GEORGE MASON UNIVERSITY

Where Innovation Is Tradition

Periodic Elements

from the College of Science

Mason Shakes, Rattles, and Rolls from 5.8 Earthquake

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Vol. 6 Fall 2011 cos.gmu.edu

Biomedical Research Laboratory Strengthens Mason's Contribution to Global Public Health

At the end of a quiet cul-de-sac on the Prince William Campus, surrounded by a ten-foot-high security fence with a guard station at the entrance, is one of the College of Science's crown jewels—the Biomedical Research Laboratory (BRL). The BRL is administered by the college's National Center for Biodefense and Infectious Diseases (NCBID), whose mission is to address the ongoing challenges to national and international security posed by the threats of bioterrorism and emerging infectious diseases. The outside security measures, replicated inside the building, are not meant to be unwelcoming or prohibitive to visitors. They are requirements from the Centers for Disease Control and Prevention (CDC) and other federal agencies for all Biosafety Level-3 (BSL-3) research facilities.

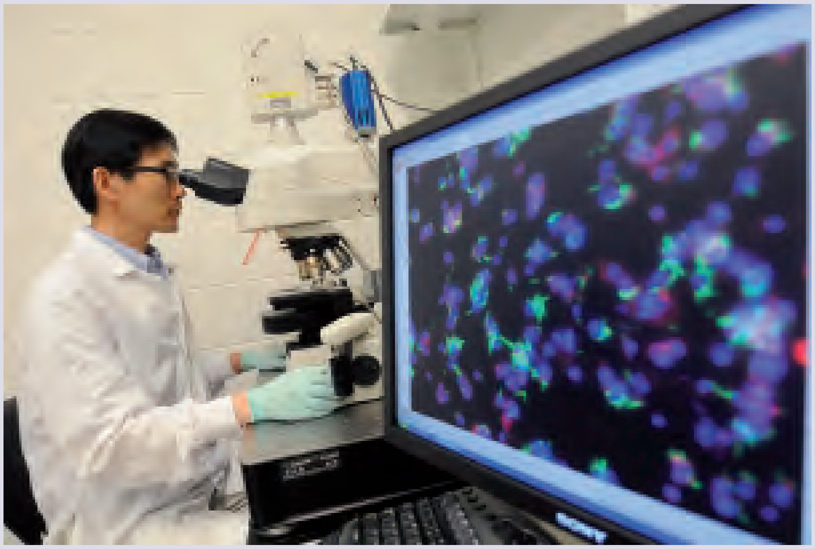

Photo: Creative Services

Myung-Chul Chung studies a slide showing Bacillus anthracis, *the bacterium that causes anthrax, that has adhered to human brain microvascular endothelial cells.*

The lab is still waiting to receive its final clearance. When fully operational, the lab will conduct research on "hot strains" of lethal pathogens using both animal models and some of the most sophisticated scientific equipment in the world. But while the scientists wait for the formality of paperwork and final inspections, they are far from idle.

NCBID Executive Director Charles Bailey has put together a dream team of scientific powerhouses from the National Institutes of Health (NIH), the U. S. Army Medical Research Institute of Infectious Diseases (USAMRIID), the CDC, as well as some of the most prestigious research universities in the country. They have unprecedented access to world-class resources, the best and brightest student researchers, and a unique collaborative environment that Aarthi Narayanan, a specialist in Rift Valley fever, says, "isn't found at other institutions."

Bailey describes the lab's mission as a facility where research is performed that assists both federal and state governments in preparations for infectious diseases outbreaks. The scientists work to develop new

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Biomedical Research Laboratory*, from page 1*

diagnostic tests and new antiviral medications and treatments for both emerging infectious diseases and those that result from bioterrorism. Researchers are currently investigating Rift Valley fever, Venezuelan equine encephalitis, AIDS, and anthrax, to name a few.

One of the lab's lead infectious diseases researchers, Fatah Kashanchi, also serves a special role as a faculty mentor, aids in grant development, and works with Bailey to make decisions about NCBID. He joined the Mason faculty from George Washington University and is excited about the new facility and his work as both a researcher and mentor.

He is highly engaged with students, as well as with faculty. Kashanchi says that for students, "working in the lab is a transient time in their careers. This is a window to do some real first-class science, and their careers should be their sole focus." Students need to discover new answers to tough questions, including who they are and what type of researcher they ultimately want to become, he explains. In addition to the science, Kashanchi teaches them how to write papers and grants and encourages them to attend meetings and conferences. He is grooming the next generation of researchers while helping Mason faculty remain at the top of their fields.

"Anthrax is not easy to treat. By the time you have symptoms, it's too late. Developing therapies that change the host response to the pathogen is a promising new approach."

A New View on Research

The BRL is unique for a variety of reasons. One is its location near Washington, D.C., and its proximity to NIH, USAMRIID, the U.S. Department of Homeland Security, as well as many other leading research facilities.

