Periodic Elements

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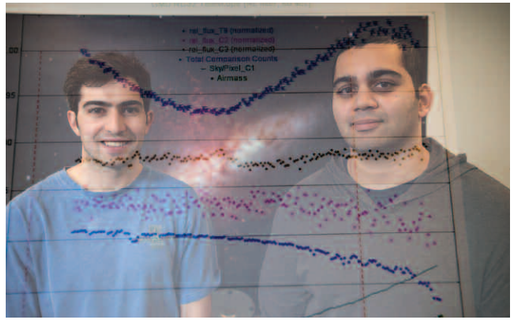

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Periodic Elements

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On the Cover

The College of Science achieves excellence in education and research through visionary thinking, collaborative ideas, and strategic partnerships.

See related stories on pages 3, 6, and 14.

EcoScience + Art: The Rain Project

Photo: Creative Services

Students work together to launch a 1,700-plant floating wetland on Mason Pond.

Communication is a "new phase of science training," says Changwoo Ahn, associate professor in the Department of Environmental Science and Policy, director of the Ahn Wetland Ecosystem Laboratory, and founder and director of EcoScience + Art. He feels scientists should be able to speak for themselves and better explain their research and what they do to the public.

Ahn has been working to improve both interdisciplinary collaboration and scientific communication by linking art and science through The Rain Project, a 1,700-plant floating wetland that was launched last year.

Twenty-four students studying environmental science, art, civil engineering, biology, communication, and film and media worked together in designing and constructing a floating wetland for Mason Pond, a small body of water on the Fairfax Campus, to aid with stormwater management. The Rain Project provided numerous implications for education, scholarship, pedagogy, and service while presenting a novel way of building a sense of community among undergraduate students for ecological awareness and literacy.

The goal of the project was to spotlight stormwater issues and to showcase an interdisciplinary, year-long collaborative activity for the campus community. The hands-on project required significant one-on-one time with biology and art majors alike. Ahn's work with film students provided footage for "The Making of The Rain Project." Art students illustrated beautiful images, and a piano player composed an inspired piece of music. Ahn calls the experience "very rewarding."

All of Ahn's students were required to present their work to high school students. He uses "near-peer presentation" as a tool for student training. He explains, "It is easy for students to explain things to their peers when they've studied with them throughout the semester, but presenting their project results to near-peer group (junior high or high school) students who came with no prior knowledge about the subject matter requires students to translate their results into lay terms."

The initial project was complete with the growing season monitoring in the summer of 2015. Ahn and his team have harvested all the plants and sediments gathered from last year. They are now processing the samples to see how much carbon and nitrogen the floating wetland captured. "We are currently testing the nutritional value of harvested plant biomass for use as a potential food source for animals," he says.

The floating wetland's size limited the cleaning efficiency, but Ahn feels The Rain Project was successful in changing stormwater management and certainly has taught his students the value of collaboration and communication, presenting a new model for interdisciplinary education.

Photo: Creative Services

Changwoo Ahn discusses The Rain Project with a student.

Computational and Data Sciences: Beyond the Boundaries

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"We are in a new era of scientific thinking and discovery," says Peggy Agouris, dean of the College of Science, and "it's driven by data."

Scientists have always collected and examined data, explains Agouris. But today, the amount of data available for all of the sciences — biological, mathematical, physical, environmental, materials, and even social — is more than any time in history. Our ability to collect and store data is seemingly limitless. Our challenge is to understand and use the data we collect to make connections that lead to new discoveries. The key lies in an old science that feels modern: the science of understanding data.

Data science is not computer science. It's not mathematics or statistics. And it has no allegiance to any one branch or subspecialty of science. Experts use computer skills, have an understanding of math and statistics, and usually are subject matter experts in a particular field of science.

"Data science is a hot topic," says Nektaria Tryfona, director of Educational Initiatives in the College of Science. One of her professional interests is to help integrate computational thinking throughout academics. She is working with College of Science faculty to expand the computational and data sciences program. She explains, "Data produces power and it produces money." Data scientists work with other scientists to help them analyze and understand their data. Data scientists employ the latest tools and methods to extract and analyze scientific findings. They interpret data and help make predictions. Tryfona says students currently come to data science through an interest in mathematics and computer science. Along the way, they develop an interest in a particular issue or find themselves working with sets of data. They see beyond the mechanics of running programs into how to

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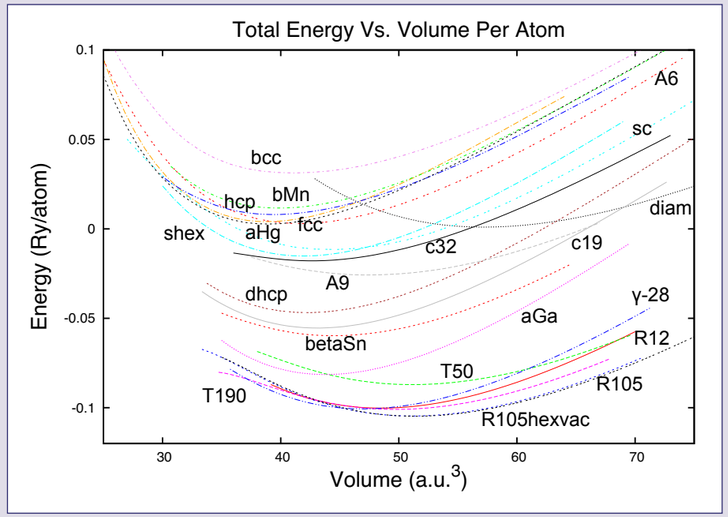


Photo: Courtesy of D. A. Papaconstantopoulos

This figure shows the results of total energy calculations of the various allotropes of the element boron and confirms the R105 hexagonal structure with a vacancy as the ground state. (Original article appeared in the Journal of Physics and Chemistry of Solids, *75 (2014) 1106-1112, by J. W. McGrady (student), D.A. Papaconstantopoulos, and M.J. Mehl)*

The new bachelor of science degree rounds out the department's offerings that currently include an accelerated master's degree program, a graduate certificate program, and a doctoral degree program.

