# Periodic Elements

from the College of Science

## Forensic Science Coming to Mason

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*From crime scene to classroom. New forensic science program prepares students for crime scene investigations.*

Vol. 2 Spring 2010 cos.gmu.edu

## Overcoming the Obstacles

photo- Creative Services

*Vikas Chandhoke*
*Dean, College of Science*

As the harshest, snowiest winter in a century buried our campuses, the irony that the College of Science is home to some of the world's most pre-eminent meteorologists and that we are now offering a new concentration in atmospheric science was not lost on us. Clearly, aside from all that we know about the weather, we still can't control it.

An unfortunate parallel can also be made with the grim budget cuts to higher education sweeping the Commonwealth. But unlike the weather, we can attempt to combat the loss of resources. Through creative planning and better utilization of proven strengths, we will identify new funding sources and develop unique programs that meet the work force demands and education needs of our region.

In this issue of *Periodic Elements,* you'll read about faculty and student researchers who are successfully competing for external funding to continue their work, collaborating with local jurisdictions to improve K-12 education, and infusing excellence among the ranks of women in science. An exciting graduate program in forensic science, already garnering attention around the country, is the college's response to a congressional mandate to provide high-quality education and training to forensic scientists nationwide.

And though we are battling smaller budgets, as we did the winter's snowfall, we will find a way to move beyond the problems and continue our search for answers to the most perplexing and fascinating issues of our day.

## Space Exploration on the Grandest Scale

February was an important milestone for NASA's New Horizons project, marking the first launch to an unexplored planet since Voyager took its first deep space pictures more than 30 years ago. The timeline on New Horizon's web site refers to the current activity as an "interplanetary cruise"— a cruise that began in February 2007 when the New Horizons team used Jupiter's gravity to catapult the spacecraft, which they launched from Earth toward Pluto in January 2006. The spacecraft will hurtle toward the outer edges of the Sun's solar system for another five years.

Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute (NASA/JHUAPL/SwRI)

*Artist's rendition of New Horizons spacecraft as it nears Pluto.*

"The fly-by of Jupiter was spectacular," says Michael Summers, newly appointed chair of the Department of Physics and Astronomy. "The spacecraft took some amazing photos of Jupiter and especially Io, the innermost of Jupiter's four large moons," he adds. Summers is co-investigator on the New Horizons project and a member of the team that proposed New Horizons to NASA. He has studied Io since 1985, when it was the topic of his doctoral thesis.

"Since then we've learned an enormous amount about Io, including the fact that it is the most volcanically active object in the solar system," says Summers. "The volcanism has produced a very unusual atmosphere made up of sulfur dioxide that flows from Io's day side to the night side, where it condenses out onto the surface creating supersonic winds. Io is the only known moon or planet that has an atmosphere like that. The volcanoes are so powerful that they throw material 200 miles above Io's surface."

Since 1994 Summers has also studied Pluto. His next role on the New Horizons mission is "to plan and interpret observations of Pluto's atmosphere once New Horizons gets there." The exploration of Pluto and its atmosphere has one of the National Academy of Science's highest priority rankings for this decade, and New Horizons is NASA's mission to

*continued on page 2*

## Faculty Spotlight: Jessica Rosenberg

# More Physics Teachers, Please

Jessica Rosenberg, assistant professor of physics and astronomy, scored another hit for the College of Science faculty when she was named a recipient of a National Science Foundation (NSF) CAREER Award last fall. It is the fifth CAREER Award captured by faculty members in the Department of Physics and Astronomy in recent years.

She'll be using the five-year NSF grant of $869,000 to recruit and train future science teachers — in particular, physics teachers. Rosenberg says, "Physics teachers tend to be in short supply."

*Jessica Rosenberg*

"Jessica is a brilliant observational astronomer," says department chair Michael Summers. "Mason is extremely fortunate to be able to recruit scientists of her caliber, both for the research expertise she brings to the university and for the opportunities she provides for student research projects."

Rosenberg plans to use a process she participated in at the University of Colorado while doing post-doctoral work. The process calls for recruiting gifted undergraduate students who show potential as science teachers and involving them with small study groups of fellow students to make introductory science courses more compelling and interactive.

> "Mason is extremely fortunate to be able to recruit scientists of her caliber, both for the research expertise she brings to the university and for the opportunities she provides for student research projects."

Other plans include hiring at least one student per summer who is on track to get a teaching certificate to help with research and to translate that research into a teaching model. She says, "It is useful for classroom teachers to understand what research entails if they are going to work with students and try to explain science to them." Currently Rosenberg has five undergraduate students working on various research and collaborative projects.