Although there are other BSL-3 labs across the nation, the BRL is one of only thirteen in the country on a university campus that was awarded construction funding from the National Institute of Allergy and Infectious Diseases through a highly competitive process. Another difference is its business model. Like all public institutions, the lab must compete on a regular basis for a dwindling pool of grant money to keep its doors open. To help maintain a steady funding level and stay self-sufficient, the lab will contract with commercial pharmaceutical companies and commercial research facilities to test new therapies. Additionally, the BRL will work collaboratively with other research facilities that look to Mason's state-of-the-art equipment and scientific brain trust of leading experts for assistance.

But from a research perspective, the most unique element of this lab and its team is its approach to viral pathogens. While most labs and researchers are looking at ways to kill pathogens, the BRL is studying how hosts respond to infectious diseases.

Photo: Creative Services

Ramin Hakami and Lana Senina discuss research notes.

When you speak with the scientists about their research on host response to pathogens, there's a flash of shared energy among them. Ramin Hakami, a specialist in Rift Valley fever, is quick to point out that host research is done at other facilities but not with the same intensity and focus that it receives here.

Narayanan explains that there is a lot of information and data about how viruses operate and that many viruses share almost identical patterns. What is different is how the host responds to each virus. By manipulating the body's response to the virus, you can control and potentially eliminate the virus.

Serguei Popov, an internationally recognized expert on anthrax, says, "Anthrax is not easy to treat. By the time you have symptoms, it's too late. Developing therapies that change the host response to the pathogen is a promising new approach." Through his research, he has successfully demonstrated how to immunize mice to the anthrax response. Researchers are able to inhibit the body's natural inflammation

> "NCBID Executive Director Charles Bailey has put together a dream team of scientific powerhouses from the National Institutes of Health (NIH), the U. S. Army Medical Research Institute of Infectious Diseases (USAMRIID), the CDC, as well as some of the most prestigious research universities in the country."

that comes from the immune system in defense of the pathogen. The bacteria are then rendered to a low-level threat and can be effectively destroyed with an antibiotic. This type of research comes from the ability to target the specific protein in the host that the pathogen attacks. By controlling the protein, you can control the gene.

The BRL has an advantage in this type of research as several of the world's leading proteomic researchers and state-of-the-art equipment are found at neighboring labs on the Prince William Campus. Narayanan says, "Our molecular-level understanding of the pathogens and host response opens up our possibilities."

The BRL team emphasizes that host response research gives them access to U.S. Food and Drug Administration (FDA)-approved drug therapies. For example, the human body's response to some types of cancer is similar to its response to many viral attacks. Drugs like interferon that works to boost the body's immune response or tamoxifen that blocks estrogen receptors may prove useful to control a life-threatening viral attack. This type of research can potentially put viable drug therapies on the market in years instead of decades. Host response research speeds up the therapy approval process by the FDA if a therapy can be identified and gives researchers access to valuable data.

Unlimited opportunities exist in infectious diseases research, and scientists at the BRL are looking for unique therapies and prevention methods with new eyes. And while the reality in today's global society is that scientists must prepare for a possible bioterrorism event through infectious diseases research, the discoveries made will profoundly advance disease management.

Photo: Creative Services

National Center for Biodefense and Infectious Diseases

Administration

Charles Bailey, PhD, Executive Director
Calvin Carpenter, DVM, Deputy Director and Veterinarian
Fatah Kashanchi, PhD, Director of Research

Principal Investigators/Research Interests

Myung-Chul Chung, PhD: Host-pathogen interaction, microbial pathogenesis, innate immunity, biomarkers of infectious diseases, mixed infection, and exosomes

Ramin Hakami, PhD: Infectious diseases, host response mechanisms in infectious diseases, and development of novel therapeutics and vaccines

Kylene Kehn-Hall, PhD: Emerging infectious diseases (HIV, bunyaviruses, and alphaviruses), host-pathogen interactions, small molecule inhibitors for therapeutics, cell cycle alterations, transcriptional regulation, RNAi modulation, and novel diagnostic platforms

Aarthi Narayanan, PhD: Host-pathogen interactions (involving bunyaviruses, alphaviruses, and human retroviruses), and roles of extracellular vesicles in intercellular communication

Serguei Popov, PhD, DSc: Infectious diseases, proteomics and cell signaling of the host in response to infection, bacterial toxins, and development of therapeutic approaches for protection from biological threat agents

Monique van Hoek, PhD: Drug delivery and treatment for *Francisella tularensis* (tularemia), other gram-negative and gram-positive human pathogens (*Pseudomonas*, *Staphylococcus aureus (MRSA)*, *Acinetobacter*, and *Mycobacterium*), host-pathogen interactions (especially phosphorylation-based signal transduction), development of novel antimicrobials and anti-biofilm compounds, microbial physiology of *Francisella*, bacterial vaccines, outer membrane vesicles, proteomics, bacterial biofilms and quorum sensing, and exosomes

Yuntao Wu, PhD: Role of cellular and, in particular, actin cytoskeletal factors in HIV-1 replication events in primary cells

Virginia Academy of Science Looks Twice at COS Research

When asked about winning the 2011 J. Shelton Horsley Research Award, Daniel Cox, graduate program director in the School of Systems Biology and associate professor in the Krasnow Institute for Advanced Study, modestly replies, "It's great to have your work acknowledged by your peers. We are grateful, but it doesn't change our drive."

