This annual newsletter highlights our Space Grant and NASA EPSCoR investments in faculty, students and teachers in the program year ending June 30, 2014. This was a great year for the Maine Space Grant Community. We welcomed three new Affiliates – Southern Maine Community College, York County Community College, and the Maine School of Science and Mathematics. We entered into a new partnership with the Perloff Foundation to support K-12 projects with high potential for impacting students and teachers. Mostly importantly, we supported 108 undergraduate students, 28 graduate students, 11 high school summer interns, 70 K-12 teachers and 23 faculty members in activities related to research, professional and curriculum development and internships, to name a few. We are unable to showcase all activities from this past year in the newsletter but know that the ones that are not, such as our Maine Student High Altitude Platform Program featuring the University of Maine’s Scientific Ballooning Program, are just as worthy. Enjoy!!

INTERNSHIPS, SCHOLARSHIPS AND FELLOWSHIPS

Natalie Ingram (Biddeford, Maine) received fellowship awards in 2012 and 2013 as an undergraduate student at the University of New England. She has been a member of a fish research lab working with Dr. James Sulikowski since her freshman year. Her research exemplifies her interest in climate change, focusing on the effects of increased water temperature on the gestation and survivability of a skate species as a model for other fish. “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. She is currently a research assistant in the Sulikowski Fish Research laboratory.

Marina Garland (Brookfield Vermont) received fellowship awards in 2009 and 2010 in marine plastics pollution when she attended the College of the Atlantic: “The research that I conducted 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.” She is currently working for the Rozalia Project for a Clean Ocean as a Mate, Scientist and Educator.
**Terence Cullen (Massapequa, NY)** received a fellowship award in 2013 during his junior year in biology at St. Joseph’s College of Maine, one of newest affiliate member. Terence worked with Dr. Nicholas Benfaremo, Professor of Chemistry, on a project titled “Synthesis and Properties of 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 then 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.”

**Tony Cole (Berwick, ME)** was a junior Geography-Anthropology student at the University of Southern Maine when he participated in our program, which provides competitive stipends to undergraduate students to intern during the summer for 10 weeks at NASA Field Centers. 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”.” “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 that 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).

**Isabella Leon Calle (Mt. Ararat High School)** participated in the 2013 summer MERITS program with Dr. Douglas Currie in the Department of Biological Sciences at the University of Southern Maine working in the Radiation and Neuroscience project. Isabella is in her first year at Stanford University in Biomechanical Engineering. “The MERITS program definitely taught me to be bold and independent. Through my research, I learned I had to ask a lot of questions to understand the research and to design my own experiment. Also, most of my hours in the lab were spend working independently. Even though, I wasn’t expecting to work so many hours independently, these hours were very valuable: I learned my strengths and weaknesses; how I personally need to prepare for presentations; and that how far and how much I want to achieve in my education and research are really up to me. However, I also learned to value of having many knowledgeable people in the lab who gave me advice, taught me to culture neurons, and helped me to analyze findings. I’m very interested in combining neuroscience with nanotechnology and biomedical engineering, and my love for science with my love for people.”
“Stellar Outflows from Oxygen-Rich Stars: Effect of Nucleation Models”. Daniel Martinez, Environmental Science, University of Southern Maine. In this Space Grant-funded project, Dr. Martinez 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. Building on Dr. Martinez’ PhD work on nucleation theory, he will further develop a methodology for modeling the condensation of high temperature metallic elements and compounds relevant to stellar chemistry. He 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 Dr. Martinez as it relates to stellar outflow modeling; however, he has significant experimental and theoretical experience in nucleation phenomena. He 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

“Developing a Sea Turtle Model for Comparison with Aquatic Reptiles at KSC.” John Wise, Sr., Professor of Toxicology and Molecular Epidemiology, University of Southern Maine. A Space Grant-funded Minority Serving Institution Collaboration was awarded to Dr. John Wise to develop his collaboration with Dr. Michael Heithaus, Professor and Director, School of Environment, Arts and Society at the Florida International University (FIU). Dr. Wise and two USM faculty members 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 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. The project will also take the first steps to 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. Students will be selected from the Department of Applied Medical Sciences.

