PennState
Educational Equity

2016 Summer STEM Institute
Executive Summary

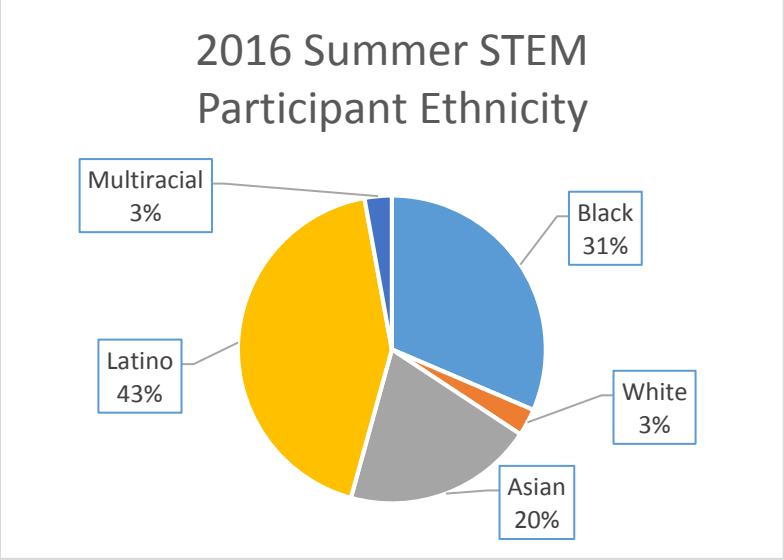
Ms. Angela Miller, Director

The Upward Bound Math and Science (UBMS) program at The Pennsylvania State University is federally funded from the U.S. Department of Education and is designed to strengthen the math and science skills of low-income, first-generation potential college students. The goal of the program is to help students recognize and develop their potential to excel in math and science and to encourage them to pursue postsecondary degrees in math and science, and ultimately careers in the math and science profession.

Program services include: a summer program with intensive math and science training; exposure to University faculty members who do research in mathematics and the sciences; computer training; and participant-conducted scientific research under the guidance of faculty members or graduate students, who are serving as mentors.

2016 Summer STEM Institute

The UBMS 2016 Summer STEM (Science, Technology, Engineering and Mathematics) Institute was held June 11 through July 21 at Penn State. This past summer, thirty-five tenth through twelfth grade students from Harrisburg, Reading, and Woodland Hills high schools participated in a six-week intensive residential program designed to increase their interest and aptitude in STEM professions. Participants had the opportunity to learn about STEM careers of interest from current Penn State students, faculty, staff, and other professionals outside the University. The participants identified a wide range of career interests, including, but not limited to: Aerospace Engineering, Biomedical Engineering, Chemical Engineering, Computer Software Engineering, Epidemiology, Forensic Science, Geoscience, Kinesiology, Microbiology, Nuclear Engineering, Pharmacy, Robotics, and Veterinary Science.



Participant Demographics

Over 88 percent of the participants were from low-income families and over 94 percent of the participants would additionally be the first person in their family to attend and graduate from higher education. All students are currently pursuing a rigorous program of study while in high school, colloquially defined as a college preparatory curriculum. The average high school grade-point average of the Summer STEM Institute participants was 3.35, with a strong emphasis in upper level science and math coursework.

Academic Coursework

Classes and activities offered during the Summer STEM Institute were specifically designed to provide a collegiate experience and increase a student's skill level and/or confidence in a particular subject. During the day, students completed coursework in Math, Science, Research Writing, Computer Skills, Public Speaking, and Library Science. While some students used this opportunity to remediate in coursework they had struggled with during the previous school year, most elected to take classes that would challenge them and provide a framework for success upon return to their school in the fall. Students also had the opportunity to take the following enrichment courses: Leadership, College Preparation, and Social Justice. In the evenings, students

