Periodic Elements

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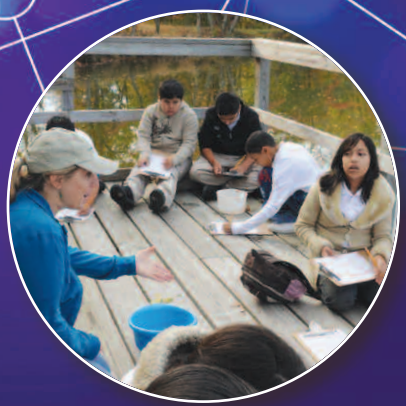
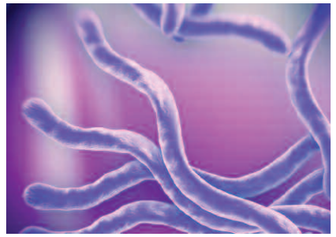


Inside:

Inside
Periodic Elements

page 2



page 14

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On the Cover

The College of Science extends STEM education to a variety of audiences through K-12 student learning experiences, internship programs, science teacher training, advanced career preparation, and community outreach.

See related stories on pages 1, 6, 12, and 18.

COS cares about the environment – please recycle

Biology Research Semester Offers Students a Competitive Edge

"Many biology majors graduate college without any hands-on experience in research or laboratory work and don't know what kinds of work are available to them, even here on campus," says Geraldine Grant, a professor in the Department of Biology. To help students gain that practical knowledge and experience outside the classroom, the College of Science instituted the Biology Undergraduate Research Semester three years ago. The program, under the direction of Biology Department Chair Larry Rockwood and supervised by Grant and fellow biology professor Arndt Laemmerzahl, teaches students how to perform research, critique others' work, and present their findings. "Every project is designed to walk students through the full research process," explains Grant.

The research semester offers students projects in a range of disciplines, from molecular biology to infectious diseases and neuroscience to the environment, using labs at the Fairfax Campus and the Science and Technology Campus in Prince William County. "Professors develop projects specifically for undergraduates to which interested students can apply," says Grant. Each student presents his or her findings at the end of the semester. "We ask students to make a poster documenting their experiences, but quite a few of them have even written papers for publication in scientific journals," adds Grant.

Participating in this program can translate into amazing job opportunities after college, as most institutions and laboratories ask that applicants have some research experience. "In 2013, Zuzanna Abdala landed a job as an aquatic ecologist technician right out of college. That job corresponded directly with the research she did during her research semester," says Grant.

Grant and her colleagues are currently working on expanding the program to more students. "We've been pushing this program in every way we can—e-mails, posters, and announcements at the start of classes. Every student we've spoken to about the semester responded with sheer excitement," says Grant. With this captivating and innovative program, Mason is sure to land at the forefront of STEM education.

An Accreditation Feather in Mason's CAP

The Center for Applied Proteomics and Molecular Medicine's (CAPMM) CAP-accredited Clinical Proteomics Laboratory is a medical technology marvel mirroring the research and testing performed inside. Lance Liotta, CAPMM codirector, along with codirector Emanuel "Chip" Petricoin, speaks seriously about the essential physical constraints of the new lab with its grounded plugs, sealed floors, temperature monitoring, and controlled access flow of inventory. But these physical elements are only a small sample of the 1,200 items that were required to meet the accreditation criteria that included testing the entire lab staff for color blindness.

The center conducts research focused on proteomics, the study of proteins. Its researchers invent new technologies with the goal of improving the diagnosis and personalized treatment of patients with cancer, Alzheimer's disease, diabetes, schizophrenia, infectious and neurological diseases, and other conditions.

A Meticulous Journey

However, the journey from a cutting-edge university research lab to a College of American Pathologists (CAP)-accredited, cutting-edge university research lab has been years in the making—literally making, by working with IT, physical plant, and safety teams, documenting, training, and monitoring every step of the process.

CAP accreditation is a continuous procedure with regular internal and external on-site inspections. Yet, despite the effort, it offers tremendous benefits to the university, researchers, and, most of all, the public. Research conducted in a CAP-accredited lab means that findings can be translated to public benefit two to three years faster than the typical university research study. CAP accreditation will attract recognition from funding sources such as the National Institutes of Health (NIH) and pharmaceutical and biotechnology industries. Liotta explains that when it comes to medical testing and results, "all we care about is the truth. Tests performed in this lab get us closer to the truth."

The College of American Pathologists states that the accreditation program is "equal to or more stringent than the government's own inspection program." The project was led by CAPMM scientist Virginia Espina, with colleagues Sally Rucker and Alessandra Luchini. Espina, who is the laboratory director of the Clinical Proteomics Laboratory and recently completed her doctorate in biosciences, has a background as a medical technician, lab director, and a blood bank coordinator. She explains that they started the project in 2006 when they began the work for CAP-CLIA certification. The U.S. Food and Drug Administration states, "the Clinical Laboratory Improvement Amendments (CLIA) regulate laboratory testing and require clinical laboratories to be certificated by their state and the Center for Medicare and Medicaid Services (CMS) before they can accept human samples for diagnostic testing." Once the exacting CLIA certification was awarded, CAPMM decided to move to full CAP accreditation.

Espina admits that the work needed to apply for the accreditation was demanding.

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A test for Lyme disease, caused by the bacterium Borrelia burgdorferi*, is being developed in the Clinical Proteomics Laboratory.*

Photo: Creative Services

Virginia Espina

Photo: Creative Services

Emanuel Petricoin (left) and Lance Liotta (center) discuss CAPMM discoveries and technologies with U.S. Sen. Tim Kaine (right) during his recent tour of CAPMM facilities.

"It involved retraining researchers to have a new mindset." She explains that biologists (and other researchers) allow for mistakes in testing and may use chemicals and agents that are old or expired or from different lots to perform tests where they are confident of the result. However, you can't do that in a CAP lab. First and foremost, CAP labs need to be consistent in producing both tests and results. "Creativity may be good for research," says Espina, "but it has to be methodical, too."

Liotta explains it well at the consumer/patient level. "If your doctor sends you to a lab for blood work," he says, "you will be sent to a CAP-accredited facility, such as Quest or LabCorp, where you can expect that your blood samples will be handled in a specific way and that the results will be accurate and consistent. Your results are important to your health and could be important for public health."

Testing the Tests

One of the most important benefits of CAP accreditation is in developing tests. Creating a new test for a disease, such as Lyme disease, which the center is working on, requires precision. If a researcher has an idea for a new test or a change to a test, it can now be developed with the CAP methodology. If the test were developed outside of a CAP lab, it would still need to be reviewed and tested at a CAP lab. This retesting costs years of valuable time and resources and delays potentially life-saving products and medical tests.

The accreditation is also huge for professional development and teaching. Researchers often do not have the opportunity to work in a CAP lab. Espina provides ongoing CEU training and proficiency testing. The lab will also attract top talent and give students exposure to new clinical procedures.

Espina, Petricoin, and Liotta are excited about the accreditation and how they can shorten the time it takes to bring life-saving therapies to the public. "Our lab is the first CAP lab in the country to be dedicated solely to proteomics research," Petricoin says. "We are extremely fortunate to have this great resource to help us move groundbreaking discoveries and innovative therapies from the lab directly to patient care."