The prestigious NSF CAREER Award also contains a research component. Rosenberg's research will focus on combining and cataloging two previously separate types of recorded data on thousands of galaxies, which will facilitate other scientists' research.

The most recent addition to the physics department faculty, Rosenberg helps quell the concern about the lack of women in science, technology, engineering and math (STEM) programs because she is an active researcher who understands the challenges facing women entering scientific studies. She holds a doctoral degree in astronomy from the University of Massachusetts and a bachelor's degree in physics and astronomy from Wesleyan University in Connecticut. Rosenberg always has been interested in the planets and space and claims her role model in high school was a "fabulous" woman physics teacher who had a doctoral degree in nuclear chemistry.

*Space Exploration, from page 1*

fulfill this objective.

In addition to funding for both undergraduate and graduate students to work with him on the project, Mason's involvement in NASA missions such as New Horizons, according to Summers, "will enhance Mason's reputation as a research institution that will influence our future ability to obtain research grants." He adds that "it is also a great means to attract top students to Mason."

> The big payoff for Mason's involvement in projects such as New Horizons is in the science on the grandest scale, according to Michael Summers, chair of the Department of Physics and Astronomy.

Ultimately, however, the "big payoff" is in the science, says Summers. "This is exploration science on the grandest scale," he says. "Just to be involved in this kind of science is both an honor and an opportunity to advance scientific understanding of the Earth's place in the universe."

Prior to his appointment as chair of the physics department, Summers was associate chair and served as acting chair last summer. He says the most daunting challenge he faces heading the department is Mason's shrinking budget. "These are tough times for everyone in the Mason community, and we will all have to do more with less," Summers says. "But frankly, I love challenges. I wouldn't have become chair unless I really wanted to do it."

# From Crime Scene to Classroom

Picture this scene inside an office building: gunshot fragments, a spatter of blood, a piece of torn cloth, and a reported missing person. Outside is a partial muddy footprint facing a row of cars, along with the contents of a woman's handbag — lipstick, tissues, and a broken cosmetic mirror — scattered on the ground. It may be the opening scene in a late night crime drama, but it could also be a homework assignment for a course in the College of Science's (COS) new forensic science program.

Last spring an 18-credit Graduate Certificate in Forensics was offered for the first time. "This certificate is a great way to introduce students to this field," says William Whildin, a retired 20-year veteran of the Fairfax County Police Department and a former senior investigator in the Office of the Chief Medical Examiner of Virginia. Whildin assisted in the design of the program and serves as its first director. "We've had a lot of inquiries from local law enforcement officers who are looking to advance their careers with this specialized training," says Whilden, who is also quick to point out that the program is interdisciplinary. Students can either follow a traditional science-based track with toxicology, chemistry, and DNA sciences or take a less science-dependent track that covers criminal law, anthropology, and biochemical forensics.

*Evidence evaluation. A technique taught in the forensics program.*

A Minor in Forensic Science was developed to acquaint students with the technical, psychological, and legal aspects of the field. This program is a suitable asset for students majoring in biology or chemistry and also provides an attractive option for those majoring in the natural sciences, engineering, or computer science.

In addition, a new Master's Degree in Forensic Science will be offered in fall 2010. The new degree program is designed to give students a broad theoretical and practical background in the scientific, legal, and investigation principles of forensic science.

Whildin is enthusiastically digging into his new role. "This program is not about following pop-culture trends," he says, though he admits that crime novels, movies, and TV have spurred interest in the field. "There is a real need for improved national standards and trained forensic experts." COS understands this need and sees that our region has an especially large number of forensic facilities with the FBI, CIA, and area military bases, he adds.

The National Institute of Justice, part of the U.S. Department of Justice, released a report to Congress last year outlining the immediate need for better trained technical and legal forensic experts. As a result, Congress has put out a mandate for improved instruction and training. "There is also a growing private sector of forensic labs," explains Whildin, "as the government needs to outsource many of its projects to keep up with its forensic investigations related to the war."