Curriculum Development

“Physics and Optics Applications of Remote-Controlled Light Aircraft.” C.T. Hess and S.T. Hess, Department of Physics and Astronomy, University of Maine. The goal of the project is to educate and train undergraduate students on the use of remote-controlled light aircrafts (DJI Phantom 2 quadcopters and DJI S100 octocopter with gimbal-stabilized mounted digital visible light and IR video cameras) to measure several parameters of atmospheric conditions including weather conditions, and electromagnetic emissions as a function of altitude. Student participants are receiving instructions in radiation and optical instrumentation, photography, aerodynamics, flight controls, flight safety and legislation, and privacy ethics. Student involvement includes Capstone projects relating to interdisciplinary research in design and use of the aircrafts, physics, aeronautics, electrical and mechanical engineering.

Continued on next page
Over 100 flights have been conducted to-date on- and off-campus locations and more than 15 videos with the visible light and IR video cameras have been taken. Interest from faculty and staff on campus and others outside the university is high. The PIs have had discussions of scientific collaborations with faculty in Forestry, the Climate Change Institute, Advanced Composites, the Visual Media Center, the Acadia National Park, and the state Center for Disease Control and Prevention, which is interested in measurements of environmental radioactivity levels in the vicinity of the decommissioned Maine Yankee reactor.

In terms of sustainability, the PIs are adapting existing course curriculum for the one- and two-semester Capstone projects typically required of senior physics, astronomy and engineering physics majors, to allow students to carry out integrated projects that involve the use of the unmanned aircrafts. The new experiment design mechanism within the current Graduate Laboratory curriculum will be adapted to include aircraft-related topics.

“The IDEA Center.” Blue Hill Consolidated Schools. In partnership with the Perloff Foundation, the Maine Community Foundation, and the Blue Hill Educational Enrichment Monies, the Maine Space Grant Foundation co-funded the IDEA Center, a new media and technology center at Blue Hill. The goal of this investment is to boost STEM curriculum at the Blue Hill elementary school through a media and technology center that merges books, computers and newly acquired technology. The IDEA Center, modeled after the MIT STAB Academy, will have digital soldering stations, a CNC machine, design tables and stations, a vinyl cutter, hand tools and supplies, and computers from the existing technology lab. The IDEA curriculum will have students not only learn how to use the tools to create objects, but also write final reports, a requirement that found favor with board members. A typical student project could be creating animotric puppets.

Bi-annual Maine STEM Summit – The Consortium continues to be a co-sponsor of the biannual Maine STEM Collaborative’s 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” to stress STEM education is important for most functions in society. Approximately 70 K-12 teachers and 120 informal STEM educators, business, industry, and state government representatives, and senior higher education administrators and STEM faculty from Maine’s two-year and four-year private and public institutions were in attendance. The keynote presentation was given 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.” Following the keynote presentation, a panel of senior administrators from Maine public and private higher education institutions 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 of innovative middle and high school teachers discussed barriers and solutions to implementing innovative STEM teaching and learning methods in classes. The afternoon schedule provided an opportunity to share STEM education success stories 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 education vision for the state of Maine.
Maine Space Day - In May 2014, the Consortium sponsored, as it does annually, Lockheed Martin’s Space Day events, which are coordinated by Sharon Eggleston, in Brunswick, Bangor, Winslow and Sanford with the goal of providing thousands of Maine students an opportunity to interact, first hand, with experts in the fields of astronomy, astrobiology, aerospace education, and engineering. Speakers from UMaine, USM and Bates College, the Challenger Learning Center of Maine, the Southern Maine Astronomers, the Civil Air Patrol, Applied Thermal Sciences, York Helicopters, Flagsuit LLC, Lockheed Martin, AEGIS Test Team members and crewmembers from the USS Miami were all on hand to showcase their fields of study. Guest speaker Brian Ewenson, an Aerospace Educator from San Antonio, Texas, gave an inspiring speech “No Shoes, No Shower, No Problem” to students at all venues to help them realize that anything is possible if they are willing to work for it. The capstone event was held in Sanford, Maine at the Willard Elementary School and the Sanford Junior and High Schools with a personal greeting from Maine Astronaut Chris Cassidy who was on board the International Space Station at that time, and a school wide video-teleconference via NASA’s Digital Learning Network to showcase the rover Curiosity and its travels on Mars.

**Educator Professional Development**

“N**ortheast Region Space Grant Collaborative Professional Development Workshop.” During the summer of 2013, we supported Chris Newcomb and Hope Tray from the Windham School District to attend the regional workshop organized by the Massachusetts Space Grant Consortium at Tufts University. The workshop focused on LEGO Robotics and Engineering using LEGO kits. Both teachers have used the skills and lessons-learned in this workshop in their activities during the 2013-2014 academic year. Each teacher coached a robotic team in their school district and has led their team to a robotic competition in May 2014.