COS Plugs into Cross-Disciplinary Energy Science and Policy

Energy represents power, and the new Center for Energy Science and Policy (CESP) is led by two powerhouse policy and research professionals. A collaborative effort between the College of Science (COS) and the School of Policy, Government, and International Affairs (SPGIA), the center is codirected by retired U.S. Ambassador Richard Kauzlarich, who also teaches in SPGIA, and Wendin Smith, president of Octant Associates, who specializes in environmental and national security.

The center's genesis was in COS in 2010 when Allison Macfarlane, then a professor in the Department of Environmental Science and Policy, before her selection as chair of the Nuclear Regulatory Commission, envisioned a cross-disciplinary energy center that would bridge the gap between policy and science to provide research and solutions for energy security. The idea for the center remained dormant until 2014, when the School of Public Policy (SPP) expanded its mission and became SPGIA.

The school's new mission merged with the academic interests of Kauzlarich, who had created and was then teaching a successful course on the geopolitics of energy security in SPP. His thirty-two-year career as a foreign service officer culminated with his assignments as U.S. Ambassador to Azerbaijan—a major energy-producing country—and Bosnia and Herzegovina. He also served as National Intelligence Officer for Europe on the National Intelligence Council and was responsible for analyzing European energy security issues. His interests and background in international affairs and energy issues meshed with Smith's.

Smith's background includes research and consulting work on nonproliferation and cooperative threat reduction programs for the U.S. Department of Energy (DOE) and the U.S. Department of Defense (DOD), as well as for several of the National Nuclear Security Administration's initiatives. She believes one of her most useful skills "is the ability to translate technical scientific issues to policy makers who often lack the time to delve deeply into the material or lack the scientific background."

Together they have defined a mission for CESP that combines the cross-disciplinary academic and technical expertise of the entire university from the scientific research and sophisticated computer modeling done in COS to domestic and international public policy studies that support the real-world needs of the business community, as well as those of energy security and growth in Virginia.

Kauzlarich says, "Mason already has high-caliber people working on science and energy policy. This center can pull those human resources together." He has seen an interest for this from the students in his classes and students from other programs. Smith echoes this excitement, saying that she has the ability to share what she knows and "mentor the younger generation about energy science." Both agree that energy science and energy policy issues will continue to grow in both domestic and international importance. They are particularly relevant to the energy future of the commonwealth in terms of renewable or zero-emission energy and the promise of offshore hydrocarbon development in the Atlantic.

The center is now reaching out to large consulting firms in the region, offering its expertise to train executives and provide specialized research. It is also engaging potential federal customers, such as the Defense Advanced Research Projects Agency (DARPA) and DOD. "The Navy has lots of interest in energy efficiency," says Kauzlarich.

Furthermore, the center is striving to become recognized as a vibrant part of a public research university. "The nuclear energy intersection is strong in Virginia. There are also ongoing debates about uranium mining and offshore oil drilling," says Smith. "We want to become a voice of science and policy to provide solutions to the state and to businesses working here in the energy field."

COS Alumna Returns to Pay it Forward

Faculty members like Kathy Pegion, PhD Climate Dynamics '07, are leaders in their fields, making important contributions to research and conducting groundbreaking experiments. After a positive experience with the "supportive and collaborative" climate dynamics program in the College of Science (COS), Pegion is thrilled to be part of the faculty. "I'm happy to pay it forward to the next generation of students."

Pegion earned bachelor of science degrees in meteorology and computer science and a master of science degree in meteorology from Florida State University. She completed her doctorate in climate dynamics at Mason with a dissertation on "The Impact of Air-Sea Coupling on Tropical Intraseasonal Variability: Simulation and Predictability."

Pegion's focus was on understanding the Madden Julian Oscillation (MJO) phenomenon, the largest element of the intraseasonal variability in the tropical atmosphere. "The challenge was to try to understand what we can and can't predict," she says. "I used a climate model to investigate how the ocean and atmosphere together and separately contribute to MJO predictability."

Pegion joined the Department of Atmospheric, Oceanic, and Earth Sciences (AOES) faculty as an assistant professor in fall 2014. She says, "I hope students will benefit as much as I did from such a great environment." She also notes the department's growth in size from nine students when she started to twenty-four.

Prior to her return to COS, Pegion worked as a research scientist at the Cooperative Institute for Research in Environmental Sciences (CIRES), a joint institute of the National Oceanic and Atmospheric Administration and the University of Colorado.

Pegion's goal is to better provide useful, reliable predictions. Working with the North American Multi-Model Ensemble project, a collaboration between national laboratories and universities, Pegion strives to improve seasonal climate prediction.

As a student, Pegion was impressed by the faculty's open-door policy. She enjoyed the approachable environment and is excited to perpetuate that by giving back as a teacher herself.

"Working with the North American Multi-Model Ensemble project, a collaboration between national laboratories and universities, Pegion strives to improve seasonal climate prediction."

Photo: Courtesy of Kathy Pegion

Training the Next Generation of Military Doctors

"The military needs doctors in combat, and Mason has a unique position in the community with a reputation of training students for a medical pathway," explains Donna Fox, COS associate dean for student affairs and special programs.

"We see connections in all the sciences," says Kenneth Johnson, an E-6 technical sergeant in the Air Force talking about his first pre-med boot camp semester in the new Enlisted to Medical Degree Preparatory Program (EMDP2) in the College of Science (COS).

Mason has partnered with the Uniformed Services University of the Health Sciences (USU) in Bethesda, Maryland—the nation's only federal health sciences university—to create EMDP2 at Mason's Science and Technology Campus in Prince William Campus.

This innovative, five-year, $8 million program aims to prepare military personnel to become doctors and health care workers in support of the U.S. military. This comes at a time when the nation's growing doctor shortage extends to the military's need for doctors and health care workers to have specialized training in combat injuries, trauma, tropical diseases, and mental health issues.

"The military needs doctors in combat, and Mason has a unique position in the community with a reputation of training students for a medical pathway," explains Donna Fox, COS associate dean for student affairs and special programs. She is the director of EMDP2, as well as an instructor in the program. She explains that the idea for this program started several years ago, and a request for proposal was issued by the federal government with a strict requirement that any selected program needed to be within fifty miles of the USU campus.

Georgetown University is already Mason's partner in the GeorgeSquared program, which offers an advanced biomedical sciences graduate certificate to prepare students for entry to medical school, research careers, or other health professions. Fox is quick to point out that GeorgeSquared is not related to this new program, but Mason's reputation, coupled with its strong faculty, cutting-edge research, state-of-the-art labs, and location, were a definite plus during the selection process.

"It's a feather in our cap to have been selected for this program," says Fox. "The selection committee was impressed with our technical abilities and felt we could deliver well what we proposed."

The first ten students enrolled in EMDP2 have been nothing short of impressive, according to Fox. They ask more insightful questions, work together effectively, and support each other. The students are also older, most with families, and have a maturity and sense of service that the typical undergraduate student entering a medical program has yet to develop.

"The military selected the students, and the available slots were evenly divided among the branches," she says. "Each student needed to meet tough criteria of having a degree, although not necessarily in the sciences, a 3.2 grade point average, exceptional military service, and most of the students have some sort of medical training, whether as an emergency medical technician, a paramedic, or working in a hospital."

What also sets these students apart is that they have all been deployed. Jesus (Jesse) Villarreal, for example, is an E-7 sergeant first class in the Army; a cavalry man who has a combined deployment time of forty-five months. His enthusiasm and commitment for the program typifies these students' work ethic.

