



GEORGE
MASON
UNIVERSITY

Periodic Elements

from the College of Science



New Century, New Science story, page 3

Mason researchers are helping to create new science to understand life.

Vol. 4 Fall 2010

cos.gmu.edu

Aspiring Scientists Start Hands-on Research in High School

For Temple Douglas and other students in the Aspiring Scientists Summer Internship Program (ASSIP), summer is more about lab experiments and research projects than vacation. This program for high school juniors and seniors and undergraduate students places participants alongside researchers in the College of Science (COS) and Mason's Krasnow Institute for Advanced Study to perform scientific research.

Offered through the Center for Applied Proteomics and Molecular Medicine in COS, the program was established in 2007 by codirectors Lance Liotta and Emanuel Petricoin. The students use the latest technology and work on real-world experiments—not just classroom-style projects—that may result in research findings that are published in top-tier scientific journals.

The experience that students gain through ASSIP sets them apart from their peers. Douglas, a participant in 2009 and 2010, learned about the program through her school's database of summer opportunities. "I had never done research before," she says, "and I wanted to try it over the summer. One of the categories was nanotechnology, which sounded really interesting."

Because several of her family members have had Lyme disease, Douglas wanted to use a specific type of nanoparticle to discover biomarkers for the disease. She presented the idea to Liotta and Alessandra Luchini, her mentor, who encouraged her to pursue this research. Her experiments were successful, and she is now first author on a patent, as well as first author on a peer-reviewed article published in the December 2010 issue of the *Journal of Biomaterials*. Douglas' test detects antigens



photo- Creative Services

Temple Douglas (left) and one of her mentors, Davide Tamburro, work in the lab.

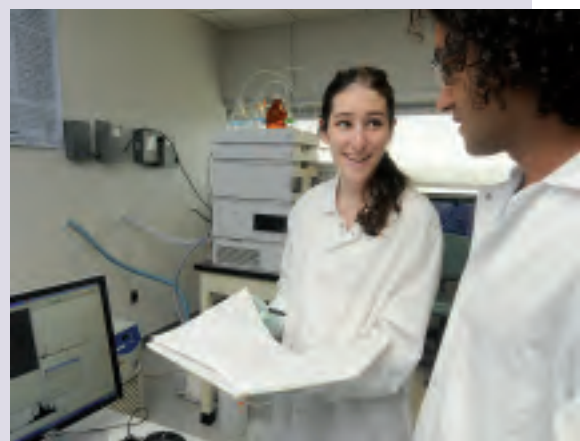


photo- Creative Services

Douglas (left) discusses her research on using biomarkers in Lyme disease testing with Tamburro.

“The program provides students the opportunity to become immersed in a cutting-edge research project, develop a scientific skill set, learn about the abundant career opportunities in science, and present their exciting work to the community.”

continued on page 2

Faculty Spotlight: Dann Sklarew Mason's Environmental Hero

While at a nature camp at age ten, Dann Sklarew first realized how much he valued nature. He had no idea that he would spend the next several decades evolving into one of Mason's environmental heroes. Building on a bachelor's degree in behavioral ecology from the University of Pennsylvania and a master's degree in cognitive science from Boston University, Sklarew followed in his mother's footsteps and came to Mason to pursue a graduate degree. He served as an ecology teaching assistant, adjunct instructor, and researcher until completing his doctoral degree in environmental biology and public policy in 2000. During the next

eight years Sklarew focused on international water management issues, leading a United Nations project that assisted communities around the globe. He returned to Mason in 2008 to engage in environmental collaboration and education closer to home.

Today Sklarew is an associate professor in the Department of Environmental Science and Policy (ESP) and associate director of the Potomac Environmental Research and Education Center (PEREC). For his tremendous enthusiasm and energy for teaching the next generation, he received Mason's 2010 Teaching Excellence Award.

Chris Jones, ESP professor and director of PEREC and the Mason Center for Conservation Studies, was Sklarew's doctoral advisor and has known him for more than seventeen years. "Dann has become an important component in ESP's ecology and aquatic biology offerings," says Jones. "He is untiringly dedicated to quality teaching."



photo: Creative Services

Dann Sklarew (right) receives the Mason Sustainability Hero Award from President Alan Merten at the 2010 Outstanding Achievement Awards ceremony.