The J. Shelton Horsley Research Award is a once-in-a-career achievement. It's the highest award given by the Virginia Academy of Science in recognition of original research. Cox joins another distinguished College of Science researcher, Monique van Hoek, assistant professor in the School of Systems Biology. She and her team of student researchers, Meghan W. Durham-Colleran and Anne Brooks Verhoeven, received the award in 2009 for their paper "*Francisella novicida* Forms In Vitro Biofilms Mediated by an Orphan Response Regulator."

Photo: Creative Services

Daniel Cox

Van Hoek's research looks at *Francisella novicida*, the bacteria responsible for tularemia, a rare infection that mostly affects rabbits and rodents but can also infect humans through tick bites. Her team's work showed that the bacteria form biofilms as a way to protect themselves as they grow and multiply. Understanding its ability to form a biofilm may partly explain how this organism survives in nature in between hosts. Van Hoek is proud of her team's accomplishment and their ability to collaborate and produce results that increase knowledge about this potentially lethal bacterium.

One of the hallmarks of science at Mason is the increasing caliber of researchers coming to the labs. Faculty members such as Cox and van Hoek bring experience and leadership, qualities that attract high-achieving students, too. Mason labs also benefit from a cross-pollination of ideas, including those from students. Cox says, "The faculty mentor drives the research, but the students are in the trenches every day doing the work."

Photo: Creative Services

Monique van Hoek

Cox uses genetically modified *Drosophila melanogaster*, fruit flies, for research models. He explains that there has been a renaissance of fruit fly research over the past twenty-five years as a study subject for nervous system functions. Fruit flies are a model organism. The insect has a simple genetic structure, and it is amenable to the characterization of nervous system function. Fruit flies also give quick results, and the pace is attractive to students who are performing research for the first time. In the span of a semester or a grant cycle, they can produce tangible results.

Cox points out that the research isn't about the fly, it's about the question that the fly can answer. For example, he says, "Much of what we know about the molecular mechanisms underlying autism comes from basic research using fruit flies. You have to start research some place, and fruit flies are a strong place to begin."

Cox's team, Eswar Prasad R. Iyer, Srividya Chandramouli Iyer, Ramakrishna Meduri, and Dennis Wang, won the Horsley award for their research paper "Class-Specific Profiling and in vivo RNAi Screen Reveal Complex Transcriptional Regulatory Networks Mediating Dendritic Architecture."

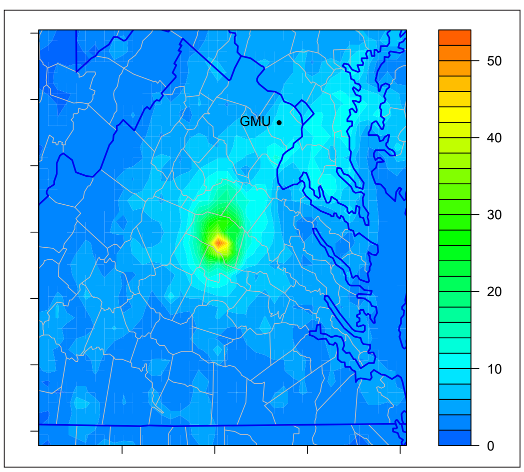
Cox and van Hoek say Mason's ability to continue working at such an accomplished rate depends on funding. The more the university can fund graduate students and postdoctoral candidates, the higher the caliber of students the labs can attract. The Virginia Academy of Science award speaks to that level of support and acknowledges George Mason University as one of the leading research universities in the state.

Virginia Earthquake Brings Global Geoinformation Research Close to Home

The East Coast earthquake in late August made worldwide news for its location in Mineral, Va., and its intensity of magnitude 5.8, characteristics that seem rare compared to earthquakes in the Pacific Rim. Guido Cervone, assistant professor in the Department of Geography and Geoinformation Science and assistant director of the Center for Earth Observing and Space Research, describes the recent quake in Mineral as a lesser-known type, an intraplate earthquake, and points out that although the Virginia earthquake is statistically rare, "it is a reminder that strong earthquakes can strike anywhere in the country."

