curricula, the rest are using STEM contents available on the web. MMSA is conducting an evaluation of the program. All teachers will be involved in pre and post testing of their knowledge of engineering pedagogical content knowledge (PCK). In this emerging field, there are as yet no validated measures of teacher PCK. However, MMSA has designed and used a pilot version of such an instrument in an existing project. This instrument tapped teachers' understanding of the elements of the engineering design process. Through concept maps and interviews, MMSA will examine teachers' understanding of how the disciplines of engineering, mathematics, and science are connected. For student achievement, MMSA is using the engineering section of the Massachusetts Comprehensive Assessment System. Selected teachers will administer these tests to students as they implement the two-week engineering unit. The student data will be primarily for teachers' own use as they develop more data-driven practices.

*Collaborative Project with the Perloff Foundation:* David Perloff is a retired aerospace engineer who worked for years in Silicon Valley. He has several NASA connections. He was a NASA graduate fellow during his college years, and his granddaughter who entered her first year at MIT last fall, was a summer NASA intern. Upon retiring in the mid-1990s, he and his wife established a foundation that provides educational grants in Maine. Last fall, Dave and Sandy Perloff celebrated their 14<sup>th</sup> year of educational grant-making to public schools in Maine. Participating schools cover the entire state, from Berwick to Madawaska and from Greenville to Lubeck. The grants support a wide range of teacher-initiated projects in the creative arts, language studies and physical education, among other areas. The Perloffs visit every funded program twice in the course of the school year. Through their Fast Track grant-making process, the Perloffs encourage teachers to be educational innovators, committed to planning, risk taking and results. Working individually or as part of a team, these are teachers who are motivated to undertake and complete groundbreaking projects that benefit the school, its students and their community. David and Sandy envision teachers as having influence far beyond their own classrooms, particularly in the area of STEM as well as the integration of the Arts to carry out innovative STEAM projects. To date, more than 300 projects have been funded with grants approaching \$1,000,000.

Last summer we established a new partnership with the Perloff Foundation to leverage the Foundation's STEM4ME Program in order to support projects in which teachers encourage students to create real-world solutions to problems in areas such as renewable energy, ecology,

automation, space science and sustainable food production, integrating wherever possible the arts and humanities, to fire the imagination of the students, thereby developing or reinforcing their interest in pursuing a STEM career. Our partnership calls for the teachers to use NASA contents in their lesson plans and activities to the extent possible and feasible. Since MSGC is using the Foundation's grant-making process, there is no administrative burden on MSGC's staff. Staff reviews the applications along with David and Sandy and mutually agrees on funding projects. MSGC issues its portion of an award directly to the schools thereby avoiding paying administrative fees if we used the Foundation's financial infrastructure.

Through our partnership with the Perloff Foundation, we are supporting the following multiple teacher-student projects . We would like to note that the Mars. Submersible ROV, Pre-Engineering and Robotics Projects are the only three that are using NASA developed contents. The rest are using STEM contents generally available on the web. As this partnership grows, we will place more emphasis on use of NASA developed contents where practical.

1. The Mars Project, Houlton Jr./Sr. High School
2. Submersible ROV, Baxter Academy
3. 3D Printers and CNC Router Program, Calais High School, Falmouth High School, and Baxter Academy
4. STEM Pre-Engineering Smart Greenhouse Research, Kennebunk High School
5. Sustainable Food Production, Buckfield Junior-Senior High School
6. Energy Efficient and Design Construction, Casco Bay High School.
7. Robotics for Young Students, Challenger Learning Center
8. Winter Flounder Trap, Deer Isle-Stonington High School.
9. Biodiesel from Algae, Leavitt Area High School.

