FRONTIERS

THE MICHIGAN SPACE GRANT CONSORTIUM NEWSLETTER

MI.SPACEGRANT.ORG

WINTER 2019

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Prof. Jeff Potoff

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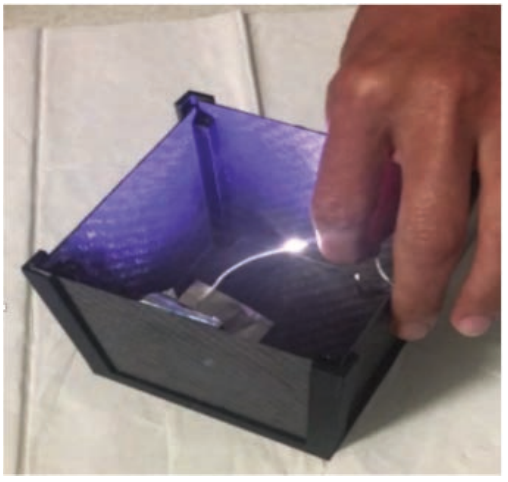
MESSAGE FROM THE DIRECTOR

2019 marks the 30th Anniversary of the Michigan Space Grant Consortium and the middle of a transitional year. Dean Alec Gallimore stepped down as Executive Director after 17 years, handing the role to me as a professor in the department of Climate and Space Sciences and Engineering with extensive experience in STEM educational initiatives ranging from local to national. Among the changes at MSGC will be the expansion of our partnerships with non-profit STEM educational groups and organizations, industry, community colleges, school districts and state and local governments. In addition, MSGC will widen its programming to include opportunities for student groups to participate in NASA design challenges and competitions. Look for a brand-new website, new logo, and new opportunities to engage with colleagues through MSGC's grants, events, and social media. More details about new faces and roles within MSGC can be found later in this newsletter. I look forward to supporting NASA's Mission by finding new and effective means of facilitating communication and collaboration among the broader STEM education and research communities throughout Michigan.

Mark Moldwin

SOLAR-POWERED CUBE-SAT DESIGNED BY NASA INTERN

Breeanne Marshall is anything but typical … in the best sense of the word. In addition to taking a complete load of classes as an electrical engineering student at Wayne State University, she works full time at the GM Technical Center. Even with so many things on her plate, Breeanne applied for and was awarded a summer 2017 internship at NASA's Kennedy Space Center at Cape Canaveral, Florida. NASA thought so highly of her that they invited her to come back the next year, and MSGC was pleased to be able to provide the support for that experience. This past summer, Breeanne's project was to develop a lightweight cube-shaped satellite (CubeSat) with a multifunctional structural battery system. The challenge was to produce walls that function as solar panel, battery, and physical support. In the end, the team was successful in creating just such a device. The sky is the limit for Breeanne.



Structural solar-powered CubeSat designed by Wayne State University undergraduate Breeanne Marshall during a NASA internship.

FOREST CHANGE IN THE WAKE OF HURRICANE MARIA

Undergraduate student Brenden Kosnik studies the effects of Hurricane Maria on fragile forest plant populations in Puerto Rico.

Caribbean islands are frequently disturbed by hurricanes, and climate change is only increasing the frequency and severity of storms and their impacts on ecosystems. GVSU Undergraduate Fellow Brendan Kosnik and his mentor Dr. Gary Greer studied the impacts of Hurricane Maria, which devastated Puerto Rico in September 2017, on epiphytes (i.e., plants that grow on trees) in El Yunque National Forest. Since 2012, Dr. Greer has studied the epiphytic community along the Rio Espiritu Santo drainage. Preliminary analysis of field data collected during May - June 2018 has revealed a 15% reduction in the total number of epiphyte species. Furthermore, loss of epiphyte biodiversity was higher on smaller trees, though larger trees were more likely to fall during the storm. Future analyses will determine which epiphyte species best avoided death and/or damage from hurricane force winds and the resulting increased sun exposure and identify anatomical traits associated with hurricane survivorship in the caribbean and other storm-prone regions of the world.

