Periodic Elements

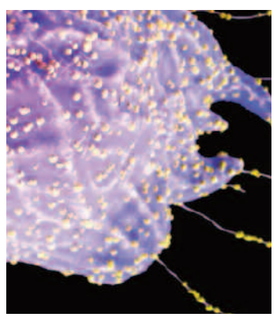
GEORGE MASON UNIVERSITY
Where Innovation Is Tradition

Fall 2013 No. 10

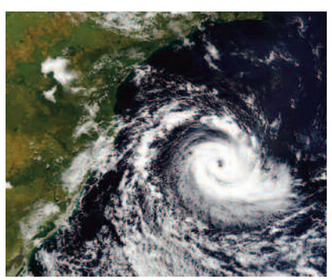
A Magazine from the College of Science

Inside:

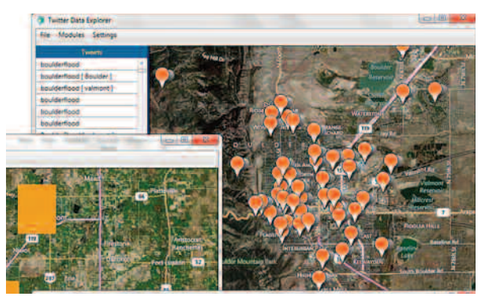
Inside
Periodic Elements



page 2



page 10



page 14

Periodic Elements

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

Administration
Peggy Agouris, Acting Dean

Evans Mandes,
Senior Associate Dean,
Finance and Personnel

Richard Diecchio,
Acting Associate Dean,
Academic and Student Affairs

Gregory Foster, Associate Dean,
Research and Computing

Martha Wescoat-Andes,
Associate Dean,
Administration

Aurilla Fusco, Assistant Dean,
Development and Alumni Affairs

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

Layout Designer:
Beth Moorcones, EWM Design
www.ewmdesign.com

On the Cover

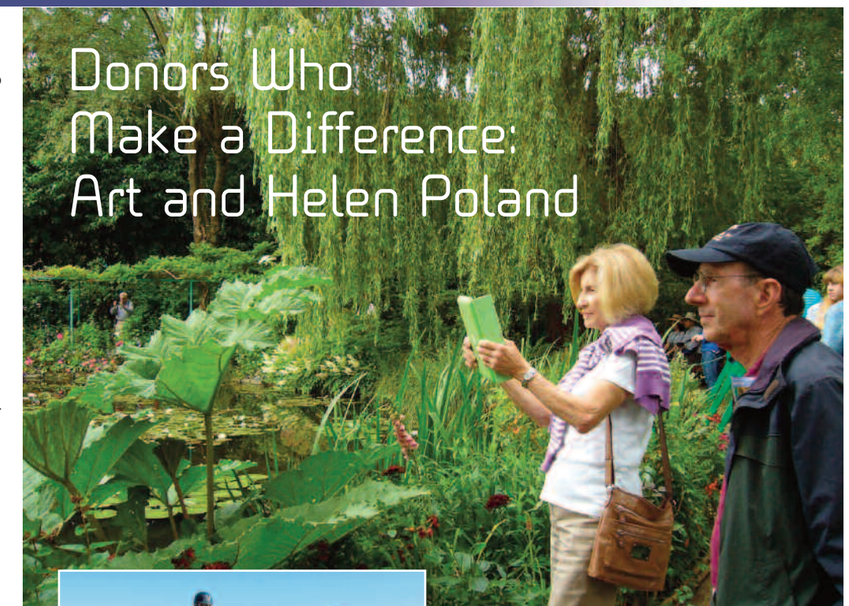
Photo: Creative Services

A modern science motif greets students, faculty, staff, and visitors to Exploratory Hall.

Story page 4

Supporting Mason

Donors Who Make a Difference: Art and Helen Poland



Photos: Courtesy of Art and Helen Poland

"I'll keep teaching until I can no longer drive to campus," says Art Poland with a laugh. Poland, a research professor in the School of Physics, Astronomy, and Computational Sciences (SPACS), feels fortunate to love the work that he does. It's a feeling shared by his wife, Helen, a veterinarian specializing in horses, who runs a clinic at their horse farm in Warrenton, Virginia. The Polands, high school sweethearts who married in college, sought professional careers that have allowed them to travel the globe and make what they feel are measurable contributions. Their professional success comes from their shared passions and ability to have had access to high-quality education.

The Polands are both committed to sharing their success and helping others. Education has been an important part of their lives, and they recognize that the skyrocketing costs of college tuition make getting a degree difficult, if not impossible, for many deserving students. To help ease this financial burden, the Polands have endowed a scholarship in the College of Science (COS) to be awarded to students pursuing a science education and in need of financial support. Mason, along with the University of Massachusetts, Amherst; Colorado State University; and Indiana University; are all receiving this generous gift. Art explains that these are all institutions where Helen and he have either studied or worked.

Art Poland's fascination with space and the genesis of his career began as a freshman in high school in 1957. Poland recalls being captivated by the Sputnik launch. Like millions of people across the globe, he looked up to the sky one evening to see if he could get a glimpse of the satellite. He was fascinated by the stars and wanted to learn more about them. He pursued his dream, earning first a bachelor's degree in astronomy and eventually a doctorate in astrophysics. He spent twenty years in senior scientific roles, including working for NASA. Upon retirement, he came to COS and helped develop new courses in space weather, which are part of the SPACS doctoral degree program in computational sciences and informatics. He also teaches, does his own research, mentors undergraduate students through the OSCAR Students as Scholars initiative, a program that pairs students with faculty members who then guide them through specific projects and research, and is president of Mason's chapter of Sigma Xi, a scientific research society.

Helen and Art Poland

Helen Poland's passions run just as deep. As an undergraduate, she wanted to study veterinary medicine but earned a doctoral degree in physical chemistry instead. Upon graduation, she took a position working for Colorado State University. Several years into her career she realized that her true calling was to be an equine veterinarian, and she pursued her degree in veterinary medicine. Today, the couple owns eight horses on their farm in Warrenton, where Helen has her clinic.

HIV research is housed in the Biomedical Research Laboratory, headquarters of the National Center for Biodefense and Infectious Diseases, on the Prince William Campus. While many labs and scientists look at ways to kill pathogens, BRL researchers investigate the host-pathogen relationship to study how hosts respond to infectious diseases.

Photo: Creative Services

HIV Research:

Routing Out HIV that Hides and Halting Its Use of a Cell's Internal Machinery

Developed in the mid-1990s, highly active antiretroviral therapy (HAART) revolutionized HIV treatment so that the virus ceased being an automatic death sentence for the newly diagnosed. Since the advent of HAART, researchers have set their sights on the ultimate challenge: finding a cure for HIV, a global pandemic that continues to infect—and in some cases, kill—millions around the world each year.