***Computational**, from page 3*

use the computer as a tool to find solutions buried in the data. However, there is a trend among scientists and engineers to see computational and data sciences as complementary to their major disciplines, and students want to acquire more knowledge on how to deal with data.

Data science has been offered at Mason as part of various academic units for more than twenty-five years. Dimitrios Papaconstantopoulos joined the faculty in the 1970s and became the first chair of the Department of Computational and Data Sciences when the College of Science was founded in 2006. He says that the innovation Mason introduced to have a stand-alone program in computational and data sciences is rare at a research university, noting that this discipline often falls under a math or an engineering department. Mason has had a very successful graduate program in computational and data sciences that continues today, and more than one hundred doctoral students have graduated from the program and many research papers were published.

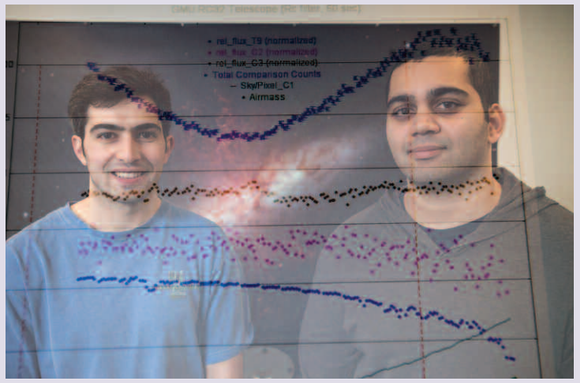


Photo: Creative Services

Graduate students Alex Panka (left) and Prabal Saxena (right) are shown with data they collected on Earth-sized planets at the George Mason University Observatory.

An interdisciplinary future

One of the benefits of having the College of Science housed in Exploratory Hall on the Fairfax Campus is the ease of which students and professors can interact. Geologists can interact with geoinformation scientists and biologists with ecologists. These interactions spur the types of ideas and collaborations that Agouris sees as the future of science at Mason. Interdisciplinary studies are always a major topic at universities, but the challenge is how to make it happen. She wants to encourage teams to go after grants and work on problems, and she is excited to talk about how data science fits into the mix.

Agouris talks about her own work in geoinformation science as a prime example of how important data science is for all researchers. She explains that her research uses large volumes of data and like many researchers, she has become a data expert — adept at using computers, writing code, and working with the results. But that all takes time and requires that in addition to her own field, she stay current in skills such as computer modeling and distributed computing. The mechanics of working with the data are time consuming, and she recognizes she is limited by her time and her abilities. By working with data scientists, she can manipulate her data in ways she never considered and formulate the right questions and extract solutions. She can concentrate on the results, not the mechanics.

This scenario is true to all scientific fields. A data scientist can work with a researcher before a study begins and help determine what the study should measure and how. It's like an architect working with a builder.

Academics for a new economy

Kevin Curtin, acting chair for the Department of Computational and Data Sciences, is excited about changes happening in the department, particularly the college's new Bachelor of Science Degree in Computational and Data Sciences.

This new degree rounds out the department's offerings that currently include an accelerated master's degree program, a graduate certificate program, and a doctoral degree program. The bachelor's degree is unique because there are not many universities offering this degree. "We already have the classes, faculty, curriculum, and reputation in place," says Curtin, also noting that four new faculty members are being hired.

Curtin explains how adaptable this new bachelor's program will be for students. Most science majors need to continue with advanced degrees and research in order to establish themselves in a career. This degree allows students to immediately enter the field with high-paying jobs and can also become a cornerstone for people interested in advanced studies. Students can follow three tracks, modeling and simulation, data science, or computational social science.

Papaconstantopoulos explains that the new degree has been designed in a way that doesn't strongly depend on hard science. "It's now more appealing to a larger pool of students." Many students currently following a computational and data sciences minor are

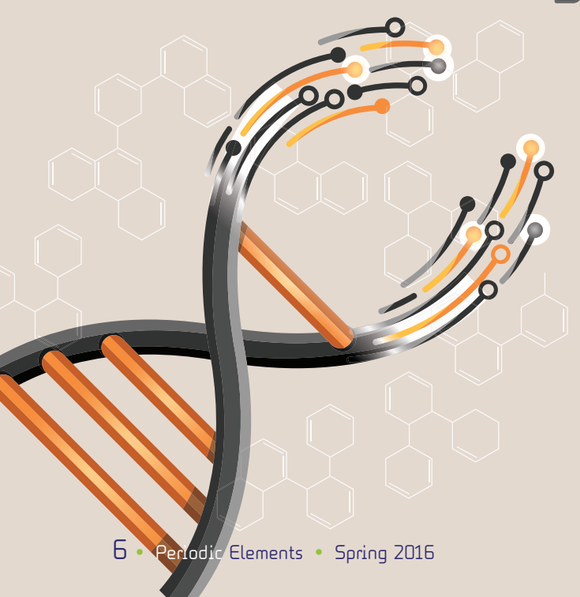
> "A data scientist can work with a researcher before a study begins and help determine what the study should measure and how."

set to move into the bachelor's program. The department also sees the new degree as a way to further raise the profile of computational and data sciences studies at Mason. That will attract more students and also feed students into the graduate program.

