Michigan Space Grant Consortium
University of Michigan
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2014 - 2015 Funding Interval

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. Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Michigan Space Grant Consortium is a Designated Program Consortium funded at a level of **$575,000** for fiscal year 2014.

PROGRAM GOALS

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals. (Employ and Educate)* Higher Education: MSGC Fellowship, Internship, and Seed Grant Programs.

The MSGC Fellowship Program

Goal: Increase the number of proposals that the MSGC Fellowship Program receives.
Goal: Improve the longitudinal tracking of the MSGC Fellowship award recipients.
Goal: Competitively award graduate and undergraduate fellowships using the National Center for Education Statistics (NCES) Digest as a guide for setting diversity targets. The MSGC target is currently 20.3%. U.S. citizenship is required.

The MSGC Research Seed Grant Program

Goal: Improve participation in the MSGC Research Seed Grant Program across the Consortium.
Goal: Increase the diversity (underrepresented minorities and women) in the MSGC Research Seed Grant Program.

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty. (Educate and Engage)* Elementary/Secondary Education: MSGC Higher Education, K-12 Educator Incentive, Pre-College, and Augmentation Programs.

The MSGC Precollege Education, Higher Education, K-12 Educator Incentive and Augmentation Programs

Goal: Increase the number of applications coming from outside of the Consortium for the MSGC Precollege Education and K-12 Educator Incentive Programs with augmentation funds available to programs that target underrepresented minorities and women.
Goal: Award quality programs that target underrepresented minorities and women.

Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission. (Engage and Inspire)* Informal Education: MSGC Informal Education and Augmentation Programs.

The MSGC Informal Education Program

Goal: Increase the number of applications coming from outside of the Consortium for the MSGC Public Outreach Program with augmentation funds available to programs that target underrepresented minorities, women, and persons with disabilities.

Goal: Award quality programs that target underrepresented minorities and women.

Goal: Award quality programs that encourage Science, Technology, Engineering, and Mathematics education in informal settings; e.g., museums science centers, boy and girl scouts, etc.

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

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals. (Employ and Educate)* Higher Education: MSGC Fellowship, Internship, and Seed Grant Programs. Highlights are provided below:

"The MSGC Fellowship award allowed me to continue with my Masters' research," says Michigan Tech student, Dulcinea Avouris. "The work I did for my thesis directly impacted my ability to continue my educational path into a doctoral program."

"I can honestly say that I am who I am today partially due to the support I received from the MSGC Graduate Fellowship Program," says University of Michigan student, Mitaire Ojaruega. "I was part of a review team for Plutonium Fuel needed for the next Mars mission – a really impressive and rewarding experience I never dreamed I would be a part of."

"The MSGC internship gave me the experience in designing, fabricating, and testing electric propulsion systems," says University of Michigan student, Charles Wyman. "This experience fed my passion for propulsion engineering in space. I am continuing my education in aerospace engineering focusing on gas dynamics as a result of my internship experience at ElectroDynamic Applications in Ann Arbor."

Assistant Professor Kerri Pratt began her career at the University of Michigan and was awarded an MSGC Research Seed Grant for her proposal, *Linking Arctic Snow Chemistry to Sea Ice Conditions and Tropospheric Bromine*. This project directly addresses NASA's Cryospheric Sciences Program goal for the *quantification of the connections between sea ice and the ocean and atmosphere* to determine the implications of sea ice change in the Arctic. "This project has involved training two graduate students and two undergraduate students and will continue beyond the grant period due to the preliminary success of the project thus far," says Dr. Pratt. "Further, the massive dataset obtained from this project will be the first to examine, in detail, the bromide content of snow near the geographic North Pole and relate this to understanding the impacts of sea ice loss on atmospheric composition in the Arctic." The results of this project are directly related to a NASA grant that Dr. Pratt was awarded in collaboration with the Jet Propulsion Laboratory.