Aspiring Scientists, from page 1

from infected ticks and patient body fluids. This method allows earlier disease detection compared to the current antibody-based method.

Amy VanMeter, program director, emphasizes ASSIP's unique aspects. "The program provides students the opportunity to become immersed in a cutting-edge research project, develop a scientific skill set, learn about the abundant career opportunities in science, and present their exciting work to the community. We believe programs like ASSIP will nurture future scientists who will be prepared to successfully enter the workforce."

For students, developing research skills and learning to think critically about science are key abilities and expertise for their future education and careers. Douglas finds that her ASSIP experience has benefited her in many ways. "I'm at Princeton [University] now, studying engineering, and the problem-solving skills I learned while working in the lab are invaluable. My mentor, Alessandra Luchini, was very supportive and helpful—always willing to explain concepts. ASSIP and the Center [for Applied Proteomics and Molecular Medicine] are a wonderful environment for learning."

Sklarew's accomplishments as an environmental leader were recently applauded university-wide when he was honored with the Mason Sustainability Hero Award. This annual award recognizes those who have furthered university sustainability efforts through their creativity, dedication, and heart.

Sklarew has a lot of heart when it comes to teaching and the environment. He is a faculty advisor to ten graduate students and serves on several environmental advisory boards. He is also active in NoVA Outside, a new alliance of Northern Virginia educators teaching people of all ages about environmental issues. Add to that his recent appointment as the university's Fellow of Sustainability Studies—a two-year assignment to promote education and research opportunities across Mason campuses—and raising twin toddlers in his personal time, and you have a busy man.

"I hope to help Mason grow its sustainability culture and identity—in our scholarship, education, and community service—so that one day my kids might be proud to be third-generation Patriots," says Sklarew.

Mapping Bacteria at the MicroBiome Analysis Center

Advances in bacterial research may help unlock many medical doors. In 2003 Human Genome Project researchers announced the completion of the international collaborative task to map the three-billion human DNA sequences. The results of the work will influence research for generations to come and have also created new avenues for science—namely microbiome research.

“We are looking at bacteria found in the human body and how it correlates with diseases and the environment.”

Patrick Gillevet, associate professor in the Department of Environmental Science and Policy, is leading the charge in the College of Science through the MicroBiome Analysis Center (MBAC). Gillevet, MBAC director, has been studying the genes of microbes since 1998 and developed Multitag Pyrosequencing (MTPS), a technology for sequencing microbial communities, in 2006. Scientists use this technology to examine, count, and barcode hundreds of thousands of microorganisms per day from samples taken from various ecological systems, including the human body. MTPS is the core of the center's research efforts.

“We are looking at bacteria found in the human body and how it correlates with diseases and the environment,” says Gillevet.

Through MBAC, Gillevet and his graduate students are working on data collection and analysis of bacteria and metabolites, a byproduct of bacteria. “Genetic sequencing technology created for the Humane Genome Project has advanced, and we can now do fifty years of work in an afternoon. Multitag Pyrosequencing is revolutionizing the study of microbial communities,” he adds.

The center's work is leading edge and requires new vocabulary to describe the findings and analyses. One new term is the metabiome, which refers to all the interactions among multiple organisms, specifically bacteria and fungi, that often live symbiotically in humans. Gillevet explains that the next generation of sequencing equipment now in use in the lab produces volumes of data on these organisms. The challenge now is to analyze the findings. “We need to identify bacteria by their function, and one type of bacteria found in one person with a disease may be different from another type of bacteria found in another person with the same

disease.” As researchers unravel the findings, they will be able to see correlations that may lead to new treatments and cures.

MBAC is currently involved in four collaborative efforts. In conjunction with Rush University Medical Center in Chicago, scientists are looking at microorganisms found in patients suffering from breast cancer, Crohn's disease, inflammatory bowel disease, cirrhosis of the liver, and HIV. This project is funded by more than \$1 million in grants from the Department of Defense and the National Institutes of Health.