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, according to Chris, if you give them some LEGOs they can design and build all sorts of great machines! His team consisted of seven students, 6th through 8th grade (1-female, 6-males). “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.”

Hope coaches a team of students in Windham, ages 9-12 through the Southern Maine Gearbots. “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 elementary students 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.”

“Geotechnology Learning Collaborative: Disseminating NASA’s Imaging Technology and Know How to Middle and High School STEM and Social Sciences Teachers.” Firooza Pavri, Associate Professor of Geography, University of Southern Maine. This project engages middle and high school teachers in a Geotechnology Learning Collaboratory (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 professional development training workshops are being held at USM’s GIS Laboratory and are structured as moderated online collaborations where participants have the opportunity to develop lesson plans based on the training they receive. USM is working 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 targets 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 directly supports NASA efforts in inspiring the future cohort of scientists, explorers and educators. Through this project the PI and her team intend to build strong and sustained linkages with area schools, teachers and their classrooms, and engage in the recruitment of high school graduates to universities.
### INSTITUTIONAL ENGAGEMENT

#### Affiliates

**Private 4-Year Institutions**
- Bates College
- Bowdoin College
- Colby College
- College of the Atlantic
- University of New England
- Saint Joseph’s College of Maine

**Public 4-Year Institutions**
- Maine Maritime Academy
- University of Maine
- University of Southern Maine

**Public 2-Year Institutions**
- Southern Maine Community College
- York County Community College

#### Non-Profit Research Institutions
- Gulf of Maine Research Institute
- Bigelow Lab for Ocean Sciences
- MDI Biological Laboratory

#### Non-Profit Educational Institutions
- Maine Math and Science Alliance
- Challenger Learning Center of ME
- ME Mfg Extension Partnership
- ME School of Math and Science

#### For-Profit R&D Institutions
- Applied Thermal Sciences
- Lockheed Martin

#### General Members
- Blueberry Pond Observatory
- Island Institute
- ME Dept. of Education
- N. ME Mus. of Science Technology Systems, Inc.

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**SMCC and YCCC receive NASA funds to increase student retention and graduation rates**

This September the Consortium received a two-year, $495,910 Community College Competition award to pilot and evaluate a model that is intended to increase the number of students at Southern Maine (SMCC) and York County (YCCC) Community Colleges that complete their degrees on time and pursue aerospace science and technology careers or transfer to four-year institutions to continue their Science, Technology, Engineering and Mathematics (STEM) education. Under this award SMCC will receive $231,045 and YCCC will receive $254,484. The Consortium selected SMCC and YCCC for this pilot project because they represent different ends of the spectrum in degree programs and student characteristics among Maine community colleges. Despite their differences both institutions are taking a similar approach in this pilot project, as outlined below, to develop a NASA-based STEM connection that will help them improve retention, graduation, and transfer rates to four-year institutions.

- **Three-semester scholarships** for cohorts of first-year students at both colleges starting in their 2nd semester and continuing to their 4th semester contingent on academic progress.
- **STEM Scholars Program** as a STEM Learning Community to widen YCCC students’ horizons by introducing them to a wide spectrum of STEM research and scientific topics.
- **Research internships** for students at both colleges to experience research at Maine universities, colleges, research institutions, technology-based businesses, and NASA facilities.
- **Bridge scholarships** for students at both colleges that are admitted to four-year institutions to ease transition.
- Infusion of NASA contents in SMCC’s Oceanography Instrumentation and Capstone Research courses, and YCCC’s Biology, Computer Technology and Microbiology courses.
- **A Faculty Development Program** to train STEM faculty from all Maine Community Colleges on how to infuse NASA contents in their courses.

The results of this pilot project should inform the Consortium how further investments could support Maine community colleges in their efforts to increase STEM student recruitment, retention and graduation rates, and transfer rates to four-year institutions, preferably in Maine.
NASA EPSCoR

“Joint leak detection and localization based on fast Bayesian inference from network of ultrasonic sensors arrays in microgravity environment: Ultrasonic Leak Sensors Arrays.” Ali Abedi, Associate Professor of Electrical and Computer Engineering, UMaine. Leaks causing air and heat loss are major source of concern in mission safety. This NASA ISS-EPSCoR-funded project involves development of a flight ready wireless sensor system based on recent NASA EPSCoR funded structural health monitoring R&D activities at UMaine. The proposed system will be able to detect and localize leaks based on ultrasonic sensor array signals using a novel fast Bayesian inference technique. The proposed system test and verification in a microgravity environment is expected to expand knowledge of sensor system operations and performance degradations in outer space. Partners include the University of Maine (UMaine) Electrical and Computer Engineering (ECE) and Mechanical Engineering (MEE) departments and NASA Johnson Space Center SC ISS Technology demonstration branch.