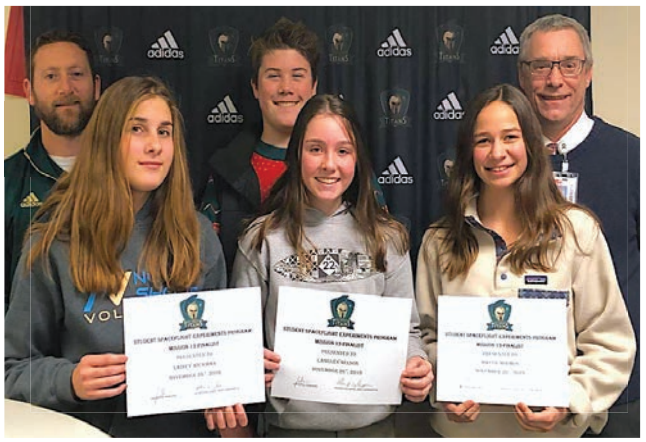
NASA WORKSHOPS: EPIC EXPERIENCES FOR GRADUATE STUDENTS

Through two MSGC Fellowships, PhD students from Michigan State University and the University of Michigan have been able to gain hands-on experiences at NASA centers that have yielded outstanding opportunities for professional and technical development. Jessica Maldonado from MSU was able to attend the 16th Synthesis Imaging Workshop in Socorro, New Mexico to learn about advanced techniques for producing a high-quality radio continuum image of M31, the Andromeda Galaxy. Beyond learning a great deal about imaging, Jessica also made connections with on-site experts that allowed her to return to Socorro in the fall to work one-on-one with her data. Once it is complete, the high-quality radio continuum image will be used to hunt for supernova remnants in M31 to determine the star or star system that existed before the supernova explosion. The expected outcomes of this research are contributions to cosmology and origins of life on Earth. UM's Abby Azari has been able to visit collaborators at the University of Colorado's Laboratory for Atmospheric and Space Sciences (LASP) to pursue the development of a new method to extract several physical parameters associated with intense particle transport events happening around Saturn. She was also able to attend the NASA SPICE training and workshop in Pasadena in November 2017. This weeklong training provided hands-on support to research scientists, graduate students, and NASA staff working with satellite trajectories.

Graduate student Jessica Maldonado stands in front of a 25-meter diameter by 29-meter high radio antenna.

EXPERIMENT FOR SPACE DESIGNED BY TRAVERSE CITY AREA STUDENTS

At night, Northern Michigan is blanketed by the dark skies that are ideal for watching the International Space Station (ISS) pass overhead. The kids in Traverse City didn't want to simply watch the ISS, though. They wanted to be on it. Teacher Patrick Gillespie had the vision, passion, and dedication to turn that dream into reality. How? By providing a way for the students to design an experiment to be performed on the space station. Within a few months, more than 800 West Senior High School students had worked on developing microgravity experiments, 200 of which were submitted to the competition that chose the winning candidate - "The Growth of Bacillus Subtilis on a Substrata Material in Microgravity." Students also were able to join a contest for creating a space mission patch for the flight. The artwork will accompany the experiment to the ISS in June 2019.



The experiment going to the International Space Station was designed by Hattie Holmes, Langley Nelson, Kale Cerny and Lainey Wickman from 9th grade Honors Biology. Also shown are teacher Patrick Gillespie (right), who facilitated this project, and Principal Joe Esper (left).

IMPROVED LEARNING OUTCOMES FROM PHYSICAL OPTICS COURSES

Optical devices play key roles in scientific and technological advances in science and engineering. Students benefit from comprehending how the theory and application of optics are interconnected, but education research shows students do not easily develop that understanding. A MSGC Research Seed Grant project designed by Prof. Chris Nakamura of Saginaw Valley State University (SVSU) seeks to develop and implement laboratory exercises within a theory-centered upper-division optics course to help students better understand how the ideas and models discussed are observable in the lab and applied in technology. Prof. Nakamura worked with two undergraduate students during summer 2017 to develop and test activities for the optics course in fall 2017. The research design was primarily a qualitative case-study using interview data. Participating students were asked to explain optics concepts through mathematical calculations, equipment demonstrations, and conceptual explanations. Prof. Marie Cassar, SVSU Psychology, collaborated in the study, interviewing the students multiple times over the semester to assess their evolving understandings. Using this data, the team is refining the instructional activities and developing more mature methods of assessing the efficacy of implementing lab activities in a theory-focused optics course.

Courtesy of Saginaw Valley State University/Michael Randolph.

Students test a dispersion experiment as part of an optics education research project supported by a MSGC Research Seed Grant.

FYRES: LIGHTING INTEREST IN STEM

In Prof. Deanna van Dijk's First-Year Research in Earth Sciences (FYRES) project at Calvin College, a "day at the beach" takes on a whole new meaning. In this course, first-semester college students spend afternoons at the beach while being in class! FYRES is an NSF grant legacy that continues to give back to students and the public in West Michigan. Through engaging, hands-on research experiences on the dunes adjacent to Lake Michigan, students' interest and abilities in performing scientific research are developed, skill in communicating through reports and presentations is honed, and mentoring skills of selected juniors and seniors in Earth science majors grow. In addition, broader impacts are achieved by conveying useful data to managers at state and county parks and by informing the public about natural processes taking place in this dynamic system. This effort is supported by a Public Outreach grant from MSGC.