*Space Day Maine:* Space Day Maine is celebrated annually around the state but with a different local/regional focus each year. This year Space Day was focused in the Sanford area school district with participant volunteers from MSGC affiliate institutions, local organizations and other groups. A highlight of the day was a recorded message to students from Maine's own Astronaut Christopher Cassidy. Participants included (affiliate members): The University of Maine, University of Southern Maine, Bates College, Applied Thermal Sciences, Inc., Challenger Learning Center of Maine, Lockheed Martin, (non-affiliate members) Southern Maine Astronomers, Civil Air Patrol, York Helicopters, Flagsuit, LLC and the Cornerstones of Sciences. Volunteers from: the Portsmouth Naval Air Base, USS Miami, and NAVSEA/AEGIS test team members from Bath Iron Works. NASA partners included: Johnson Space Center - Digital Learning Network, Teaching from Space Program, and Ms. Bridget C. McInturff, JSC Curation Education Lunar/Meteorite Disk Specialist. Participating schools included: Sanford High School, Sanford Jr. High School, Willard School, Brunswick Jr. High School, Harriet Beecher Stowe Elementary School, Winslow Jr. High School, three Sanford area Head Start Programs, Biddeford Head Start Program, Pine Hill Nursery School (Pre-K) and the Sweet Peaz Preschool. (Note: student numbers/data below do not account for any pre-school students) Lastly, MSGC participated in the New England Regional Collaborative Professional Development Workshop, which was part of the Tufts University Center for Engineering Education and Outreach, held at Tufts University in Massachusetts. The workshop targeted K-12 teachers in the use of LEGO NXT and LabVIEW software. These are powerful and engaging

tools for teaching engineering, technology, science, and math. Tufts University's CEEO Summer LEGO Engineering Institute gave teachers the background they need to make effective use of these tools in their classrooms. Through hands-on, open-ended design projects, participants learned engineering concepts, LEGO hardware & software, and associated pedagogy/educational theory. MSGC supported two K-12 teachers to attend this workshop and to bring the knowledge and resources back to their classroom and after school robotic teams. Chris Newcomb is the Gifted and Talented teacher at the Windham/Raymond School Department. Hope Tray teaches Chemistry in grades 10-12 at the South Portland High School and is also involved in the Southern Maine Gearbots. The Southern Maine Gearbots seeks to introduce students in grades K through 8 to the concepts of Science, Technology, Engineering and Math using building blocks and computer software. They use the US First Junior Lego League Program for students in Grades 1 through 3 and Lego Mindstorm with the Maine Robotics Challenges for students in grades 3 through 8.

**Objectives:**

1. On an annual basis, at least six middle and high school teachers will participate in summer research experiences in NASA-related STEM research. ***This program has been discontinued.***
  - a. Accomplishments: 0 teacher participants. ***As discussed in our mid-course assessment improvement report, we have discontinued the teacher part of the MERITS Program and will no longer report data on this objective.***
2. On an annual basis, four high school juniors will participate in summer research experiences in NASA-related STEM research.
  - a. Accomplishments: **Nine selected** high school juniors, will participate in summer research experiences through our MERITS program. **NOTE: As mentioned above, we are in the process of placing our nine selected students at applicable host institutions. We will confirm the data once we have received official notification from our affiliated host institutions that each student has been accepted.**
3. On an annual basis, two new or improved curricula that uses NASA themes and content will be introduced in Maine K-12 schools.
  - a. Accomplishments: **Five improved curricula** that will use NASA themes and content will be introduced in Maine K-12 schools.
    - i. This data is based on two of our Pre-College projects 1) The K-12 Curriculum and Professional Development Program, which resulted in two teacher/curricula under the “Engineering Connections for K-8 Classrooms” project with the Maine Mathematics and Science alliance; and 2) Our Collaborative project with the Perloff Foundation, which resulted in three teachers/improved curricula.