Agouris admits that the in depth integration of computational and data sciences' capabilities throughout the College of Science will take time. She is confident that the college's move toward interdisciplinary collaborations and initiatives will create a natural merger. She feels future grants will be awarded to teams of researchers who are pushing the boundaries of their science, and a computational and data sciences expert in the mix is a powerful resource.

Photo: St. Augustine Alligator Farm Zoological Park

Barney Bishop poses with an alligator at the St. Augustine Alligator Farm Zoological Park, which provides blood samples for his reptile blood research.



Institute for Biomedical Innovation:

Focused Sciences for Life-changing Results

There is a lot of excitement these days in the medical press about personalized medicine. It's the concept of customizing disease treatments based on an individual's genes and proteins, lifestyle, and even the environment.

Robin Couch, associate professor and researcher in the Department of Chemistry and Biochemistry, describes it as "omic" science, or the science of looking at a focused field of biology. Today, scientists and physicians have gone beyond what was once considered cutting-edge research, such as mapping the human genome, and have moved into genomics, proteomics, and metabolomics, one of the newer fields.

These specialized areas of research are thriving at Mason's Institute for Biomedical Innovation at the Science and Technology Campus in Prince William County. The campus is more than research labs, says university Provost David Wu. "We want to declare our intentions that science and engineering are important areas of growth and will complement Mason's portfolio as a comprehensive research university." He sees the current programs and resources as tremendous assets to leverage and looks ahead for even greater depth and impact.

Support from Richmond

Last December, Virginia Governor Terry McAuliffe joined the announcement of a strategic partnership between Inova, the largest health system in Northern Virginia, and Mason, the largest research university in Virginia. McAuliffe sees "biomedical research as a pillar of the New Virginia Economy."

Wu sees Inova as a critical strategic partner that gives the university access to clinical practice and clinical data. He says that "we have been working on this partnership over the past year, and it's coming to fruition at the right moment. Inova is investing heavily in personalized medicine research, and our broad array of capabilities from proteomics to bioinformatics to health policy made us a perfect partner." Wu also remarks this could benefit different aspects of our health education for years to come.

Small focus: mighty result

Robin Couch's "omic" is metabolomics. He explains that living organisms use proteins to make metabolites, small molecules such as amino acids, lipids, carbohydrates, and vitamins that are essential to life. His team is researching specific metabolites, looking for disease markers and ultimately preventative and curative solutions.

Photo: Creative Services

Robin Couch consults with a student about lab results.

Photo: Creative Services

> "Today, scientists and physicians have gone beyond what was once considered cutting-edge research, such as mapping the human genome, and have moved into genomics, proteomics, and metabolomics, one of the newer fields."

He jokes about his glamorous "poo research" (his words), but more specifically, the metabolites found in fecal samples. He is both enthusiastic and serious about his work and has received funding from the National Institutes of Health to determine if fecal samples can be used to find markers for gastrointestinal diseases. His team also pioneered a method that can determine if a person is healthy or an alcoholic through a rapid diagnostic assessment of poo.

Another of Couch's projects is funded by the U.S. Department of Agriculture (USDA) and looks at whip worms as a treatment for diseases such as Crohn's. A second study, also USDA-funded, is investigating pigs to see if probiotic supplementation can offset the negative effects attributed to chronic consumption of a high-fat diet. And initial results demonstrate that it does.

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Institute, from page 7

"Omic" research is fueled by technology. Sophisticated equipment capable of examining and analyzing the most complex parts of a cell has been around for a while. But now it is more portable, affordable, and faster. Consider it took thirteen years to map the human genome. Now there is technology that can conduct genome sequencing in a few hours.

Proteomics — the study of proteins — is another of the "omic" sciences. The College of Science Center for Applied Proteomics and Molecular Medicine (CAPMM), led by Lance Liotta and Emanuel Petricoin, has a global reputation for its research and its therapies.

Petricoin is a staunch supporter of applying research to real-world clinical applications and developing new methods that support personalized medicine. He also believes "that the best discoveries and inventions are useless unless they can be commercialized" and put out into the marketplace. In 2008, Ceres Nanosciences, Inc. was founded on CAPMM discoveries utilizing nanoparticle technologies. Collaborating with Liotta, Petricoin, and other CAPMM researchers, Ceres has developed the first urine test for Lyme disease and with funding from the Bill and Melinda Gates Foundation, is working on a urine test for tuberculosis. They will soon be starting a clinical trial with Sentara Healthcare to find a way to eliminate false positive results from mammograms. The group is also looking at traumatic brain injury and ways that this difficult injury can be properly diagnosed.

> "Consider it took thirteen years to map the human genome. Now there is technology that can conduct genome sequencing in a few hours."