"My research involves using remote sensing satellite data to assess the damage resulting from earthquakes," Cervone says. "I'm also interested in the study of precursory phenomena that might one day give early warning information about impending events. Earthquakes are the final frontier in terms of natural hazard forecasting. We have reliable early warning systems for other types of natural disasters, including hurricanes, tornadoes, and asteroid impacts, but for earthquakes we can provide very little—on the order of a few seconds—to no warning before impending events."

Cervone explains that the Earth's surface is divided into a mosaic of regions called plates, which constantly move toward, away from, and past each other at speeds that vary from a few millimeters to more than 100 millimeters per year. This movement builds strain in the rocks, which deform until they break. "Earthquakes are the result of the sudden release of seismic energy caused by the rocks fracturing," he says.



Courtesy of Guido Cervone

Peak ground acceleration: g-force of ground movement

"Earthquakes do not occur randomly throughout the planet," continues Cervone. "About ninety percent of all earthquakes occur along the plate boundaries." The earthquakes on the U.S. West Coast, and in Chile, Japan, and New Zealand all have the same characteristics of earthquakes along major plate boundaries.

The remaining ten percent of earthquakes, those that occur away from the plate boundaries, are called intraplate earthquakes and are not as well understood. As an intraplate earthquake, the Virginia earthquake occurred in a relatively stable region, where earthquakes are rather infrequent and of low magnitude. "Even in these usually quiet regions, massive earthquakes can still produce devastating results," Cervone notes. "In fact, the strongest earthquake in recorded history in the lower 48 states occurred in 1812 near New Madrid, Mo."

Photo: Guido Cervone

Guido Cervone takes his passion for his work outside the lab. Shown here in the North Atlantic, he was collecting sea surface temperature to correlate with satellite data.

Although the Virginia quake effects were felt over a very widespread area, that's not unusual for an intraplate earthquake. Depending on the characteristics of rocks beneath intraplate earthquakes, seismic shockwaves can sometimes be felt at a far greater distance than those of earthquakes along plate boundaries. "Fortunately, the epicenter was in a sparsely populated area—the damage would have been much more severe if it had been closer to Richmond or Washington, D.C., with their higher populations," Cervone points out. Because earthquakes are so uncommon here, building codes don't require construction to withstand seismic shockwaves, another reason damage can be greater in non-earthquake-prone areas.

With a master's degree in computer science and a doctoral degree in computational science and informatics from Mason, Cervone has combined his career interests in data mining and remote sensing. At the intersection of these two research foci are real-world applications with societal impact. "With constant advancements in computer and sensor technologies, our ability to collect and store data about the Earth and its environment is rapidly increasing. However, the results are often data rich but information poor," he notes. "My strength is in generating knowledge from large amounts of remote sensing and model data to study hazards. I hope that this research will one day help save lives."

NanoNotes

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

Robert Sachs, Department of Mathematical Sciences professor, was recently honored with the John Smith Award for Distinguished College or University Teaching by the Maryland-District of Columbia-Virginia Section of the Mathematical Association of America. The award is given annually by each regional section of the association "to honor college or university teachers who have been widely recognized as extraordinarily successful and whose teaching effectiveness has been shown to have had influence beyond their own institutions."

The award is named for the late John Smith, a former professor in the math department and the first recipient of the award in 1992. Sachs was nominated by his department chair, Stephen Saperstone.

Photo: Creative Services

The Class of 2011 contributed approximately 500 new members to the increasing ranks of COS alumni, expected to top 10,000 by 2013. Veronica Johnson, NBC News4 meteorologist, was the keynote speaker at college convocation ceremonies in May.

Among the graduates, a select group had assisted the Japanese government with satellite data analysis following the devastating tsunami that struck coastal cities in the country earlier in the year; another student was headed to Paris under a prestigious National Science Foundation award to present geographic and assistive geotechnology research results at an international conference; and a married couple shared the spotlight as they received doctoral degrees in environmental science and public policy.

A rainy Saturday morning last spring was a bright day in COS history. A much-anticipated **telescope** was installed in the Astronomy Observatory located outside Research Hall. Not an ordinary telescope, this 32-inch Ritchey-Chrétien telescope boasts the largest diameter of any telescope located on a college campus in the region, possibly the entire East Coast. It is powerful enough to bring the Andromeda galaxy—2.5 million light-years from Earth—into close range. Students will have unique opportunities to study the 690 verified planets around stars beyond the solar system, as well as other astronomical interests. In addition, regularly scheduled evenings under the stars are planned to share the wonders of the universe with the Northern Virginia community.

Photo: Creative Services

Photo: Creative Services

COS Dean **Vikas Chandhoke** (left) and **Howard Federoff**, Georgetown University's executive vice president for health sciences and executive dean of the School of Medicine, prepare to hoist a shovel at the September event that celebrated the start of construction for the Life Sciences Lab Building and Beacon Hall at the Prince William Campus.