- ii. In addition, although we are not reporting the data at this time because the project is still ongoing and the data is not yet complete, another project that will impact this objective was supported under our Higher Education Program, the project titled “Geotechnology Learning Collaborative (GLC): Disseminating NASA’s Imaging technology and knowhow to middle and high school STEM & Social Studies Teachers” with the University of Southern Maine proposes to Impact up to five K-12 teachers. More information and final data will be reported on in our next report.
- 4. On an annual basis, two middle school and/or high school teachers will use NASA contents and themes to enhance their STEM curricula.
  - a. Accomplishments: **Five teachers** will use NASA content.
    - i. This data is based on two of our Pre-College projects 1) The K-12 Curriculum and Professional Development Program, which resulted in two teachers under the “Engineering Connections for K-8 Classrooms” project with the Maine Mathematics and Science alliance; and 2) Our Collaborative project with the Perloff Foundation, which resulted in three teachers.
- 5. On an annual basis, 40 middle school and/or high school students will be exposed to NASA-mission related activities, STEM disciplines and careers.
  - a. Accomplishments: **Over 4,800 middle and high school students** have been exposed to NASA related activities. The following programs contribute to this objective: K-12 Curriculum and Professional Development Program (MMSA project) resulted in an estimated 1,220 students (61 participating teachers impacting an estimate 20 students per teacher); our Collaborative Project with the Perloff Foundation resulted in 238 students; Space Day Maine held in multiple areas of the state, but with a focus in Sanford, resulted in an estimated 3,427 students (based on individual school and grade enrollment for each participating school). *Note: The metric variance for this objective between this report and our mid-course assessment improvement report is based on the additional number of students involved in our Space Day Maine program, which was not reported on in the mid-course assessment improvement report.*

Outcome 3: *“Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA’s mission”*

**MSGC Goal for Informal Education:** Increase the public’s awareness of STEM research, education and activities that are associated with NASA and the affiliates

MSGC supported two informal education projects: 1) A new partnership with the Cornerstones of Science (COS) titled “Sharing Telescopes and Astronomy Resources (STAR) Program” and 2) the bi-annual STEM Conference

## Projects:

*The Cornerstones of Science program:* this program supports the participation of two public library communities in the STAR Program - Thompson Free Library (Dover Foxcroft) and SeDoMoCHA Middle School, and Witherle Public Library (Castine) and Adam Elementary School. The STAR Program creates a link between schools and public libraries to increase access and opportunity to hands-on astronomy and space science experiences, and establishes public libraries as a community resource that provides youth, adults and families with high-quality accessible STEM opportunities year round.

Approximately 20 information educators will participate in this project. The new COS partnership is also supporting the development of a sustainable STAR Science Trunk which will be loaned to libraries. The trunk includes a modified Orion 4.5” Starblast Telescope, curriculum of hands-on activities, reference materials, and access to the Science Provider Network of professional and avocational astronomers and space science researchers willing to present in libraries to enhance the STAR Trunk experience. Four evaluation questions guide the data collection and analysis for the library collaborative in Dover-Foxcroft and Castine.

1. How does the STAR project affect the nature of the relationship between the school libraries and the public libraries in the two partner towns?
2. How does the STAR project support the astronomy programming in particular and the science programming in general for the library collaboratives in the two partner towns?
3. What programs did the collaboratives implement and what were the outcomes of those programs?
4. How do the library personnel engaged in the collaborative work view the sustainability of their work together with astronomy and other science programming after the grant period ends?

At this moment, they are in the development phase for the STAR program Science Trunk and Evaluation. They have completed modifications to telescopes and have met with their collaborators on the project to begin establishing public library capacity to sustain the STAR Program within their libraries successfully.

*Bi-annual Maine STEM Summit:* MSGC continues to be a major sponsor of the biannual STEM Summit to promote critical issues in STEM education in Maine. This year, the STEM Summit was held at Colby College. Dr. Shehata was the chair of the planning committee and the moderator for the event. The theme was “*STEM is Everywhere and Everyday*”. This theme stressed STEM education is important for most functions in society, from professional, technical, to being just an educated citizen of Earth who can understand phenomena such as climate change, and can make informed decisions that will affect their daily lives and in the voting booth.