Another research initiative running at the Science and Technology Campus is a 7.7 million dollar project funded by the Defense Threat Reduction Agency to analyze peptides in reptiles. Barney Bishop, associate professor in the Department of Chemistry and Biochemistry, along with his collaborator Monique van Hoek, associate professor in the School of Systems Biology, and their project lead, Joel Schnur, College of Science professor of bio/molecular science, have been hunting alligators. Not literally in the swamp, but rather peptides in their blood in College of Science labs. Bishop explains that alligators and crocodiles recover from serious gashes and wounds, even the loss of a limb, with low incidence of infection. This survival secret may be one of the reasons these creatures have been around for 200 million years. Working with blood samples provided by the St. Augustine Alligator Farm Zoological Park, the team has screened close to 120 peptides. Fifty of them have antimicrobial properties and some fight against anthrax, tularemia, staph, and pseudomonas. Bishop says that he hopes their work will not only directly translate into new potential therapeutics against infection, but will also provide essential resources for expanding research efforts aimed at developing new antibiotics.

These researchers and their projects are only a part of what is happening at the Science and Technology Campus. Wu sees the Institute for Biomedical Innovation and the entire campus "as a hub of innovation where an entire ecosystem can develop with biomedical science, as well as bioengineering, mechanical engineering, material science, and others" working toward larger goals and discoveries.

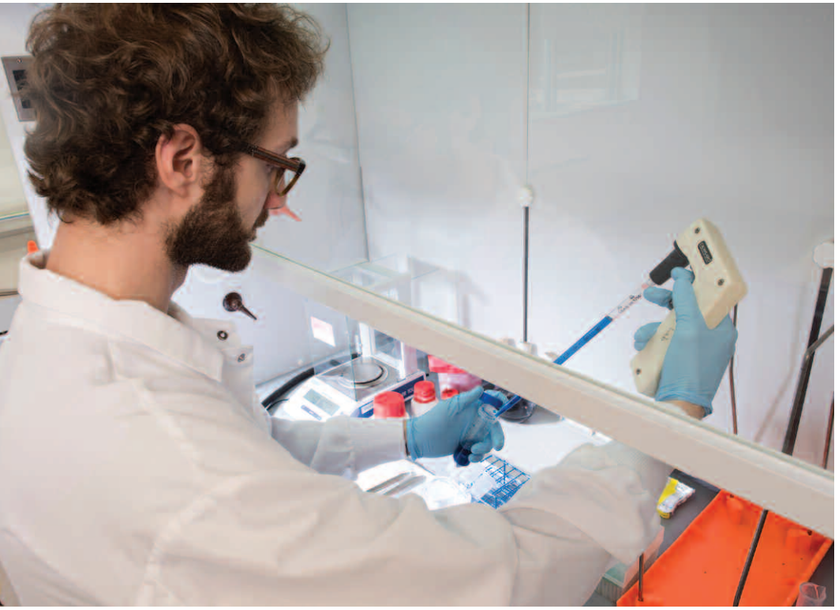


Photo: Creative Services

CAPMM research associate Ruben Magni works in the nanoparticle lab.

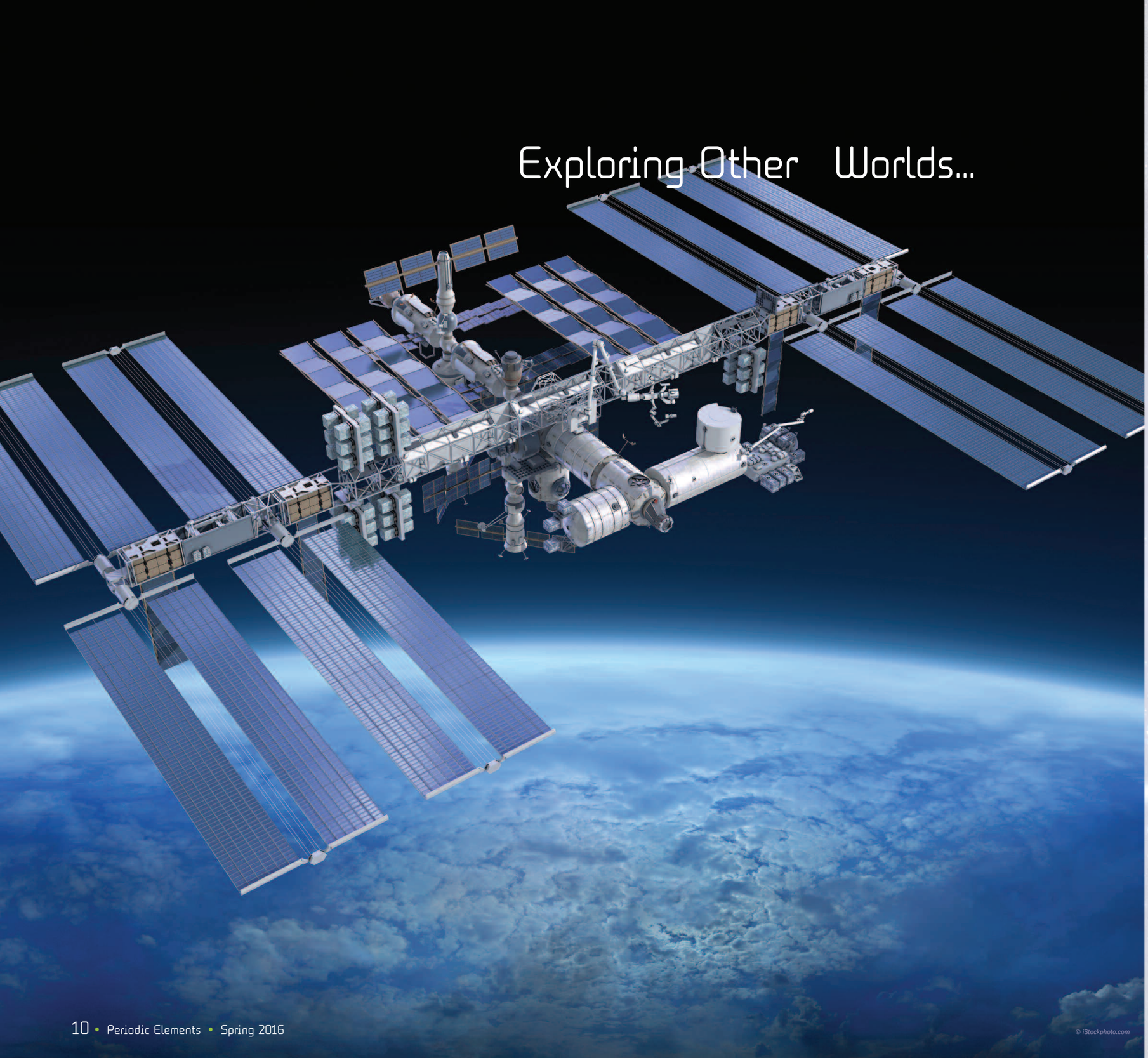
Advanced Training for A New Era in Medicine

