

The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD – this document) 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.

Maine Space Grant Consortium
Lead Institution: Maine Space Grant Consortium
Director: Terry Shehata, Ph.D.
Telephone Number: 877-397-7223
Consortium URL: www.msgc.org
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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 2014.

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 affiliate academic institutions to conduct STEM related research.
- d. Provide undergraduate students with a 10-week research experience (internships) at NASA field centers and Maine STEM companies.
- e. Support new STEM course offerings.

A. 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 education's strengths of the Affiliates

B. 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, we support the following objective:

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

PROGRAM/PROJECT BENEFIT TO OUTCOME (1, 2, and 3)

Outcome 1 and 2: Robbie F., University of Maine (UMaine), participated in the "Safety and applications of Lightweight Uninhabited Aircraft Systems" in 2014, where he mentored students and assisted faculty in quadrotor construction and programming. He began his relationship with MSGC in 2011 as a high school Junior in our MERITS program working in a Mechanical Engineering project at UMaine. He also received a MSGC incoming Freshman scholarship the following year. At the end of his first year, he decided that his passion was Physics and changed his focus. Robbie has excelled in this field, working alongside Dr. Neil Comins on the investigations of instabilities and dynamics due to near interactions or collisions between galaxies. He recently presented his poster, "Generation of composite galaxies in dynamic equilibrium" with Dr. Comins at the American Astronomical Society conference in Seattle Washington. In April he presented at UMaine's Physics and Astronomy Colloquium. Robbie will graduate from UMaine in May, 2015 and has been accepted into a PhD. Program at the University of Colorado where he will work to develop a semiclassical theory for cavity-assisted atom

cooling in the narrow-linewidth regime. While there, he will conduct research at NIST in the Optical Frequency Measurements Group.

Outcome 1: Vincent L., UMaine received an undergraduate Fellowship award to work as a Research Assistant on inflatable structures in the Mechanical Engineering Department. Vincent graduated in 2014 and founded L&K Manufacturing with another Umaine graduate. L&K focuses on high end manufacturing using 3D printing processes to enhance manufacturing of high end products. They are working with the aerospace industry to fabricate masking systems that dramatically reduce the labor involved in spray coating of exotic engine components. They are also working to develop a high performing material system for energy absorption that can be placed in products like running shoes. *“The skill set I learned through my research on inflatable structures I use almost every day with my company, L&K Manufacturing, Inc., skill sets such as; Experimental and Testing Protocols, Data Acquisition, Data Analysis, Code Writing, circuitry and all around hands on engineering. These kinds of skills would have been very expensive for the company during its startup phase and with the knowledge I acquired through my research, my company was able to retain this capital and use it to further develop our manufacturing processes and push our company towards high growth.” Vincent L*

Outcome 1: Bryn N., UMaine received a MSGC fellowship to conduct work on the propagation rate of fibroblast cells after exposure to neutron radiation. The work attempts to model the neutron flux conditions experienced inside current manned space structures. A better knowledge of the effects will help space habitation safer for Astronauts in the future. She also participated in the “Safety and applications of Lightweight Uninhabited Aircraft Systems” project funded by MSGC. Bryn is currently defending her masters in Engineering Physics with a May 2015 graduation date, and will also receive a postgraduate certificate in Aeronautical Engineering. When asked about her future: *“I am very interested in the space program or at least pursuing some sort of work in the aerospace field. I am particularly interested in how I can help to make spaceflight safer for people in the future. I am excited by the prospect of manned missions outside of low earth orbit and I would like to help make that possible.” Bryn N.*

PROGRAM ACCOMPLISHMENTS

Actual accomplishments to date are in bold, parenthesis and italics (X) and are listed beside the proposed metrics. Due to timing issues between our program dates (programs are currently on-going) and this report date, we do not have complete and final data to include at this time. We will report the final data at a later time.

Outcome 1:

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

Objectives:

- 1.*** On an annual basis, at least 38 (**40**) undergraduate and graduate students will receive scholarships and fellowships to participate in NASA-related STEM research conducted by the Affiliates and NASA field centers. ***NOTE: Final data will be reported at a later time.***

MSGC Research Infrastructure Program: 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 was awarded to UMaine, Electrical and Computer Engineering Department, titled “Leak Signature Research for Pressurized Space Models”. *Minority Serving Institution*

Collaboration Program: One Minority Collaboration is currently being developed with the College of the Atlantic and Trinity Washington in the District of Columbia.