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty. (Educate and Engage)*
Elementary/Secondary Education: MSGC Higher Education, K-12 Educator Incentive, Pre-College, and Augmentation Programs. Highlights are provided below:

Hope College's Center for STEM Inquiry in partnership with the Muskegon Area Regional Math and Science Center, and with the assistance of local area teachers, recruited promising high school students from underrepresented populations (33) for the Engineering the Future Academy. "Designed as a learning experience for high school students, a research and mentorship opportunity for STEM education and engineering majors, and a professional development for teachers, the summer academy immersed student engineering design teams in a one-week challenge to design a building of the future to meet local community needs while exploring properties of materials in the college's engineering labs," says Eric Mann, Assistant Professor of Mathematics Education at Hope College. "Pre-service teachers and engineering students planned the week in conjunction with the participating teachers." Grant funds provided academy materials, breakfast and lunch for the students and transportation to and from the students' school. Participating teachers were provided classroom sets of the Engineering the Future curriculum from the Museum of Science, Boston. Baseline data was collected to assess the long-term impact of this experience on both teacher and student participants with respect to STEM attitudes, beliefs, and dispositions. Follow-up contact with participating high school students and teachers is ongoing. Qualitative evidence suggests Participants received a deeper understanding of the engineering design process. The small number of students limited the statistical assessment of quantitative data, however, improvements in perceptions of academic competency and relevance of school along with their willingness to work with unfamiliar topics were noted.

Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission. (Engage and Inspire)* Informal Education: MSGC Informal Education and Augmentation Programs. Highlights are provided below:

"*Very inspiring…. thank you*, was the response when Michigan Tech brought its state-of-the-art Mobile Laboratory to 141 cadets at the 2014 Michigan Civil Air Patrol Summer Cadet Encampment," says Marlene Lappeus, Academic Advisor in Mechanical Engineering. The Civil Air Patrol is the volunteer auxiliary of the U.S. Air Force, and its mission is to develop tomorrow's aerospace workforce. The Cadet Summer encampment combines leadership training with aerospace education. MTU researchers inspired cadets with hands-on discovery experiences to promote an awareness of education, research, and careers in space science and aeronautic technologies. The cadets, ages 12 – 20, responded with enthusiasm: "I enjoy these classes every year at encampment!" Over a two-day period, 141 cadets were guided through hands-on activities demonstrating the fundamental applications of rocket thrusts, air foils & lifts, micro-grids and controls, along with career explorations demonstrating the breadth and depth of STEM fields and the impact those professions have for the environment and humankind. Surveys were given prior to the activities to gauge the cadets' level of familiarity and interest in STEM careers; cadets were then surveyed after the hands-on activities to gauge the impact the activities had on their interest in STEM careers. There was a significant increase in interest after participation in the activities. The surveys indicated interest in learning more about at least one specific STEM career possibility increased from 19% to 60% for female cadets and from 35% to 72% for males. Of the 141 cadets, 30% were female; the fastest growing professions are being created in STEM fields, so encouraging women to explore these fields is important for their financial security and the economic growth of our nation.

PROGRAM ACCOMPLISHMENTS

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals. (Employ and Educate).* Higher Education: MSGC Fellowship, Internship, and Seed Grant Programs.

The MSGC Fellowship Program

Goal: Increase the number of proposals that the MSGC Fellowship Program receives.
Metrics: Compare the number of proposals received from year-to-year.
Approach: Provide brochures to all MSGC campus representatives to supplement the other ways (newsletter, website, postings, and e-mails) in which we announce the MSGC Fellowship and Internship opportunities.
Accomplishment: The MSGC flagship Fellowship Program received 51 proposals in 2014 as compared to 57 in 2013 (we anticipate that this number will increase significantly for year 2015). We received 23 proposals to the MSGC Undergraduate Fellowship Program and 28 proposals to the MSGC Graduate Fellowship Program.

Goal: Improve the longitudinal tracking of the MSGC Fellowship and Internship award recipients.
Metrics: Track the next steps that students take after they are awarded fellowship funding from the MSGC.
Approach: Mark Fischer, Executive Director of the National Space Grant Foundation, provides us with results from the surveys that he routinely sends to our Fellowship and Internship award recipients with the contact information provided by Bonnie Bryant, MSGC Program Coordinator. Bonnie also contacts the mentors of Fellowship and Internship award recipients for input.
Accomplishment: The number of students that received funding from the 2014 MSGC Fellowship Program was 34 and from the MSGC Internship Program was 20 as compared to 39 Fellowships and 19 Internships in 2013. More details will be provided in our longitudinal tables which will be provided within the next few months per NASA Headquarters' direction.