The STEM Summit started with a keynote presentation by Dr. Jay Labov, Senior Advisor for Education and Communications, National Research Council, National Academy of Sciences on “The Changing National Landscape of STEM Education: Connecting the Dots Across the Educational Ecosystem”. Dr. Labov is a former Biology faculty member at Colby College for 18

years before leaving in 1997 to join the NRC. The keynote presentation was followed by two panel discussions on what public and private institutions of higher education are doing to improve their students' STEM experiences. The first panel, which was moderated by Dr. Shehata, included representatives from Colby College, the University of Maine, the University of Southern Maine, and Southern Maine Community College. The panelists were challenged to answer two questions in a dialogue with the audience: Is the Maine K-12 Educational System graduating college ready students? Are higher education faculty properly prepared to use update pedagogical and technological teaching and learning methods? The second panel included teachers from middle and high schools who are implementing innovative STEM teaching and learning methods in their classes. The afternoon schedule provided an opportunity to share STEM education success stories, many supported by Maine Space Grant Consortium, from K-12, public and private higher education institutions and industry including in-class activities, curriculum development, internships, and mentoring, among others. The Summit culminated with the appearances of two of the three gubernatorial candidates who discussed their STEM research and education vision for the state of Maine.

Based on actual check-ins, 189 K-12 teachers, informal STEM educators in STEM, business and industry representatives, state government representatives from the Department of Education, and senior administrators and STEM faculty from Maine's two-year and four-year private and public institutions of higher education were in attendance. Of this total approximately 71 were K-12 teachers – eight elementary school, 21 middle school, and 42 high school teachers. Based on the estimated number of teachers in attendance and using 20 as the average number of students per classroom, an estimate of the number of K-12 students reached is 1,420

### **Objectives:**

1. On an annual basis, two informal education activity that uses NASA themes and content will be supported.
  - a. Accomplishments: **Two informal education activities** were supported. See above for a detailed description
2. On an annual basis 100 students and/or members of the public will have a better appreciation of STEM and NASA.
  - a. Accomplishments: **Over 1,600 students and/or members of the public** were impacted. This number reflects the actual number of participants (189 teachers/general public) plus the estimated number of students impacted based on an average 20 students per teacher who attended the STEM Summit (total 71 K-12 teachers attended totals 1,420 students).

## PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

*Note: The data below only reflects 2013 longitudinally tracked data. In the past, MSGC reported all data from the first year it began tracking students. We received clarification for this report that tracking data should be annual and not cumulative.*

### **Student Data and Longitudinal Tracking:**

Number of student participants (for 2013 only) who are:

Total awards that are being longitudinal Tracked	43
Number of scholarship/fellowships (subset of total awards)	38
Number of Higher Education (subset of total awards)	3
Number of Research Infrastructure (subset of total awards)	2
Employed by NASA	0
Employed by Aerospace Contractors	0
Employed by Universities	0
Employed by other education institutions	0
Employed in other STEM fields	0
Pursuing advanced education in NASA-related disciplines	0
Still enrolled in current degree program	43
Underrepresented	8*

\*all eight students are in the scholarship/fellowship programs

MSGC longitudinally tracks students that receive a significant award or benefit from the award/experience. Notices are sent out to these students twice annually requesting information on their academic and workforce status as well as data on publications, presentations, and proposals submitted to other funding agencies, as a result of their Space Grant award.

Because MSGC has been tracking students for quite some time, we have received some great student success stories over the years. However, because the annual report requires that we only include highlights from students/projects funded in the year reported, we feel that some great stories are not being told. Below are some highlights and quotes from two of our past awarded students.

Natalie I. received a fellowship award in 2012 and 2013 when she attended the University of New England: “My experience with the Maine Space Grant allowed me to apply knowledge of my field in a research setting. Working through the scientific process to achieve a novel finding fueled my passion for research. In November of 2013, I traveled to Warsaw, Poland for the 19th Conference of Parties of the United Nations Framework Convention on Climate Change. I was an American Chemical Society (ACS) representative and was responsible for reporting the events of the conference to promote climate literacy among my peers. For the first week of the conference I attended and reported on talks, panels, and other presentations on climate science and policy. Next August, I will be presenting at the American Chemical Society annual meeting

on my experience as an ACS representative”. Natalie is still in her current degree program at UNE, she has presented her work at two conferences and has another conference presentation planned for the spring 2014.