HIV research at George Mason University began in earnest in 2003 when Yuntao Wu was recruited to the National Center for Biodefense and Infectious Diseases (NCBID) from the National Institutes of Health (NIH) in Bethesda, Maryland. Seven years later, researcher Fatah Kashanchi arrived at the center and set up a second lab devoted to HIV and other retroviruses.

The Human Immunodeficiency Virus, or HIV, attacks the immune system, destroying a person's natural disease-fighting capabilities. If left untreated, HIV leads to AIDS, or Acquired Immunodeficiency Deficiency Syndrome, the final stage of HIV infection where immune cell counts are so low that opportunistic infections cause a person to die. HIV is transmitted through the exchange of bodily fluids, like blood, semen, and breast milk.

Kashanchi and Wu belong to the vanguard of viral researchers attempting to pin down how HIV interacts with a host cell once HIV infects it. Understanding how HIV hijacks a cell's internal mechanisms to replicate itself can lead to better drugs and, ultimately, a cure or a vaccine. AIDS research is a hypercompetitive field and both Wu and Kashanchi have distinguished themselves, publishing papers in prestigious journals like *Cell* and *PLOS Pathogens*, *Journal of Virology* and receiving multiyear NIH grants to support their research. Here is a closer look at their work:

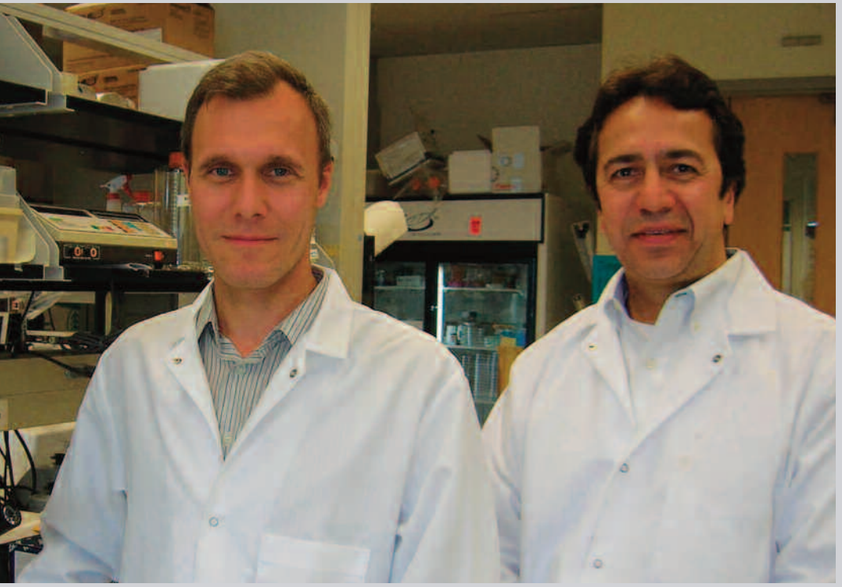


Photo: Archana Pyati

Sergey Iordanskiy, Fatah Kashanchi

Kashanchi Lab: A New Approach to "Shock and Kill"

A vexing problem long-term HIV survivors face is viral reservoirs, areas in the body where HIV is alive but in a dormant state. The virus goes into hiding by integrating its own genetic material into a host cell's DNA, lingering in patients for decades. HAART won't work on these latent cells since the virus isn't actively replicating itself. Yet these latent cells are a "big time threat," says Kashanchi, since they "can allow low levels of virus population to take place once in a while." Latent cells, along with HIV, have to be eradicated. But how can this be done safely without destroying an HIV patient's healthy, uninfected cells?

> "Understanding how HIV hijacks a cell's internal mechanisms to replicate itself can lead to better drugs and, ultimately, a cure or a vaccine. AIDS research is a hypercompetitive field and both Wu and Kashanchi have distinguished themselves."

Over the years, HIV researchers realized that the only way to get at these viral reservoirs is to turn the inactive virus "on," treat it with HAART and destroy the latent cells so they're no longer hospitable to the virus. This approach, known as "shock and kill," is problematic because it doesn't explain how not to kill the body's uninfected cell population at the same time.

Kashanchi and NCBID researcher Sergey Iordanskiy think they may have an answer. Giving patients low doses of X-ray radiation activates HIV proteins while triggering latent cells to self-destruct. Once the virus is shocked into replicating itself, it can be treated with HAART, which Kashanchi and Iordanskiy demonstrated in humanized mouse models — mice with human immune cells embedded in them.

Radiation treatments are tricky because they usually damage the DNA of healthy, uninfected cells, which potentially leads to cancer. Kashanchi and Iordanskiy say the radiation level they propose is low enough to be safe and to trigger a healthy cell's own DNA repair process through the p53 pathway, a protein-based chain reaction that protects the cell from genetic mutations.

Kashanchi, who has trained dozens of postdocs and graduate and undergraduate students during his twenty-year career studying HIV, says he and Iordanskiy may have found a safe approach to "shock and kill," which might one day eradicate HIV in a patient who receives the treatment. He and Iordanskiy are hopeful as they wait to hear from NIH and other funding agencies on grants they've submitted to support their research.

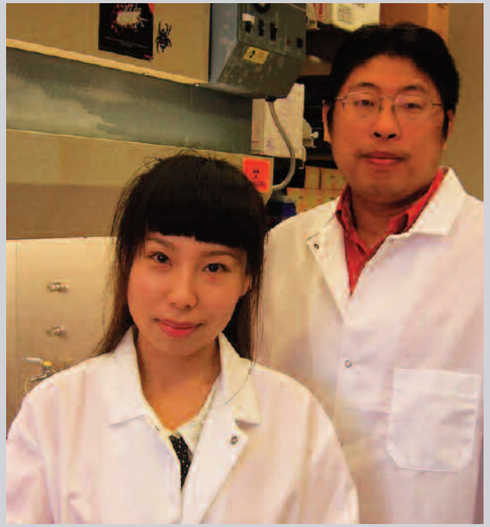


Photo: Archana Pyati

Jia Gua, Yuntao Wu

Wu Lab: HIV on the Cytoskeleton Treadmill

Meanwhile, Wu and Jia Guo are examining how HIV is able to exploit an immune cell's internal machinery to gain access to the nucleus, the place where HIV makes copies of its own DNA. So far, antiretrovirals haven't been able to stop HIV at this phase of its life cycle, known as transcription. Wu and Guo are particularly interested in treatments that disrupt HIV's use of cellular machinery even when the virus mutates. HIV is a notoriously unstable virus that is constantly mutating.