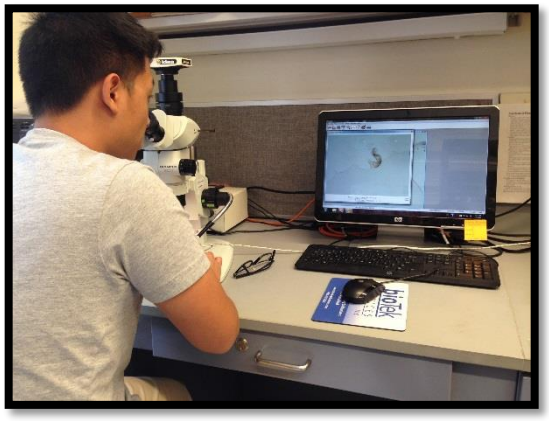
participated in teambuilding activities, enjoyed social events with peers from other school districts, and completed homework assignments in preparation for the next day.

Instructors for the Summer STEM Institute were made up of current collegiate faculty; current graduate students with the College of Education; local teachers; as well as Penn State seniors majoring in Education. All students were issued a UBMS laptop for use during the entire six weeks and instructors utilized technology for the majority of their coursework. Students became familiar with posting assignments to the Penn State Course Management System (ANGEL) and learned how to collaborate via technology.

Partnerships

Since 1998, the UBMS program has collaborated with faculty from various STEM fields at Penn State to provide opportunities for UBMS scholars to work with faculty, graduate students, and undergraduates on conducting hands-on research projects. The partnership between UBMS and the College of Earth and Mineral Sciences began in 1998 and was later augmented by partnerships with the Eberly College of Science in 2007 and the College of Agricultural Sciences in 2013. Since 1998, nearly 1,000 low-income, first-generation high school students have had the opportunity to work in top-notch research facilities, learn from world class research experts, and gain valuable skills paving the way to a successful college experience.

In summer 2016, thirty-five students completed mentored research projects in addition to their challenging academic coursework. These students were assigned to sixteen research teams sponsored by faculty with the College of Agricultural Sciences Summer Experience (CASSE), the Summer Experience in the Eberly College of Science (SEECoS), and the Summer Experience in Earth and Mineral Sciences (SEEMS). Students received intensive lab training and mentoring from faculty and graduate student mentors six hours per week. Through the course of the program, students learned how to conduct collegiate-level research, and gave a juried presentation on their findings. In addition, the following contributions were received this past year:



College of Agricultural Sciences Summer Experience (CASSE) Contribution:
Mr. Derek James, coordinator of Multicultural Programs within the College of Agricultural Sciences, is the liaison for the partnership between UBMS and the College of Agricultural Sciences. This year, UBMS was fortunate to have three faculty and four graduate student mentors who dedicated their time, lab space, and resources to the success of the Summer STEM Institute over a six-week period. Additionally, through a partnership with EOPC (Equal Opportunity Planning Committee through the Office of the Vice Provost for Educational Equity), the College of Agricultural Sciences provided stipends to the graduate mentors who assisted UBMS students in the amount of $3,500.

Summer Research Experience in the Eberly College of Science (SEECoS) Contribution:
Dr. Lori Van Der Sluys, Eberly College of Science Outreach Fellow, is the liaison for the partnership between UBMS and the Eberly College of Science. This year, six faculty and twelve graduate student mentors dedicated their time and lab space to the students with the UBMS Summer STEM Institute. In addition, through funding received by various National Science Foundation grants, the Eberly College of Science was able to provide stipends for graduate mentors and offset the costs of materials for the UBMS students.

Dr. Kristin Dreyer, program director for Education and Outreach, Center for Nanoscale Science, partnered with UBMS for the Central Pennsylvania Festival of the Arts – Children and Youth Day (i.e., Arts Fest Kid's Day), held

Wednesday, July 13. UBMS students, working in multi-level teams with current Penn State undergraduates and graduate students, prepared and conducted fun and educational activities at nine science experiment booths with patrons of Arts Fest Kid's Day. Science experiments were primarily focused in Physics, Chemistry, Biology, and Geology and covered the following topics: Bridges, Thin Film Rainbows, Light and Optics, Graphene, Music and Sound, Liquid Nitrogen Ice Cream, Light and UV Beads, Mirrors and Reflection, and Acid-Base Indicators.