"I always had a calling to be a doctor," says Villarreal. "But my path in life didn't take me there. I joined the Army and I've been serving for thirteen years. I told my wife that I wanted to somehow be involved in medicine and began looking for training opportunities in the Army. Nothing was available to me, and I was making plans to look for something else, giving up on my dream, when this program came along. It feels as if it were designed perfectly for me."

Photo: Courtesy of Kenneth Johnson

Kenneth Johnson

Johnson echoes this sentiment. He was working as a medical lab technician in a hospital and wanted to do more with his interest in medicine. The chance to become a doctor and stay in the Air Force through EMDP2 was a perfect fit.

The first hurdle these students faced was the application process. Both Villarreal and Johnson describe how the opportunity "popped up" without much notice. They scrambled to get their applications ready. When they were accepted, they quickly moved their families to Virginia to start the program. Fox says that on-campus graduate housing is available to the students, but because they all have families, this first group worked to find off-campus solutions. Villarreal

continued on page 8

Military Doctors, from page 7

and Johnson agree that the support from the military and from Mason has made the transition seamless.

An important element of this program is that the students are in a dedicated cohort. They take the same undergraduate classes as all pre-med students, but they are taught in separate sections with a group of professors selected by Fox. The students report that the quality of the professors and tutors is exceptional.

EMDP2 is a multiyear journey for these students. The first year consists of undergraduate science courses, then a summer session covering organic chemistry, a year of graduate-level courses, followed by officer training school, and finally medical school. Johnson explains they can apply to any medical school in the country, but most of them would like to attend USU. USU comes with military benefits, including the opportunity to train for a specialty anywhere in the world that has a U.S. medical facility. That is a huge perk to a student who hopes to deploy to a specific location, such as Hawaii or Germany.

When asked about the condensed schedule and the experience of going back to college after so many years, Johnson says, "It's difficult, but unlike taking science classes one at a time, everything being taught together allows us to understand how it is all related. We understand more and at a deeper level."

There are ten students for this pilot year with about twenty-five more expected as the program moves forward. When the program is fully enrolled, there will be a total of fifty students: twenty-five in undergraduate studies and twenty-five in the graduate program.

Fox has been teaching at Mason for twenty-two years and says she sees a real difference in these students. "These students make me proud every day," she says. "They come to us with life experiences we can't even imagine. They are wise beyond their years, and they have an unfaltering commitment to excel and to serve others."

> "What also sets these students apart is that they have all been deployed. Jesse Villarreal, for example, is an E-7 sergeant first class in the Army; a cavalry man who has a combined deployment time of forty-five months. His enthusiasm and commitment for the program typifies these students' work ethic."

Photo: Courtesy of Jesse Villarreal

Jesus (Jesse) Villarreal

Physician Shortage Study

A recent study from the Association of American Medical Colleges (AAMC) warns of a shortage of up to 90,000 physicians in the United States by 2025. The shortage of primary care physicians is estimated to be between 12,000 and 31,000, while a shortfall of between 28,000 and 63,000 non-primary care physicians is projected, with most occurring in surgery specialties.

Darrell Kirch, M.D., president and chief executive officer of AAMC, says the shortage is real, significant, and especially serious for the type of medical care that will be required for the nation's growing and aging population. He suggests a multipronged approach to the solution, citing the need for more innovative and efficient models of health care delivery and increased federal support for graduate medical education. A minimum of 3,000 new doctors a year is necessary to meet health care demands in 2025.

"In the College of Science, we feel a responsibility to help solve the problems and issues that affect our nation and society," says Dean Peggy Agouris. "Preparing students for medical school through programs such as the Enlisted to Medical Degree Preparatory Program with the Uniformed Services University and GeorgeSquared with Georgetown University is a contribution we are making to help meet the challenging health care needs of the coming decades."

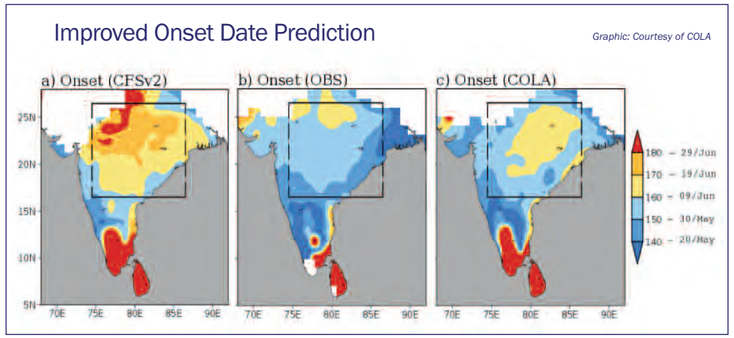
Advancing the Science of Monsoon Forecasting

> "By making progress on monsoons, we're hitting one of the three hardest nuts in weather forecasting. Cracking that nut will be huge for science and for the world's one billion people who live in monsoon regions," says COLA's James Kinter. The South Asia monsoon affects nearly 25% of the global population as it sweeps across South and Southeast Asian countries. Other monsoon systems affect the Sahel in Africa and the U.S. Southwest."

Each year between May and September, drenching monsoon rains pour down on hundreds of millions of Indians and transform land from arid to arable. Monsoon rains are vital, yet a fluctuation of just ten percent in the amount of rain can mean deadly floods or drought and famine. In 2013, after especially disastrous monsoon flooding, India's Ministry of Earth Sciences awarded a three-year, $1.2 million project to the Center for Ocean-Land-Atmosphere Studies (COLA) in the College of Science. This project works to improve monsoon prediction so that everyone, from India's national government to villages and farmers, will have life-saving, crop-saving time to prepare.

According to James Kinter, COLA's director and a professor in the Department of Atmospheric, Oceanic, and Earth Sciences, "In India, rain-fed agriculture is the norm for a few hundred million people. The earlier monsoon events can be predicted, the more time village farmers have to deploy the right kinds of seeds or equipment, or store rainwater in their irrigation system." A number of factors contributed to India's choice of COLA for the project, including its decades-long commitment to improved seasonal prediction in India and its specific experience in modeling and predicting the Indian monsoon.

The COLA team is focusing on the accurate mathematical representation of initial data on ocean, land, and atmospheric factors that affect monsoons, and the many complex interactions between them. Soil moisture, ocean surface temperatures, and ocean ice are just a few of the variables that determine how heavy, how long, how warm, and exactly where an upcoming Indian monsoon will be. In particular, the team is building on the U.S. National Centers for Environmental Prediction's Climate Forecast System version 2 (CFSv2) climate model.



In India, even two weeks' deviation from an expected monsoon onset can ruin a farmer. COLA's improved models now can pinpoint when monsoon rains will begin.

Now halfway through the project period, the COLA team already has "adapted the model to several supercomputer platforms and, by producing 'retrospective forecasts' for the past thirty years, identified and corrected several errors in the CFSv2," Kinter says.

Additionally, the team's use of CFSv2 in research mode has improved monsoon formation forecast accuracy tied to El Niño events. A persistent deviation in ocean temperatures of just 0.3% from the mean constitutes an El Niño weather pattern (colder) or La Niña weather pattern (warmer). Both anomalies perturb the tropical atmosphere and determine airflow, either in a downward, rain-suppressing direction for El Niño or the opposite for La Niña.