Objectives:

1. On an annual basis, two (**1**) research collaborations between affiliates and NASA Centers will be seeded.
2. On an annual basis, four (**2**) faculty will be supported in research collaborations between affiliates and NASA centers.
3. On an annual basis, four (**6**) undergraduates and graduate students will participate in NASA-related STEM research conducted by affiliates
4. On an annual basis, one (**0**) new research collaboration between an Affiliate and Minority Serving Institution will be seeded. **NOTE: One new collaboration has started, however we are waiting official commitment from Trinity Washington. We do not report data until we have an official commitment. We expect the collaboration to continue and we will report final data at a later time.**
5. On an annual basis, two (**0**) faculty will be supported in the research collaborative between an affiliate and a Minority Serving Institution. (*see note above*)
6. On an annual basis, three (**0**) undergraduate and graduate students will participate in a collaboration with a Minority Serving Institution. (*see note above*)

MSGC Higher Education Programs: Programs under Higher Education include 1) Maine Aerospace Workforce Development Program (10-week NASA/Maine STEM Internships), 2) Maine Student High Altitude Platform (MeSHAP) Program which includes High-Altitude Ballooning and Rocketry projects, and 3) Higher Education Innovation in STEM Education (Other) program which allows us to fund other innovative higher education projects. **Programs:** Maine Aerospace Workforce Development Program: MSGC funds undergraduates students attending a Maine college or university with a ten week research experience at a NASA field center or a Maine STEM company. This program is currently on-going. We only report students who have officially been placed. To date four students (1 female, 3 males) have been placed at GSFC and MSFC.

MeSHAP (Maine Student High Altitude Program): MSGC continued its MeSHAP program at the University of Maine (UMaine) and the University of Southern Maine (USM). The Maine Maritime Academy did not participate this year due to staffing schedules. MSGC Higher Education Innovation in STEM Education Program: MSGC funded two Higher Education projects: 1) “Safety and applications of Lightweight Uninhabited Aircraft System” at the University of Maine, Dept. of Physics and Astronomy. This project is a follow on award from a project that we previously funded. 2) “Research Science on Sebago Lake: A course to improve retention of early science majors at Saint Joseph’s College”, awarded to Saint Joseph’s College of Maine. This project will develop a new course for Freshman and Sophomore Natural Science majors at the college, that will introduce them early to research with a goal of retaining a greater number of STEM majors. These projects are still on-going, therefore we do not have complete data to report at this time. We expect that a minimum of one new course will be developed as a result of Saint Joseph’s project.

Objectives:

1. On an annual basis, at least five (**16**) undergraduate and graduate students will participate in NASA-related STEM research conducted by the affiliates.

2. On an annual basis, at least two (0) courses that integrate NASA-related resources into STEM disciplines will be developed or improved. *Note: At least one new course is in development at Saint Joseph's College. We will report the data once it is final.*
3. On an annual basis, at least four (4) undergraduate students will participate in summer research experiences in NASA-related STEM research conducted at Maine Technology-based companies and/or NASA Field Centers. *Note: As of this reporting date, four students have been accepted at NASA field centers. We expect two more students to be awarded internships.*

Outcome 2:

MSGC Pre-College Programs: Our programs include Maine Research Internships for Teachers and Students (MERITS), Collaboration with the Perloff Foundation, K-12 Professional and Curriculum Development Program, Space Day Maine, and a K-12 Other program that supports small-scale activities. **Programs: MERITS:** The MERITS Program provides summer research opportunities for motivated high school Juniors who are interested in STEM careers to experience ‘real-time’ applications in a research-focused work world at host institutions conducting research and technology development. The MERITS program is still ongoing at this time. We have selected nine students to place at host institutions. We do not report data on our students until they have been officially accepted at a host institution. Currently three have been “officially” placed to date. We will continue the process of matching students to applicable host institutions until they are all placed. Collaborative Project with the Perloff Foundation: We began this collaboration with David Perloff last year, and have continued jointly supporting teacher-initiated projects. Teachers are encouraged to be educational innovators, committed to planning, risk taking and results. The Foundation’s STEM4ME Program supports 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. We have supported a range of projects through this program. Due to space limitations, we are only including a few projects: 1) Video Game Club (programming), United Technology Center, Bangor; 2)IDEA Center STEM Education, Blue Hill Consolidated School; 3)Biotechnology and Bioinformatics for Biddeford High School; 4)Virtual High School, state-wide support. Space Day Maine: Space Day Maine is celebrated annually around the state but with a different local/regional focus each year. Our 2014 Space Day Maine program was focused in the Auburn area school district with participant volunteers from MSGC academic affiliate institutions, non-profit organizations, US Navy, industry and other local organizations and STEM groups. Our 2014 Space Day Maine guest of honor and key-note speaker was Maine’s astronaut Christopher Cassidy. Other: We supported two small-scale activities in this year: Travel support for a Maine SeaPerch team to compete in the National SeaPerch competition and travel support for a retired science teacher to present at the Space Exploration Educators Conference (SEEC) in Houston, TX.

Objectives:

1. On an annual basis, four (3) high school juniors will participate in summer research experiences in NASA-related STEM research. *Note: We have awarded nine students through this program, but do not officially count them until they have been accepted at a host organization. At the time of this report, three students have officially been placed at host organizations. This program is on-going.*
2. On an annual basis, two (0) new or improved curricula that uses NASA themes and content will be introduced in Maine K-12 schools. *NOTE: We are still collecting data from on-going projects at this time and will report on the final data once the school year is finished.*
3. On an annual basis, two (0) middle school and/or high school teachers will use NASA contents and themes to enhance their STEM curricula. *NOTE: We are still waiting on completion reports from projects awarded through our Perloff Foundation Collaboration. ALSO: Our informal education activity distributed NASA content, but teachers' usage was not tracked.*
4. On an annual basis, 40 (5,000) middle school and/or high school students will be exposed to NASA-mission related activities, STEM disciplines and careers.