The $50 million lab facility will add 75,000 gross square feet for university research and collaborative opportunities, and completion is expected in spring 2013. Beacon Hall will house graduate students and researchers participating in the GeorgeSquared program, a partnership between Mason and Georgetown University that provides advanced biomedical training to students pursuing careers in health professions or research. The five-story, 105,000-gross-square-foot building will include apartments, meeting space, and retail operations. Completion of the $18 million project is expected in summer 2012.

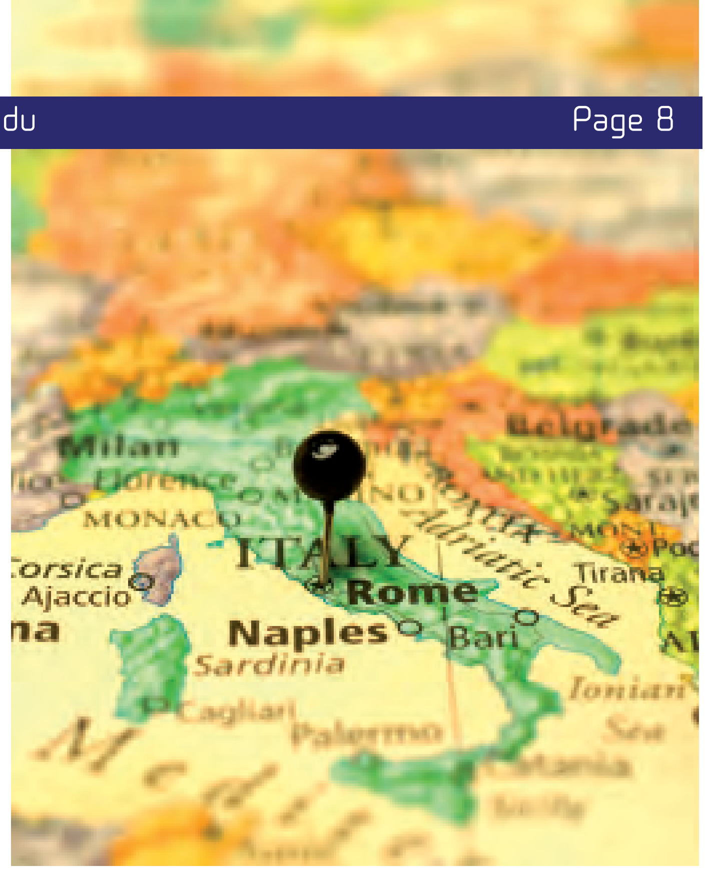
Photo: Duane King

New and returning students and faculty members were welcomed to the college at the COS Fall Convocation held in early September. Good food, engaging conversation, and friendship were on the program for this annual tradition as attendees mingled to learn more about the college and to become better acquainted with other members of the COS community.

Nearly 3,400 students are pursuing degrees in the college this year. Many of them also are participating in cutting-edge research projects, valuable internships, and other unique experiential learning opportunities.

Photo: Duane King

Summer Course in Rome Spotlights Cancer Research Collaboration with Italian Scientists



Last July, American and Italian students visited Rome for a week-long course as part of a collaboration between the Center for Applied Proteomics and Molecular Medicine (CAPMM) and Italy's Istituto Superiore di Sanità (ISS). The "Bench to Bedside: Translational Molecular Research" summer course gathered eminent American and European scientists to present cutting-edge research in oncoproteomics: applying the study of the structure and function of cell proteins to clinical cancer treatment.

Alessandra Luchini, CAPMM research assistant professor, was one of several faculty members teaching during the course, along with Lance Liotta and Emanuel Petricoin, cofounders and codirectors of CAPMM; College of Science Dean Vikas Chandhoke; and Virginia Espina, CAPMM research assistant professor. The summer course is part of the CAPMM/ISS joint effort in translational medicine and education, whose goal is to develop new methods for diagnosing and treating cancer through the discovery of drug targets and biomarkers for early disease detection.

A key indication of the collaboration's success is the sharing of technology and knowledge between the United States and Italy through training Italian scientists. "The Istituto Superiore di Sanità is the Italian equivalent of the National Institutes of Health and has organized a network of cancer centers in Italy that have made use of the research developed at CAPMM," Luchini explains. "For Mason's teaching faculty, this summer course presents an extraordinary chance to meet their Italian colleagues and discuss and plan the future direction of their joint research."

Another collaboration has benefited from CAPMM's partnership with ISS: the GeorgeSquared biomedical sciences program between Mason and Georgetown University. GeorgeSquared offers graduate certificate and master's degree programs as additional preparation for those applying to medical and other health care–related professional schools. "The Rome course provided GeorgeSquared students with three credits toward the completion of the certificate program," notes Luchini.