Goal: Competitively award graduate and undergraduate fellowships and internships with demographics as specified by NASA of 20.3% underrepresented minority (NCES). U. S. citizenship required.
Metrics: Compare the number of proposals received each year by gender and ethnicity.
Approach: The Summer Research Opportunity Program (SROP), a long-standing minority student recruitment program for graduate school, focuses on exposing rising sophomores, juniors, and seniors to on-campus research activities. The Council of Graduate Schools, a *Big Ten Plus* consortium of graduate schools that routinely brings dozens of high-achieving underrepresented minority undergraduates to its campuses each summer supports the SROP Program. SROP runs through the graduate school at UM and at MSU. In 2014, MSGC dedicated funds to 11 SROP students in order for them to participate in internships at the University of Michigan. The MSGC also offers a fellowship program targeted to undergraduate, underrepresented minority students. In this program, strong mentorship is required. Mentors qualify for $1,000 per student. A mentor may have up to two underrepresented minority students on his/her team. A $500 incentive is offered to mentors of underrepresented students not eligible for this program, for example, underrepresented graduate students.
Accomplishment: Our target is to award a minimum of 20.3% underrepresented minority students in our fellowship program. The target is derived from the underrepresented minority

student enrollment percentage for the state of Michigan as per the NCES Digest. Our commensurate minimum for women is 40%. During funding interval 2014, 30% of the fellowship and internship award recipients were underrepresented minority students; the amount of underrepresented minority students that we awarded in 2013 was 24%. During funding interval 2014, 46% of the fellowship and internship award recipients were women. The amount of women awarded in 2013 was 36%.

The MSGC Research Seed Grant Program

Goal: Improve participation in the Research Seed Grant Program across the MSGC.

Metrics: Compare the distribution of awards across the institutions within the MSGC.

Approach: Keep a record of the proposals we received overall as well as the distribution across the Consortium.

Accomplishment: During funding interval 2014 – 2015, we received proposals to the MSGC Research Seed Grant Program from 10 out of 11 affiliate universities as compared to 6 out of 11 affiliate universities in 2013. We funded proposals from 8 of these universities as compared to 6 universities in 2013.

Goal: Increase the diversity (underrepresented minorities and women) in the MSGC Research Seed Grant Program.

Metrics: Record the number of applicants each year by gender, ethnicity, and persons with disabilities.

Approach: Target announcements to college and university groups using e-mail, group meetings, and invitations from the director and campus representatives.

Accomplishment: During the 2014 funding interval, we were pleased to receive 7 proposals from women as compared to 7 in 2013. Four proposals from women were funded. Underrepresented award recipient was Professor Miguel Abrahantes from Hope College.

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty. (Educate and Engage)*

Elementary/Secondary Education: MSGC Higher Education, K-12 Educator Incentive, Pre-College, and Augmentation Programs.

The MSGC Precollege Education, Higher Education, and K-12 Educator Incentive Programs

Goal: Increase the number of applications coming from outside of the Consortium for the Precollege Education, K-12 Educator Incentive, and Augmentation Programs (all K-12 Educator Incentive Program proposals come from outside of the MSGC).

Metrics: Record the number of applications that the MSGC receives from outside of the Consortium.

Approach: Some 8,000 brochures are sent to public and intermediate school districts, including high, middle, elementary, charter along with the Boy and Girls Scouts, museums and after-school clubs.

Accomplishment: During the 2014 funding interval, we received 12 proposals from outside of the MSGC as compared to the 19 proposals we received during the 2013 funding interval. Six of these proposals were from the MSGC K-12 Educator Incentive Program.

Goal: Encourage quality programs that target underrepresented minorities and women.

Metrics: Record the number of programs targeted to underrepresented minorities and women.

Approach: Announce that augmented support will be available (via the Augmentation Program) to those programs that target underrepresented minorities and women. Within the announcement

add that to be considered for augmented support, an additional page describing in detail why added funds are necessary to assure the success of program targeting underrepresented minorities and/or women.

