

# PENNSTATE



## UPWARD BOUND MATH *and* SCIENCE PROGRAM

### 2014 Summer STEM Academy 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.

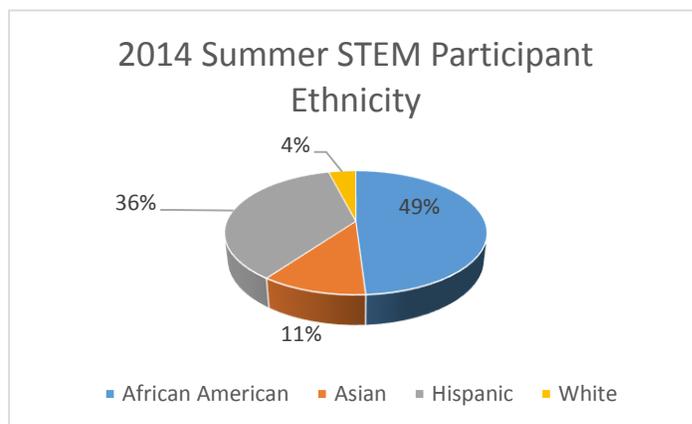
Program services include: summer programs with intensive math and science training; exposure to University faculty members who do research in mathematics and the sciences; computer training; and participant-conducted scientific research under the guidance of faculty members or graduate students, who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

### **2014 Summer STEM Academy**

The UBMS 2014 Summer STEM Academy was held June 15 through July 25 at Penn State. This past summer, forty-seven ninth through eleventh grade students from Harrisburg, Martin Luther King, and ASPIRA Olney Charter in Philadelphia, 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, Chemical Engineering, Computer Software Engineering, Epidemiology, Forensic Science, Geoscience, Microbiology, Nuclear Engineering, Robotics, and Veterinary Science.

### **Participant Demographics**

Over 91 percent of the participants were from low-income families and over 77 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 Academy participants was 3.05, with a strong emphasis in upper level science and math coursework.



### **Academic Coursework**

Classes and activities offered during the Summer STEM Academy 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 Foreign Language. 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 select from the following elective courses: Intro to Kinesiology, Nuclear Energy, College Essay Writing 101, Intro to Drawing, and Best Practices in Social Media. 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 Academy were made up of current collegiate faculty; current graduate students with the Colleges of Earth and Mineral Sciences, Education, Arts and Architecture; Residence Life; 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.

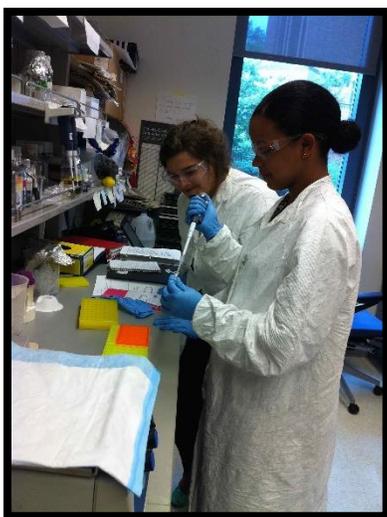
### **Partnerships**

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 2014, forty-seven students completed mentored research projects in addition to their challenging academic coursework. These students were assigned to nineteen 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 four faculty and four mentors who dedicated their time, lab space, and resources to the success of the Summer STEM Academy 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 was able to provide stipends to the graduate mentors who assisted UBMS students.



#### **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, twelve faculty and nineteen mentors dedicated their time, lab space, and in some cases an investment of financial resources to the students with the UBMS Summer STEM Academy. 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. Additionally, the housing and food costs of three UBMS participants was provided by a faculty member in the Eberly College of Science totaling \$4,200.

Ms. 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 10. UBMS students, working in multi-level teams with current Penn State undergraduates and graduate students, prepared and conducted fun and educational activities at eleven science experiment booths with patrons of Arts Fest Kid’s Day. Science experiments were on the following topics: Electricity in a Number 2 Pencil, Scotch Tape Helps Win Nobel Prize, World’s Largest Graphene Model, Pocket tech – Color Display, Color Wheels – Mixing Light, Colorful Chromatography, Solar Energy, Sun Paper Imprints, UV Bead Bracelets, Hot + Cold = Electricity, Liquid Nitrogen Ice Cream.



#### **Summer Experience in Earth and Mineral Sciences (SEEMS) Contribution:**

Ms. Pauline McCarl, administrative support coordinator with 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 Academy was fortunate to have six faculty who invested their time, lab space, and materials as well as stipends for five graduate mentors.

