Maine Space Grant Consortium
Lead Institution: 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 (MSGC) is a Capability Enhancement Consortium funded at a level of **$535,000** for fiscal year 2008.

PROGRAM GOALS

A. Goals and Objectives Relevant to NASA Education Outcome 1

The MSGC's Research Infrastructure, Higher Education and Workforce Development goals are in alignment with activities to achieve Outcome 1. These goals are to: (a) strengthen the Affiliates' science and engineering research capacity in areas mutually beneficial to Maine and NASA (Research Infrastructure); and (b) 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 Workforce Development). To achieve these goals in a manner that will yield results consistent with Outcome 1, we proposed to implement the following objectives:

a. Support multi-institutional collaborations, including Minority-serving institutions, around targeted science and engineering areas where collaboration greatly enhances the development of such programs.
b. Support scholarships and fellowships for undergraduate and graduate students at Maine's graduate institutions to conduct STEM related research.
c. Support scholarships for Maine undergraduate students matriculating at Maine's primary undergraduate institutions to conduct STEM related research.
d. Increase S&E 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.
e. Provide undergraduate students with a 10-week research experience at NASA field centers.
f. 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) ***s***trengthen the capacity of Maine K-12 teachers to deliver educational programs that increase student awareness, knowledge, and participation in STEM activities (Pre-College). To achieve these goals in a manner that will yield results consistent with Outcome 2, we proposed to implement the following objectives:

- Seed the integration of an Astrobiology curriculum in Secondary Schools
- Support STEM research experiences for High School Juniors and Seniors
- 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 Public Service goal is to increase the public's awareness of science and engineering research and education that are associated with NASA and the Affiliates. This is in alignment with activities to achieve Outcome 3. To achieve this goal in a manner that will yield results consistent with Outcome 3, we proposed to support existing efforts to leverage STEM resources and activities to inspire school age students and their parents in science and technology.

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

A. NASA Education Outcome 1

Research Infrastructure Program

Lunar Outpost Wireless Monitoring and Analysis System - The goal of the research (Dr. Vince Caccese, UMaine) is to develop a structural health monitoring system, the Lunar Outpost Wireless Monitoring and Analysis System (LOWMAS), for the lunar outpost. This project will be performed as a combination of efforts between the hybrid structures and wireless sensing groups at the University of Maine and much emphasis will be placed upon synergistic tasks regarding this cooperation. This program is currently under development in conjunction with NASA/JSC, and NASA/GRC and provides an ideal platform for integration of these groups. The primary function of the LOWMAS system is to increase safety for future inhabitants of space habitats, stations and vehicles as well as to increase functionality and performance of structures such as antennas and sails. (Three undergraduate students and three graduate students are working on this project.)

Engaging Diverse Student Perspectives in the Development of Case Studies for Climate Change Impacts of Arabian Sea Ecosystems – The goal of this project (Annette DeCharon, UMaine) is to train the next generation of NASA scientists through the development of data-driven case studies and to investigate and document how to accommodate diverse perspectives on climate change using interactive multimedia. The project aligns with NASA Education Outcome 1 by training undergraduate students to use -and share broadly -the research project's copious science, technology, engineering, and mathematics (STEM) assets. Entraining students and educators at high school through undergraduate levels will help support NASA Education Outcome 2. Despite the small scope of this research supplement, this activity contributes to NASA Education Outcome 3 through several strategic linkages with broader education and public outreach (EPO) activities such as NASA Aquarius and COSEE-OS (Centers for Ocean Sciences Education Excellence)-Ocean Systems).

Scholarship and Fellowship Program

This program provides research opportunities to undergraduate and graduate students including incoming Freshmen in aerospace- related research which is broadly defined to include biological, physical, social, earth science, human exploration and development of space, space science, and other science, technology, computer or engineering related fields. Our goal is to increase participation of Maine undergraduate and graduate students in science and engineering research conducted by the Affiliates and NASA field centers.