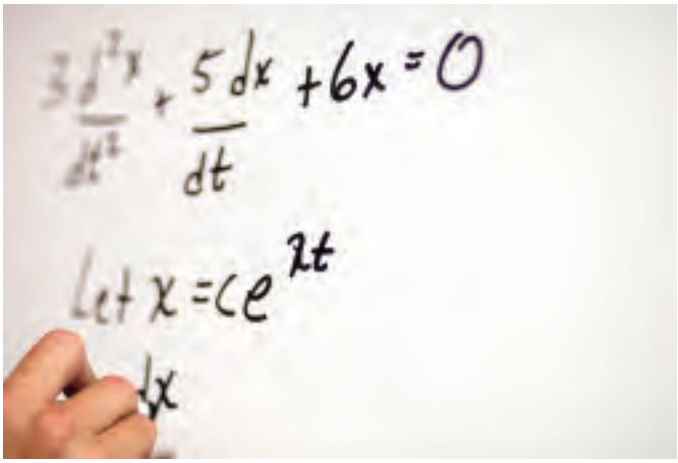
*Photos above and below, hands-on lab work in Mason chemistry labs and in local forensic labs.*

Whildin's vast experience and extensive personal field contacts combine to bring students unique learning opportunities in forensic science. He believes students need hands-on field work to truly learn the material, and he has designed the program to accomplish that. Students can expect their professors — often FBI agents and law enforcement experts — to come straight from the streets or, in many cases, the lab. Students review actual cases and learn the hands-on how-to of evidence collecting, identification, fingerprinting, shoe casting, and even identifying insects to determine a victim's time of death. Coursework relies on Mason's own labs for experiments and training, but students can also expect to visit actual working forensic labs courtesy of their professional faculty.

Whildin actively works to find local internships and job opportunities for students through his vast network of professional contacts. Though he won't guarantee that students will have jobs upon graduation, he says they will leave with specialized skills that are in high demand.

Applications are now being accepted for fall enrollment. Additional information is available at http://chemistry.gmu.edu/MSForensic.

# Math/Education Partnership to Create Center for Math Excellence




Their enthusiasm is contagious and their energy almost palpable as they discuss their plans. Padmanabhan Seshaiyer, associate professor in the Department of Mathematical Sciences, and Jennifer Suh, assistant professor in Mason's College of Education and Human Development, are about to launch another intensive professional development program for teachers of mathematics. Building on the success of their two previous collaborations — ACT NOW (Algebraic Connections and Technology in Middle Grades, 2008-2009) and IMPACT (Improving Mathematical Practices via Algebraic Connections and Technology in Elementary and Middle School Mathematics, 2009-2010) — Seshaiyer and Suh have been given the green light by the State Council of Higher Education for Virginia (SCHEV) to establish a professional learning and coaching center at Mason for K-12 math teachers.

Funded with two separate grants of about $350,000 each from the Virginia Department of Education, the new Center for Excellence in Mathematics Professional Learning and Coaching in Northern Virginia — nicknamed COMPLETE — will include summer institutes, seminars, content-focused webinars, and video and online coaching to help elementary and middle school math teachers, LEP (limited English proficient) teachers, and special educators improve their delivery of math instruction to students.

*K-12 math education programs excite teachers and students.*

Seshaiyer and Suh were asked by SCHEV to apply for the highly competitive grants as recently as last October. Part of the application process was to identify school district partners, and Seshaiyer and Suh will work on this new project with schools in Fairfax County, Loudoun County, and Prince William County, as well as schools in the cities of Falls Church, Alexandria, and Manassas.

The grants that support COMPLETE are an outgrowth of Improving Teacher Quality State Grants Awards, which were developed as a result of the No Child Left Behind Act. Seshaiyer and Suh will begin recruiting teachers from the six participating school districts this month. They expect to enlist 120 teachers for each grant to attend a summer institute tentatively planned to take place in early August.

## COMPLETE Objectives

There are a number of goals for COMPLETE, but Seshaiyer and Suh intend to focus primarily on the creation of a network of school district leaders, Mason faculty and students, national experts, nonprofit organizations, and business partners to accomplish the following objectives:

- Develop critical thinking, problem solving, communication, collaboration, and creativity skills in both teachers and students.
- Provide high-quality professional development for K-12 mathematics teachers.
- Provide academic opportunities for economically disadvantaged students and those who have limited English proficiency.
- Develop an e-learning technology infrastructure at Mason that contains mathematics education modules for teachers and students.
- Research and evaluate the effectiveness of teaching practices and student learning outcomes.