David Leon, who earned a GeorgeSquared certificate, attended the summer course for its "healthy dose of pathology" and the chance to see the major tools used for translational research in cancer, such as laser capture microdissection and flow cytometry. He plans to attend dental

Photo: Saro Internullo

Students and top cancer scientists from the United States and Italy gathered in Rome for the latest in bench-to-bedside cancer research and technology.

school and complete a postgraduate degree in oral health and pathology. Leon says, “GeorgeSquared has helped me build my capacity to handle an intense medical education, and the summer course provided supplemental knowledge in a rapidly growing field of medicine.”

Liotta emphasizes the cultural and informational exchange. “Our groundbreaking Mason/Italy collaboration and our innovative Mason/Georgetown biomedical sciences program are designed to train and inspire the next generation of physician scientists and medical researchers.” He continues, “Last summer in Rome, we celebrated both programs in a jointly sponsored course in which Italian and American students met one-on-one with thought leaders and role models, learning the latest biomedical technology.”

Mohammad Loynab earned a GeorgeSquared certificate to gain graduate-level science knowledge before entering medical school. “Working with graduate students from other countries forces you to tap into all your communication skills to break the language barrier,” Loynab says, “even ‘sign language’ and drawing. But research and medicine are a universal language, transcending English and Italian.” Major draws for Loynab were the emphasis on individualized therapies and the chance to work side-by-side with renowned researchers.

Luchini outlines the interdisciplinary nature of the summer course. “During the mornings, students heard lectures on topics in translational research: molecular and cancer biology, physiology, bioinformatics, cancer stem cells, clinical trial design, nanotechnology, and novel imaging and therapeutic strategies. In the afternoons, they participated in practical hands-on workshops on technologies such as mass spectrometry, confocal microscopy, laser capture microdissection, and flow cytometry.” She continues, “They then worked in groups to design clinical trials to answer critical unmet medical challenges. For students interested in science or medical careers, this course offers a unique opportunity to see from an inside perspective how experts in both fields collaborate.”

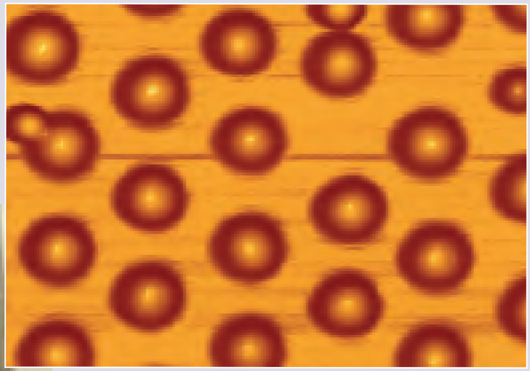
Photo: Creative Services

Alessandra Luchini leads a team of researchers exploring ways to use nanoparticles in preserving biomarkers for early disease detection.

Popular Science’s “Brilliant Ten” Taps COS Scientist

In its October 2011 issue, *Popular Science* magazine named Alessandra Luchini one of the “Brilliant 10,” the magazine’s annual list of the top ten scientists nationwide under the age of 40. She was cited for her research in developing nanoparticles that capture, isolate, and preserve biomarkers that may detect cancer and other diseases in blood, sweat, and urine.

Luchini and her CAPMM colleagues created spherical, carbon-based nanoparticles that mix with body fluids to harvest and stabilize molecular disease markers.



Atomic force microsope image of smart hydrogel nanoparticles.

The biomarkers are difficult to detect in most lab tests, and Luchini’s breakthrough technology prevents the degradation of these scarce and short-lived molecules.

Virginia-based Ceres Nanosciences, Inc., licensed this pioneering nanotechnology as the Nanotrap® to meet critical needs in the life sciences industry. Ceres has already commercialized a sample preparation product for research and development needs and is in the process of developing a number of improved Nanotrap® diagnostic assays, including one for Lyme disease.

The Nanotrap® has led to the discovery of a variety of molecular markers and enables researchers to develop further diagnostic tests and new treatments based on those biomarkers. The technology holds the potential to revolutionize early disease detection for cancer, heart disease, neurological disorders, and infectious diseases. Earlier detection means earlier treatment and greater chances of success and recovery.

NIH Awards Fund Research into Calcium's Role in Cardiac Arrhythmia

Most of us take our cardiac health for granted, rarely contemplating what makes our hearts beat: electrical impulses from the heart muscle itself. Cardiac arrhythmia, a term encompassing various types of irregular heartbeats, is a condition stemming from problems with the heart's electrical system. Calcium couples the electrical excitation of the heart to its muscular contractions and is central to the heart's function as a pump.