Student Highlight:

John Wise, Jr from the University of Southern Maine (USM), funded under our scholarship program, visited the Johnson Space Center as part of his award. He gave a presentation to a team of senior scientists on his work involving the investigation of the toxicity of lunar dust on human lung cells. While there he was informed about the reduced gravity flight opportunities program. The visit to NASA taught him that microgravity can significantly alter biological function, thus the research question really was how toxic is lunar dust in lung cells in microgravity. John subsequently wrote a proposal to NASA through the Reduced Gravity Student Flight Opportunity program to fly an experiment to test whether altered gravity affects chemical-induced DNA damage. The proposal was funded and John led a team of 10 including six undergraduates to Houston. Remarkably the data from that flight showed that altered gravity did indeed affect chemical-induced DNA damage. John recently submitted another proposal to this program again and was accepted to fly another experiment in 2009. This is the first team from Maine to be awarded under this program.

Maine Higher Education Program

The Higher Education projects below were recently awarded due to a delay in the program, therefore there are no results to report yet.

A Project-Based Class in Residential Windpower - The centerpiece of this project (Dr. David Feldman, College of the Atlantic) is a new interdisciplinary class to be offered in the 2009 Spring quarter at College of the Atlantic. In this class students will be involved in all aspects of siting, installing, and evaluating a working residential-scale wind turbine, gaining practical hands-on skills and experience. Course participants will also learn the basic physics of energy generation and conservation, scientific knowledge which is essential for students who wish to conserve energy, evaluate options for renewables, and organize and advocate for alternative energy projects.

I Mentor K-12 Students (iMeK) - The iMeK project at the University of Maine, is focused on enhancing the STEM connections between undergraduate education, early secondary education, and the career opportunities associated with NASA missions. Sixteen undergraduate students are being competitively recruited from the seven University of Maine System campuses. These students will be engaged in a science and engineering design process workshop aligned with a current NASA mission. They will then act as classroom mentors for K-12 students preparing for mission simulations hosted by the

Challenger Learning Center of Maine (CLC of ME).

Developing distance courses in remote sensing to enhance Maine's capacity in NASA's space-based imaging technologies – This University of Southern Maine project (Dr Firooza Pavri) is developing distance courses in remote sensing such that interested individuals state-wide will be able to enhance their skills in image processing technology using NASA acquired remotely sensed data. There are no other remote sensing courses being offered via distance education anywhere in the state of Maine. The distance courses in remote sensing will be targeted to undergraduate institutions across the state that do not as yet have capacity in remote sensing technology, to faculty interested in expanding their skill set in geospatial technologies, and to practitioners in the workforce that are already employed in allied fields but wish to also extend their image processing knowledge.

Maine Aerospace Workforce Development- This program provides Maine undergraduate students with a 10-week research opportunity at a NASA Field Center working within its priority areas. The goal is to motivate outstanding undergraduates in Maine to seriously consider career opportunities as NASA employees, contractors to NASA or as principal investigators. Students actively participate in viable research projects at NASA Field Centers in areas of interest to NASA.
To date four students who have participated in this program are now working at NASA.

Collaboration with a Minority-Serving Institution
Flight Test of Wireless Accelerometer Array Using Aerospike Rocket - The collaboration between UMaine and California State University at Long Beach (CSULB) is broadening participation of minorities in research and educational activities in science and engineering. UMaine researchers have developed an array of wireless accelerometers (WIAC) to monitor vibration and rotation in space vehicles. Following successful ground tests on the system, the next step is to flight test and evaluate their performance in harsh environments. The CSULB team has developed and successfully tested an aerospike rocket engine to improve thrust efficiency during the atmospheric boost phase of a launch vehicle ascent. This collaboration will create a concrete foundation for future proposal developments by both institutions involved.

B. NASA Education Outcome 2
Astrobiology Curriculum for Secondary Schools
A Collaboration to Pilot and Assess the Effectiveness of the Astrobiology: An Integrated Science Approach Instructional Materials to Increasing Student Aspirations and Achievement - MSGC and NASA's Astrobiology Institute are funding an effort to implement and evaluate the efficacy of Astrobiology, An Integrated Science Approach, in Maine schools. This project involves multiple partners including 10 Maine high schools, It's About Time publisher, TERC, the Maine Department of Education, Lockheed/Martin, and the Center for Science and Mathematics Education Research from the University of Maine.