"We're finding that the CFSv2 model does a great job of connecting any 'winter' El Niño or La Niña event that occurs with a subsequent June/July monsoon," Kinter says. "That gives months of lead time to prepare for flood or drought." The team looks forward to COLA research ultimately providing six to nine months' advance word on the duration, regional distribution, and intensity of the next monsoon to come.

Dolphins in Dhaka

All photos for this article: Courtesy of Jennifer Lewis

In 2005, the Yangtze River dolphin was declared extinct.

Port Dhaka, Bangladesh

Pollution had destroyed most of its habitat, and damming projects along the river caused the final blow by separating the animals' dwindling population to the point the animals could no longer breed.

This sobering fact haunts Jennifer Lewis, a marine biologist now pursuing a doctoral degree in the Environmental Science and Public Policy program in the Department of Environmental Science and Policy (ESP). Admitting that she is different from the majority of students in her program because she already has a doctoral degree in biology from Florida International University, Lewis says she was attracted to the Mason program because it suits the needs of students who are either interested in research or already working in environmental policy.

A team surveys for dolphins in Sundarbans, Bangladesh.

She is also the founder of the nonprofit Tropical Dolphin Research Foundation, dedicated to the conservation of wild tropical dolphins. She says she first became interested in dolphins in high school and began studying them as an undergraduate student at San Diego State University. "Dolphins interest me because they are a top-of-the-food-chain predator and easy to monitor. When you see species like these in decline, it points to deeper problems throughout the food web."

Passionate about her research, Lewis explains there are only three known remaining species of river dolphins. "Many Americans don't even know river dolphins exist as there are none in the United States." Their appearance contributes to the lack of attention. River dolphins don't look like typical SeaWorld stars. They have long mouths and razor-sharp teeth. Unlike the other two species of river dolphins, the Ganges River dolphin has nonfunctioning pinprick eyes. "They've adapted so they don't need to see to survive in their murky environment."

Lewis recently traveled to India, Nepal, and Bangladesh to make a documentary film about the Ganges River dolphin. The film—*Who will Save the River Dolphin?*—captures the appalling everyday experiences of young student conservationists in the region as they struggle to survive in these poverty-stricken places and their determination to save a species at risk. Economic and political conditions in Nepal and Bangladesh prevent effective conservation efforts, Lewis explains. Country-wide strikes, coupled with deadly violence, frequently grip these countries.

Noting how inspired she was by the dedication of the students, a group she met through her foundation, Lewis says, "It made me think about the nature of conservation. The challenges these students face are intertwined with those of the dolphins. Human rights issues are also issues of conservation."

Jennifer Lewis conducts interviews in Nepal for her documentary about the Ganges River dolphin.

Lewis works through her foundation to mentor students, as well. Collaborating with Shambu Paudel from Nepal, she helped him develop research methods, analyze data, and prepare a manuscript for publication. As a result, Paudel and Lewis are coauthors of his paper.

As part of her doctoral program, Lewis is also studying filmmaking and storytelling. She points out that Thomas Lovejoy and Lee Talbot, two of the foremost researchers and voices in the field of conservation, have a unique affiliation with ESP. As a scientist, she also wants to be a voice for the conservation issues she cares about and sees filmmaking as a way to accomplish this goal.

Mason is in a fantastic location, Lewis says. It offers proximity to a hotbed of documentary filmmaking with the Discovery Channel and National Geographic, as well as the headquarters for conservation organizations like the World Wildlife Fund and the Smithsonian. She sees her future here in the Washington, D.C., community and involved with Mason. For her, the chance to learn how to affect public policy, tell compelling and important conservation stories, and teach biology—all in a location where grassroots efforts begin—is extremely fulfilling.

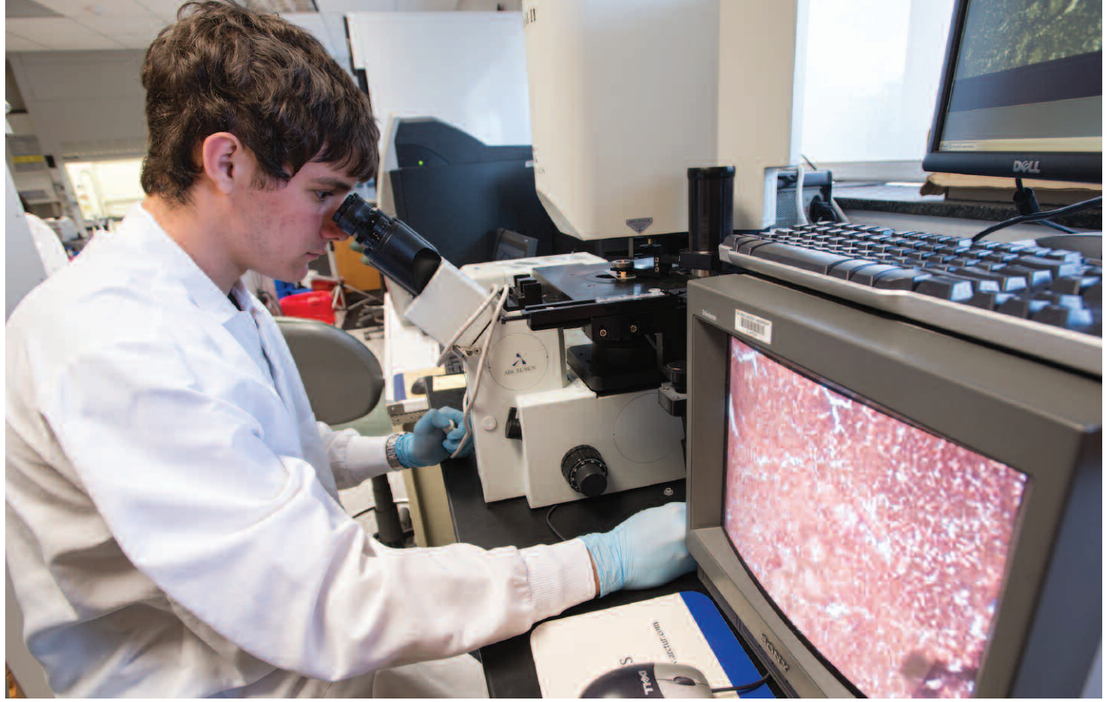


Photo: Creative Services

ASSIP students (pictured above and below) gain valuable hands-on experience during their summer assignments.

STEM Spark Ignites at an Early Age

A recent study suggests that students who are exposed to experiences in science, technology, engineering, and mathematics (STEM) early in life may go on to pursue educational and career goals in STEM.

Appearing in *CBE-Life Sciences Education*, a publication of the American Society for Cell Biology, the study was based on responses supplied by high school and undergraduate students enrolled in the Aspiring Scientists Summer Internship Program (ASSIP) offered through the College of Science. Sixty-five percent of the students surveyed said a family experience or childhood activity fueled their ongoing interest in STEM, and more than ninety percent said a hands-on laboratory experience convinced them to prepare for a STEM career.

Amy Adams, ASSIP director, suggests that these findings could shape public policy and encourage community-centered activities designed to foster a keen interest in science at an early age. "I am inspired by the ASSIP students' recollections of what initially got them interested in science," she says. Researchers recommend nature walks, science gifts, and experimentation as basic activities to promote a child's interest in STEM.