# Geospatial Intelligence: Modeling the World


*A look inside the new geospatial intelligence lab.*

Peering through the window of the new geospatial intelligence and geoinformatics lab in the College of Science is like staring at a mission control post on a movie set. Four large flat-panel screens display images from a revolving 3-D model of the Fairfax Campus, as well as real-time graphic placement of ships at sea around the world and satellite images of clouds. A bank of computers, powered by sophisticated six-figure software generously donated by Intergraph Corporation, takes up most of the space. The lab is part classroom and part research center — and if Anthony "Tony" Stefanidis, the lab's enthusiastic director, has anything to say about it — it will soon be command central for Northern Virginia's booming geospatial intelligence industry.

Geospatial intelligence — the study of the collection, organization, and management of physical features, buildings, objects, people, activities, and events within an area — has tremendous industry and military applications. "Anything that has a physical footprint can be modeled and mapped," says Stefanidis. "We can model and predict the movement of a chemical spill in the ocean or in a vapor cloud. We can also provide sophisticated real-time intelligence for soldiers on the ground entering unfamiliar combat areas." Much of this work is done by calculated modeling where a database of elements, such as buildings, roads, or geographic landmarks, are mapped and then applied to other areas around the globe. These images can be both street-level and birds-eye views and have pinpoint accuracy.

Two years ago, in response to guidelines and suggestions from the United States Geospatial Intelligence Foundation, the Department of Geography and Geoinformation Science created a Graduate Certificate in Geospatial Intelligence. Hoping to take this specialized training to the next level, Mason is now awaiting approval of its newly developed Master's Degree in Geospatial Intelligence from the State Council of Higher Education for Virginia. "There is tremendous interest in this program," says Stefanidis. "We currently have 60 students with plans to expand. The certificate is a great way to introduce students to the field, and the master's degree is a natural extension."

The geospatial intelligence industry has also expanded rapidly, with geospatial analysis becoming a key component of the intelligence community. The National Geospatial-Intelligence Agency, for instance, has plans to move 8,500 workers from other research facilities in the country to nearby Fort Belvoir. This influx of personnel in Mason's backyard will mean a greater demand for training and services that the university will be expertly qualified to provide.

"Northern Virginia," says Stefanidis "nationally has the highest concentration of federal agencies and companies in the geospatial intelligence industry." In the fall, Mason will host a regional conference for the Potomac Chapter of the Imaging and Geospatial Information Society. The conference, due to its location, will draw 250 of the country's leading researchers in this field to Mason.

Mason is one of only four universities in the country to offer this specialized training.

*Images of the Fairfax Campus and the world greet visitors.*

Mason is one of only four universities in the country to offer this specialized training. Contracts within the high-tech industry, particularly those with locally based giants such as BAE Systems, SAIC, and the U.S. Army, allow students to move beyond theoretical applications and into actual projects. Mason students are now working on modeling projects that will have a global impact.

Geoinformation science is rapidly changing as both hardware and software improve and modeling databases grow. Like any field that relies on technology, it will be different even six months from now. When asked how he became interested in this expanding field, Stefanidis, an engineer by training, laughs and says, "I just fell into it." Taking a more serious tone, he adds, "My job now is to help students navigate through all the constant changes and prepare them for what they will find in the work force." This work translates into internships and, ultimately, high-paying jobs.

Additional information on the geospatial intelligence program is available at http://gigc.cos.gmu.edu/index.cfm.

# NanoNotes

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

**Potomac Environmental Research and Education Center** hosted a community program titled "Does Time Outside Make Us Healthier?" on World Water Day (March 22). This was the inaugural event for the newly formed NoVa Outside: An Alliance of Environmental Educators, a regional network of educators, parents, students, and citizens interested in nature.

**Environmental Science and Policy** students and faculty members contributed substantially to the creation of Mason's first Climate Action Plan, which outlines strategies and projects to achieve carbon neutrality. After two years of development, the plan was accepted by university administrators in January.

**Darshan Desai**, undergraduate student in Biology, received the Outstanding Presentation Award at the Virginia Academy of Science Fall Meeting for Undergraduate Research, held in October, for his poster titled "Markers of Insulin Resistance During HCV Treatment: A Relationship to Sustained Virologic Response." As part of the award, Desai received a travel grant to attend the American Society for Biochemistry and Molecular Biology Annual Meeting in Anaheim, California, this spring. His work was performed in collaboration with Inova Fairfax Hospital.

**Abul Hussam**, Chemistry and Biochemistry, received an honorary doctorate of science from the University of Dhaka in Bangladesh during the university's 45th convocation in December. Hussam is an alumnus of the university.