Next-generation sequencing equipment speeds up MBAC data collection.

Alcoholic encephalopathy is the focus of studies with Virginia Commonwealth University and Hunter Holmes McGuire VA Medical Center in Richmond. Working with the U.S. Department of Agriculture, scientists are investigating obesity in Ossabaw pigs, and studies with Case Western Reserve University in Cleveland examine the oral mycobiome in HIV patients.

In addition to overseeing these large projects, Gillevet is teaching the next generation of researchers how to look at this new science. “We initially had only three to four students interested in the field per year,” he says, “but that number has expanded, and we are seeing dozens of applications each year.” He also has a student from Thomas Jefferson High School for Science and Technology, a regional public school that offers a specialized education for selected students, currently working in his lab on an environmental project about the degradation of dispersed oil by marine bacteria.

Gillevet says that he's “had students in his lab for the past fifteen years.” The challenge for these students is to keep up both with Gillevet and his passion for this new science and the new findings and changes that are constantly being discovered.

Governor's School and GeorgeSquared Programs Showcase COS at Mason's Prince William Campus

Two new programs at the Prince William Campus exemplify the College of Science's (COS) commitment to its mission to provide world-class scientific research and education to its students and the community. The Governor's School @ Innovation Park offers an advanced, intensive program for selected high school juniors and seniors interested in the science, technology, engineering, and mathematics (STEM) fields. GeorgeSquared is an innovative educational initiative between Mason and Georgetown University to prepare college graduates to enter health profession schools.

Governor's School @ Innovation Park: College Courses for High School Students



Biology instructor Kim Sanders (left) discusses an assignment with Briana Carter.

photo: David Kidd

The Governor's School @ Innovation Park brings together the Manassas city, Manassas Park city, and Prince William County public school systems to offer academically advanced students a unique curriculum in the STEM subjects. State-of-the-art research facilities at the Prince William Campus provide the perfect setting for these high school juniors and seniors to interact with Mason faculty and industry experts. In the planning stages since 2007, the Governor's School started its first semester this fall with sixty-four juniors enrolled in the two-year program. Going forward, school officials are planning for 120 students.

Karen Dalfrey, a three-time Mason alumna and program director, notes that this Governor's School differs from other governor's schools in many ways. "Our program is the first in Virginia to be affiliated with a four-year university," she says. "The dual enrollment opportunity allows students to earn high school and college credit through the undergraduate-level coursework."

“Our program sets an example of how Mason and other universities can create accomplished dual-enrollment schools and STEM programs for rising gifted and talented undergraduates.”

Having Mason faculty from COS on-site to work with the students is a unique feature for a governor's school, and the faculty are also helping with curriculum development. Guest speakers from a variety of COS departments emphasize the program's focus on earth sciences, sustainability, and biotechnology. Richard Diecchio, COS associate dean for academic and student affairs, says the program hopes to "attract the best of the best [students] from the three school districts. The school is innovative in that it has a half-day program focused on science and technology."

"A major goal of our program," adds Reid Schwebach, COS coordinator for the Governor's School, "is to provide a curriculum that both advances science learning at the transition from high school to college and sets an example of how Mason and other universities can create accomplished dual-enrollment schools and STEM programs for rising gifted and talented undergraduates."

Another aspect of the Governor's School is a mentorship program that involves local industry leaders in student education. Businesses, including BAE Systems, Dewberry & Davis, Dominion Power, ECS Mid-Atlantic, Lockheed Martin Corporation, Micron Technology, and Progeny Systems, among others, are supporting students in their research projects.

Dalfrey's hope is that the program will enhance interest in the STEM subjects and that the students will pursue degrees in these fields and ultimately establish careers in the local workforce. "We're hoping that the students are so impressed with what they see here at Mason that they want to stay here. We're trying to show them that there's a real need for them in the local workforce so that they'll want to go to Mason and stay in the area."



Governor's School students Joshua Paquin (left) and Varun Gupta work with biomolecules.

photo- Karen Dalfrey

“The GeorgeSquared program provides education in the biomedical sciences, along with technical training and advising for applying to medical schools.”