Established in 2007, ASSIP is a highly competitive program for high school and undergraduate students to gain hands-on experience and work with Mason researchers across campus laboratories. Participants use cutting-edge technologies to solve hypothesis-driven questions and often have their work presented at scientific conferences or published in scientific journals.

Photo: Creative Services

New Initiatives in Multidisciplinary Research

Multidisciplinary research is a hot topic in higher education circles, and for good reason. "In order to solve issues for society, you have to open your mind to new perspectives, get out of your comfort zone, and find answers in different places and with different disciplines," says Peggy Agouris, dean of the College of Science (COS). She's passionate about the subject and has seen firsthand in her role as dean how linking different groups and people creates a cross-disciplinary wave of new ideas and solutions. COS is a natural place to explore how disparate groups can achieve new breakthroughs. Just consider how a biologist can work with a geoinformation specialist or a forensic scientist with an animal conservationist.

Connecting the Deans

When S. David Wu became Mason's new provost last July, he took on the task of implementing the university's strategic plan to develop research of consequence. Agouris has been working closely with him to support his vision for new university-wide activities that spearhead, foster, and promote multidisciplinary research. She is drawing from her experience connecting traditionally disparate departments and encouraging new avenues of research in COS.

Agouris explains that her approach is based on three key elements. The first is to raise awareness across Mason for the need to build multidisciplinary teams, the benefits that come from new collaborations, and at the most basic level, find a way to introduce people and groups to share research.

The second part is to look for internal and external funding sources to support teams and projects. While there are many exciting ideas, without funding they will never develop.

The third piece involves incentives. It's not always easy to convince researchers to share ideas, resources, and funding. However, when this barrier is crossed, it is shown that multidisciplinary teams are more creative and productive, produce better papers, and find new avenues for funding. Additionally, this will all lead to a stronger reputation for Mason; something that benefits everyone.

> "In order to solve issues for society, you have to open your mind to new perspectives, get out of your comfort zone, and find answers in different places and with different disciplines."

April Symposium

With the three elements defined, the next step was to develop a delivery mechanism. On April 27, there will be a university-wide multidisciplinary research symposium—the first of its kind at Mason. Agouris says, "We needed a theme that represented one of Mason's signature areas, that was universal and could pull together as wide a range of projects and people as possible. We chose to start with health. It has implications into policy, pathology, data, engineering, humanities, even history, to name just few."

Faculty, students, staff, and alumni have been invited to participate in this inaugural symposium. Interested participants have been asked to put together a poster with a unique twist. A traditional poster presentation highlights research findings. In addition to the "this is what I have done" focus, researchers are tasked to document what they need to finish or enhance their research and why. It could be a particular, unexpected way to look at a problem, or a diverse team. The need is as individual as the project.

Presenters will also have the opportunity to participate in a two-minute pitch session where they will connect with other people. The idea is to leave with new ideas and having met people from other scientific areas and academic units. The symposium will also include program officers from major funding agencies like the National Science Foundation, the National Institutes of Health, the Defense Threat Reduction Agency, and others. These are the types of organizations that are eager to see and support innovative projects.

After the symposium, the real work begins. The provost has just announced a call for multidisciplinary research proposals to be supported by up to $50,000 in seed funding to develop new research teams, prototypes, proof-of-concept approaches, and ultimately lead to innovative projects that can attract substantial external funding.

"This is a long-term campaign," says Agouris. "We hope next year to work with other signature themes, such as big data and climate change." This effort, and Mason's increasing expectations for multidisciplinary achievements, has also increased interaction among the deans, a group Agouris describes as an interactive academic think tank where ideas and discussions are open and free-flowing. "We share a camaraderie that is unique to Mason, a spirit to get things done," concludes Agouris.

Photo: Creative Services

Periodic Elements Q&A

Proceed with Science

Editor's Note: Last spring, we introduced one of the newest research centers in the College of Science, the Center for Collision Safety and Analysis (CCSA), and learned about their plans for a $16 million grant from the U.S. Department of Transportation and, among other things, deconstructing a Volkswagen. Now that Cing-Dao (Steve) Kan, CCSA director, and his team have settled into their new facility, we decided to check in to see what's new. We caught up with Kan who had just returned from meeting with the Toyota tech team in California.

PE: *What were you working on with Toyota?*
Kan: We talk with a lot of different car and parts manufacturers throughout the year. We don't have a specific project with Toyota at the moment. I can tell you that as a company, Toyota is concerned about the quality of engineers in the automotive industry. They are looking to research centers like CCSA to provide specific training and develop engineers who may not be aware of the opportunities in this industry.

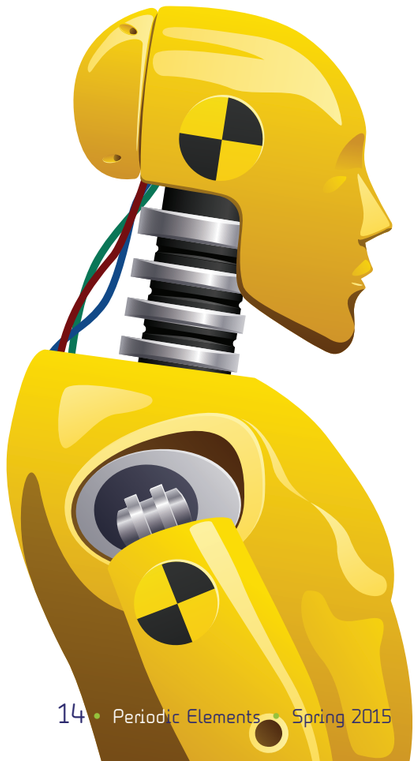
PE: *How is the work you are doing different from engineering as we traditionally think of it?*
Kan: CCSA definitely is a multidisciplinary place. The tools we are using employ a lot of modeling and simulation work, big data analysis, computational science, and material science modeling. Traditional engineering isn't enough anymore. The models we used for car crashes twenty years ago are no longer sufficient to predict what will happen today. The data we have today about crashes far exceeds what we once had. Add in real-time weather and traffic conditions, and the data grows exponentially.

> "Traditional engineering isn't enough anymore. The models we used for car crashes twenty years ago are no longer sufficient to predict what will happen today. The data we have today about crashes far exceeds what we once had."

This need for multidisciplinary support is one of the reasons Mason is a good fit for the center. A growing part of our data analysis also includes the social sciences. We need to understand how people think about driving and respond to all of the new technology built into cars. For example, Lexus, Infinity, and BMW all have lane keeping and blind spot warning alerts. This technology is new and there are no government regulations or monitoring for it. We need to understand how people react and whether it improves their driving or if it's an added distraction that may cause more accidents.

We also need to work with experts on public policy and urban development. Washington, D.C., is one of the most heavily congested areas in the country. But what happens when you look at a different city? What happens when a city plans a significant growth expansion? Can urban planners, armed with transportation data from congested areas make more livable communities?

PE: *What do you think about map applications such as Waze that will route drivers, potentially hundreds of them, through neighborhoods to avoid congestion?*
Kan: That's another example of where we need to look at the data. We are all data driven these days and rely increasingly on GPS for real-time information. This goes back to urban planning. Cities and towns now have to look at making improvements to roads and intersections that they didn't anticipate as traffic lanes. Our data can help provide some solutions.