**Kenneth Dere**, Computational and Data Sciences, received the Royal Astronomical Society's 2010 Group Achievement Award in Geophysics as a member of the society's CHIANTI team. Along with Dere, the team comprises scientists from the U.S. Naval Research Laboratory, the University of Cambridge (United Kingdom), and the University of Florence (Italy). The CHIANTI team developed an atomic database for astrophysical spectroscopy and was acknowledged for the establishment of a systematic, easy-to-use, and publicly available product, resulting in a significant impact on solar and stellar physics.

**Allison Macfarlane**, Environmental Science and Policy, has been appointed to the 15-member Blue Ribbon Commission on America's Nuclear Future, 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. The commission is co-chaired by former U.S. Rep. Lee Hamilton and former National Security Advisor Brent Scowcroft.

**Judith Skog**, Environmental Science and Policy, has been elected president of the Botanical Society of America. The three-year commitment includes one year each as president-elect, president, and past president. She currently is serving as president-elect.

**Dann Sklarew** and **Cindy Smith**, Environmental Science and Policy, have received additional funding from the National Oceanic and Atmospheric Administration to expand their watershed education program to include up to 21,000 seventh-graders from Fairfax County public schools, along with more than 15,000 sixth-graders from Prince William County public schools who already are participating. This unique three-year program will provide a significant watershed experience for middle school students while encouraging a personal interest in environmental stewardship.

**Peggy Agouris**, Geography and Geoinformation Science, has been elected to the Board of Directors of the United States Geospatial Intelligence Foundation. The mission of the foundation is to promote the geospatial intelligence tradecraft and to develop a stronger community of interest between government, industry, academia, professional organizations, and individuals who share a mission focused on the development and application of geospatial intelligence to address national security objectives.

**Harold Geller**, Physics and Astronomy, recently gave a community lecture titled "Radio Astronomy: More Than Meets the Eye" at the Great Falls Library. Geller explained how radio telescopes have unraveled the mysteries of a star's life cycle.

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

# NSF Funding for Math Majors

It's not exactly a well-kept secret, but according to Daniel Anderson, associate professor in the Department of Mathematical Sciences, "Students aren't always aware of this spectacular program." Anderson is referring to the National Science Foundation's Computational Mathematics Research grant, which supports up to 10 undergraduate math majors through a year's worth of individual research.

A specific objective of the grant is to prepare and encourage students to attend graduate school in mathematics or a related field. Because Anderson's research specialty is fluid dynamics, several students he has mentored in the program have based their study on the dynamics of human tear films — or dry eye syndrome — which he says is "an interesting and accessible problem for an undergraduate student." Two of Anderson's former students — Katlyn Winter and James Nong, whom he considers success stories — are now in graduate school, and a number of the program's students have been published or have received recognition for their research at national conferences.

What is unique about the program, says Anderson, is that it is an opportunity that "undergrads typically don't see." Those who are accepted into the program are able to work on individual research projects in computational mathematics guided by one of several faculty mentors. Students enter the program during the summer before their junior or senior year and continue throughout the following fall and spring semesters. Guided by their mentors, they work alone or in pairs on solving real-world problems using computer-based mathematical models. Students also learn how to write papers and create posters and have opportunities to present their research at conferences and seminars.

Through their individual research, students develop the ability to apply computational techniques to predict outcomes. The human tear film project is ongoing. "It is something I know these undergraduates can make progress on throughout the year," Anderson says. Other recent or current projects include material science applications, fluid structure interactions in aneurysm modeling, physics and gravitational lensing, and financial mathematics.

Computational mathematics is "an important field in which quantitative calculations can improve understanding of a problem," says Anderson. "And there is a lot of interest in applying these math methods in medicine and biology."

Students interested in the program should apply in March of their sophomore or junior year. Successful candidates will receive $11,000 to work on an individual research project through three semesters, as well as additional financial support to attend conferences across the country. Additional information is available at http://math.gmu.edu/urcm/.

Anderson says this is a "totally awesome opportunity" for any qualified math major.

*Rebekah Evans leading students through campus during the Sally Ride Science Festival.* photo- Creative Services

## Rebekah Evans, PhD Candidate

# The Sky is the Limit!

Look around the physics department at any university, and you'll see a preponderance of men. And while men traditionally dominate most science and technology departments, the College of Science is working to improve the balance with outstanding female faculty members and an atmosphere that attracts some of the brightest female research students in the nation.