To enter a cell, HIV has to bind to several proteins dotting the cell's surface. First, HIV attaches itself to the CD4 receptor, then to one of two coreceptors, CCR5 or CXCR4. The coreceptor chosen to gain entry into the cell depends on the type of HIV a patient has been infected with. CCR5 is used by a more common and less lethal form known as M-tropic HIV; CXCR4, meanwhile, is used by T-tropic HIV, a deadlier form researchers speculate is a mutation of the earlier M-tropic version.

When these coreceptors are activated, the cell knows that something is wrong. Its natural immune response kicks in, causing the cell to physically migrate toward the source of the infection. The cell is propelled forward by a treadmilling process created when a protein called cofilin starts breaking up cytoskeleton fibers in the cell. Over a six-year period, Wu

continued on page 16

Photo: Creative Services

The renovation of Exploratory Hall and construction of the Lab Annex were part of a five-year plan to create a comprehensive science center on the Fairfax Campus.

Open for Science and So Much More

Five years ago, a plan was started to create a consolidated science presence on George Mason University's Fairfax Campus. The five main goals were: Create a community science center; provide flexible learning environments for all science learners, both majors and nonmajors; promote research; teach sustainability through the building and sites; and use technology to its best advantages.

This fall, the College of Science (COS) opened the doors to its completed science center, a full 164,050 square feet of new labs, classrooms, student study areas, permanent science displays, and technology.

Nancy Conwell, COS director of facilities planning, operations, and marketing, says, "The whole idea of the building is to give us a campus within a campus." The renovated facility, which comprises Exploratory Hall, Planetary Hall, and a new Lab Annex, stands between Research Hall and David King Hall. Conwell gives a great deal of credit to the team of faculty, administrators, and architects who truly thought through what would best serve the students and help the college continue to grow.

Vikas Chandhoke, former COS dean and now Mason's vice president for research and economic development, was instrumental in all facets of the building's design. Chandhoke says, "The renovation of Exploratory Hall and the Lab Annex addition are the result of a cooperative, university-wide effort to offer Mason students the space and the tools to receive the best science education possible."

A look at the new space reveals much more than classrooms and labs, but rather an integrated environment that builds a science community.

A Look Inside

Exploratory Hall is a LEED Silver–certified building. Care was taken in both the materials used in the construction and in how the building operates. An abundance of clear and frosted glass promotes the direct passage of light while allowing for privacy and energy efficiency. The openness of the structure allows people to see actual science happening. Conwell says that traditional science labs and classrooms had been closed off from each other. "Vikas wanted a collaborative community that is cross-disciplinary, and here everything is open." Researchers can set up a variety of permanent displays for student research, instruction, and for others to see. There is no longer the need to keep collections locked away in storage and bring them out only for lessons.

Larry Rockwood, a professor in the Department of Environmental Science and Policy (ESP) and director of the Undergraduate Biology Program, was involved in the building design. "One of the most immediate benefits in the open layout is that it's easier to see what everyone is doing and to communicate." He explains that in the older buildings, in addition to everyone being spread out, it was difficult to know just who was around. He says, "The faculty is enjoying the new rooms, the natural light, and all the new technology."

Another immediate benefit, says Rockwood, is the new labs. "Each lab comes with dedicated PC and document cameras, which aid in demonstrations." Additionally, there is now dedicated lab space; previously, labs would have to be broken down and set up for different classes, something both time consuming and limiting for instructional quality.

Green on Top

Mason has always enjoyed a green campus with patches of wildflower gardens showcasing native plants and encouraging insects and birds. Exploratory Hall is no exception and boasts a greenhouse on the roof. The new greenhouse is part of ESP and has several distinct areas: a room to prep plants and control pests, a place for tools and equipment, an open, drier space suited for cacti and succulents, and an area for plants needing higher humidity. The entire space is computerized, helping control the different microclimates and allowing easy control for temperature, ventilation, and shade. One of the biggest benefits is that now plants are closer to the labs where students study them. The greenhouse can be used for specific projects because the labs, classrooms, and greenhouse are all in one easy-to-access location.

An Alternative Way to Learn

Exploratory Hall houses the university's first active learning with technology

continued on page 6

Photo: Creative Services

Open for Science, from page 5

(ALT) classroom, a specially designed room that is built to facilitate a learning paradigm that is active, collaborative, and takes advantage of technology to strengthen student learning. Kim Eby, Mason's associate provost for faculty development and director of the Center for Teaching and Faculty Excellence, lights up when talking about the design of the learning space and all its possibilities. Eby has been involved in the design and planning of the classroom and specializes in teaching and learning. She says, "This type of classroom was piloted about fifteen years ago in other areas of the country. We're excited to have both the funding and the commitment to bring inquiry-guided, technology-rich learning here to Mason."

And it is a classroom for the entire university. Eby explains that though the ALT classroom is in Exploratory Hall, faculty members from across the university submit proposals to (re)design courses to teach in the room. "This semester, we have a science, a math, and an English composition class." Eby says that from the moment you walk into the space, you realize it's not a traditional classroom. The room has eight circular tables, each with nine seats. Each table has a wall monitor connected to it, and students can plug in at the tables. The faculty station is in the center, encouraging the professor to move around so that his or her back is not to the students. The walls are floor-to-ceiling whiteboards and "scream collaboration." Open floor layout allows in natural light. The professor has the ability to control all the monitors, thus allowing teams to share their work or concentrate on specific activities at their table.

The faculty members using the room this semester are also serving as pioneers for exploring the room, the technology, and the new way of teaching. Eby says that they meet regularly to help answer questions and give support for ways to use the technology and encourage students to work together. This group will be teaching again in the spring, and then the room will rotate for new classes, giving more teachers and students the chance to learn in this new environment.

Creative Collaboration

The bones of Exploratory Hall are the former Science and Tech II building—not a place revered for its aesthetics. It was important that this new science center become a place where people want to gather. The open areas encourage students to socialize and study together and aid in building a science community. The whole building is based on science—tables and chairs are printed with elements from the Periodic Table of Elements, designs on the floor represent water droplets and the double helix structure of DNA, and science quotes on conversation benches outside the building were solicited from the faculty.

"We definitely hit on the wow factor with a design that is aesthetically pleasing and lifts your spirits when you enter the building," says Peggy Agouris, COS acting dean. "Students are extremely receptive to the modern, open, informal setting, and faculty members appreciate the ease of moving between classrooms and labs. And we continue to get accolades from visitors and parents, too."

Photo: Creative Services

Wood panels in a student lounge depict the geometric derivation of the Fibonacci spiral.