Outcome 3:

MSGC Informal Education Program: MSGC supported the 2014 STEM Educators Camp through our newest affiliate member the Maine School of Science and Mathematics. The week long professional development camp is designed for educators across Maine who are interested in improving their teaching in science, technology, engineering and mathematics (STEM).

Objectives:

1. On an annual basis, one (1) informal education activity that uses NASA themes and content will be supported
2. On an annual basis 100 (*over 1,400*) students and/or members of the public will have a better appreciation of STEM and NASA. *NOTE: 71 teachers participated. We estimate 20 students per teacher will be impacted. NASA content was handed out to teachers, but their usage was not tracked.*

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Diversity: Institutions:** Our affiliate representation is a mix of higher education, non-profit research and education institutions and private sector (see below for a list of our affiliates): **Faculty:** We are still gathering data on faculty participants, but at this time our male/female faculty participant level is at: 63% male and 38% female. Our female direct numbers are expected to increase once we have final data on some activities. **Student participant:** As of this reporting date (subject to change once projects are complete and final data is submitted) our male/female student participant level is: 60% male and 40% female. The female participation percentage meets our target of 40%. **Minority participants:** As of this reporting date (subject to change once projects are complete and final data is submitted) our total program minority participant level is at 6%. This is slightly lower than our target of 8% minority participation. We expect that our percentage will increase when we receive the final number from our newest minority collaboration currently under development.

In addition, one of MSGC's newest board members is a minority female from the University of Southern Maine's Lewiston/Auburn campus. Our representation on the board is now at 42% female, 58% male and 9% minority participation.

- **Minority-Serving Institution Collaborations:** Maine does not have a minority-serving institution. However, we have had a total of three minority institution collaboration within the past few years. We are currently working on another minority collaboration with faculty from the College of the Atlantic (Maine) and faculty from the Trinity Washington University in Washington, D.C. Faculty from both institutions are planning to meet in May 2015 to discuss their project and collaboration in more detail. We will report on this collaboration when plans are finalized.

- **NASA Education Priorities:**

- 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 3), Research Infrastructure (page 3), Higher Education (page 4) and MERITS program (page 4 under pre-college programs) apply to this priority area

- 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).

MSGC's Pre-college programs (page 4 under pre-college programs) apply to this priority area.

- 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 (page 4 under pre-college programs) apply to this priority area.

- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.

MSGC's programs are open to our Community College affiliates

- 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 (page 3) apply to this priority area

- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.

MSGC's Research Infrastructure/ apply to this priority area (page 3)

- 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 (page 3) apply to this priority area

IMPROVEMENTS MADE IN THE PAST YEAR

This year MSGC recruited three new Board of Directors and added one affiliate member. Two of these members are females. One is a minority and the other represents one of our affiliate community colleges. Our new affiliate member is the Maine School of Science and Mathematics (MSSM) located in far northern Maine in the town of Limestone, a public residential high school. New board members include Dr. Janet Sortor from the Southern Maine Community College, Dr. Joyce Gibson, University of Southern Maine and Mr. Luke Shorty from MSSM. In addition, in order to keep our programs current with active participation, we dropped two inactive affiliate members, BioAnalyte, Inc. and the Island Astronomy Institute.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Higher Education Affiliates: Bates College, 4-year or above, Private, Baccalaureate College-Liberal Arts, participates in MSGC programs and activities; Bowdoin College, 4-year or above, private, Baccalaureate College-Liberal Arts. Conducts scholarship fellowship program, participates in MSGC program and activities; Colby College, Waterville, 4-year or above, Private, Baccalaureate College-Liberal Arts, participates in MSGC programs and activities; College of the Atlantic, Bar Harbor, 4-year or above, private, Baccalaureate College-Liberal Arts, conducts scholarship/fellowship programs, participates in MSGC program and activities; Saint Joseph's College, Standish, 4-year, Private, Baccalaureate College-Liberal Arts, conducts scholarship/fellowship program, participates in 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 in 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 in 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 in MSGC programs and activities; Maine Maritime Academy, Castine, 4-year or above, Public, Specialized Institutions, conducts Scholarship/Fellowship Program, participates in MSGC programs and activities; Southern Maine Community College, South Portland, 2-year, Public, Associate Degree granting institution, member of the Board of Directors, conducts Scholarship Program, participates in MSGC programs and activities; York County Community College, York, 2-year, public, Associate Degree granting institution, conducts Scholarship program, participates in 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 in 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 MSGC program and activities; Applied Thermal Sciences, Inc., Sanford, High Tech Small Business, member of the Board of Directors, participates in MSGC program and activities; Maine Mathematics and Science Alliance, Augusta, Private not-for-profit, Education, member of the Board of Directors, participates in MSGC program and activities; The Challenger Learning Center of Maine, Bangor, Private not-for-Profit, Education, participates in MSGC program and activities; Lockheed

Martin, Industry, participates in MSGC program and activities; Maine School of Science and Mathematics, Limestone, public residential, Education, member of the Board of Directors, participates in MSGC programs and activities.