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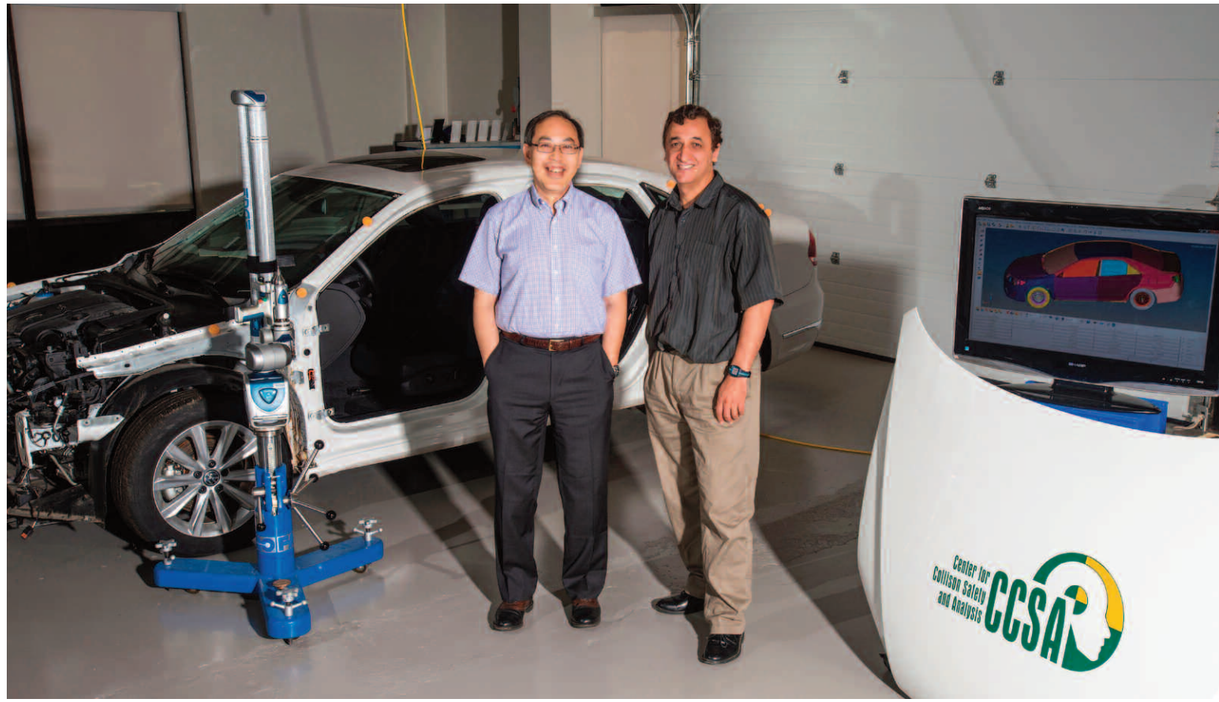

CCSA's Steve Kan and Dhafer Marzougui, research director

Photo: Creative Services

PE: *Delphi Automotive modified an Audi Q5 to make it driverless and is attempting the first cross-country trip from California to New York. What do you think is the future for driverless cars?*
Kan: Google and other major players in this space are looking to the government to regulate vehicle-to-vehicle communications and standards. If you send the wrong information to the car, or different cars are not able to communicate, there will be crashes. There are also legal issues to consider. If a driverless car causes an accident, who is at fault? We also need to look at mapping issues. Designers can't possibly know every community, and changes happen fast. Work will continue, but it will take a while.

PE: *What is CCSA testing at the moment?*
Kan: Each year, we have about twenty-five different tasks to support the first part of a multimillion dollar grant we have from the National Highway Traffic Safety Administration. Through our modeling and simulation work, we are examining small overlap impact, the effect of large trucks on the freeway hitting small cars, and different types of roadside hardwares, such as safety barriers.

PE: *Any new projects?*
Kan: Yes, we just received a two-year award from the American Chemistry Council to analyze composite materials. These materials are lighter and stronger than traditional metals used by both aerospace and the automotive industry. However, they are complex in how they are constructed. There are no standard material models that can be used at the moment. We need to understand how they perform in crashes so that they can be designed for important components in vehicles and ultimately to protect lives.

CCSA research assistant Shai Cohen

Photo: Creative Services

NanoNotes

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

Department of Geography and Geoinformation Science. The Geospatial Intelligence Graduate Certificate Program and the master of science degree program in Geoinformatics and Geospatial Intelligence have been reaccredited by the U.S. Geospatial Intelligence Foundation (USGIF) for five years. USGIF accreditation ensures that these programs match the necessary knowledge and skills required of students in the professional workforce.

Lance Liotta

Lance Liotta, Center for Applied Proteomics and Molecular Medicine, received a 2015 Outstanding Faculty Award from the State Council of Higher Education for Virginia (SCHEV). The award, the highest honor for faculty in Virginia's public and private colleges and universities, recognizes accomplishments in teaching, research, scholarship and public service. Liotta, along with Paul D'Andrea, Mason's Robinson Professor of Theater and English Literature, were among twelve faculty members honored by SCHEV this year.

Emanuel Petricoin III, Center for Applied Proteomics and Molecular Medicine, was named 2015 Innovator of the Year by the Fairfax County Chamber of Commerce. In its inaugural year, the chamber's Greater Washington Innovation Awards program celebrates the thought leadership, innovation, and creativity of individuals and organizations in select industries in the Washington, D.C., metropolitan area.

Jagadish Shukla, Department of Atmospheric, Oceanic, and Earth Sciences and the Institute of Global Environment and Society, has been appointed to the Governor's Climate Change and Resiliency Update Commission by Virginia Gov. Terry McAuliffe.

Claudette Davis, Department of Biology, was one of six applicants selected from colleges and universities nationwide to participate in the 2014–2015 Biology Scholars Program Transitions Residency. The program, managed by the American Society for Microbiology and funded, in part, by the National Science Foundation, is a national leadership initiative to improve undergraduate biology education based on evidence of student learning.

Larry Rockwood

Larry Rockwood, Department of Biology, received the 2014 David J. King Teaching Award, the highest teaching honor presented by Mason. The award is presented annually to a professor who has made significant, long-term contributions to the overall educational excellence of the university.

Abul Hussam, Department of Chemistry and Biochemistry, was honored with the University of Pittsburgh's 225th Anniversary Medallion, awarded to an alumni whose achievements have brought honor to the university and contributed to its progress.

Alonso Aguirre, Department of Environmental Science and Policy, was the recipient of the Warner College of Natural Resources Honor Alumni Award, presented by the Colorado State University Alumni Association.

Thomas Lovejoy

Thomas Lovejoy, Department of Environmental Science and Policy, received the Woodrow Wilson Award for Public Service for his outstanding commitment to public service relating to environmental issues, biodiversity, and climate change. Lovejoy is the eleventh recipient and first scientist to be honored and joins Hillary Clinton, Condoleezza Rice, William H. Gates, Sr., and other distinguished awardees.

Serda Ozbenian, MS Environmental Science and Policy '13 and a doctoral student in the Environmental Science and Public Policy program in the Department of Environmental Science and Policy, received a grant from the Fulbright U.S. Student Program to explore wildlife conservation issues in Armenia, focusing on human-wildlife conflict with threatened large carnivore species. She will work with the American University of Armenia's Acopian Center for the Environment to conduct the first noninvasive population surveys of the gray wolf and the brown bear.