NanoNotes

Elements of Distinction about the College of Science, its Faculty, Staff, and Students

Timothy DelSole, Department of Atmospheric, Oceanic, and Earth Sciences, was a contributing author to chapter ten, "Detection and Attribution of Climate Change: From Global to Regional," of the Fifth Assessment Report of the United Nations Intergovernmental Panel on Climate Change, and a reviewer for chapter eleven, "Near-term Climate Change Projections and Predictability."

Kamil Stelmach, a master's student in the Department of Chemistry and Biochemistry, was awarded a NASA Earth and Space Science Fellowship. She successfully competed against 587 applicants from universities nationwide and was one of only twenty-six students awarded a fellowship in the Planetary Science division.

Victoria Stotzer, an undergraduate student in the Department of Chemistry and Biochemistry and the Program in Forensic Science, was honored with the 2013 NASA Goddard Space Flight Center Summer Intern Award for Outstanding Science Contribution. Her presentation, "The Application of Superhydrophobic Self-Assembly Monolayers on Nanotextures," was selected for the top award from more than 200 projects.

Victoria Stotzer

Allison Macfarlane, Department of Environmental Science and Policy, was unanimously confirmed by the U.S. Senate for a full five-year term as chair of the Nuclear Regulatory Commission, effective July 1. Macfarlane previously was appointed to complete the final year of the previous chair's term, which expired June 30.

Thomas Lovejoy, Department of Environmental Science and Policy, received the 2013 World Wildlife Fund Leaders for a Living Planet Award. The award recognizes environmental leadership and outstanding and inspirational work in conservation.

Vivek Prasad, PhD Environmental Science and Public Policy '11, was selected to attend the first two of five sessions of the Resilience Academy, a cooperative program between the United Nations University Institute of Environment and Human Security, the International Center for Climate Change and Development, and the Munich Re Foundation. The first session was held in Dhaka, Bangladesh, in September, and the second session is in Munich, Germany, in 2014. The theme for both sessions is livelihood resilience.

Several doctoral students in the Environmental Science and Public Policy program in the Department of Environmental Science and Policy have received awards and fellowships to assist with their research:

Carolyn Boules, dissertation award from the American Institute for Maghrib Studies, "Water Management Arrangements and Resilience in Dryland Agricultural Systems: A Comparative Analysis," (Tunisia)

Stacie Castelda, Fulbright Program award, "Evaluating Human Threats to Three Canid Species of the Brazilian Cerrado," (Brazil)

Ashley Milton, Fulbright Program award, "Forest Resilience for Livelihoods and Ecosystem Services," (Democratic Republic of the Congo)

Ashley Milton

Robert Slate, Doan Fellowship at the Chemical Heritage Foundation, "Regulating Nanomaterials: Drawing Lessons from TSCA and REACH" (Philadelphia, Pennsylvania)

Owen Kelley, Department of Geography and Geoinformation Science, was invited to participate in the fall lecture series offered by the Science, Technology and Business Division of the Library of Congress. Kelly discussed his work with NASA's Tropical Rainfall Measuring Mission (TRMM) satellite and the statistics collected on the association of hot towers and hurricane intensification.

Kirk Borne, School of Physics, Astronomy, and Computational Sciences, gave an invited talk on "Human-Machine Collaboration in Information Extraction for Data-to-Decisions" at the Big Data Retreat in September, sponsored by the Office of the Assistant Secretary of Defense.

Harold Geller, School of Physics, Astronomy, and Computational Sciences, contributed a chapter to *Extraterrestrial Altruism*, which explores questions about the motivations of civilizations beyond Earth.

Michael Summers, School of Physics, Astronomy, and Computational Sciences, presented the keynote address at the Prince William County Science Teachers' Professional Day. He discussed astrobiology as a means to teach integrated sciences to middle and high school students.

continued on page 16

COS Students Travel the World for Science

This past summer, College of Science (COS) students had the opportunity to view the Swiss Alps, Mt. Kilimanjaro, and the Dublin coastline as they traveled the world with their professors, extending their classroom learning.


Photo: Courtesy of Katelyn Fariss

Katelyn Fariss

Summer at CERN

Physics major Katelyn Fariss spent eight weeks as an intern in the CERN summer student program in Geneva, Switzerland. CERN, the European Organization for Nuclear Research, is one of the most preeminent particle physics research facilities in the world and home to the Large Hadron Collider, the world's largest particle accelerator.

Mason students are supported by a National Science Foundation (NSF) grant administered by physics professor Phil Rubin, in the School of Physics, Astronomy, and Computational Sciences, who also does research at CERN. The grant pays for two COS students to attend the CERN program each summer. "It was exciting to be working there," says Fariss. "Students are given their own projects to work on and also attend lectures along with interacting with students from around the world." Fariss worked on a computer programming project called NA62 where she helped update electronic systems. "This work opened my eyes to just how important computer programming is to physics research and taught me a lot about particle physics." Fariss plans to return next summer and continue her work on the project and has plans to pursue a graduate degree in either physics or astrophysics after she graduates.

Mathematics in Tanzania

Would you like to go to Africa to work on a research project? It's not a question most math majors are asked, but for graduate students Byong Kwon and Tom Stephens it was. Kwon and Stephens traveled to Tanzania along with Padmanabhan Seshaiyer, their professor in the Department of Mathematical Sciences, to teach an intensive ten-day mathematics workshop at the Nelson Mandela Institute to a select group of students and instructors. Through his teaching and research, Seshaiyer became involved with the Nelson Mandela Institute in Tanzania three years ago to help the program develop both master and doctoral degree curricula. He is also a professor at the institute.

"It was an amazing experience," says Kwon. "We taught the students how to use computational software, such as MATLAB, and discussed how to prepare research proposals and seek funding. We were so impressed with these students and how they want to solve real-world—not theoretical—issues." Stephens agrees, adding, "We delivered a new tool to them that will help them better model and predict events such as the spread of a virus" and the efficacy of a vaccination program. Both students came away with a new appreciation for how their studies can have cross-disciplinary and global applications. Seshaiyer was pleased with his students' work, explaining that part of the project's goals is to develop leaders and thinkers who can connect and make a difference outside the classroom. Both Kwon and Stephens are corresponding with several Tanzania students and helping them work through issues and share data.

Credit: Courtesy of CAPMM

Students and faculty who attended the summer course on translational biomedical research are pictured outside the National Institute for Cellular Biotechnology at Dublin City University.

Research in Ireland

"Bench to Bedside: Translational Molecular Research," a one-week summer course for students from the United States and Ireland, took place at Dublin City University (DCU) in July. The course covered both theoretical and practical aspects of translational biomedical research, with particular emphasis on the latest and most important advances in personalized molecular medicine technology.

Lance Liotta, codirector of the Center for Applied Proteomics and Molecular Medicine (CAPMM) in COS, along with CAPMM researchers Virginia Espina and Alessandra Luchini, organized and taught the course with health care and academic collaborators at DCU. Faculty members from Georgetown University who teach in GeorgeSquared, a joint program between Mason and Georgetown in advanced biomedical sciences, also participated in the program.