Marina G. received a fellowship award in 2009 and 2010 when she attended the College of the Atlantic: “The research that I conducted while supported by the Maine Space Grant Consortium gave me the kind of experience that few undergraduates get; designing my own research project, writing a grant proposal, and then conducting a rigorous study gave me the skills to go into the science world directly after graduating. These real-world, widely applicable skills not only prepared me for, but also gave me the confidence to engage in the science work I am passionate about. Being able to experience science as the real thing – not just a subject in a textbook – reaffirmed my desire to pursue science after graduating. I found that I not only loved the field work, but also processing samples, running statistical tests, and grappling with how to present data to both the scientific community and the general public in a meaningful way. While science is not the only thing that I do in life, it remains a huge part of my interdisciplinary approach to work and life.” Marina’s research project while at COA was in Marine plastic pollution. She is currently working for the Rozalia Project for a Clean Ocean as a Mate, Scientist and Educator responsible for shipboard operations, the science program and is a marine educator to a wide variety of audiences.

### **Minority-Serving Institution Collaborations:**

Maine does not have a minority-serving institution. However, we were successful in establishing a collaboration between Dr. John Wise, Professor in the Department of Applied Medical Sciences at the University of Southern Maine (USM) and Dr. Michael Heithaus, Professor and Director, School of Environment, Arts and Society at the Florida International University (FIU). In this project, Dr. Wise and two USM faculty are leveraging an ongoing collaboration with NASA to establish a program for monitoring and evaluating the genotoxic impact of climate change and chemical exposures on the environmental health of Kennedy Space Center (KSC). When complete, this program can be applied to other NASA centers and resources, adjusting it for their specific needs. For KSC’s needs and environmental context, Dr. Wise’s short-term objective focuses on the American alligator as a sentinel species for human health and the impacts of climate change. This proposed project will expand the use of aquatic reptiles as environmental sensors and develop sea turtles as a companion model system to compare with the reptiles from KSC. This proposal will also take the first steps and draw on Dr. Heithaus’ sea turtle expertise and the Wise Laboratory’s reptile cell culture and genotoxicity expertise to begin to develop a comparative site for KSC. In addition to Dr. Wise, two USM faculty members participating in this project are Dr. Laura Savery and Dr. Hong Xie. Undergraduate students have been selected from the Department Applied Medical Sciences. MSGC funds are not supporting Dr. Heithaus participation in the project. We are in discussion with the Florida Space Grant Consortium to provide support to the FIU undergraduate and graduate students.

This collaboration is the second successful collaboration with a minority serving institution that we have had so far. Although we have been working with several faculty members over the past year, the others unfortunately did not work out. We began working with a faculty member at the College of Atlantic and another faculty member at USM, who had expressed interest in

establishing relationships with faculty at the Johnson C. Smith University and the Mississippi Valley State University (MVSU). Details are below.

Dr. David Feldman from the College of the Atlantic began communicating with faculty at the Johnson C. Smith University after giving a lecture at their institution regarding an MSGC funded project. MSGC began working with Dr. Feldman shortly thereafter to assist him in developing a minority collaboration with faculty at Johnson C. Smith University. At the time we submitted our 2012 report, the potential collaboration was moving along smoothly, with faculty from both institutions corresponding together very favorably. A few months later, however communications stalled. Dr. Feldman tried on a few occasions to keep the lines of communication open, but unfortunately the collaboration did not work out as hoped or expected.

MSGC then proceeded to work with another faculty member at the College of the Atlantic, in collaboration with faculty at the University of Maine who began working on a project that, in part was funded previously by MSGC. This project had recently been extended to include a Maine tribal government. The idea was to use our Minority Collaboration program to help fund the collaborative side of the project with the Native American community. Unfortunately our faculty contacts made the decision that they were not at the stage in the project where they could use funding for this purpose, but expressed a great interest in working with us and this program next year as they felt that at that time, they would be in a better position to benefit from this program.