Space Day Maine- Lockheed Martin's Space Day is a national educational program dedicated to the achievements, benefits and opportunities in the exploration and use of space, and is held annually on the first Friday in May. Maine conducts its celebration on this day each year with a range of activities in the days leading up to, as well as on Space Day.

Maine Research Internships for Teachers and Students (MERITS)- The MERITS Program provides summer research opportunities for highly motivated high school students to experience 'real-time' applications of STEM in a research-focused work world at host institutions in Maine who are conducting R&D.

C. NASA Education Outcome 3
MSGC is a participant in **the STEM Collaborative,** formed in response to Maine's crucial need for a higher quality and larger STEM workforce. The STEM Collaborative is a partnership of organizations including businesses, government, research, education and nonprofit sectors striving to improve the economic impact of Maine students through better STEM educational opportunities. The Collaborative sponsored Maine's first STEM Summit in January 2008 to increase public awareness of STEM needs and learning opportunities. The Summit successfully triggered a statewide STEM conversation and galvanized organizations to develop a more formal and permanent voice with broad representation across the state.

PROGRAM ACCOMPLISHMENTS

NOTE: Because our funding year ends in April, 2009, the majority of the academic institutions are still awarding 2008 funds. The data below is not complete at this reporting date, and more students will be awarded soon.

A. NASA Education Outcome 1

1. **Research Infrastructure Program**
   - We proposed: 2 interdisciplinary proposals funded; 4 undergraduate students directly impacted; 2 graduate students directly impacted; 2 Maine/NASA mentor collaborations; Participation of underrepresented minority students is targeted at 4% of total awards and participation of women is targeted at 40% of total awards
   - Accomplishments to date: 2 interdisciplinary proposals funded; 9 undergraduate students directly impacted; 2 graduate students directly impacted; 2 Maine/NASA mentor collaborations
2. **Scholarship and Fellowship Program**
   - For the Graduate Institution Program we proposed: Up to 15 funded undergraduate students, or; Up to seven funded graduate students, or a combination of both; Up to 15 student and NASA mentor collaborations
   - For the Undergraduate Institution Program we proposed: Up to 8 funded undergraduate students; Up to 8 student and NASA mentor collaborations
   - For the Incoming Freshman Program we proposed: Up to 14 funded freshmen scholarships; Participation of underrepresented minority students is targeted at 4% of total awards and participation of women is targeted at 40% of total awards
   - Accomplishments to date: *(NOTE: data is not completed at this time)*
     - For the Graduate Institution Program: 11 undergraduate students awarded; 1 graduate student awarded ; Student and NASA mentor collaborations (we are still gathering information on NASA mentors)
     - For the Undergraduate Institution Program: 8 funded undergraduate students; Student and NASA mentor collaborations (we are still gathering information on NASA Mentors)
     - For the Incoming Freshman Program: We do not have data for this program yet
3. **Higher Education Program**
   - We proposed: 2 interdisciplinary proposals funded; 5 undergraduate students directly impacted; Participation of underrepresented minority students is targeted at 4% of total awards and participation of women is targeted at 40% of total awards; 1 higher education course developed or revised
   - Accomplishments to date: 2 interdisciplinary proposals funded; undergraduate students directly impacted (data is not complete at this time)
4. **Maine Aerospace Workforce Development Program**
   - We proposed: 5 student research experiences at NASA field centers ; 5 student/NASA Collaborations; 5 Maine high schools receive undergraduate presentations
   - Accomplishments to date:5 Student research experiences at NASA field centers; 5 student/NASA collaborations; 1 high school presentation (We are still conducting presentations at this time)
5. **USM Scientific Ballooning Program**
   - We proposed: 4 undergraduate students' directly impacted/senior design projects; Revised curriculum incorporating scientific ballooning option for engineering students
   - Accomplishments to date: This project has not been funded and is on hold
6. **Collaboration with Minority Institutions**
   - We proposed: One research collaboration with a minority serving institution
   - Accomplishments to date: Funded collaboration between Cal State University-Long Beach (Hispanic-serving Institution) and UMaine involving two UMaine undergraduate students and two UMaine Faculty.