The daily schedule included lectures in the morning and afternoon workshops. Seventeen Mason students and alumni traveled to Dublin to take the course, joining twelve DCU students.

Physics student Matt Johnson was one of the attendees. He explains that so many times in a classroom experiment setting, you are given directions and told to conduct an experiment or solve a problem. This course was completely different, "we had hands-on instruction and guidance using the equipment and were working to solve real problems." Johnson has a bachelor's degree in physics but says, "All the interesting problems are in biology." He is now pursuing a master's degree at Mason with plans to complete a doctoral degree in biophysics. His background in bioinformatics and data analysis was helpful to the other workshop attendees as he was able to review data in a different way. "This was my first time using biology lab equipment, actually looking at cells under a microscope. It really opened my eyes to research possibilities." And though the course was only a week, Johnson sees how important the opportunity was for him and his studies.

Long-time Climate Research Partner Joins COS

Photo: Thomas Wakefield

James Kinter addresses attendees at a reception held last spring to celebrate COLA's move to the Fairfax Campus and its climate research affiliation with COS.

> "We feel that the presence of COLA on campus can serve as a catalyst for bringing these groups and activities together to form an intellectual powerhouse for studying climate variability and change, its impacts on the natural environment and socioeconomic systems, and policy issues associated with global environmental change."

A longstanding collaborative research affiliation with the College of Science (COS) has prompted the Institute of Global Environment and Society (IGES) and its world-renowned Center for Ocean-Land-Atmosphere Studies (COLA) to relocate from Calverton, Maryland, to Mason's Fairfax Campus.

The vision for COLA and IGES was first articulated by Jagadish Shukla, University Professor in the Department of Atmospheric, Oceanic, and Earth Sciences (AOES) and IGES president, and the two organizations were founded as a nonprofit research institution in 1993 by several Mason scientists, including James Kinter, Paul Dirmeyer, Bohua Huang, Edwin Schneider, David Straus, and Ben Kirtman (now at the University of Miami). The idea was that the climate system has several processes and phenomena that occur over time scales longer than a typical weather forecast of ten days. James Kinter, director of COLA, explains, "As a result, understanding and modeling these processes could establish the predictability of climate variations and provide a basis for making long-range projections."

COLA has refined this hypothesis over the years and made significant scientific contributions that are documented in more than 500 peer-reviewed papers published during the past two decades. First is the establishment of a scientific basis for quantitative dynamic seasonal and decadal prediction, grounded in classical predictability theory and the use of the latest numerical models of the physical climate system. Other innovative approaches to analyzing and predicting climate variations include an emphasis on the role played by interactions between the land surface and the atmosphere, the use of ensembles of climate model predictions to provide guidance for probabilistic climate forecasts, and the application of information theory to the problem of climate predictability and prediction.

COLA's structure for funding and other resources has been considered a model for federal interagency cooperation since its inception. Three agencies, the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), and the National Aeronautics and Space Administration (NASA), jointly agreed to fund and review COLA in five-year block grants. The agencies jointly issue an invitation to prepare a proposal, jointly conduct an anonymous peer review of the proposal, and jointly determine the funding levels each agency will provide.

The move from Calverton to the Fairfax Campus was a natural evolution. Many COLA scientists hold joint appointments at both COLA and Mason and teach. "We now have a single point of operations for the education, graduate training, and research aspects of the center," notes Kinter.

Kinter expects the move to bring even greater opportunities to COLA and Mason. The challenge of understanding global environmental change has become a matter of serious concern to peoples, economies, and governments. The prospect of dramatic environmental change over the next several decades in response to human activities, notably increasing greenhouse gas and aerosol concentrations in the atmosphere and changes in land use, has gripped the world's attention and stimulated discussions about how to adapt to inevitable changes and how to mitigate the potentially catastrophic changes that may occur.

Many high-quality education and research activities at Mason address various aspects of global environmental change, making the university an ideal base for a coordinated environmental change enterprise. Kinter says, "First, its location near the seat of the federal government gives it special status as the go-to source of knowledge when the agencies need advice." Second, Mason has worked to build environmental programs that are well positioned to address this challenge.

"We feel that the presence of COLA on campus can serve as a catalyst for bringing these groups and activities together," Kinter notes, "to form an intellectual powerhouse for studying climate variability and change, its impacts on the natural environment and socioeconomic systems, and policy issues associated with global environmental change."

While COLA and other climate study institutions have made great strides in advancing an understanding of the climate system, there remains much to explore. About COLA's plans and future goals, Kinter says, "We intend to continue our work on understanding the fundamental predictability of climate from days to decades. This includes doing a better job of understanding and exploiting the land-driven predictability in sub-seasonal to interannual time scales, and probing the predictability of El Niño, monsoons, and other interannual fluctuations on multiyear time scales." COLA scientists intend to address how predictable the climate system may be at lead times of a decade or more, a time scale that is clearly affected by global climate change.

COLA remains committed to helping transition its research and that of its peers into tangible products that can be useful to society. "We intend to continue with the multimodel approach and will work closely with the operational agencies like NOAA and the Navy to make our research relevant to the real-time imperatives that they face," Kinter says.

Photo: Thomas Wakefield

Also attending the spring reception were (left - right) Vikas Chandhoke, Mason vice president for research and economic development; Peter Stearns, Mason provost; Jagadish Shukla, IGES president; James Kinter, COLA director; Ángel Cabrera, Mason president.

COLA Accesses Government Agencies' Computer Resources

At the Fairfax Campus, COLA maintains a state-of-the-art computing facility that optimizes the efficient management, analysis, and visualization of climate model output generated by their experiments. Nearly all the climate model production computing is done off campus at shared facilities operated by NSF, NASA, and the U.S. Department of Energy. In recent years, COLA scientists have been awarded high-performance computing resources at the level of tens of millions of processor hours on these national supercomputers.

COLA scientists make use of all the national climate models that are developed and supported by the National Center for Atmospheric Research, the National Weather Service, the NOAA Geophysical Fluid Dynamics Laboratory, and the NASA Goddard Space Flight Center. The multimodel approach has enabled COLA to provide objective evaluations of national models and to formulate climate prediction strategies that take advantage of the strengths and minimize the weaknesses of the various models. COLA scientists have also had the opportunity to collaborate with foreign groups, which has enabled a more direct and constructive comparison of the U.S. models with competitors from abroad.

In addition, COLA scientists and software experts have developed a software system, the open source Grid Analysis and Display System (GrADS), an essential tool for analysis of multiple climate models, ensembles of simulations and predictions, and global and regional objective analyses. The software package is implemented worldwide by tens of thousands of users.