Summer Experience in Earth and Mineral Sciences (SEEMS) Contribution:
Mr. James Guyton, coordinator of Multicultural Programs within the College of Earth and Mineral Sciences, is the liaison for the partnership between UBMS and the College of Earth and Mineral Sciences. Support for SEEMS has come from direct financial support through the National Science Foundation program "Opportunities to Enhance Diversity in the Geosciences," which totals $25,000 annually for four years. Additional monies are provided from funds awarded to Dr. Tanya Furman, associate vice president and associate dean for Undergraduate Education, when she received the Presidential Award for Excellence in Mathematics, Engineering and Science Mentoring, conferred by President Bush in 2005. As a result, the UBMS Summer STEM Institute was fortunate to have five faculty who invested their time, lab space, and materials as well as stipends for seven graduate student mentors.

Earth and Space Science Partnership (ESSP) Contribution:
Apart from the colleges previously mentioned, the Earth and Space Science Partnership (ESSP) is a five-year, National Science Foundation funded $9.2 million award, which supports UBMS. Under the direction of Dr. Tanya Furman, associate vice president and associate dean for Undergraduate Education, ESSP provides funding and support for three important components of the program. They are: $1,000 stipends for participating high school students, stipends for undergraduate/graduate mentors, and professional development for mentors. For further information about the ESSP program, please visit **http://essp.psu.edu/**

Equal Opportunity Planning Committee (EOPC) Contribution:
The Equal Opportunity Planning Committee through the Office of the Vice Provost for Educational Equity, provides $10,500 annually in support of UBMS. This year's support provided UBMS students with funding to travel to visit several colleges and cultural sites in Erie, Pennsylvania, at the end of the summer program. Students had an opportunity to tour Allegheny College, Edinboro University of Pennsylvania, Gannon University, Penn State Behrend, and Mercyhurst College as part of the trip. Students were also invited to take part in a tour of the General Electric Transportation, Locomotive Division facilities in Erie, which is described in more detail below. Additional EOPC support is provided through funding of the CASSE partnership ($5,000), as previously noted. EOPC also supports an Eberly College of Science program "Summer Research Experience" ($1,300) that focuses on creating a welcoming climate for students who attend ECoS (Eberly College of Science) summer programs, in which SEECoS students participate. For further information about EOPC, please visit **http://equity.psu.edu/eopc**

General Electric Transportation, Locomotive Division (GE) Contribution:
On Wednesday, July 20, the GE Transportation, Locomotive Division hosted the UBMS students for an in-depth look at how locomotives are manufactured, as well as career information for those interested in working in industry. UBMS students had an opportunity to tour the assembly building where we viewed a locomotive engine in the final stages of completion as well as the innovation lab where we learned about 3D printing and how it relates to the engineering process. The engineers then facilitated a "beginner" engineering task and discussion followed around the topic of teamwork, engineering, and other business related issues that students will encounter in the "real world" when they work for an engineering firm. After a lunch hosted by GE and several engineers, we toured the innovation center "high bay lab" focusing on locomotive engineering advances. Students had an opportunity to ask current engineers about their career, collegiate training, high school preparation, and future goals. For further information about the diversity and inclusion initiative at GE, please visit **http://www.getransportation.com/diversity-inclusion**.

Upward Bound Math and Science program students with representatives from the General Electric Transportation, Locomotive Division, July 20, 2016.