Personalized medicine, an individualized approach to the health management and therapy of chronic diseases, looks at a patient's genes and proteins, environment, and lifestyle to define targeted treatments. To meet the increasing demand for highly trained professionals who can apply the latest advances in personalized medicine to improve patient care, the College of Science has developed a Graduate Certificate Program in Personalized Medicine.

"Health care is going through a transformation," says Ancha Baranova, associate professor in the School of Systems Biology and director of the new program. She explains that now is the ideal time to offer this specialized training. "In ten years, genome profiling will be key to diagnosis, helping to determine the type and dosage of medications for each patient." She says there are more diagnostic tools available than ever before, and more professionals need training on how to properly use them to benefit patients.

The fifteen-credit program in personalized medicine is designed to meet the goals of a variety of professionals working in health care and related industries. Students will study with some of the college's most renowned professors in the fields of personalized medicine and systems biology. Courses are offered in the evenings and include human genetics, personalized medicine, genomics, proteomics, and bioinformatics, with a choice of electives in cancer genomics, pathogenic microbiology, and advanced topics in immunology. Twelve of the credits earned in the program may be counted toward the Master of Science in Biology degree program.

Exploring Other Worlds...



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Revolutionizing Ours

A robotic spacecraft developed by private industry lands on an asteroid and begins to mine the asteroid for raw materials that will be used in everything from building human habitats to food for future human occupants. The raw materials include rare earth elements to be used in the next generation of computers that simulate reality at speeds far beyond current capabilities. International protocols for mining the asteroid have been negotiated through the new and emerging field of space law. The new knowledge gained from the mining mission itself is informing plans for an upcoming, pioneering human settlement on a more distant asteroid, or possibly on the planet Mars.

This is not a call for volunteer space colonists or a news flash of previously undisclosed scientific breakthroughs. It is a realistic preview of a future that has become closer than ever, thanks in large part to space missions such as the New Horizons mission. New Horizons gained unprecedented attention with its July 2015 flyby of Pluto, which completed NASA's ambition, begun almost fifty years ago, to robotically explore all the planets of the solar system.

Bigger than the Industrial Revolution

"The New Horizons mission completed our first reconnaissance of the major planets of the solar system," says Michael Summers, professor in the Department of Physics and Astronomy, and NASA's deputy lead on the New Horizons Atmospheres Team. "The space program has given us a comprehensive understanding of our near-space environment, and with New Horizons we have now explored all the way to the outer boundary of our neighborhood in space. This knowledge is opening the way to unlimited opportunities for space research, space commercialization, and space industry — all of which will lead to space manufacturing, permanent space habitats, space medicine, and space law. This is going to be vastly bigger than the Industrial Revolution."

Space commercialization has already begun. For example, NASA is subcontracting supply missions to the International Space Station (ISS) to a private company. There are now more than half a dozen private organizations focused on building vehicles that will take humans to space profitably. We now have a 3D printer

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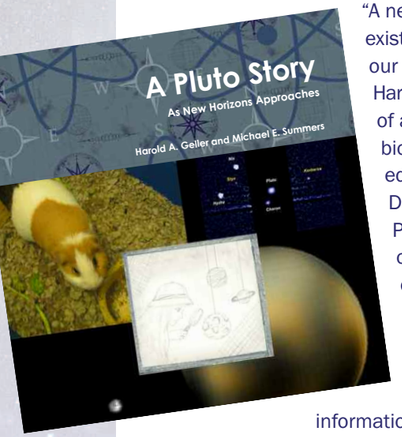
The Lights in the Sky



"A new era of human existence begins with our children," says Harold Geller, professor of astronomy, astrobiology, and science education in the Department of Physics and Astronomy and director of the George Mason University Observatory. It's a bold statement but with new information coming to us from the New Horizons space mission, there is a feeling in the science community that what we know about space is about to expand.

