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.

Massachusetts Space Grant Consortium
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Director: Jeffrey Hoffman
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Consortium URL: www.maspacegrant.org
Grant Number: NNX10AT92H

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 MA Space Grant Consortium (MASGC) is a Designated, Consortium funded at a level of $575K for fiscal year 2014.

PROGRAM GOALS

The following are the Consortium's goals for the three NASA education outcomes:

NASA Education Outcome 1 – Educate and Employ

a. Diversity

MASGC Goal – Extend Space Grant programs and opportunities to the broadest possible cross-section of the Massachusetts population, particularly encouraging participation by women, underrepresented minorities, and students with disabilities.

b. Fellowship Program

MASGC Goal - Provide NASA competency-building education and research opportunities to develop qualified undergraduate and graduate students who are prepared for employment in STEM disciplines at NASA, the aerospace industry, and higher education.

c. Higher Education and Research Program

MASGC Goal – Provide research fellowships to as many Massachusetts students as possible to enable them to work with faculty members and/or researchers.

NASA Education Outcome 2 - Educate and Engage

Precollege Education

MASGC Goals –

- Encourage teachers to incorporate STEM instruction in their classrooms, using NASA content as much as possible.
- Provide continuing in-service opportunities to help teachers maintain competency in STEM instruction.

NASA Education Outcome 3 – Engage and Inspire

Informal Education and outreach

MASGC Goals –

- Enhance interest and proficiency in STEM disciplines.
- Inform the public about NASA's mission activities.
- Develop a pool of qualified presenters to communicate significant aerospace and climate-related issues to large audiences.

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

The following is a testimonial of the impact of space grant funding on students in the state:

January Operational Internship at KSC

I am first and foremost incredibly thankful to have had the opportunity to experience the frontier of space exploration this January at the Kennedy Space Center. I can only imagine the amount of time and effort which went into making this trip a success, and I am incredibly thankful to all those who made is possible particularly Raji Patel from the MA Space Grant Consortium. This trip re-ignited my passion for aerospace engineering. I graduated from high school five years ago excited to be a rocket scientist. While the desire to push the limits of space exploration never dimmed, the excitement did. Enough problem sets and late nights of coding will do that to you, I guess. After five years just trying to survive the onslaught of math and physics, I badly needed something to remind me why I wanted to be an aerospace engineer in the first place. After these two short weeks, I don't think I'll ever forget again. I want to be an aerospace engineer because I want to solve the toughest problems in the world. The applied physics lab, failure analysis labs, and corrosion analysis facility are solving problems every day with limited time and resources. The design vis group is breaking new ground in simulation and modeling to catch problems before they even take shape. And the prototype lab is inventing new technologies to prepare us to take on whatever challenges the future has in store. I want to be an aerospace engineer because I desire to serve my country. The museums and exhibits at KSCA, filled with artifacts of the recent past, call us forward to once again lead the world in extending mankind's reach into the stars. The legacies of Apollo, the Space Shuttle, and the International Space Station demand that my generation stand on the shoulders of the giants who came before us and build higher still. The United States was founded by pioneers and explorers. I'm not about to let that legacy die.

Most importantly, I want to be an aerospace engineer because I love it. Standing on the roof of the VAB and looking out at the place where space exploration became a reality, I got goose bumps. I remembered the dream I had always wanted to be a part of.

The people who showed us around KSC were incredible. The kindness with which they brought us into their lives and shared their wisdom is something I will carry with me forever. The NASA personnel through an unmistakable love of their job and the country they serve, reminded me why I started this journey five years ago.
God willing, once my formal education is complete, that journey will lead me to NASA once again.
Mic Byrne, MIT Mater's student

PROGRAM ACCOMPLISHMENTS

Outcome 1: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goal Educate and Employ

Objective: Diversity.
Proposed Metric: Offer at least 25 student fellowships for higher education and research.
Outcome: Awarded 68 student fellowships for higher education & research.
Achievement: Exceeded metric.