GeorgeSquared kicked off its first semester this fall with fifty-one students in the Advanced Biomedical Sciences Certificate Program. With a master's degree program projected to start in fall 2011, program administrators are planning for future enrollment increases.

Drawing on the strengths of each school (Mason in research, technology, and engineering, and Georgetown in biomedical sciences and education), GeorgeSquared also combines the talents, interests, and expertise of both schools' faculties. Georgetown's urban location makes facility expansion a challenge for which Mason's excellent research facilities at its Prince William Campus provide the solution.

(Editor's note: Donna M. Fox has been appointed director of the GeorgeSquared program. She previously served as an associate dean in the Office for Academic Integrity at Mason.)

GeorgeSquared: Biomedical Education for the 21st Century

Mason has partnered with Georgetown University to create GeorgeSquared, a postbaccalaureate program for health professional school applicants. For students who have completed undergraduate degrees, with or without premed coursework, GeorgeSquared enhances their science education for a variety of health professions, including medical, dental, and veterinary. The program also provides advising and support for professional school entrance exams and applications.

Adam Myers, interim program director, says, “Many students who are well suited for the medical profession may need that extra boost to enhance their undergraduate education. The GeorgeSquared program provides education in the biomedical sciences, along with technical training and advising for applying to medical schools.”

By increasing both Mason's and Georgetown's capacity for biomedical education, the program helps meet the growing demand for physicians and other medical bioscience experts. Dicchio notes, “The shortage of doctors across the country is worsening, and there are few programs for students who need to bolster their background before going to med school. The GeorgeSquared program enlarges the pool of applicants that both schools are able to admit.”



photo- Evan Cantwell, George Mason University

Mason Provost Peter Stearns (left) and Howard Federoff, executive vice president for health sciences at Georgetown University and executive dean of the School of Medicine, shake hands after signing a memorandum of understanding to create the GeorgeSquared program.

NanoNotes

Elements of distinction about the College of Science, its faculty, staff, and students

Lakshmi Matukumalli, Bioinformatics and Computational Biology, along with members of the Cattle Genomics Consortium, received the U.S. Department of Agriculture Secretary's Annual Honor Award for "helping America promote sustainable agricultural production and biotechnology exports as America works to increase food security." They were recognized for their novel discoveries leading to development of a commercial cattle DNA assay and developing methods for incorporating those data into the national dairy cattle genetic evaluation system.

Amanda Zirzow, Biology graduate student, received an award of \$1,500 from the Sigma Xi Grant-in-Aid of Research program to complete her work on the development of a novel type of vector for therapeutic siRNA delivery. She also presented her research at the 26th Southern Biomedical Engineering Conference hosted by the Fischell Department of Bioengineering at the A. James Clark School of Engineering, University of Maryland at College Park.

James Boddu, **Myurajan Rubaharan**, and **Maximillian Garland**, Biology undergraduate students, and **Mathieu Kurosawa**, Neuroscience undergraduate student, presented their research at the 2010 Sigma Xi Research Conference in Raleigh, N.C. Rubaharan was selected for best poster and presentation in the Cellular and Molecular Biology category for his work titled "Investigating the Role of RNAi Regulation in Class Specific Dendrite Morphogenesis." All four students are participants in Mason's Undergraduate Apprenticeship Program and are under the mentorship of **Dan Cox**, Molecular and Microbiology.

Galina Karman, BS Chemistry '10, was selected to be a RISE (Research Internships in Science and Engineering) intern in Germany, where she will work with research groups and be mentored by doctoral students. Housing and living expenses are provided by the program, which is part of the German Academic Exchange Service.

Erica Porter, BS Chemistry '10, was awarded a Fulbright Scholarship to pursue tuberculosis research at the Institut Pasteur in France.

Dimitris Papaconstantopoulos, Computational and Data Sciences, was recognized in the September issue of *Labstracts*, a publication of the Naval Research Laboratory, for his pioneering work in the U.S. Navy's superconductivity programs. He began work on the theoretical effort on superconductivity in 1973.