A first-year student in Calvin College's FYRES course performs useful, hands-on research on the dunes at Hoffmaster State Park.

STIMULATING NEUROBIOLOGY RESEARCH

Neurons generate time-varying voltage signals to process information by controlling the flow of charged particles through their cell membranes. Electrodes with microscopic tips are used to inject currents into biological neurons to better understand their function. MSGC Graduate Fellow Lucas Essenburg is developing the electronic circuitry needed to deliver these tiny electrical currents. Generating such minute currents presents a variety of design challenges. Solving these challenges will significantly enhance the Western Michigan University Neurobiology Engineering Laboratory's electrophysiology expertise and provide the last component needed to complete the design of a hand-held neural stimulation device that Lucas and his senior design project teammates presented at the annual MSGC conference last fall. This work is the basis of his ongoing Master of Science in Electrical Engineering thesis that relies on in-house expertise in biology and engineering. Researchers at WMU are exploring algorithms to evoke desired neuron responses but with reduced current levels with potential application in medical devices. Lucas' research in electronic instrumentation supports ongoing development of new methods to study biological neural systems in space and on the ground.

MSGC Graduate Fellow Lucas Essenburg monitors the performance of a neural stimulation device in WMU Dept of Biological Sciences Jellies Laboratory.

NSF AWARD AND HIGH-IMPACT PAPERS VIA RESEARCH SEED GRANTS

Brooklyn Tobias works with Prof. Katie Polasek on the setup for the rubber hand illusion. Credit: Hope College PR.

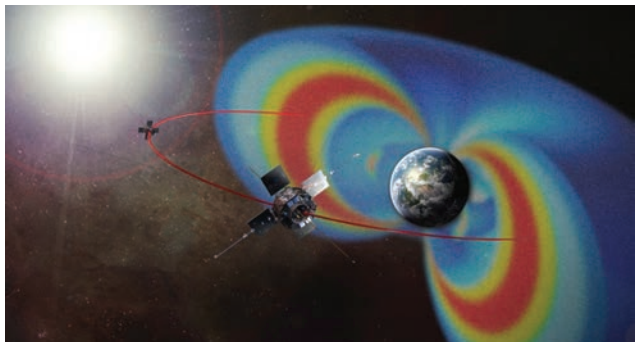
Two projects from 2017-18 supported by MSGC Research Seed Grants yielded very successful products - a NSF grant and high impact publications. Dr. Katharine Polasek at Hope College is working to develop a treatment for phantom limb pain. As part of understanding the proposed treatment, she decided to use electroencephalography (EEG) to monitor the brain. MSGC funded her initial work in the summer of 2017 to collect EEG data on people without amputations while performing parts of the proposed pain treatment. The preliminary data obtained were a major contribution to a NSF proposal submitted in October 2017 and funded June 2018 that will look in more detail at brain activity changes after an amputation and during the proposed treatment to reduce pain. In addition to the advances in science, this project provided three undergraduate students, two of whom were women, with an in-depth summer research experience. Another grant awarded to Professor Yuejian Wang of Oakland University is enabling the development of an improved method for characterizing the phase transitions and elastic properties of three materials in the family of chromium-based spinel, potential candidates for electrode materials in supercapacitors used in various advanced aerospace devices. The approach utilizes X-ray diffraction generated by the synchrotron radiation source at Argonne National Laboratory to record changes in atomic spacing as a material is compressed under extremely high pressures. This effort resulted in two publications in high-impact peer-reviewed journals - Physical Review B and Journal of Physical Chemistry C. The grant also enabled undergraduate Christopher Knill to conduct several experiments at Argonne, which contributed to his acceptance into a PhD program at Arizona State University.

TEACHER WORKSHOPS: TEACHING "STEM" USING UNDERWATER REMOTELY OPERATED VEHICLES

Michigan Technological University teamed up with Square One Education Network to hold hands-on workshops that teach educators how to present hands-on STEM experiences centered on remotely operated vehicles (ROV's), specifically, in this case, underwater ROV's. One workshop was held in the UP, involving teachers who work in schools with rural, at-risk populations. Another was held in Bay City, incorporating educators who work with many minority students. All participants were excited by the content and kit materials, and 80-100% felt confident in their ability to deliver the program activity to students. The workshops served as impactful tools for inspiring teachers and students in science, technology, engineering and mathematics, building lifelong skills as well as an interest in both engineering and scientific discovery.