Objective: Scholarships/Fellowships.
Proposed Metric: Maintain minority participation at ≥15%.
Outcome: Increased minority participation to 16.2%.
Achievement: Exceeded Metric.

Objective: Higher Education.
Proposed Metric: Involve at least 8 academic affiliates including western MA.
Outcome: Awards made to 11 academic affiliates statewide.
Achievement: Exceeded metric

Objective: Research Infrastructure.
Proposed Metric: Expose at least 15 undergraduates to space- or climate-related research.
Outcome: Provided 23 fellowships to undergraduates to work on space-related research.
Achievement: Exceeded metric.

Objective: Aerospace STEM.
Proposed Metric: Place at least 10 students at NASA or JPL centers.
Outcome: Supported 1 student at NASA Centers.
Achievement: We only received a single request from NASA to support one summer student.

Proposed Metric: Send 8 Massachusetts students to KSC for the JOI program.
Outcome: Supported 6 students at KSC
Achievement: (See Section A, below.)

Proposed Metric: Integrate NASA resources into at least 1 STEM project.
Outcome: Support SSEP program at Monty Tech School to conduct one experiment annually on the ISS.

Achievement: 2014 Monty Tech payload is scheduled to launch Spring 2015. Met metric.

Outcome 2: Attract and retain students in STEM disciplines through a progression of educational opportunities for pre-college students and teachers to achieve NASA's strategic goal Educate and Employ.

Objective: Teacher Professional Development.

Proposed Metric: Support at least one workshop targeting teachers from underserved areas in the state or teachers for students with disabilities.

Outcome: Supported a teacher workshop at the Boston Museum of Science.

Achievement: Met metrics (See section B, below).

Objective: Hands-on activities for K-12 students.

Proposed Metric: Support the participation of at least 10 schools in the Space Explorers program.

Outcome: Program was discontinued by the organizers.

Achievement: N/A.

Proposed Metric: Bring at least 25 inner-city students to the Challenger Learning Center who would normally not be able to attend.

Outcome: Brought 88 inner-city students from Ashburnham, MA, 80 students from Framingham (95% of the students receive free or reduced lunch) and 144 from the Swampscott Middle School to the Challenger Center.

Achievement: Exceeded metrics.

Proposed Metric: Expose at least 200 K-12 students to NASA-related research.

Outcome: Exposed 399 K-12 students.

Achievement: Exceeded metrics.

Proposed Metric: Conduct at least one scientific ballooning launch.

Outcome: The ballooning program at Kuss Middle School is dormant due to personnel changes.

Achievement: SSEP program at Monty Tech achieves better NASA-related hands-on experience then ballooning.

Proposed Metric: Engage at least 5 students in rocketry competitions or similar hands-on activities.

Outcome: Engaged 87 girls from the Science Club for girls in rocketry and STEMinista Clubs.

Achievement: Exceeded metrics.

Proposed Metric: Include the Perkins School for the Blind as a consortium member.

Outcome: The school is unable to meet the obligations needed to become a full member.

Achievement: The school will continue participation in selected MASGC activities.

Outcome 3: Build strategic partnerships and linkages between STEM formal and informal education providers that promotes STEM literacy and awareness to achieve NASA's strategic goal to Engage and Inspire.

Objective: Support Informal STEM education.
Proposed Metric: Have at least 200 students and teachers attend Space Day.
Outcome: Over 500 teachers and STEM education stakeholders attended the STEM Summit.
Achievement: Exceeded metrics.

Objective: Organize events with NASA themes and content. Increase public awareness about Aerospace and NASA. Inform public about NASA's mission.
Proposed Metric: Have at least 100 people attend the annual Space Grant Distinguished Lecturer Talk.
Outcome: 120 people attended the Annual Public Lecture given by NASA Astronaut Stanley Love.
Achievement: Exceeded metrics.