B. NASA Education Outcome 2

1. **Astrobiology Curriculum for Secondary Schools**
   - We proposed: 5 K-12 schools participating; 5 K-12teachers trained in Astrobiology; Estimated 100 K-12 students impacted by new Astrobiology Curriculum
   - Accomplishments to date: 10 K-12 schools participating; 10 K-12teachers trained in Astrobiology; Estimated 100 K-12 students impacted by new Astrobiology Curriculum
2. **Space Day Maine**
   - We proposed: 2 trips supporting STEM professionals participating in Space Day Maine; 2 Rocketry teams supported
   - Accomplishments to date: No data available since Space Day Maine is scheduled in May 2009
3. **Maine Research Internships for Teachers and Students (MERITS)**
   - We proposed: 16 high school students placed in internships at Maine STEM companies, non-profit research laboratories or academic research projects; 16 Maine STEM internship hosts (companies, non-profit, academia)
   - Accomplishments to date: 14 high school students placed in internships at Maine STEM companies, non-profit research laboratories or academic research projects; 13 Maine STEM internship hosts

NOTE: The competition for the 2009 summer internships are underway. We received over 35 applications.

C. NASA Education Outcome 3

- We proposed: Up to two ISE activities funded
- Accomplishments to date: ***We do not have the data for this program yet since we are waiting to find out the priorities of the STEM Collaborative.***

PROGRAM CONTRIBUTIONS TO PART MEASURES

- Longitudinal Tracking: ***(Note: data is not complete for 2008 at this time)***
  - 172 total students tracked (102 students in Fellowship/Scholarship(F/S); 70 students in Higher Education/Research (HE/R); 1 underrepresented student award in F/S; 1underrepresented student award in HE/R; 4 students are now employed by NASA; 1 student is employed by an Aerospace Contractor; 18 students are employed in a STEM position; 19 students are pursuing an advance degree
- Course Development: Distant Learning Remote Sensing Course (***we do not have complete data at this time)***
- Matching Funds: The ratio of matching funds is: MSGC 43%, NASA 57%
- Minority-Serving Institutions: As previously noted we are in the early phase of nurturing a relationship between the University of Maine and the California State University at Long Beach (CSULB), a Hispanic serving institution. Moreover, we are in the discussion phase between researchers at Bigelow Laboratory for Ocean Sciences and faculty at the Central State University in Ohio.

IMPROVEMENTS MADE IN THE PAST YEAR

Based on feedback from the Summer 2008 meeting with the Affiliates to review the 20th Year Performance Evaluation document we restructured the higher education and research programs into two major competitions. The first competition would provide seed funding for two research activities over a two-year funding cycle at $60,000 each. The second competition would be annual and would provide $5,000 to support higher education or research related activities consistent with the Goals and Objectives of MSGC. Applicants would have the opportunity to submit one application for higher education or research or a combined higher education/research proposal. If the latter, the application must demonstrate the synergy between higher education and research, describe them separately and provide separate budgets.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Higher Education Affiliates

- Bates College, 4-year or above, Private, Baccalaureate College-Liberal Arts
- Bowdoin College, 4-year or above, Private, Baccalaureate College-Liberal Arts
- Colby College, Waterville, 4-year or above, Private, Baccalaureate College-Liberal Arts
- College of the Atlantic, Bar Harbor, 4-year or above, private, Baccalaureate College-Liberal Arts
- University of Maine, Orono, 4-year or above, Public, Doctoral/Research-Extensive, member of the Board of Directors
- University of Southern Maine, Portland, 4-year or above, Public, Master's Colleges and Universities II, member of the Board of Directors
- University of New England, Biddeford, 4-year or above, Private, Master's Colleges and Universities II.
- Maine Maritime Academy, Castine, 4-year or above, Public, Specialized Institutions

Non-Higher Education Affiliates

- Bigelow Laboratory for Ocean Sciences, Boothbay Harbor, Marine Research and Education, member of the Board of Directors
- 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
- National Semiconductor, South Portland, High Tech Large Business
- Applied Thermal Sciences, Sanford, High Tech Small Business, member of the Board of Directors
- Maine Mathematics and Science Alliance, Augusta, Private not-for-profit, Education
- Astronomical Society of Northern New England, Kennebunk, Private not-for-profit, member of the Board of Directors, Education
- The Challenger Learning Center of Maine, Bangor, Private not-for-Profit, Education