Allison Macfarlane, Environmental Science and Policy, received a \$160,000 grant from the MacArthur Foundation to support her work on the Blue Ribbon Commission on America's Nuclear Future. The commission was established by the Obama administration to provide recommendations for developing a safe, long-term solution to managing the nation's used nuclear fuel and nuclear waste.

Nigel Waters, Geography and Geoinformation Science, was named the Henrietta Harvey Distinguished Lecturer at Memorial University in St. John's, Newfoundland, earlier this fall. He gave a public presentation of "GIS Research: Why is it Important to the University and to the Public?" for his 2010 Henrietta Harvey Distinguished Lecture.

Avis Foster, Mathematical Sciences undergraduate student, was one of eighty-three college students nationwide to receive a GEICO Achievement Award. The \$1,000 awards are given to outstanding college students who have excelled academically in business, computer science, mathematics, or a related program and have demonstrated leadership on campus or in the community.

Harold Geller, Physics and Astronomy, was an invited speaker at the Almost Heaven Star Party at the Mountain Institute in Spruce Knob, W.Va., in September. His presentation, part of a weekend of activities for amateur astronomers, was titled "If the Galaxy is Full of Intelligent Civilizations, Why Haven't We Found Them Here? The Fermi Paradox."

Faculty and staff are encouraged to send their NanoNotes to cosnews@gmu.edu.

An Elemental Find

In 2009 Aryan Khojandi was a junior at Thomas Jefferson High School for Science and Technology, a public school that offers a specialized education for Northern Virginia students who are selected through a competitive admissions process. He had completed the school's physics curriculum and was on course to finish the mathematics curriculum by the end of the first semester of his senior year. He wanted something more and thought research was the answer. "I knew that I would require a mentor to 'get into' the research scene," says Khojandi.

His inquiries led him to Dimitrios Papaconstantopoulos, chair of the Department of Computational and Data Sciences (CDS) and previously a senior research scientist at the Naval Research Laboratory. Explaining that computational and data sciences research is usually performed by graduate students, Papaconstantopoulos says because Khojandi was from Thomas Jefferson, "I was willing to talk to him."

Together they agreed on a project where Khojandi would investigate the electronic structure and superconductivity power of radium. An element that has not been extensively researched, radium's atomic structure is related to calcium and allows for some suitable hypotheses. Khojandi embraced the research, which required an understanding of quantum mechanics.

"I started by giving him real assignments," says Papaconstantopoulos. He explains that Khojandi lacked a high-level mathematics and physics background and that he needed to just accept certain principles of quantum mechanics without proof. "He would quickly finish everything I gave him and wanted more, and he wanted to learn as much as he could. He was working at a graduate student level."

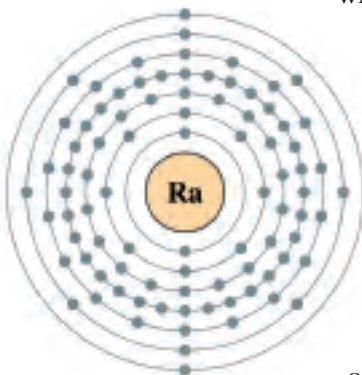
Khojandi and Papaconstantopoulos published their findings—"Electronic Structure Calculations and Determination of Related Properties for Radium"—in *The Physical Review* this past October. Their research showed that radium could become superconductive under pressure, but because of its radioactive properties, radium was not suitable for industrial use.

Khojandi had submitted an earlier version of the paper to the Siemens Competition in Mathematics, Science and Technology in summer 2009 and was named a finalist, a ranking that placed his project among the top thirty individual projects in the nation. He also submitted the paper to the Intel Science Talent Search and received semifinalist standing.

And last spring, he entered a regional science fair and advanced to the Intel International Science and Engineering Fair, where he placed second in the Physics and Astronomy category.

Accepted at most of the top research universities in the country, Khojandi is now a freshman at the Massachusetts Institute of Technology in Cambridge. He says that "the caliber of the undergraduate education at MIT is really unmatched." However, he attributes his research and time at Mason as a reason for his acceptance. "Perhaps the most important lessons gained from it [the research] were not the fine points of the calculations or of the underlying physics (though these were certainly helpful)," he says, "but rather those concerning the approach to research, the mindset, and the development of the wide variety of universally applicable analytical skills."