"What we know about Pluto has increased more than a thousand times. It has mountains and valleys, and there's still the possibility of ice volcanoes," says Geller. He is keen to make sure that children in particular are inspired by these findings. "Kids come to the observatory with their parents and they want to know about the lights in the sky."

Geller teamed up with colleague Mike Summers to write *A Pluto Story*, a children's book about Pluto using the best information available at the time from the Hubble Telescope.

Geller explains the history and geology of the distant dwarf planet using a much smaller Pluto, his pet guinea pig, who shares the celestial body's name. "I made some linkages and comparisons between my guinea pig and what we know about Pluto."

Geller has already spoken to Summers about creating an update for the book, hoping to bring the joy of the new discoveries to children. New Horizons has inspired more people to look toward the sky. Geller and Summers are considering creating a series of books for all the planets.

A Pluto Story is available online through Amazon and Barnes & Noble.

***Exploring**, from page 11*

on the ISS, and that technology alone will be responsible for building almost anything in space, from space ships to internal organs for transplants patients. In the next ten to twenty years, Summers estimates, robotic spacecraft will use replicating machines to build more advanced 3D printers on asteroids, Mars, and our moon, where they will harvest metals, rare elements, ice, and organic materials needed for the permanent human presence in space.

"This has been science fiction until now. To see this develop in our lifetime is exciting beyond words," he says.

Onward to the Kuiper Belt

Launched in January 2006, the New Horizons spacecraft did a flyby of Jupiter in early 2007. It was the July 14, 2015, flyby of Pluto, though, that captured the attention and imagination of our planet. Posted on the Internet, images of Pluto were seen in almost real time by millions around the globe. Data continue to pour in, delivering surprise after surprise. Who knew that Pluto had ice volcanoes, moving nitrogen ice glaciers, and an atmosphere of nitrogen like that of Earth? Or a surface structure shaped like a heart? Now called a "dwarf ice planet," Pluto's surface is much more active than ever expected and in some places is less than a few million years old. Pluto is also geologically active and is orbited by five moons. The largest moon, Charon, is made mostly of water ice. "It has been surprise after surprise," says Summers.

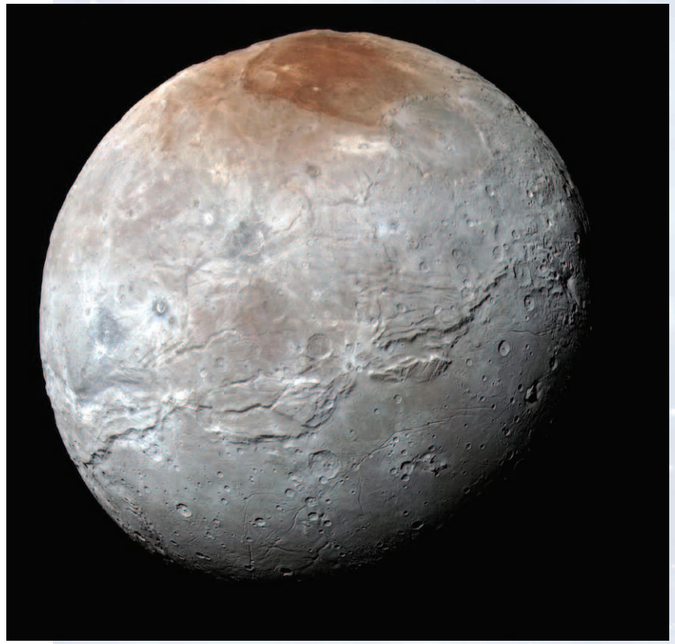


Photo: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute

A New Horizons image of Charon, Pluto's largest moon, showing a massive fracture around its equator that formed when an underground water ocean froze. Charon's dark pole is visible near the top of the image.

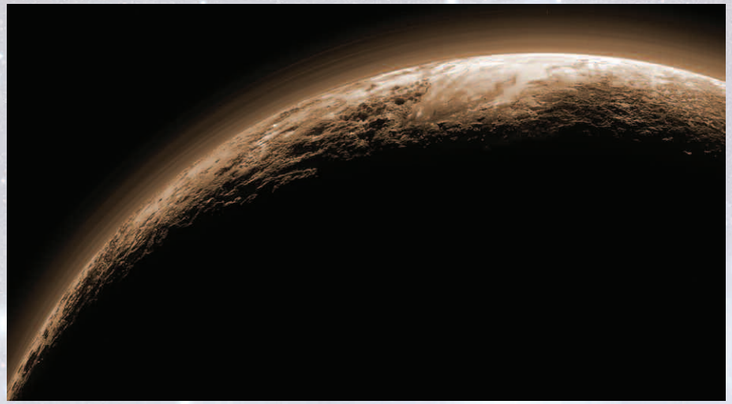


Photo: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute

A New Horizons image of Pluto's edge, showing its complex haze layers. Dozens of haze layers cover Pluto's entire globe and are seen when sunlight reflects off tiny particles in its atmosphere.