Interdisciplinary Focus Boosts Growth for SPACS

When the School of Physics, Astronomy, and Computational Sciences (SPACS) was formed by the College of Science in 2011, one key motivation was to bring the four fundamental pillars of modern science together in one unit to provide an education and research base for strong interdisciplinary scientific research and education.

Michael Summers, director of SPACS and professor of planetary science and astronomy, describes the four pillars of modern scientific research as theoretical, experimental/observational, modeling/simulation, and big data science, the most recent pillar that is now widely acknowledged as a foundation of modern research in almost every domain. "The biggest problems facing society, such as understanding climate change, the brain, the origin of life, and emergence of complex systems in general," says Summers, "all require aspects of these four pillars, as well as strong foundation in the physical sciences."

By merging the Department of Physics and Astronomy (in existence since the mid-1960s) and the Department of Computational and Data Sciences (formed in 2006), SPACS presents a powerful but broad set of capabilities with these four pillars of science. SPACS courses provide students with a background of many of the problem-solving techniques they need for careers in most fields requiring analytical thinking to deal with complex problems.

SPACS is becoming an international player in a broad spectrum of the sciences. "We do a wide range of research from extra-solar planets to fireflies, from black holes to novel materials, from quantum optics to big data sciences, and the list goes much further," notes Summers. Simulation and modeling groups are pursuing interdisciplinary research, such as applying fluid dynamics to human blood flow, and using NASA planetary missions to study other planets and search for life elsewhere.

Such interdisciplinary topics in SPACS' programs have attracted not only traditional physics students who typically pursue degrees from the undergraduate through the doctoral levels, but also the much larger population of students who want a terminal bachelor's or terminal master's degree. " Our undergraduate enrollment has really taken off, with growth of about twenty percent over just the last year," says Summers. "Our physics majors have nearly doubled in the past three years."

Beyond the science itself, the faculty members in SPACS are exploring better and more efficient ways of teaching science. Variations on the flipped classroom, incorporating inquiry-based instruction, and collaborative classrooms are showing very promising results in student retention.

SPACS' activities are attracting interest and attention. SPACS won an $85,000 grant for course development from 4-VA, a consortium of four Virginia universities working to improve success in science, technology, engineering, and math (STEM) programs. Additionally, the American Physical Society (APS) featured a video of interviews with several SPACS faculty members and students at its annual meeting last spring (video available at spacs.gmu.edu).

Summers feels that the recognition from APS has been both a result of and a catalyst for change. "We're trying to establish a learning community that can adapt to anything science and technology can throw at it," explains Summers. "Education has to change in response to technology changes, and to help students truly engage with real-world interdisciplinary challenges."

SPACS is defining itself in several special areas of scholarship where it truly shines, and it is now being recognized for this new and special type of learning community that it represents. "Science seems to be cool again, and I get two to three requests a week to talk to local school groups about what Mason is doing in science. Maybe geeks will indeed get the last word."

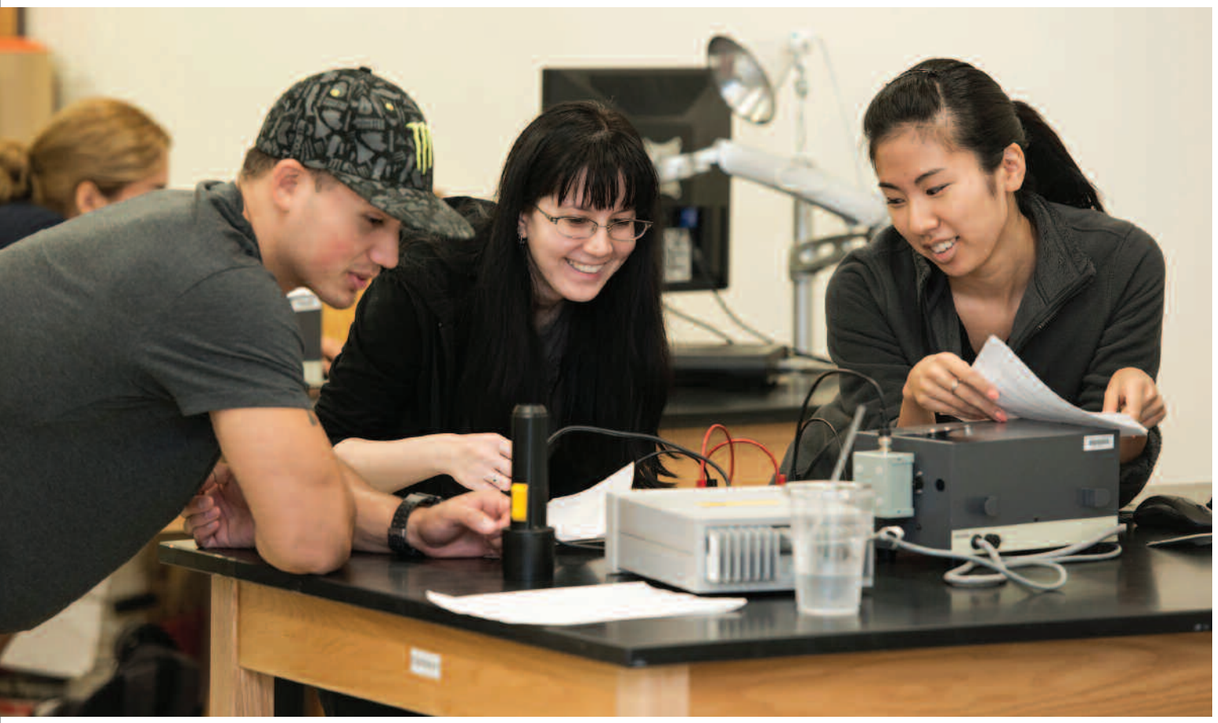


Photo: Creative Services

Physics students experiment with the photoelectric effect.

Photo: Michael Summers

Astronomy students in the ALT classroom in Exploratory Hall

SPACS Wins Grant from 4-VA

4-VA, which recently awarded SPACS an $85,000 grant for course development, is a consortium among George Mason University, James Madison University, the University of Virginia, and Virginia Tech. With the mission of promoting interuniversity collaboration, 4-VA works to enhance student success in STEM courses and programs. The consortium also seeks to decrease the costs of delivering instruction, expand access for Virginians to programs that prepare them for rewarding careers, and increase research competitiveness—all aligning with SPACS' work and philosophy.

Summers believes that some of SPACS' early experiments in using the flipped classroom combined with collaborative learning techniques and inquiry-based instructional styles attracted 4-VA's attention. "Our excitement about bringing our own scientific tools to bear on the educational process was intriguing enough to get this seed support from 4-VA," Summers explains.