We also worked with a faculty member at USM who originally identified a faculty member at MVSU as a potential collaboration. Unfortunately, this collaboration didn't blossom.

- **NASA Education Priorities:** *Accomplishments related to the "Current Areas of Emphasis" stated in the 2010 Space Grant solicitation. Report on areas that apply to work proposed in your proposal and budget.*
  - Authentic, hands-on student experiences in science and engineering disciplines – the incorporation of active participation by students in hands-on learning or practice with experiences rooted in NASA-related, STEM-focused questions and issues; the incorporation of real-life problem-solving and needs as the context for activities.
    - *MSGC's Scholarship and Fellowship Program (page 6), Research Infrastructure (pages 7-10), Higher Education (pages 10-13) and MERITS program (pages 13-18 under pre-college programs) apply to this priority area*
  - Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).
    - *The Consortium has diverse group of Affiliates representing higher education, non-profit research and education institutions, and private sector (see below for our affiliate mix). In addition, we have successfully increased our minority student participation percentage to 12 percent\*,*

*exceeding our metric goal (per our mid-course improvement goal) of 8 percent. MSGC also increased our women student participant percentage from 36% last year (final numbers reported in our OEPM data) to 43% this year, exceeding our overall goal of 40%*

*\*the percentage variance between the mid-course assessment improvement report (15%) and this report(12%) is due to additional student participant data that was reported to us, after we submitted our mid-course assessment report.*

- Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise. Capabilities for teachers to provide authentic, hands-on middle school student experiences in science and engineering disciplines (see above).
  - *The Consortium's Pre-college programs (pages 13-18 under pre-college programs) apply to this priority area. We reinstated our K-12 Professional and Curriculum Development program which added to our number of teachers served, began a new collaboration with the Perloff Foundation, and supported two teachers to attend a regional NASA related Lego Robotics workshop.*
- Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers.
  - *MSGC's MERITS program (pages 13-18 under pre-college programs) apply to this priority area. The majority of our awarded students participate in projects at our higher education affiliate institutions*
- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.
  - *The Consortium recruited the York County Community College as an affiliate in this year, the second community college recruit in two years. We also began a Space Grant scholarship program here that is currently ongoing.*
- Aeronautics research – research in traditional aeronautics disciplines; research in areas that are appropriate to NASA's unique capabilities; directly address the fundamental research needs of the Next Generation Air Transportation System (NextGen).
  - *MSGC's Research Infrastructure Program (pages 7-10) apply to this priority area*
- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.

- *MSGC's Research Infrastructure/Collaboration with a Minority-Serving Institution apply to this priority area (pages 7-10)*
- Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities.
  - *MSGC's Research Infrastructure Program (pages 7-10) apply to this priority area*

## IMPROVEMENTS MADE IN THE PAST YEAR

In May of 2013, the MSGC Affiliates Working Group met to address two major issues. The first is to agree on specific strategies for achieving an eight (8) percent minority participation in MSGC-funded activities. The second objective is to agree on specific strategies for supporting K-12 Professional and Curriculum Development and Informal Education activities. The Working Group included representatives from the Institute for Broadening Participation, departments or schools of education from our higher education Affiliates, and the informal education providers. As the result of the discussions and related actions, the following accomplishments were realized over the past year

- One new collaboration between faculty at the University of Southern Maine and Florida International University, a Minority-Serving Institution.
- Two informal science education activities: a library telescope lending program with the Cornerstones of Science, and the bi-annual STEM Summit, held at Colby College, in which the Chair of the Planning Committee and MC of the Event was the Director of the Maine Space Grant Consortium.
- One K-8 teacher professional development program on integrating engineering in curriculum, with the Maine Mathematics and Science Alliance
- Ten middle and high school student STEM projects with the Perloff Foundation  
Achieved 12% minority participation (*the percentage variance between the mid-course assessment improvement report (15%) and this report (12%) is due to additional student participant data that was reported to us, after we submitted our mid-course assessment report*).