Accomplishment: During the 2014 funding interval, we received 22 proposals that directly targeted underrepresented minorities and/or women, compared to the 25 proposals that we received during the 2013 funding interval.

Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission. (Engage and Inspire)* Informal Education: MSGC Informal Education and Augmentation Programs.

The MSGC Informal Education Program

Goal: Increase the number of applications coming from outside of the Consortium.

Metrics: Record the number of applications that the MSGC receives from outside of the Consortium.

Approach: Some 8,000 brochures are sent to public and intermediate school districts, including high, middle, elementary, charter along with the Boy and Girls Scouts, museums and after-school clubs.

Accomplishment: During the 2014 funding interval, we received 4 proposals from outside of the MSGC, compared to the 6 proposals that we received during the 2013 funding interval.

Goal: Encourage programs that target underrepresented minorities and women.

Metrics: Record the number of programs targeted to underrepresented minorities and women.

Approach: Announce that augmented support will be available to those programs that target underrepresented minorities and women. Within the announcement we added that to be considered for augmented support, an additional page describing in detail why additional funds are necessary to assure the success of program targeting underrepresented minorities and/or women.

Accomplishments: During the 2014 funding interval we received 7 proposals that directly targeted underrepresented minorities and/or women, compared to 10 proposals that we received for the 2013 funding interval.

Goal: Encourage programs that include Science, Technology, Engineering, and Mathematics in informal settings (e.g., museums, science centers, boys and girl club, etc.).

Metrics: Record the number of applications that come from libraries, museums, planetariums, and others that offer STEM education in informal settings.

Approach: Some 8,000 brochures are sent to public and intermediate school districts, including high, middle, elementary, charter along with the Boy and Girls Scouts, museums and after-school clubs. We also encourage MSGC campus representatives to reach out to these establishments in their communities.

Accomplishment: During the 2014 funding interval, all of the programs awarded offered STEM education in informal settings with highly trained staff that provided supplemental materials; the same was true of the 2013 funding interval. Informal settings included libraries, symposiums, and planetariums, for example, The Detroit Area Pre-College Engineering Program, The Detroit Zoo, The Cranbrook Institute of Science, and the Michigan Science Center.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Diversity:** Benchmarks for diversity within the MSGC Fellowship and Internship Programs have consistently been met as reported within this and past ADP's. Over half of the Program

proposals are targeted to underrepresented minorities or to women. Again this year, an unprecedented amount of women proposed to the MSGC Research Seed Grant Program.

- **Minority-Serving Institutions:** The underrepresented minority enrollment for students attending Wayne State University and Eastern Michigan University is 36% and 20%, respectively, as compared to 4% - 13% at other MSGC-affiliated universities and colleges. The only historically black college that we have in the state of Michigan is Lewis College, a non-accredited business college in Detroit. Bay Mills Community College and Keweenaw Bay Ojibwa Community College, and Saginaw Chippewa Tribal College are the three tribal colleges located in Michigan but at this time, no engineering programs are offered on these campuses. Our focus remains to recruit minority students and junior faculty members from MSGC institutions and through the SROP Program.

- **NASA Education Priorities** are noted throughout this progress report: **Avouris** – page 2; **Ojaruega** – page 2; **Wyman** – page 2; **Pratt** – page 2; **Mann** – page 3; **Lappeus** – page 3.

IMPROVEMENTS MADE IN THE PAST YEAR

The University of Michigan and the National Center for Manufacturing Sciences co-hosted MI Robotics on April 10th. Bonnie Bryant assisted with the coordination of this event that had over 500 people in attendance. The event gave guests the opportunity to experience the cutting-edge advances made by Michigan robotics' companies and research organizations, hear from leaders in the field, and see how students are diving into the field at the high school and colleges levels.

The 2014 regional meeting was held in Des Moines. The theme of the meeting was reaching out to underrepresented students. Richard Carrillo, a 2013 SROP intern, talked about his experience in Dr. Dawn Tilbury's laboratory within the Mechanical Engineering at UM. Dr. Elaine Dowell talked about the NextProf Workshops. NextProf workshops were designed to encourage talented individuals with a demonstrative commitment to diversity in engineering and science to consider academia as an exciting and rewarding career and are held on the Michigan's College of Engineering campus.