“Earth System Data Solutions for Detecting and Adapting to Climate Change in the Gulf of Maine.” Andrew Pershing, Chief Scientific Officer, Gulf of Maine Research Institute. Utilizing NASA’s high-quality Earth System Data and a partnership with Jet Propulsion Laboratory, Dr. Pershing’s NASA EPSCoR Research-funded project will create high-resolution dynamic models of the distribution of commercially and ecologically important marine species based on Earth system data. These products will provide a foundation for hindcasts, real-time estimates, and seasonal forecasts to support climate adaptation in fisheries throughout New England, including specific forecasts for Maine’s $1B lobster industry. The project will also establish a team of ecologists, ecosystem modelers, and data scientists focused on ecological forecasting and will develop strong ties to NASA scientists and NASA data products. Dr. Pershing’s project will advance ecological forecasting and deliver forecast information that will be critical for supporting climate change adaptation in natural resource management. The types of forecasts we will be developing will enable resource managers and industry participants to make proactive decisions as they strive to sustain businesses, industries, and economies in the context of climate change. Lessons learned from the immediate applications of this work to fisheries in the Gulf of Maine will have broad national relevance as resource-based industries increasingly confront the challenges of operating in changing and no-analog conditions. The infrastructure developed through this project—including information technology, the algorithmic framework, and scientific capacity of early career scientists—will provide a strong foundation for future work and will establish this team as regional and national leaders in marine ecological forecasting.

“Simulated Microgravity and its Impact on Phosphatidylinositol Composition and Plasma Membrane Dynamics in Leukocytes.” Stephen Pelsue, Associate Professor of Immunology and Molecular Biology, University of Southern Maine. With the return of human space travel, a better understanding of the effect of zero gravity on the development and function of the immune system is paramount to the health of astronauts spending extended time in space. Phosphatidylinositol (PI) and its phosphorylated derivatives play a critical role in maintaining cellular membranes as well as regulating cell signaling complexes. Dr. Pelsue’s lab has determined that the regulation of PI-4 Kinase is critical for the normal regulation of leukocytes, particularly lymphocytes. To better understand the cellular and molecular impact of microgravity on immune function using a rotating wall vessel culture system, Dr. Pelsue’s NASA EPSCoR Research Infrastructure Development (RID)-funded project will evaluate simulated gravity on the cellular structures and dynamics related to PI composition in leukocyte cell lines. This will be accomplished by the evaluation of organelle structure and function, PI composition, PI-4K and PI-5K activity, and stress responses (particularly ER stress) in leukocyte cell lines cultured in simulated microgravity.
LONGITUDINAL TRACKING

The Consortium maintains a longitudinal tracking system for students who receive a significant award (≥$5,000) or experience (≥160 hours). Notices are sent out to all students twice annually requesting information on their academic and workforce status and other information. Tracking ends once the students advance to their next level whether that is graduate school, employment, or another status. Since tracking started in 2005, approximately 460 of the 864 undergraduate and graduate students that participated in Space Grant and NASA EPSCoR met the above criteria. The graph on the lower right shows the status of 165 students who responded to our latest request for information. The data shows that 90% of the students that graduated are either pursuing advanced STEM degrees or are employed in STEM fields. The rest of the students are either still enrolled in academic programs, are seeking STEM employment, or have not responded to our requests. We are tracking all MERITS scholars who participated in the program since 2008.

Maine Space Grant Consortium

We are a 501(c)(3) corporation and a member of the national network of 52 state-based consortia funded by the NASA National Space Grant College and Fellowship Program. Our mission is to improve our Affiliates research infrastructure in areas of mutual interest to NASA and Maine; to encourage more students to pursue STEM careers; and to enhance NASA’s presence throughout Maine. We also administer the Maine NASA EPSCoR Program, which provides competitive seed funding that will enable Maine to develop a research enterprise directed toward long-term, self-sustaining, nationally competitive capabilities in aerospace-related research. This capability will, in turn, contribute to Maine’s economic viability and expand the nation’s base for aerospace research and development.

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Terry Shehata, Ph.D., Director
terry.shehata@msgc.org
Jana Hall, Controller and
Director of Education Programs
jana.hall@msgc.org

87 Winthrop Street, Suite 200
Augusta, Maine 04330
877-397-7223
www.msgc.org