Objective: Develop qualified presenters to interact with the public on aerospace and climate-related issues.
Proposed Metric: At least 5 Massachusetts informal educators should participate in McAuliffe Challenger Center.
Outcome: Arranged for 20 informal educators and parents to attend the Challenger Center.
Achievement: Exceeded metrics.

Proposed Metric: At least 10 Museum of Science informal education staff should attend the annual Space Day activities.
Outcome: Held Teacher Training workshop at the Museum of Science to which 40 informal educators/teachers attended.
Achievement: Exceeded metrics.

A. The consortium has exceeded each of the goals in Outcome 1, i.e. "Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals", except for supporting students at NASA Centers. The Consortium has had to reduce the number of NASA internships it awards because of a combination of budget constraints and the large number of students engaged in aerospace related research within the state who are benefitting from fellowships at our affiliate campuses. We supported 6 students to participate in the JOI Program. The pedagogical purpose of this program is to introduce students to the design and operational aspects of space flight and the systems engineering approach at NASA. Understanding the relationship of design and operations is critical for the successful practice of engineering and is a core part of MIT's Aeronautics and Astronautics CDIO curriculum.

B. The results for Outcome 2, "Attract and retain students in STEM disciplines through a progression of educational opportunities for pre-college students and teachers" are satisfactory, because we have deliberately shifted some of the programs to NASA's Summer of Innovation program in Massachusetts (MA SoI). The MA SoI initiative, which has been active since 2010, was intended solely to support pre-college students and teachers, and it is being conducted in partnership with our consortium members. Both Space Grant and the Summer of Innovation are

NASA programs, and the management and participants in Massachusetts are essentially the same. Given the extra SoI support for pre-college, the Consortium has shifted some Space Grant funding from pre-college to higher education, in response to the needs of our members and the state.

In addition, the consortium has participated in numerous high-profile STEM initiatives in the Commonwealth. The Co-Director serves on the Governor's STEM Summit Planning Committee and has also participated in the Cambridge Mayor's STEM Roundtable. These efforts enable the consortium to provide publicity for the NASA education mission at every level of STEM education establishment in Massachusetts.

C. The consortium has also exceeded each of its goals in Outcome 3, i.e., "Build strategic partnerships and linkages between STEM formal and informal education providers that promotes STEM literacy and awareness."

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student data and Longitudinal Tracking**:

Starting in 2006, MASGC has carried out longitudinal tracking of students who have participated in the Consortium's programs with extra time for support staff in our budget to support this activity.

Of the 577 students who have graduated from the initial degree they were pursuing when supported by MASGC, 268 are pursuing advanced STEM-related degrees, 44 are actively seeking STEM employment, 83 are employed by aerospace contractors, 64 are employed in non-aerospace STEM positions, 10 are employed by NASA/JPL, 13 are employed in K-12 STEM, 31 are employed in "other" STEM academic fields and 64 in non-STEM employment.

- **Minority-Serving Institutions:** The Consortium's members include Roxbury Community College, the Commonwealth's only designated "minority-serving institution". Attracting community college students to aerospace-related activities is challenging, because aerospace is a field of endeavor most of the students have not thought about. Therefore, MASGC offered fellowships and a STEM seminar series to community college students, to encourage them to enter the aerospace workforce pipeline. All students who have participated in this program over the past three years have gone on for a 4-year college program in engineering.

- **NASA Education Priorities:**

Hands-on learning: The consortium is engaged in and enables various hands-on student experiences in science and engineering disciplines examples of which, Rocket Teams both at the Science Club for Girls, described in the highlights above, and a number of inner-city schools in Western Massachusetts with over 95% of the students receiving free/reduced lunch. The consortium worked with the Challenger Center to enable 168 middle school students to attend the McAuliffe Center Program.

Curriculum Enhancement for middle school teachers: In an effort to engage middle school teachers in curriculum enhancement capabilities through exposure to NASA scientific and technical expertise, MASGC has been working with the Museum of Science, a MASGC affiliate, to organize a STEM teacher training activity using the Museum's newly refurbished Planetarium.