Dr. James Cutler was the keynote speaker at the MSGC Annual Fall Conference that was held in October 2014. Dr. Cutler is an Associate Professor of Aerospace Engineering at the University of Michigan. Dr. Cutler's interests center on space systems – a multidisciplinary approach to enabling future space capability with particular emphasis on novel, nanosatellite missions. He is developing next generation communication capability and robust space computing infrastructure. Dr. Cutler was the Co-PI on the first National Science Foundation space mission, the Radio Aurora Explorer (RAX). As chief engineer, he led a team of students that developed the satellite bus for the RAX mission in the laboratory he founded, The Michigan Exploration Laboratory (MXL). Dr. Cutler was the past director of the Space Systems Development Laboratory (SSDL) at Stanford University, where he earned his Ph.D. in Electrical Engineering. Dr. Cutler is also an advocate of the next generation of scientists and frequently talks to K-12 students about the path he took to becoming a research scientist and professor of Aerospace Engineering. Dr. Cutler's keynote talk was titled, *CubeSats: Enabling Bold Flight to the Extremes*. CubeSats are transforming our approach to space and reinvigorating past generations while enabling new generations to boldly go where no one has gone before. They were conceived of in 2000 when small satellites were mixed with a university in the fertile cradle of Silicon Valley.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

The MSGC Executive Board consists of the following members:

Calvin College • Private four-year liberal arts college: Larry Molnar is a Professor of Physics and Astronomy with research in the field of solar system studies.

Ann Arbor Public Schools: Mr. Michael Madison is an elementary school principal. Mr. Madison was recently elected President of the Ann Arbor Administrators' Association for a two-year term. He is also Executive Board member of the Ann Arbor Hands-On Museum, and Vice-President of the Pioneer High School Boosters.

Eastern Michigan University • Public Ph.D.-granting university: James Sheerin is a Professor of Physics and Astronomy and is active in space physics research and in developing science courses for non-majors and pre-service teachers.

Grand Valley State University • Public Master's-granting university: Bopi Biddanda is an Aquatic Microbial Ecologist interested in the Carbon Biogeochemistry of natural waters. In his research, he addresses questions of carbon flow driven by microorganisms in nature.

Hope College • Private four-year liberal arts college: Peter Gonthier is an astronomer and Professor of Physics. Professor Gonthier recently won an NSF grant for his proposal, *Radio, X-Ray, and Gamma-Ray Emission from Neutron Stars*.

Michigan State University • Public Ph.D. granting university: Michael Velbel is a Professor of Geological Sciences where he investigates the geological, mineralogical, geochemical, and geomorphic factors that control mineral alterations at the Earth's surface.

Michigan Technological University • Public Ph.D. granting university: Robert Warrington is the director for MTU's Institute for Leadership and Innovation.

Oakland University • Public Ph.D. granting university: Laila Guessous is an Associate Professor of Mechanical Engineering with research in the field of computational fluid dynamics and computational heat transfer.

Saginaw Valley State University • Public Master's-granting University: Garry Johns is Professor of Mathematics and also consults with high school mathematics teachers in the Buena Vista School District regarding best teaching practices and curriculum alignment. Buena Vista has a large African-American population.

University of Michigan (lead institution) • Public Ph.D. granting university: Alec Gallimore is the MSGC director, Arthur F. Thurnau Professor of Aerospace Engineering and was recently named Associate Dean for Academic Affairs (ADAA) for the University of Michigan's College of Engineering.

University of Michigan • Public Ph.D. granting university: Dr. Cinda Davis is the director of the Women in Science and Engineering Program.

Wayne State University • Public Ph.D. granting university: R. Darin Ellis is the Associate Dean of Academic and Student Affairs Wayne State University. He is currently on the faculty of the Industrial Engineering Department where he holds the rank of Associate Professor and teaches courses including statistics, human factors in product development, work design, and ergonomics.

Western Michigan University • Public Ph.D. granting university: Massood Atashbar is Professor of Electrical and Computer Engineering and the director of Advanced Smart Sensors and Structures and the Sensor Technology Laboratory.

Respectfully submitted on April 8, 2015.

Alec D. Gallimore, MSGC Director