Since receiving the grant, the SPACS faculty has adapted several introductory physics and astronomy courses to be taught in the ALT (active learning with technology) classroom in Exploratory Hall, and this approach has already shown startling results. The number of students getting A's on the first exam was up by 54 to 67 percent over the control classes. The number of students failing the first exam went down by approximately 14 to 85 percent.

Summers also wants to use the Mason 4-VA telepresence room with other members in the consortium to share what the SPACS faculty is doing and learning about physics and astronomy education. "I'm really excited about the blending of online factual information, group interaction, and problem solving, both online and in person, as well as virtual group workspaces adapted to interactive contexts for problems, such as in modern gaming," Summers says. This provides a powerful and effective learning environment.

Social Media Meets Satellites for Emergency Response

> "The project is based on crowdsourcing, the idea that a large group of people (usually in an online community) providing small bits of information can provide accurate and detailed information about an event, often in minute detail."

Hurricanes, floods, fires, earthquakes, and blizzards all cause massive disruptions to communications and infrastructure at the most critical times needed to save lives and property. The ability of first responders to do their jobs, and for governments to rally resources, is often hindered by our ability to see what is happening to affected areas. But in today's connected society, there are eyes on the ground everywhere. When communications are disrupted, time and again we have seen that online communications and SMS messaging still function.

Nigel Waters, a professor in the Department of Geography and Geoinformation Science (GGS) and director of the Geographic Information Science Center of Excellence, Guido Cervone, associate professor in GGS, and Emily Schnebele, a doctoral candidate in GGS, are working on a U.S. Department of Transportation (USDOT) research project. They are working to develop "a new capability to use social networks for cueing commercial remote sensing of transportation conditions in response to natural events." In more approachable terms, the team, working with commercial partner The Carbon Project, is tracking social media messages, mainly Twitter, for personal accounts of conditions during a disaster. Then they overlay the messaging with satellite imagery from DigitalGlobe, Civil Air Patrol photos, unmanned aerial vehicle (UAV) imagery, and current geographical map data.

"This is a data fusion project," explains Schnebele. "Our goal is to produce as close to real-time data as possible from disaster areas." The group is in the middle of a two-year project to collect data and to determine how it can be used to protect those in harm's way.

The project is based on crowdsourcing, the idea that a large group of people (usually in an online community) providing small bits of information can provide accurate and detailed information about an event, often in minute detail. In this case, the crowdsourced information describes on-the-ground conditions for natural disasters.

One drawback to the testing is that the group is able to test its theories only when a natural event occurs. The recent September floods in Colorado proved to be one such event. Industry partner The Carbon Project has developed an application called the Carbon Scanner. The program scans Twitter messages for specific key words and geolocates tweets. When the key word density in an area is reached, an alert is sent to the team, who then uses temporal information to refine the geolocation. This information is then fused with maps and photographs. Additionally, information is sent to DigitalGlobe, a company that owns and operates several high-resolution commercial earth imaging satellites "capable of collecting over 1 billion km^2 of quality imagery per year and offering intraday revisits around the globe." The ability to compare before and after images is valuable to evaluating situations and providing the proper help. "DigitalGlobe's resources are powerful," explains Waters, "but can be limited due to weather. The satellite can't see through cloud cover. The data fusion model works well because it doesn't rely on any one source, and we were able to add Falcon UAV imagery from below the clouds."

Waters explains that the idea for this data fusion model came directly from USDOT. The agency sent out a request for proposal, and Waters and his team responded with a plan that was vetted, modified, and ultimately accepted.

As they work to perfect the data fusion and improve the geolocation of the tweets into the second year, the team is looking forward to the next step—helping define the best way to push this valuable information to those who need it. Waters feels that the information flow will be a fusion, as well, of cell phone messaging alerts, emails, and a website with full data and mapping information. "We're seeing more natural disasters as a result of global warming," says Waters. "This technology can make a difference."

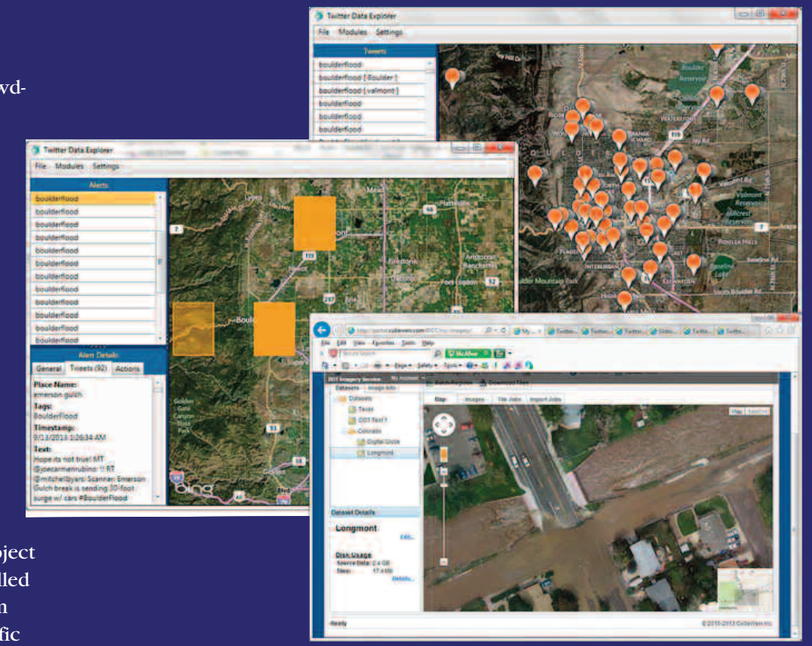


Photo: Carbon Project, Inc.

This mosaic represents how social media can be fused with maps and photographs to cue commercial remote sensing of transportation conditions during a natural disaster.

HIV Research, from page 3

discovered that when HIV uses the CXCR4 coreceptor, it hitches a ride on this treadmill so that it can enter the nucleus and begin transcription. In 2008, he published his results in a well-received and widely cited paper in *Cell*.

Wu and Guo, who began in Wu's lab as a postdoctoral researcher before her current position as a research assistant professor, are now trying to determine if the same treadmilling process occurs when HIV, in its M-tropic strain, binds to the CCR5 coreceptor. They're also exploring how genistein, a compound found in soybeans, can slow down treadmilling, depriving HIV the necessary machinery to cross into the nucleus. Published in the June issue of *Retrovirology*, their findings suggest it can, based on low doses of genistein given to rhesus monkeys with SIV (simian immunodeficiency virus), a disease similar to HIV.