For decades, researchers have been working to uncover the specific role that calcium plays in cardiac function. Saleet Jafri, a professor in the School of Systems Biology (SSB), has been researching calcium regulation and cardiac arrhythmia,

Photo: Creative Services

Saleet Jafri was recently awarded a $5.5 million, five-year NIH grant for research into calcium's role in cardiac arrhythmia.

specifically in applying mathematical and computer modeling to cardiovascular medicine and biology. He and two colleagues, Jonathan Lederer of the Department of Biomedical Engineering and Technology at the University of Maryland-Baltimore and Raimond Winslow of the Institute for Computational Medicine, part of the National Heart, Lung, and Blood Institute's Systems Biology of the Heart funding program, were recently awarded a grant from the National Institutes of Health (NIH) to continue their research into calcium-entrained arrhythmias.

During normal cardiac functioning, the electrical excitation of the heart opens calcium channels (the same ones targeted by anti-arrhythmic calcium channel blockers) that allow calcium to enter cardiac cells. This calcium triggers additional release from internal calcium stores, which activates muscle contraction. When this calcium regulation system does not function correctly, cardiac arrhythmia can occur—and can be fatal.

With the $5.5-million, five-year award from NIH, Jafri, Lederer, and Winslow will pursue a joint experimental and computational multiscale systems approach to understand how the action of proteins involved in calcium regulation can lead to cardiac arrhythmia. "Our previous work focused on cellular and subcellular mechanisms of cardiac calcium regulation and how these might change under pathological conditions," says Jafri. "We also focused on developing new computational algorithms for efficiently solving the large-scale stochastic models needed to study these phenomena." Through the NIH award, Jafri and his colleagues will take this research to the next level. Using the algorithms that they previously developed, they are developing more detailed models of the cellular and subcellular mechanisms of arrhythmia and extending them to model sections of heart tissue.

Mason's strong emphasis on applied computation and its integration with the experimental sciences is what attracted Jafri. His background, with his degrees in mathematics and biomedical sciences, includes extensive experience in bioinformatics and computational biology. "Training in both mathematical and computational sciences as well as the biological and experimental sciences is a unique combination," notes Jafri. "That interdisciplinary strength enables me to approach problems with an integrated systems biology methodology."

Jafri has worked with Lederer, an experimental scientist, and Winslow, a computational bioengineer, on several joint publications about cardiac calcium regulation and excitation-contraction coupling—each bringing a different perspective. They work together to advise postdoctoral fellows and graduate students and integrate them into research groups. This interaction among researchers from various disciplines combines a variety of experiences and insights in this project, a dynamic approach.

One of Jafri's postdoctoral fellows in SSB, George S. B. Williams, has received a National Research Service Award (NRSA) from the National Heart, Lung, and Blood Institute for similar research. Jafri and Lederer serve as Williams's advisers, and through his research, Williams will complement their

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Agricultural Weather Research Holds Promise for Global Food Production

Photo: Di Wu

International experts from nine countries recently met at Mason to discuss sustainable agricultural development in Africa. COS participants included John Qu and Vikas Chandhoke.

The news images of famine gripping large areas of the African continent are heart breaking. Africa's seesaw of weather from droughts to floods combined with political instability has displaced millions of people. And though no one can control the weather, steps can be taken to support farming communities. According to Ray Motha, the U.S. Department of Agriculture (USDA) chief meteorologist, "Agroecological farming can double food production in Africa over the next ten years." However, to achieve this goal, African farmers must have adequate knowledge, tools, and resources to make decisions for sustainable development.

Innovations in weather data gathering and reporting, both short term (daily weather) and long term (seasonal weather patterns and climate change), are critical for agricultural management, from the national to the farm level. The Environmental Science and Technology Center (ESTC) in the College of Science is becoming a major contributor to these innovations. The center, a joint interdisciplinary endeavor between the United States and China, focuses on environmental and climate research using satellite remote sensing technology. Initiatives include the tracking of soil moisture and vegetation moisture estimations, drought conditions, climate change, and crop production.

ESTC recently entered into an agreement with the World Meteorological Organization (WMO) to work on ways to gather, organize, and share agricultural weather data. The World AgroMeteorological Information Service (WAMIS), a dedicated web server (http://WAMIS.cos.gmu.edu), is an agroclimate decision support system that combines the resources of weather and climate information to assist in agricultural management.

John Qu, associate professor in the Department of Geography and Geoinformation Science, is ESTC's director. He describes how ESTC fits into the worldwide WAMIS system. "WAMIS was originally created to host agrometeorological bulletins and data products issued by WMO members in more than 180 countries on a centralized web server," says Qu. "ESTC will support WAMIS by providing critical meteorological modeling information," he explains, "and the College of Science is hosting the next generation of the system."

Within the WAMIS system, technologies such as satellite remote sensing and soil and crop moisture data are integrated with advanced decision-making models and communicated to decision makers, ranging from national policy makers to the farming community. The system is not foolproof, but it is a step in the right direction toward providing guidance to the user communities.