### **Minority Participation:**

Minority participation has always been a challenge for Maine. However, MSGC and its affiliates committed to redouble our efforts to increase minority participation in all its program activities. The MSGC Affiliates Working Group convened in May 2013 and discussed several strategies to achieve an eight (8) percent minority participation in MSGC-funded activities. MSGC incorporated language into its program guidelines that encouraged interdisciplinary projects and partnerships of faculty and students between STEM and non-STEM majors. MSGC affiliates have actively promoted and sought out minority participants and encouraged those identified to apply or participate in MSGC programs.

In addition, MSGC, in partnership with the University of Maine, held an information session event to show and tell engineering students the various aerospace research activities underway at the institution and aerospace career opportunities at NASA and other sectors. The primary purpose of this event was to increase awareness of engineering students, primarily minority students, of funding opportunities for research and internships at the University and NASA. This awareness would result in minority students applying for space grant research fellowships and internships in the next academic year. Twenty-three students attended the event; five or 22% were minority students. Prior to tours of two NASA EPSCoR-supported laboratories, presentations were provided by Drs. Shehata and Abedi (Associate Professor of Electrical Engineering), and by Mechanical Engineering Ph.D. candidate Radic Glasier. Dr. Shehata discussed NASA research and internship opportunities. Dr. Abedi discussed flight opportunities with the International Space Station, nano satellite and rocket launches, and the NASA EPSCoR-funded Lunar Habitat. Mr. Glasier discussed inflatable structures. Following these presentations, Dr. Abedi gave the students a tour of the lunar habitat. The event was concluded by a presentation on an inflatable atmospheric decelerator device for spacecraft re-entry and a tour of the NASA EPSCoR supported work being done on this futuristic technology at the Advanced Structures and Composites Center. Dr. William Davids, John C. Bridge Professor of Civil and Environmental Engineering led this presentation.

#### **Collaborations with Minority-Serving Institutions:**

As discussed on page 8, we were working on three separate collaborations this year with two different faculty at the College of Atlantic, and one faculty at the University of Southern Maine (USM) who had expressed interest in establishing relationships with faculty at the Johnson C. Smith University, Mississippi Valley State University (MVSU) and with faculty at the University of Maine and a Maine tribal government. Unfortunately these collaborations did not work out, however we did have a successful collaboration with Dr. John Wise from the University of Southern Maine and with Dr. Michael Heithaus, Professor and Director, School of Environment, Arts and Society at the Florida International University (FIU). In this project, Dr. Wise and two USM faculty members are leveraging ongoing collaborations with NASA to establish a program for monitoring and evaluating the genotoxic impact of climate change and chemical exposures on the environmental health of Kennedy Space Center (KSC). For more details, please see pages 8-10.

#### **Increase Support for K-12 and Informal Education Activities:**

We completed two action items under our Precollege programs. First, we reinstated our K-12 Professional and Curriculum Development program, as stated in our original 5-year proposal and second, we established a partnership with the Perloff Foundation, as described on page 15. These actions resulted in supporting a project with the Maine Mathematics and Science Alliance and multiple teacher/student projects with the Perloff Foundation.

#### **Informal Education:**

We recognized the importance of informal education and committed to continuing our program at the level indicated in our original 5-year plan.

MSGC actively sought out projects that would fit well within our Informal Science Education Program and would be beneficial to Maine communities. This resulted in two informal science education projects being supported. First, we established a partnership with the Cornerstones of Science (COS) to support a project titled “Sharing Telescopes and Astronomy Resources (STAR) Program. As described on page 19, this program supports the participation of two public library communities in the STAR Program - Thompson Free Library (Dover Foxcroft) and SeDoMoCHA Middle School, and Witherle Public Library (Castine) and Adam Elementary School. The STAR Program creates a link between schools and public libraries to increase access and opportunity to hands-on astronomy and space science experiences, and establishes public libraries as a community resource that provides youth, adults and families with high-quality accessible STEM opportunities year round.