Rebekah Evans is one of those students, and as a fourth-year physics graduate student, she knows what it's like to be the lone woman in a science class. While an undergraduate at the University of Delaware, she learned to cope with the intellectual isolation of being female in a male-dominated discipline. "Being a minority can lead to insecurities about being taken seriously," Evans says, "especially if you have an idea that is radically different or challenges commonly accepted ideas."

As a graduate student at Mason, however, Evans says she is delighted to find her classes more gender balanced. "I have a totally different experience," she says. "There are sometimes more women in the room than men."

Having completed her graduate coursework this past fall, Evans is now conducting her dissertation research in space weather. "My research is focused on events called coronal mass ejections (CMEs)," Evans explains. "During a CME, the Sun sends plasma and magnetic fields hurling into space. CMEs are the source of geomagnetic storms that can damage satellites and power grids."

Evans chose Mason for her graduate study in part for its close proximity to the scientific community in the Washington, D.C., metropolitan area. For example, because she and her advisor, Merav Opher, associate professor of physics and astronomy, collaborate with a scientist at NASA Goddard Space Flight Center, Evans has been able to spend time there. "Working outside the university is a fantastic opportunity," Evans says, "because it gives me a glimpse of what my future could be."

And what does the future hold for Rebekah Evans? Most likely post-doctoral work in space weather. For now, however, what motivates Evans about studying physics is "that you have the ability to make amazing discoveries, and the only thing that determines what you do is you. The sky really is the limit!"

# Passing the Torch to Tomorrow's Scientists

*Karen Dalfrey*

It only takes a brief chat with Karen Dalfrey — BS Biology '92, MS Education '03, PhD Biodefense '09 — to detect her contagious enthusiasm for science. Spend a few more minutes with her, and there's no doubt this enthusiasm is what fuels her passion for teaching and her dedication to her students.

But she wasn't always a teacher. Dalfrey began her career as a cytogenetics technician for a commercial medical laboratory. For more than a decade, she analyzed chromosomes and genetic variations in cell cultures that provided clues about cancer and other diseases. When she began teaching junior technicians, she discovered a new interest. "I found that I really enjoyed helping others get as excited about science as I was," she says.

This new interest led Dalfrey back to the classroom to prepare to teach high school students. She landed a faculty position in biology with Prince William County (Virginia) public schools nine years ago, and she was promoted to her current position as biotechnology center coordinator at Osbourn Park High School last year. Along the way, she again returned to Mason to "fill in the gaps" in her own education and learn about new technologies and developments in her field. "My goal was to be able to pick up any article about microbiology, environmental science, bioinformatics, or related fields and understand it," she explains, "and I can do that now."

Dalfrey administers the largest of the ten interest-based specialty programs offered to high school students in Prince William County. More than 800 students are enrolled in the biotechnology program, which integrates courses in history and English, along with science.

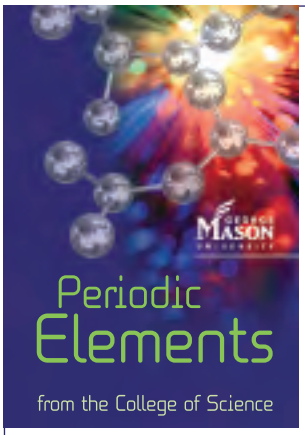
Admitting that she was "never a teacher to use the textbooks," Dalfrey brings real-world experiences to her students. Last fall she worked with the Prince William County Department of Economic Development and Mason's Prince William Campus to present the first Biotech Bonanza for high school students. The daylong program — which drew a capacity crowd and scored a hit with both students and parents — offered attendees an opportunity to meet with scientists and educators and learn about career options; participate in demonstrations involving DNA, forensics, and cutting-edge technologies; and attend workshops about preparing for college. She also arranges mentor experiences for her seniors enrolled in the program's independent research course.

Currently four students are working with College of Science faculty members at the Prince William Campus on projects in biology, chemistry, and environmental science.

Dalfrey thinks that seeing students reach that "light bulb moment" is one of the greatest satisfactions in teaching. "It's so important for them to realize the impact of what they're doing — both in the classroom and in their high school years, in general — and how hard they have to work to prepare for college."

## College of Science Convocation
## Thursday, May 13, 2010, 10:30 a.m.
### Recreation and Athletic Complex, Fairfax Campus

**Curt D. Jones**, founder and president of Dippin' Dots Inc., will deliver the keynote address. An inventor, entrepreneur, and microbiologist, Jones leads one of the fastest-growing and most innovative companies in the United States. His diverse business interests also include investments in medical software, development of ethanol fuel production technology, and the entertainment industry.

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