Next on New Horizons' itinerary is the Kuiper Belt, a region of space beyond Neptune where it is estimated that over 100,000 additional dwarf ice planets, like Pluto, exist. The target for this next flyby is the yet-unnamed 2014MU69 object. It is about nine times the Sun-Earth distance from Pluto, and much smaller than Pluto. The New Horizons encounter with 2014MU69 is scheduled for January 1, 2019.

Photo: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute

A crowd gathered at the Johns Hopkins University Applied Physics Laboratory to celebrate when New Horizons successfully completed the flyby of Pluto on July 14, 2015.

Resources on asteroids could revolutionize life on Earth

Summers says it's hard to imagine the magnitude of the resources in space near us in orbit around our sun. "A single asteroid that might be a kilometer in size could contain enough metals to build a thousand large space ships. Larger asteroids, such as Ceres and Vesta, are small worlds in themselves. Their metals and other raw materials, as well as a possible underground brine ocean, could spur habitats, industry, and space trade between worlds."

Ever-nearer opportunities such as these drive Summers to inspire the public — and especially young people — with New Horizons' ongoing discoveries. In addition to motivating his students, he speaks worldwide, accepting virtually every invitation to engage people in astronomy. "Sharing the thrill of scientific exploration and discovery inspires young people to want to be a part of it all. They sense that this new wave of space explorers will be made up of people from their own generation," he explains. But entire disciplines will have to be reinvented first, he adds. Space medicine is a new challenge for humans in space. How does one do CPR in zero gee? Space law will be an international challenge, because it will need to determined in the very near future who owns or shares the riches in space.

"Space is the future home for humanity," he says. With the hazards that could befall us on Earth, we could easily become extinct. But if we spread out in thousands of settlements in space, we have a much greater likelihood of surviving for millions of years or beyond."

Happy Anniversary College of Science

Ten years ago, George Mason University's School of Computational Sciences and the College of Arts and Science shared a warm handshake and agreed to merge some of its programs. Two new schools were formed, the College of Humanities and Social Sciences and the College of Science.

The College of Science had a bold agenda to focus resources and propel science at the university for the betterment of the commonwealth. The new college, under the leadership of notable bioscientist and founding dean Vikas Chandhoke, established new roots.

All this isn't to suggest there was no science before the creation of College of Science. Quite the contrary, science was flourishing at Mason. But with the expansion of high-technology industries, coupled with a population explosion in Northern Virginia, there needed to be a greater focus on science to meet the needs of Virginia, to fill jobs, and educate students. Chandhoke says, "My job was to create big opportunities and to give people the latitude to grow and succeed."

Chandhoke believed then and does today that for a university to succeed, "there needs to be an equilibrium between learning and research," and it's all driven by people. If you can attract the right researchers and give them an environment to flourish, they will attract much needed grants and funding. This drives more research and attracts students, increases knowledge, creates depth of expertise, and ultimately scientific discoveries for the betterment of society. This sounds like a lofty goal but it works. Chandhoke was given the support and space he needed to implement the university's vision for the new College of Science. Under his watch, the school stretched and innovated. Science at Mason had evolved into a community.

Physical and philosophical

When asked how he was able to attract the talent the school has today, Chandhoke becomes thoughtful. The college boasts physical spaces with academics in mind, such as Exploratory Hall, a LEED-certified facility on the Fairfax Campus. There has also been extensive growth at the Science and Technology Campus in Prince William County, including the College of Science Biomedical Research Laboratory and Mason's Institute for Biomedical Innovation, and new facilities at the Smithsonian Conservation Biology Institute in Front Royal, where Mason enjoys a longstanding relationship with the Smithsonian Institution for global conservation and biodiversity studies. Chandhoke says that while these new physical spaces are necessary and help attract top talent, the physical space came after the people.

He explains that the college was able to offer support. Researchers were and are allowed to pursue their science and their entrepreneurial ideas with the tools (students and funding) that make it all possible.

> "The College of Science had a bold agenda to focus resources and propel science at the university for the betterment of the commonwealth."

Peggy Agouris, now College of Science dean, was hired just as the new college was taking its first leaps. She remembers Chandhoke explaining his ideas for more interdisciplinary work and the type of people he wanted to attract. She became chair of the Department of Geography and Geoinformation Science and oversaw its growth and development. Today, she talks about how to use the college's combined strengths to solve larger problems, such as environmental issues that contribute to medical problems or using social media and mapping technologies to track the spread of infection. She becomes animated and excited when describing the college's passion for interdisciplinary work and how her next big initiative is with the Department of Computational and Data Sciences *(see page 2)*. She says that the college must serve the state's need for a science-literate workforce. She points to Governor McAuliffe's workforce development initiative that estimates 500,000 new jobs will be created in Virginia by 2022, many of them in STEM fields.

Reaching the stars

In the past decade, the college has made stellar progress. The College of Science boasts relationships with public and private organizations such as NASA's New Horizons mission *(see page 10)* and its Goddard Space Flight Center in Greenbelt, Maryland, where the College of Science Center for Earth Observing and Space Research uses satellite data to track earth weather. The college was also competitively selected as a Center of Academic Excellence in Geospatial Sciences, one of only seventeen centers nationwide, by the National Geospatial-Intelligence Agency and the United States Geospatial Intelligence Foundation.

Enrollment has grown a steady four percent each year over the past ten years. On any given day, hundreds of undergraduates, graduates, researchers, professors, and even high school students take to the labs and classrooms for real-world, hands-on science exploration.