Participants of a teacher training workshop launch remotely operated vehicles into Lake Huron to survey a shipwreck. Courtesy: Square One Education Network, MTU, Barb Land.

TEACHER TRAINING: HOW TO UTILIZE NASA DATA IN LESSON PLANS



Van Allen Probes (top) provided data for class exercises (Photo credit: NASA)

Supported by a MSGC Teacher Training grant, Prof. James Sheerin of Eastern Michigan University developed an entry-level interdisciplinary course for pre-service teachers using NASA resources integrated into each lesson module. The emphasis is on the exploration of our geospace environment surrounding Earth. Extensive use is made of data from NASA's missions such as Van Allen Probes, the Solar Dynamics Observatory, and the Magnetospheric MultiScale Mission. Pre-service teachers prac- tice using data products from current NASA missions and becoming familiar with the idea of incorporating them into lesson plans. This experience enables new teachers to communicate science to their students in a way that increases their awareness of science, Earth's environment in space, and NASA's role in discovery benefiting society.

THE VALUE OF K12 EDUCATOR INCENTIVE GRANTS

Tiny investments can lead to terrific initiatives. Through a modest K-12 Educator Incentive grant from Michigan Space Grant Consortium, teacher Amy Kuntz was able to supplement her current hands-on science curricular materials with tornado and earthquake simulators for a project about real world situations in earth and space science. Amy has designed a month-by-month curriculum of challenges that require students to use LEGO robotics, simple machines, and building brick challenges to create solutions to common issues faced during natural disasters as well as future issues in space exploration. After she received the funds from MSGC, Amy was able to apply for and receive even more funding through the local community foundation that valued the investment MSGC made in Amy's efforts. After just a few years, her experientially-based lesson plans are well on the way to becoming her science curriculum throughout the year.

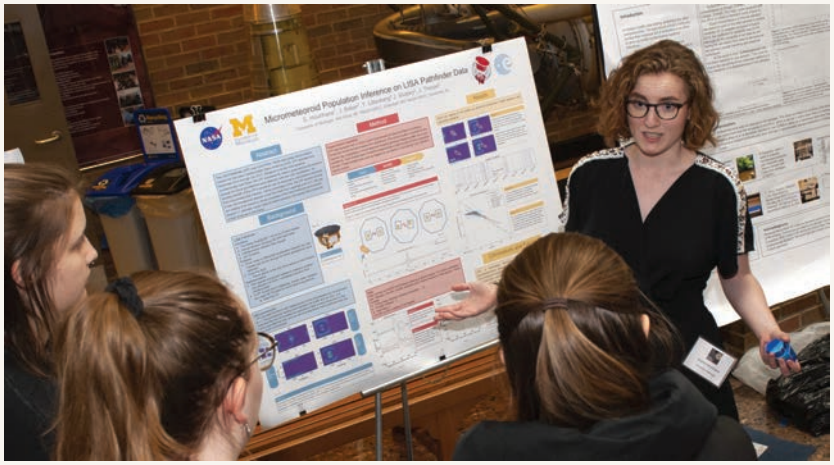
4th grade students from Caro, Michigan learn first-hand about earth science and extreme weather conditions though the use of tornado labs.

KUDOS FOR ACCOMPLISHMENTS

- Dr. Brian Nord (UM, MSGC Fellow alumni) appeared in NOVA Wonders cameos http://www.pbs.org/wgbh/nova/wonders/#universe-made-of
- EMU Prof. Patrick Koehn (PhD, UM) joined NASA HQ as a Program Scientist in the Solar and Heliospheric Physics program, working with current and future spacecraft teams as a point of contact at NASA.
- Prof. Bopiah Biddanda's (GVSU) "Postcard from the Field" in EOS Earth and Space Science News – October 2018

MSGC 2018 FALL CONFERENCE

Michigan Space Grant Consortium held an engaging Fall Conference on Saturday, November 10, 2018. This annual event is an opportunity for the MSGC award recipients and other groups from academia, industry, and the local community to share their research experiences and knowledge in areas related to NASA strategic interests. This year, over 120 people and 50 presenters participated. Keynote speaker Prof. Kristina Lemmer of Western Michigan University talked about student groups that are building and launching space-related technologies such as CubeSats and high-altitude balloons. The rest of the day was filled with talks and poster presentations by students and faculty from every affiliated college and university in the consortium.