This year, EMS provided UBMS with two graduate students to teach math and science courses during the academic component of the summer program, offsetting their wages as further commitment to the success of UBMS. This partnership provided students with high-quality instruction as well as mentoring in STEM fields. One of the graduate students was able to arrange for a behind-the-scenes tour of the Smithsonian Natural History museum while the UBMS students were visiting Washington, D.C. at the end of the summer program. Students received a first-hand look at the Smithsonian’s mineral storage and cataloguing system as well as the secure storage area known as the Blue Room and nearby Gem Vault. An overview of the tour can be found here: <http://www.gia.edu/gia-news-research-smithsonian-gem-mineral-collection>

#### **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 Washington, D.C. at the end of the summer program. Students had an opportunity to visit the Smithsonian Natural History Museum, the Capitol, and several monuments in the National Mall. Students were also able to tour Georgetown University and Howard University as part of the trip. 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 summer programs, in which SEECoS students participate. For further information about EOPC, please visit <http://equity.psu.edu/eopc>

### **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 \$50,000 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 Academy. For further information about the Bayer Foundation, please visit <http://www.bayer-foundations.com/en/homepage.aspx>

### **Research Presentations**

The UBMS Summer STEM Academy Research Symposium was held on Monday, July 21 from 8:00 a.m. to 4:00 p.m. in the Berg Auditorium, located in 100 Life Sciences Building on Penn State's 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, 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 nineteen research teams, presentation scores ranged from 3.1 to 3.82.

### **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 C: *CSI Microbiology – What's that in your burger?* under the direction of Dr. Vivek Kapur, Veterinary and Biomedical Sciences and mentors Dr. Lingling Li, research associate, and Robab Katani, graduate student. Three eleventh grade students from Harrisburg, Olney Charter, and 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 eleven research groups was group K: *Watching the primary cilia live* under the direction of Dr. Aimin Liu, Biology, and Xuan Ye, fifth year graduate student. Two eleventh grade students from Reading High School were awarded this honor.

Two teams tied for second place out of a total of eleven research groups. The first was group M: *Combinatorial Synthesis of Azo dyes and study of their structure activity relationship* under the direction of Dr. Alexander Radosevich, Chemistry, and Samantha Damiano, second year graduate student. Three students were awarded this honor: An eleventh and ninth grader from Harrisburg, and an eleventh grader from Olney Charter High School.

The second of two teams who tied for second place was group L: *Exploring Lithium Ion Battery at Different Temperatures* led by Dr. Thomas Mallouk, Chemistry, Jennifer Dysart, Rosemary Kanters, and Chris Li, all graduate students. An eleventh grader from Woodland Hills and a ninth grader from Harrisburg High School were awarded this honor.

### **Summer Experience in Earth and Mineral Sciences (SEEMS)**

The first place winner out of a total of five research groups was group Q: *Chemical Fingerprints of Plants in the Environment* under the direction of Dr. Katherine Freeman, Geosciences, and Christine Doman, graduate student. Two eleventh grade students from Harrisburg and Olney Charter, and a ninth grader from Reading High School were awarded this honor.

The second place winner out of a total of five research groups was group S: *Identify Molecules in the Universe with a Pinch of Theory and a lot of Supercomputers* led by Dr. Ismaila Dabo, Materials Science and Engineering, and Dr. Nicolas Poilvert, postdoctorate. An eleventh and a tenth grade Harrisburg student were selected for this honor in addition to one tenth grade student from Reading High School.

### **Overall 2014 Summer STEM Academy Research Group Winner**

Receiving the highest score of any research group with a high score of 3.82 was research group P: *A Weather Forecast Verification Study*, under the direction of Dr. Jon Nese, Meteorology, Dr. David Titley, Meteorology, and graduate student Alison Stidworthy. Two Harrisburg high school students in the tenth and eleventh grade won this honor. Further information about this particular research group can be found here:

<http://news.psu.edu/story/322605/2014/08/11/academics/college-ems-upward-bound-math-and-science-team-takes-top-honors>

### **Evaluation**

Instructors for the UBMS Summer STEM Academy were asked to complete an evaluation of program services and to rate their experience as an instructor for UBMS. The following are a few of the comments made by teachers in response to the question:

- “Very positive. This group was enthusiastic and worked well together.”
- “This class was engaged, hard-working, and respectful. They came prepared, asked for even more concepts and worked well together.”
- “The class room was a respectful and safe environment where students encouraged each other.”
- “A majority of the students had a positive attitude toward learning.”

Participants in the UBMS Summer STEM Academy were asked to complete an evaluation of program services. The following is a snapshot of some of the more note-worthy comments from the students:

What did you enjoy most about UBMS this summer?

- "I enjoyed all the opportunities the program allowed us to experience that I wouldn't have in Harrisburg."
- "I enjoyed the research experience the most."
- "Learning about the field I want to work in from the people who work in it now."

What is one thing you've learned this summer?

- "How to become a better public speaker."
- "I've learned how to work with different people."
- "I learned what it takes to be a college student and so many things that will help me grow as a person."
- "I need to stop procrastinating."
- "Be on time for everything. Be confident when public speaking."

Was the UBMS Summer STEM Academy a positive experience for you overall?

- "Yes, because it was a great experience and it filled my summer with educational fun."
- "It was a positive and worthwhile experience."
- "This was one of the best experiences of my life so far."
- "YES! It was an amazing experience for me that impacted me in a positive way!"
- "Yes, I learned many things."

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



UBMS students with Pennsylvania District Five Representative Glenn Thompson (center) while visiting Washington, D.C.

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