Ryan Clark Richards, a doctoral student in the Environmental Science and Public Policy program in the Department of Environmental Science and Policy and a Smithsonian-Mason Research Fellow, received a grant from the Fulbright U.S. Student Program to conduct research in Brazil on the impact of policies that promote forest restoration and conservation to improve water quality in the Cantareira Water Supply System.

Harold Geller

Harold Geller, School of Physics, Astronomy, and Computational Sciences, continues as a Solar System Ambassador for NASA's Jet Propulsion Laboratory, a position he has held since 2012. His role in this outreach program is to share information and excitement with the public about the laboratory's space exploration missions and recent discoveries.

Austin Bradley, **Ryan Pfeile**, and **Wesley Toler**, School of Physics, Astronomy, and Computational Sciences, won a silver medal in the fifth annual University Physics Competition held last November. Undergraduate students from 131 universities around the world competed in the forty-eight-hour online contest sponsored by the American Physical Society and the American Astronomical Society. The Mason team performed a theoretical analysis of an assigned problem—"Where could a planet have a stable orbit in a system with two stars?"—and presented their findings in a formal paper.

The College of Science Dean's Awards are given annually to celebrate the success of the college through the recognition of excellence, achievement, and service. The 2014 awards and recipients are:

Early Career Excellence
Aarthi Narayanan, National Center for Biodefense and Infectious Diseases. Narayanan's in-depth knowledge of infectious diseases and scientific methods make her a highly productive research scientist. She has developed impressive collaborative relationships with the private sector, federal government agencies, and laboratories. In addition to teaching and publishing, her research explores the development of diagnostics, therapeutics, and vaccines for the Ebola virus and other infectious diseases.

Impact Award
Chi Yang, School of Physics, Astronomy, and Computational Sciences (SPACS). Under Chi's leadership as acting director of SPACS, faculty members and programs received numerous awards and honors, and her work as a dedicated mentor was highly regarded. She also continued her research in computational marine hydrodynamics, which has brought her worldwide acclaim.

Distinctive Service
Chris Aguilar, Department of Mathematical Sciences. Aguilar is recognized as a strategic thinker and is credited for bringing many departmental initiatives to fruition, increasing operational efficiency, and being an innovative problem solver. His ideas, opinions, and judgment are sought and respected by his colleagues throughout the college.

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

College of Science Welcomes Key Administrators

Ted Wynn, Director of Development, joins the College of Science with fifteen years of fundraising and development experience. Coming to Mason is a bit like coming home—Wynn is a Newport News, Virginia, native, with an undergraduate degree from the College of William and Mary and a juris doctor degree from the University of Baltimore School of Law. He says that the greater Washington, D.C., area is among the nation's top three philanthropic markets. He plans to implement a comprehensive advancement strategy to engage companies, foundations, alumni, and friends while working with units across Mason to publicize the college's accomplishments and create career opportunities for its students.

He says, "Mason is one of the most remarkable stories in American higher education. In less than fifty years, the university has emerged as a national research institution." Wynn has a strong interest in science that comes from his experience raising private support for biomedical research. Prior to Mason, Wynn was a director of development for the University of New Mexico School of Medicine and a director of development for the Keck School of Medicine of the University of Southern California. Wynn has set himself a busy schedule. "For the first time in my fifteen-year career, I feel I have the green light and support to implement a program that I am confident will yield positive results over time."

continued on page 21

STEM Accelerator Outreach Captures Statewide Award

Padmanabhan Seshaiyer's STEM Accelerator office in the College of Science (COS) is a jumble of books and resources piled on his desk representing projects and people who come through his door every day. The need for more professionals trained in STEM careers—science, technology, engineering, and math—is the nation's latest education clarion call. Seshaiyer's office is typical for any busy, high-energy COS professor until you look a little closer. Floor to ceiling white boards come together where two corners of the room meet and are covered with lists, diagrams, and timelines detailing a Girl Scout event, a middle school STEM day visit, a STEM symposium at a nearby high school, and a K-8 science and engineering fair to be held on campus in May.

Photo: Creative Services

Seshaiyer is a professor in the Department of Mathematical Sciences, where he has a second office. He specializes in applied mathematics or, as he explains, understanding problems and finding solutions using math. In 2013, he accepted the position as director of the STEM Accelerator program. The program began in 2011 with a mission to increase the number of STEM majors, improve student retention rates, reduce graduation times, and assist with job placement upon graduation.

To increase the number of students coming to Mason, Seshaiyer explains, it's necessary to reach them before they are even considering college. That leads to creating programs that start in elementary school and reach both students and teachers. The results are innovative professional development programs for teachers, science fairs for students, and pairing undergraduates with students and teachers in mentoring relationships.

Important Lessons

A STEM boot camp in COS for entering freshmen is an intense week where students are crammed with college-level science and engineering material. Seshaiyer says they come and "choose their pain." It's impossible for the students to learn a semester's worth of chemistry, cell biology, calculus, or physics in a few days and ultimately teach the students to learn to rebound after they fail the tests. It may seem counterintuitive to have this happen, but that's the point, he explains. "The students need to learn to fail. It's okay. The more important lessons of the program are the ones where the students learn how to ask questions, structure their study time, work together on projects, and begin the school year with more realistic expectations." The program is still new, but Seshaiyer reports that already they are seeing that students who have completed the program are doing better than their peers. Statistically, the college knows that students who falter in their freshman STEM classes often leave their programs and gravitate to other degrees.

Photo: Creative Services

Participants in a summer camp for Females of Color Underrepresented in STEM (FOCUS) offered through the STEM Accelerator

> "This award acknowledges the excitement Seshaiyer and the entire faculty share for STEM and the power it holds for the next generation of scientists."

This program is one of the most effective in the state, and the Accelerator's team, methods, and ideas have achieved international attention. Seshaiyer is working with the Organization of American States and teaching a class in Suriname. He recently traveled to South Korea with six Mason students, one of who was a dual-enrolled high school student from the Virginia Governor's School @ Innovation Park, where Seshaiyer is a program liaison and professor to the school's juniors and seniors.

Award-Winning Team

The STEM Accelerator's far-reaching efforts are managed by a dedicated staff of faculty: Claudette Davis, Mary Ewell, Kelly Knight, Mary Nelson, Julia Nord, Katherine Pettigrew, and Reid Schwebach. In January, the Accelerator was honored with a "2015 Programs that Work" award from the Virginia Mathematics and Science Coalition. The award "recognizes effective student and teacher educational programs, and the coalition reviews exemplary programs for which there is evidence of a positive impact on student or teacher learning."

This award acknowledges the excitement Seshaiyer and the entire faculty share for STEM and the power it holds for the next generation of scientists. If you can solve a problem with math as your tool, imagine the societal challenges that could be solved by students armed with a complete arsenal of STEM resources.

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From Social Media Data to Social Knowledge

To the geosocial analysis researchers in the Department of Geography and Geoinformation Science (GGS), the half-billion tweets that go out into the cyber world daily, together with vast numbers of YouTube, Flickr, and other social media postings, are far more than nonstop random blips of communication. They are a huge source of data that, when carefully analyzed, can produce valuable insights into human behavior and activities.

How do people react to a major event? How, when, and where do they get their information about it? How do cyber communities form and behave? What drives people to get information from one source rather than another? How do people's feelings about a place define it? How do these feelings change and influence a place's evolving form? The GGS geosocial analysis team develops novel approaches to analyze social media content and respond to questions like these.