ESTC hosted several meteorological meetings at Mason's Fairfax Campus this past summer, including the "Expert Meeting on the Preparation of a Compendium on National Drought Policy" and the "Expert Meeting on the National Early Warning System for Agricultural Weather Management." Both meetings were cohosted by USDA, and the program was organized by WMO.

The latter meeting was a follow-up to one held in Seoul, Republic of Korea, in April 2010, where a project to focus on Africa was deemed worthy of a more detailed discussion. International experts from national meteorological and hydrological services, climate and agricultural research institutes, universities, and public policy organizations gathered to discuss a major problem in monitoring climate extremes in agriculture: it is difficult to collect standardized data on soil moisture and vegetative conditions. Qu presented ESTC's capabilities in these specific areas.

Severe drought and famine in Africa and around the world cannot be eliminated in one season, but technology and on-the-ground communication efforts can improve crop yield and sustainability. Ongoing research in ESTC can have lasting results across the globe, and Qu is enthusiastic about the potential outcomes. "Within a year, we can make usable remote sensing data available for farmers in some countries to help guide their decisions."

Happy Anniversary COS

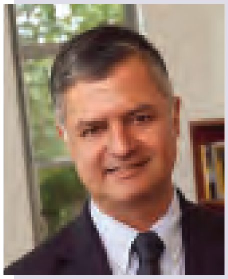


Photo: Creative Services

Vikas Chandhoke
Dean, College of Science

We recently marked the fifth anniversary of the College of Science, which was established in 2006 through the merger of the School of Computational Sciences and the science and mathematics departments of the former College of Arts and Sciences. The odyssey began with approximately 2,500 students, nearly 300 faculty members, and a variety of academic and research programs in traditional science education.

In spite of reeling from the worst economic conditions since the Great Depression, the nascent years of the college were filled with growth and change. Specialized jobs were hitting the employment radar and quickly morphing into futuristic careers in science. Workforce demand became the catalyst for the development of sought-after academic programs in high-profile disciplines to prepare students for these emerging careers. Research initiatives began to focus on challenges that affect today's global society, such as health care, homeland security, climate change, and the environment.

This fall our student population is approaching 3,400, and the faculty has grown by approximately ten percent. Undergraduate degree programs have increased to nineteen, thirteen master's degree programs are offered, and eleven doctoral programs are available. In addition, ten graduate certificate programs are offered to help students reach the next level in their professional or academic careers.

To accommodate new academic programs, research initiatives that are gaining momentum, and a growing student population, the college has developed an ambitious blueprint for construction. With a combined price tag of nearly $150 million, these projects are expected to be completed by 2014.

Philanthropic donations that support undergraduate scholarships, graduate fellowships, and research have more than tripled since 2006, and sponsored research funding has increased twenty-three percent during the past five years. Intriguing partnership opportunities also are being explored.

Beginning its third year of publication, Periodic Elements is growing and changing, too. We've increased its size by fifty percent and made editorial changes to better showcase the programs and the people in the college. As always, we welcome and encourage your comments and suggestions.

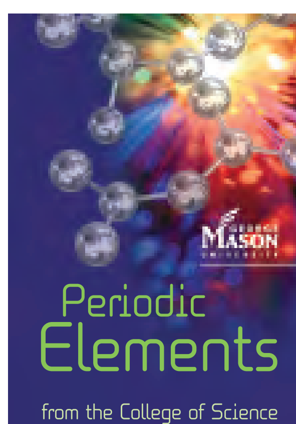
***NIH Awards**, from page 10*

work by studying the mechanisms of specific cardiac arrhythmias, using a joint experimental and computational approach like Jafri's research.

With his award, Williams will explore the molecular mechanisms that cause calcium leak in heart cells. "The movement of intracellular calcium underlies cellular contraction, and alterations in calcium handling can change the intracellular calcium balance, leading to pathological conditions such as arrhythmias and even heart failure," explains Williams. "My research focuses on the sensitivity of intracellular calcium channels, and I'll use what I learn from this work to inform the arrhythmia research." Results from his experiments will also be applied to the computer modeling efforts that he and Jafri are working on to develop new patient treatments.

Williams has worked with Jafri since 2006 during his doctoral work in applied science. With his degrees in chemistry and applied science, Williams has done postdoctoral research with Jafri at Mason and with Lederer at the University of Maryland–Baltimore. Williams's affiliate appointment with Mason enables him to continue these collaborations, and the NIH award supports his long-term plans to combine theoretical investigations with practical tests in research on cardiac cellular function.

Jafri's collaboration with Lederer, Winslow, and Williams is producing real-world results in applications for new treatment therapies. Understanding the molecular mechanisms of a certain class of arrhythmia will help identify the specific proteins and genes to target for new medications. Williams says, "Heart failure is associated with changes in calcium leak from intracellular compartments, and understanding these dynamics may provide new avenues for developing therapeutics—such as drugs that alter the intracellular channel's sensitivity to calcium."



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