Papaconstantopoulos expects great work from Khojandi and is pleased that he and CDS will have contributed to that success.



Dean's Message



photo: Creative Services

Vikas Chandhoke
Dean, College of Science

Throughout history, scientific collaborations have been responsible for propelling humanity to solve problems and understand the natural world. In the early twentieth century, Marie and Pierre Curie were pioneers in radioactivity research. A few decades later, James Watson and Francis Crick unraveled the mystery of the structure of a DNA molecule. Thousands of researchers across the globe have expanded on these seminal ideas, moving science in new directions.

In the College of Science, our mission is to move science in new directions, and we recognize the power of collaboration. In this issue of *Periodic Elements*, you will read about our unique collaboration with Georgetown University—GeorgeSquared, which responds to the need for advanced biomedical training for students preparing to enter health profession schools.

However, we also recognize the need to spark the creative genius at all levels of education and for all scientific disciplines. We do this through the Aspiring Scientists Summer Internship Program, the Governor's School @ Innovation Park, and one-to-one mentoring.

As one of the region's fastest growing research universities, we feel it is vital for the future of science to provide leadership and education to students of all ages throughout the community. If we grasp opportunities to expose students to real science and encourage their passions, we can feel proud of our efforts to move science in new directions.

College of Science Participates in the USA Science & Engineering Festival

As one of more than 350 academic, government, and corporate partners from around the country, the College of Science (COS) led Mason's participation in the inaugural USA Science & Engineering Festival held throughout the Washington, D.C., metropolitan area this fall. From October 10 through 24, a variety of events, seminars, and presentations were held throughout the region, with seventy-five satellite events held nationwide.



The festival concluded with a massive two-day Science Expo on the National Mall and at surrounding locations. Approximately 1,500 exhibits and demonstrations greeted the crowd of more than 500,000 potential scientists and supporters of all ages.

Faculty members and students from COS, New Century College, and the Volgenau

School of Information Technology and Engineering entertained and educated thousands of visitors at the expo with robots, antlers and horns from endangered animals, geography lessons, climate change demonstrations, genetically altered fruit flies, and much more. Earlier in the month, the university sponsored a panel discussion about the growing citizen science movement, titled "Do It Yourself: Tapping the Wisdom of Crowds," as a preamble to the festival.

According to event organizers, the festival was intended to "reinvigorate the interest of our nation's youth in science, technology, engineering, and math (STEM) by producing and presenting the most compelling, exciting, educational, and entertaining science gathering in the United States."



Biosciences doctoral student Eswar Iyer explains what can be learned from observing genetic mutations in fruit flies.

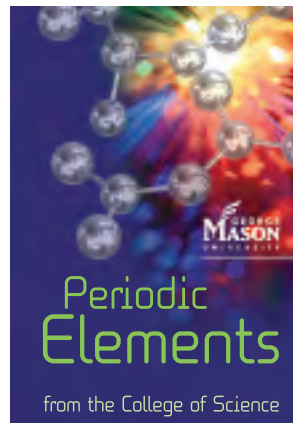
Padmanabhan Seshaiyer, Department of Mathematical Sciences, was named one of the festival's Nifty Fifty scientists and engineers charged with visiting middle and high schools in the region to encourage student interest in STEM disciplines. Selected from hundreds of nominations from around the country, he visited students at Patterson Mill Middle/High School in Bel Air and Montgomery Blair High School in Silver Spring in October and discussed the application of problem-solving techniques and mathematics to real-world problems.



photo- Creative Services



Are they horns or antlers? Jim McNeil, Mason Center for Conservation Studies at the Smithsonian Conservation Biology Institute in Front Royal, challenges this young student to choose the correct answer.



A publication of the
George Mason University
College of Science
cos.gmu.edu

Patty Snellings
Director of College Relations
College of Science
703-993-8783
cosnews@gmu.edu

Newsletter Editors:
Home Row Editorial
Sharon Ritchey, Liesl Wiederkehr
www.homerowed.com

Layout Designer:
Beth Moorcones, EWM Design