Left: Thomas Bye from Michigan Technological University talks about the impact of respiratory muscle fatigue on upper-body work performance during space flight . Right: Sophie Hourihane from the University of Michigan discusses the research she did at NASA's Goddard Space Flight Center over the summer of 2018.

NEW FACES AT MSGC

Along with transitions to a new Director and UM lead-department this past year, Michigan Space Grant Consortium also saw turnover in three additional positions. A two-time alum of University of Michigan's College of Engineering (BS and MS in MSE), Brenda Vyletel (top right) joins MSGC as Program Manager. She brings with her years of technical and project management experience and a passion for STEM education. Dr. Khandaker Abir Rahman (middle right), the Chair and Associate Professor of Computer Science & Information Systems at Saginaw Valley State University (SVSU), is now on the MSGC executive board. Abir became familiar with MSGC through supervising multiple MSGC-funded undergraduate student research projects over several years. His research interest includes cybersecurity, behavioral biometrics, machine learning, and artificial intelligence. Tom Pachera (bottom right), the STEAM Coordinator for Ann Arbor Public Schools, has also joined the MSGC executive board this year as an expert in K-12 education. He has taught Technology Education for 29 years and currently teaches Introduction to Engineering Design and Engineering Design & Development courses for Skyline High School. MSGC is thrilled to welcome these talented individuals. Simultaneously, the consortium salutes the outgoing members of the core team - program coordinator Bonnie Bryant (UM) and board members Garry Johns (SVSU) and Michael Madison (AAPS), thanking them for decades of productive, dedicated service.

Program Manager
Brenda Vyletel

Board Member (SVSU)
Khandakar Abir Rahman

Board Member (AAPS)
Tom Pachera

MSGC 2017-2018 AWARD RECIPIENTS

Undergraduate Fellowships
Anna Barget (UM)
Josiah Brouwer (Hope College)
Thomas Bye (MTU)
Michael Dennis (Hope College)
Brandon Derstine (Hope College)
Lucas Essenburg (WMU)
Sean Gitter (Hope College)
Marcello Guadagno (MTU)
Montana Hauke (GVSU)
Noah Kochanski (Hope College)
Joseph Nichols (GVSU)
Zakry O'Brien (GVSU)
Anne O'Donnell (Hope College)
Nishva Patel (Oakland University)
Zachary Reinke (WMU)
Brian Seper (Calvin College)
Courtney Stewart (MSU)
Daniel Tjapkes (GVSU)
Katherine Underwood (SVSU)
Anna Washburn (Hope College)
Madelyn West (GVSU)

Graduate Fellowships
Abigail Azari (UM)
Nicholas Ingarra (Oakland University)
Matthew Kilgas (MTU)
Rachel Kirpes (UM)
Katie Knapp (GVSU)
James Logan (MSU)
Jessica Maldonado (MSU)
Luis Martinetti (MSU)
Stephen McNamara (UM)
Heather Miller (MSU)
Kevin Nevorski (MTU)
Alicia Schooley (UM)
Nagual Simmons (WMU)
Dana Wessels (GVSU)

Research Seed Grant
Amanda Eckermann (Hope College)
Erik Fredericks (Oakland University)
Geoff Lenters (GVSU)
Anyi Liu (Oakland University)
Chris Nakamura (SVSU)
Paul Pearson (Hope College)
Katharine Polasek (Hope College)
Darren Proppe (Calvin College)
Yuejian Wang (Oakland University)

NASA Interns
Joseph Backlas (MSU)
Michael May (UM)

Teacher Training, Public Outreach, PreCollege
Susan Brown (Hope College)
Alec Gallimore (UM)
Charles Gibson (Michigan Science Center)
Karen Gipson (GVSU)
Chris Kobus (Oakland University)
Sara Maas (GVSU)
Eric Mann (Hope College)
Rose Martell (MTU)
Maria Newhouse (Kalamazoo Air Zoo)
Doug Oppliger (MTU)
Shawn Oppliger (Western Upper Peninsula Center for Science, Mathematics, and Environmental Education)
Chelsea Ridge (GVSU)
James Sheerin (EMU)
Kevin St. Onge (Eastern UP ISD)
Gerry Thompkins (ESD)
Deanna van Dijk (Calvin College)
Maria Webb (DAPCEP)
Randy Willett (Community Resources Volunteers)

MSGC 2019 CALENDAR

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February 7, 2019

Award decisions for 2019-2020 funding

July 20, 2019

50th Anniversary of Apollo landing on the moon

September 1, 2019

Applications open for next funding cycle

October 12, 2019

MSGC Fall Conference
Ann Arbor, MI

November 13, 2019

Applications close for next funding cycle

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