Now, Wu and Guo are taking their work a step further by collaborating with Shenyang-based China Medical University, where 800 HIV-positive patients will participate in two different studies: one that more closely examines the role of cofilin during the HIV life cycle and another to determine if genistein can reduce the viral load of HIV and increase the number of healthy immune cells in human beings.

Previous AIDS research focused heavily on HIV proteins, and Wu was looking for "new and unknown territory," he says. In studying how HIV exploits cellular machinery to reproduce, Wu seems to have found his niche. His results can't seem to come fast enough: "HIV is a big problem not only for this country, but for the whole human race."

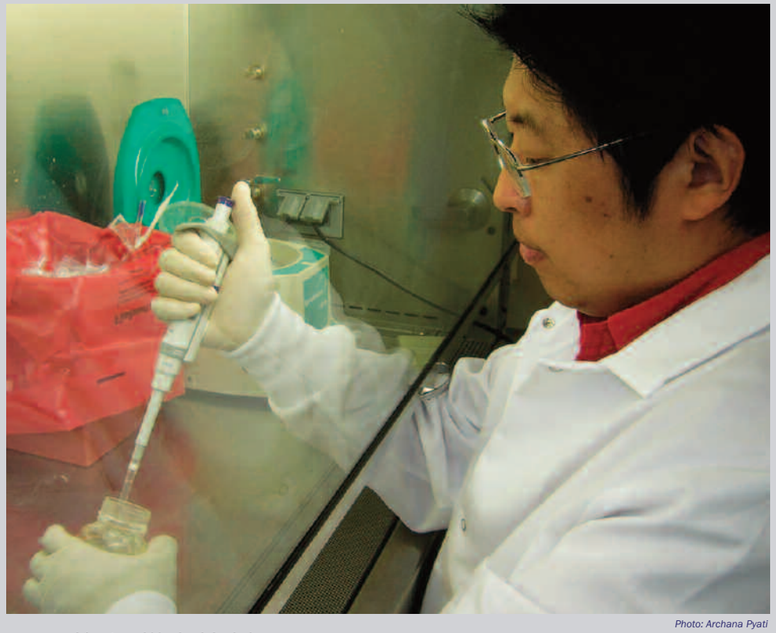


Photo: Archana Pyati

Yuntao Wu in his lab

COS Fall Lineup

Total Students:	3,435
Full-time:	2,341
Part-time:	1,094
Female:	1,890
Male:	1,541
Gender Not Reported:	4
Undergraduate:	2,373
Graduate:	1,062

NanoNotes, from page 7

"The impact of IL28B genotype on the gene expression profile of patients with chronic hepatitis C treated with pegylated interferon alpha and ribavirin," published by scientists in the **Center for the Study of Chronic Metabolic Diseases** in the School of Systems Biology, has received the distinction of "highly accessed status" in BioMed Central (BMC). The paper was published in the *Journal of Translational Medicine*, one of a group of open access, peer-reviewed, research-only journals in BMC. This is the third paper published by the center to received this status, a hallmark of future citation rates. The paper has been accessed more than 3,800 times since publication.

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

Periodic Elements Q&A

Peggy Agouris was appointed acting dean of COS in June when Vikas Chandhoke, former dean, was selected as Mason's vice president for research and economic development. Agouris joined Mason from the University of Maine in 2007 and was named chair of the Department of Geography and Geoinformation Science and director of the Center for Earth Observing and Space Research the following year.

PE: Both the new facilities and the search for a new dean are huge transitional changes for COS. Your appointment appears to be a perfect fit because you have such history with the college and your colleagues and a passion for science at Mason. What do you see as your primary role in this important phase of the college's growth and development?
Agouris: I see my role as an exciting opportunity to facilitate the transition of the college to the next phase of evolution. While maintaining our strengths and our legacy, we need to look at who we are, where we are, who we want to be, and how to get there. Through this process, we will carve a new path, discover new strengths, and move to a higher level of interdisciplinary relationships and collaboration. At the same time, we can take advantage of and benefit from the direction being forged by new university leadership.

PE: What differences and similarities are you finding between your former position as a department chair and your current position as acting dean?
Agouris: Both positions are about connecting with people and allowing them to do what they do best. They both require vision and an obligation to take a holistic view and consider the common good. The most striking difference is in scope. A chair's role unfolds in a homogenous environment, but a dean must navigate a complex, multidisciplinary profile. Fortunately, the skills transfer between positions.

PE: You've watched COS transform over the past seven years into a thriving center of learning and community. What are some of the more significant changes you've personally noted?
Agouris: COS is one of the fastest growing academic units at Mason, so the most significant and obvious change is rapid growth. Under the leadership of (former dean) Vikas Chandhoke, we came together as a cohesive unit, which is never easy for a new organization. Now we better understand our identity, strengths, and direction.

Dean's Message

Photo: Creative Services

Peggy Agouris
Acting Dean, College of Science

It is an honor to be serving as acting dean of this dynamic College of Science (COS) and working alongside colleagues and friends. I am extremely proud of the level of new research happening at both the Fairfax and Prince William campuses, the quality of students filling our classrooms, and the excitement in science and research we share with our supporters, alumni, and the greater community.

This is an exciting time for students, faculty, and staff in the college as we showcase our new state-of-the-art science facility — Exploratory Hall. We are all working together to figure out just where the light switches and outlets are, and we are also taking some time to stretch out our legs and make ourselves at home. This issue of *Periodic Elements* offers a look inside our new surroundings, and I invite you to visit us and see science in action at the Fairfax Campus.

Periodic Elements

Read past issues of Periodic Elements at cos.gmu.edu

Connect with COS!

/GeorgeMasonCOS

@GMU_COS

Mason Science

/MasonCOS

/Mason_COS

College of Science 2013 Award Recipients

Each year, the College of Science recognizes its scientists who embody the creativity, dedication, and discoveries that shape today's world.

The **Teaching Award** recognizes outstanding teachers or mentors or individuals who have made major contributions to educational activities during the previous year.

Ernest Barreto, School of Physics, Astronomy, and Computational Sciences
Daniel Cox, School of Systems Biology
Stacey Verardo, Department of Atmospheric, Oceanic, and Earth Sciences

The **Publication Award** recognizes high-impact, creative, and well-written scholarly contributions by individuals who are at the forefront of scientific research.

Ancha Baranova, School of Systems Biology
Sheryl Luzzadder Beach, Department of Geography and Geoinformation Science
Jie Zhang, School of Physics, Astronomy, and Computational Sciences

The **Impact Award** recognizes individuals who have made major contributions to their field of scientific research or education over the course of their career at Mason. This can be demonstrated in research by high publication and citation rates or in teaching by major contributions to educational programs and demonstrated excellence in teaching.

Kylene Kehn-Hall, National Center for Biodefense and Infectious Diseases

Congratulations!