The Bayer USA Foundation Contribution:
The UBMS program receives corporate support from the Bayer USA Foundation as part of a long-standing relationship with Penn State to develop the next generation of global leaders in materials science and engineering. Both UBMS and Bayer share a similar goal: to encourage underrepresented students to enter math- and science-related careers through hands-on, intensive, relevant, year-round intervention. To that end, Bayer provides $75,000 per year to underwrite the housing, food, and activity costs associated with students from Woodland Hills High School in Pittsburgh to attend the UBMS Summer STEM Institute. For further information about the Bayer Foundation, please visit
http://www.bayer-foundations.com/en/homepage.aspx

Engaged Scholarship at Penn State

College of Education:
The UBMS program partnered with the College of Education to identify potential engaged scholarship opportunities for undergraduates. As a result, the UBMS program was able to hire several current Penn State

College of Education students to serve as teaching faculty for the academic portion of the summer program. These students had completed at least 91 credits of collegiate instruction and had to demonstrate a commitment to helping underrepresented students realize their potential academically. This partnership was very beneficial to both UBMS students and Penn State undergraduates.

Research Presentations

The UBMS Summer STEM Institute Research Symposium was held on Monday, July 18, from 9:30 a.m. to 3:00 p.m. in the Foster Auditorium, located in the Paterno Library on Penn State's main campus. Student research groups gave a ten minute presentation about their findings and fielded questions from the audience. A panel of seven judges from Chemistry, Agricultural Sciences, Earth and Mineral Sciences, the Office of the Vice Provost for Educational Equity as well as Education and Public Policy were represented. Panelists were asked to critique and score each presentation according to an extensive rubric that measured the following criteria: verbal communication; nonverbal communication; integration of visual aids and technology; use of graphs, tables, and statistics; purpose of the research; methods and procedure; results and discussion of findings. Research teams could earn a score of "4" on each of the aforementioned criteria, with their highest possible overall average score being a "4." Of the thirteen research teams, presentation scores ranged from 3.24 to 3.898. A video of the 2016 Research Symposium can be found on the UBMS website **http://equity.psu.edu/ubms.**

Research Presentation Winners

The following teams were judged to have the highest scores in their respective categories:

College of Agricultural Sciences Summer Experience (CASSE)
The first place winner out of a total of three research groups was group G: *It's invisible but is there: detection and sequencing of a plant virus* under the direction of Dr. Cristina Rosa, Plant Pathology and Environmental Microbiology, and graduate mentor Paolo Margaria from Plant Biotechnology. One eleventh grade student and one tenth grade student from Reading High School were awarded this honor.

Summer Research Experience in the Eberly College of Science (SEECoS)
The first place winner out of a total of six research groups was group E: *The Search for Exoplanets, the Search for Life* under the direction of Dr. Catherine Grier Beatty, Astronomy and Astrophysics, and graduate mentors Kimberly Cartier and Michael Rodrurk, both from Astronomy. One twelfth grade student from Reading and one tenth grade student from Harrisburg were awarded this honor.

The second place winner out of a total of six research groups was group D: *Exploring plant-insect ecological networks* led by Dr. Katriona Shea, Biology, and graduate student mentors Laura Russo and Joe Keller, both from Ecology. Two students were awarded this honor: A tenth grader from Harrisburg and an eleventh grader from Woodland Hills high school.

Summer Experience in Earth and Mineral Sciences (SEEMS)
The first place winner out of a total of four research groups was group M: *Two Dimensional (2D) superconductor-Niobium (II) sulfide* under the direction of Dr. Joan Redwing, Materials Science and Engineering, Post-Doctorate student Tanushree Choudhury, Materials Science and Engineering, and graduate

student mentor Azimkhan Kozhakhmetov, Materials Science and Engineering. One twelfth grade student from Reading high school, as well as one twelfth grade and one tenth grade student from Harrisburg were awarded this honor.

Overall 2016 Summer STEM Institute Research Group Winner - SEEMS
Receiving the highest score of any research group with a high score of 3.898 was research group K: *Understanding Reactive Transport of Marcellus Shale Waters in Natural Aquifer Systems* under the direction of Dr. Li Li, Energy and Mineral Engineering, and graduate mentors Zhang Cai and Wei Shi from Petroleum Engineering. Two Reading high school students in the tenth and eleventh grade won this honor.

More information about the Upward Bound Math and Science program at Penn State can be found on our website: **http://equity.psu.edu/ubms.**

Upward Bound Math and Science program students following the 2016 Research Symposium.

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