The second program we supported was the bi-annual Maine STEM Summit. MSGC continues to be a major sponsor of the biannual STEM Summit to promote critical issues in STEM education in Maine. The theme of the STEM Summit “STEM is Everywhere and Everyday”, stressed STEM education is important for most functions in society, from professional, technical, to being just an educated citizen of Earth who can understand phenomena such as climate change, and can make informed decisions that will affect their daily lives and in the voting booth.

### **Community College Involvement:**

MSGC also recruited a second community college affiliate member (York County Community College) and began a scholarship program here.

## **PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION**

### **Higher Education Affiliates:**

- Bates College, 4-year or above, Private, Baccalaureate College-Liberal Arts. Participates (faculty and students) and volunteers in multiple MSGC programs and activities.
- Bowdoin College, 4-year or above, Private, Baccalaureate College-Liberal Arts. Conducts scholarship/fellowship program, participates and volunteers in multiple MSGC program and activities.
- Colby College, Waterville, 4-year or above, Private, Baccalaureate College-Liberal Arts. Participates (faculty and students) and volunteers in multiple MSGC programs and activities
- College of the Atlantic, Bar Harbor, 4-year or above, private, Baccalaureate College-Liberal Arts. Conducts scholarship programs, participates and volunteers in multiple MSGC program and activities.
- Saint Joseph’s College, Standish, 4-year, Private, Baccalaureate College-Liberal Arts. Conducts scholarship/fellowship program. Anticipate participation and volunteer in multiple MSGC programs and activities.

- University of Maine, Orono, 4-year or above, Public, Doctoral/Research-Extensive, member of the Board of Directors, conducts scholarship and fellowship programs, participates and volunteers in multiple MSGC program and activities
- University of Southern Maine, Portland, 4-year or above, Public, Master's Colleges and Universities II, member of the Board of Directors, conducts scholarship and fellowship programs, participates and volunteers in multiple MSGC program and activities
- University of New England, Biddeford, 4-year or above, Private, Master's Colleges and Universities II. Conducts Scholarship/Fellowship Program, participates (faculty and students) and volunteers in multiple MSGC programs and activities.
- Maine Maritime Academy, Castine, 4-year or above, Public, Specialized Institutions. Conducts Scholarship/Fellowship Program, participates (faculty and students) and volunteers in multiple MSGC programs and activities.
- Southern Maine Community College, South Portland, 2-year, Public, Associate Degree granting institution. Scholarship and Fellowship Program to be initiated in Fall 2013. Anticipate participation and volunteer in multiple MSGC programs and activities.
- York County Community College, York, 2-year, public, Associate Degree granting institution. Scholarship program established. Anticipate participation and volunteer in multiple MSGC programs and activities.

#### **Non-Higher Education Affiliates:**

- Bigelow Laboratory for Ocean Sciences, Boothbay Harbor, Marine Research and Education, member of the Board of Directors. Participates and volunteers in multiple MSGC program and activities.
- Gulf of Maine Research Institute, Portland, Private not-for-profit, Marine Research and Education
- Maine Manufacturing Extension Partnership, Augusta, Private not-for-profit, Manufacturing Extension, member of the Board of Directors. Participates and volunteers in multiple MSGC program and activities.
- Applied Thermal Sciences, Sanford, High Tech Small Business, member of the Board of Directors. Participates and volunteers in multiple MSGC program and activities.
- Maine Mathematics and Science Alliance, Augusta, Private not-for-profit, Education, member of the Board of Directors. Participates and volunteers in multiple MSGC program and activities
- The Challenger Learning Center of Maine, Bangor, Private not-for-Profit, Education. Participates and volunteers in multiple MSGC program and activities
- BioAnalyte, Portland, Industry. Participates and volunteers in multiple MSGC program and activities
- Island Astronomy Institute, Private not-for-Profit, Education. Participates and volunteers in multiple MSGC program and activities
- Lockheed Martin, Industry. Participates and volunteers in multiple MSGC program and activities.

**The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.**