College and University Student Fellowships: Higher education is at the top of MASGC's priorities, and summer opportunities for students receive the largest allocation in our budget. During this academic year, MASGC awarded 6 fellowships to students from 3 affiliate schools. This summer, the Consortium is funding 35 summer internships at 11 affiliate institutions.
Community Colleges: Over the years, the consortium has helped develop and provide speakers and funding for a 12-part STEM series at the Roxbury Community College. In 2014, however the Consortium's focus for engagement with community colleges has shifted to development of an Aeronautics Technology and Aircraft Maintenance program through another grant.

Student Travel Opportunities: In keeping with MASGC's guiding principle of using Space Grant funding to enable students to engage in NASA-relevant activities they would otherwise not have access to, we provide funding for students to attend conferences in which they will present a research paper or poster, or to attend aerospace-related competitions. This year, we funded 18 students to attend conferences and competitions, including the Human Factors Conference, Flight Software Workshop, the NASA Centennial Challenge Robotics Competition and the 2015 AIAA Region 1 Student Paper Conference held at VPI, Blacksburg,
MASGC sponsors a "Modern Space Science and Engineering" seminar course to introduce students to contemporary space research. Approximately 360 students and 20 members of the public attended the seminars with presentations from personnel from NASA, and academia.

IMPROVEMENTS MADE IN THE PAST YEAR

MASGC has made the following adjustments to maximize the benefits from reduced funding, changes in programs and increase the consortium's involvement in the state's education system:
Speaker support: The line item in MASGC's budget supporting speakers for public lectures at affiliate institutions has been underutilized over the past few years. We will continue to encourage more affiliates to hold MASGC-supported public lectures.
STEM development: MASGC's Co-Director has worked with the planning committee of the state wide STEM Council on the STEM Summit to showcase NASA education resources. She has hosted NASA astronaut Sunita Williams and moderated a panel at the STEM Summit, which brings together over a thousand STEM stakeholders in the state to show the importance of STEM education for the nation's space program and the unique education resources for teachers and informal educators available from NASA.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Currently, the Massachusetts Space Grant Consortium has 20 academic affiliates and 2 institutional (outreach) affiliates, covering the entire state from Cape Cod to the Berkshires. Members are listed below, together with the name of each affiliate's representative to MASGC:

Academic Affiliates

Massachusetts Institute of Technology, Lead	Professor Jeffrey Hoffman
Boston University (Boston)	Professor John Clarke
Bridgewater State University (Bridgewater)	Professor Martina Arndt
College of the Holy Cross (Worcester)	Professor Matthew Koss
Framingham State University	Dr. Irene Porro
Five College Astronomy Department	Dr. Alexandra Pope*
Harvard University (Cambridge)	Professor Jonathan Grindlay
Massachusetts College of Liberal Arts	Professor Michael West
Mount Holyoke College (South Hadley)	Professor Darby Dyar
Northeastern University (Boston)	Professor Alain Karma
Olin College (Needham)	Professor Christopher Lee
Roxbury Community College (Boston)	Dr. Javad Moulai
Tufts University (Somerville)	Prof. Danilo Marchesini
University of Massachusetts (Amherst)	Prof. Daniella Calzetti
University of Massachusetts (Dartmouth)	Professor Robert Fisher
University of Massachusetts (Lowell)	Prof. Supriya Chakrabarti
Wellesley College (Wellesley)	Professor Kim McLeod
Williams College (Williamstown)	Professor Jay Pasachoff
Worcester Polytechnic Institute (Worcester)	Professor Nikolaos Gatsonis
Worcester State University (Worcester)	Professor Matthias Dietrich

* Five-College Astronomy Department, which in addition to Amherst, Mount Holyoke and UMass, also includes Hampshire and Smith Colleges.

Institutional Affiliates (Outreach)

Museum of Science (Boston)	Mr. Paul Fontaine
Christa McAuliffe Center (Framingham)	Dr. Irene Porro