Photo: Creative Services

Anthony Stefanidis

> "Our geosocial analysis research is revealing patterns that are not spatial or social or cyber, but an aggregation across these dimensions."
> — Anthony Stefanidis

Necessarily, theirs is a multidisciplinary team, with GGS professors Arie Croitoru, Dieter Pfoser, and Anthony Stefanidis (all affiliated with the Center for Geospatial Intelligence) collaborating with GGS computer engineer Jacek Radzikowski and computational social scientist Andrew Crooks from the Krasnow Institute for Advanced Study. Building on their diverse scientific backgrounds, the researchers develop new tools for harvesting and analyzing social media data and for communicating their findings. By studying the spatial and temporal patterns of information propagation, the group tries to define the mechanisms behind what its members refer to as the "geosocial waves" of interaction and communication in social media. "When something happens, people pick up on it, and then other people pick up on that. In this manner, waves of information propagate across a crowd," says Crooks.

In its three years together, the group has applied its geosocial analysis approach to a variety of major events. These include natural disasters such as earthquakes and hurricanes to geopolitical events such as the unfolding situation in Syria. Ultimately, their tools and findings may become vital, actionable resources for political research, urban planning, media research, marketing, emergency response planning, and other fields. Public health research may be among the first areas to benefit through insight on how societies react to disease outbreaks such as flu and Ebola.

"This is a new way to gauge society that was not possible before," say Croitoru. Instead of basing findings on samples of a few hundred people, we can now study millions of people, connecting their cyberspace activities to the physical space in which they act. The emerging possibilities to advance our understanding of how the world around us is organized and continuously reorganized as a system of connections across social, physical, and cyber spaces are endless.

***New Key Administrators**, from page 17*

Ali Andalibi, Associate Dean for Research, is one of the newest members of the College of Science leadership team, having stepped into his role in February.

Mason is a good fit for Andalibi, whose background is in genetics. He earned his doctorate from the University of California, Los Angeles (UCLA) and has worked in academia, as well as in government and the biotechnology industry. He has held leadership positions at the National Cancer Institute and the National Science Foundation, and was the vice president for research at the Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center. Prior to joining Mason, Alibi was the assistant vice president for research development and technology commercialization at the University of Connecticut. Andalibi will be focusing on enhancing the college's research activities and expanding its culture of innovation and entrepreneurship.

"I'm excited to contribute to Mason's future by supporting faculty and expanding research and entrepreneurial activities and programs," Andalibi says. "Mason should be seen as a place of research excellence with worldwide recognition."


Photo: Creative Services

Biology students examine flowers on the Fairfax campus.

Dean's Message


Photo: Creative Services

Peggy Agouris
Dean, College of Science

Spring is finally making its way across our campuses, and our students are taking their studies outside to share the sunshine and warmth with other students. This natural interaction evokes the spirit of learning at Mason and in the College of Science.

As a community of science, we can't exist in isolation. In the same way that our students are sharing the season with each other, we must also interact with other parts of society.

This issue of *Periodic Elements* highlights some of the conversations and connections that the college engages in throughout the year. You'll read about activities that introduce young students to science, how we provide teachers with new methods and best practices for teaching science, and why we explore problems in search of solutions that benefit our global neighbors.

I know you'll be both excited and impressed to learn about the different programs and people who are associated with the college and our many connections that promote STEM education to a wide variety of audiences. I invite you to find your own warm patch of sun or a place with a nice view and spend some time with these stories. I hope the connections we are making will inspire you to connect with us, too.

Periodic Elements

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

Connect with COS!

/GeorgeMasonCOS
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Mason Science
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Join us for the College of Science Convocation Wednesday, May 13, 2015, 2 p.m. at the Patriot Center

Taking Science to the Community

Following many years of planning, support, and perseverance among university, community, and government leaders, the long-awaited and much-anticipated Potomac Science Center opens next year near Belmont Bay in eastern Prince William County.

The three-story, 50,000-square-foot waterfront facility reinforces Mason's commitment to environmental conservation and sustainability through the use of sustainable building materials and unique features such as rainwater harvesting, stormwater management, and sustainable functions for energy, lighting, and operations.

The building stands on property that was generously donated by long-time builder and developer Preston Caruthers. He has used his resources and his outstanding record of public service to provide educational opportunities and a better quality of life for citizens throughout Northern Virginia and the commonwealth. Caruthers first envisioned developing the Belmont Bay area nearly fifty years ago and is still leaving his mark on the area today.

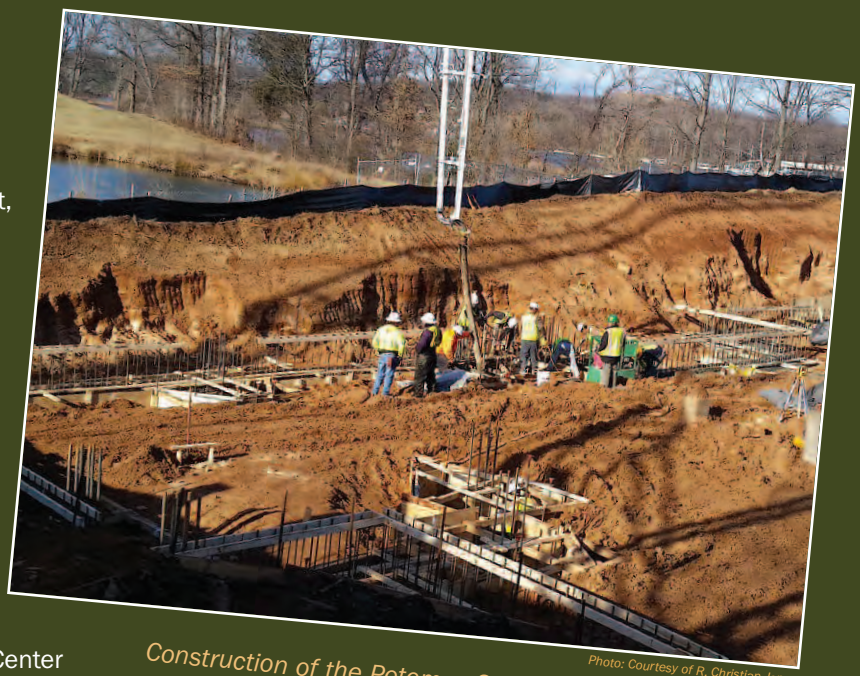

Photo: Courtesy of R. Christian Jones

Construction of the Potomac Science Center is underway.

The Potomac Environmental Research and Education Center (PEREC) will be among the first programs at Potomac Science Center. Founded on nearly three decades of research on the Potomac River Watershed, PEREC scientists monitor and promote the health of the Potomac River and its surrounding waters and ecosystems in Northern Virginia. Along with graduate students and volunteers, they also partner with schools and community organizations to advance environmental education, conservation, and stewardship

Geoinformation scientists based at the Potomac Science Center will engage in the discovery and development of industry-related tools and products. Incubator space is planned to support new companies founded on the results of these activities, which may produce a positive impact on regional economic development. The secure environment surrounding the center will also support collaborative projects with the National Geospatial-Intelligence Agency.

As part of its partnership with the community, the Potomac Science Center will nurture interest and participation in science through displays, hands-on projects, workshops, and other activities for area residents, students, and educators.