The first College of Science handshake has been repeated over the decade with military and federal government collaborations, educational partnerships with Georgetown University, affiliations with Inova Health System and Sentara Healthcare, and many more.

At the College of Science, students and researchers can study the effects of car crashes at the Center for Collision Safety and Analysis, deforestation in the Amazon Jungle with the renowned conservationist Thomas Lovejoy, nanoparticles, proteomics, and personalized cancer treatments at the Center for Applied Proteomics and Molecular Medicine, and can look to the stars for a new era in space exploration. The next decade looks to be just as evolutionary, and Agouris is excited to see where it goes.

Forensic Science gets Real

Students dig for clues as part of a field exercise.

Photo: Courtesy of Forensic Science Program

Inch by inch, students carefully make their way around a grid placed on a muddy forensic excavation and research site. Their assignment: to unearth evidence of a staged outdoor crime scene, knowing that somewhere beneath the mud lies "human remains." It's the stuff of hit TV drama series. But for these students, the day's rain-soaked efforts deliver far more than drama. They deliver real-life forensic science training, critical to qualifying for a career that already is waiting for them.

Whether advertised in page after page of federal government job sites or noted by community agencies across the country, demand for forensic scientists is skyrocketing, as is the interest in high-quality forensic science training. The College of Science has responded. Begun as a graduate certificate program in 2009, the Forensic Science Program added a master's degree in 2010 and a bachelor's degree in 2011. In addition, the accreditation process has been initiated for several sections of the graduate and undergraduate degree programs with the American Academy of Forensic Sciences, the accreditation body for forensic science programs nationwide.

More growth is in sight. Today, the entire program is on the brink of major initiatives that will distinguish it from every other forensic science program in the United States.

Only at Mason

When Mary Ellen O'Toole, director of the college's Forensic Science Program, came on board in spring 2015, one of her early priorities was to survey the ideas and expertise of her faculty. Together, they developed creative new ventures for the program. The new concentration in Forensic/Biometric Identity Analysis is a perfect example. Beginning this fall, it becomes the only concentration of its kind in the nation and one of four concentrations that master's candidates can choose for their degree program.

Forensic/biometric identity analysis utilizes the latest technology

continued on page 18

A 360-degree experience

"I can't underscore enough how our training sets us apart. When our students come here, they don't just read a book or two about forensic science. They get their hands dirty. They work with real equipment. They dig in the ground and walk across crime scenes. It's this kind of hands-on experience that makes a difference when you apply for a job. That's what we give students: a 360-degree experience with forensic science. We believe it makes ours a premier program here in Northern Virginia and across the country."

— Mary Ellen O'Toole, Director

Photo: Courtesy of Forensic Science Program

Students try to uncover evidence at a mock crime scene.

Photo: Courtesy of Forensic Science Program

***Forensic Science**, from page 17*

for identifying people through forensic and biologic attributes such as DNA or fingerprints and prepares students for careers in the federal government, primarily as identity intelligence analysts. The concentration was, in fact, created when the college learned of the U.S. government's need for skilled identity analysts, ensuring that "students will have their pick of careers in the federal government when they graduate," says Emily Rancourt, assistant director of the program.

Both the Forensic Science Program and the university have become widely known in Japan as a result of documentaries about two cold-case homicides that happened there. A Japanese film company made three trips from Tokyo to the Fairfax Campus to record faculty in daylong consultations on the complex cases. Forensic and behavioral aspects of the cases were explored, their implications for offender behavior, personality, and relationship to the victims, as well as investigative suggestions for Japanese law enforcement officers. The documentaries were aired in Japan in 2015 and again in early 2016 and, in both instances, received the highest ratings for any programs shown in the same time frame. "Because the filming was done at Mason," O'Toole says, "this is a wonderful recruiting tool for both undergraduate and graduate students who plan to come from Japan to study in the United States."

A new partnership, a new institute…and the Dead family

Also set to get underway is a partnership with the Northern Laboratory of the Virginia Department of Forensic Science facility in Prince William County where actual crime scene evidence is submitted for analysis. Beginning this fall, College of Science students will take lecture courses at the department and use its DNA and controlled substance laboratories for training purposes.

Still in the planning stage is the Institute of Forensic and Behavioral Science, which will bring forensic science faculty, students, and community agencies together to examine cold cases of all kinds, including homicides, sexual assaults, and child abductions. Planners foresee a speakers' bureau, seminars, and agency-led training focusing on these cases, which O'Toole says, "typically don't get the attention they need."

And then there is the Dead family, newly acquired mannequins that simulate real-world homicide victims. Students are required to apply their learning to these gruesomely realistic dummies, documenting wound patterns, decomposition, and other findings essential to a case.

The real world

In both current and upcoming training opportunities, every aspect of education in the Forensic Science Program is relentlessly realistic. Hands-on labs are integrated with lectures. Guest speakers open students' eyes to less well-known careers in the field. Chemists, DNA analysts, and crime scene investigators interact as a team. "We promote this approach," O'Toole says, "because that's the way the real world is.

From FBI Luminary to Forensic Science Program Director: Meet Mary Ellen O'Toole

Photo: Courtesy of Mary Ellen O'Toole

Mary Ellen O'Toole

Mary Ellen O'Toole's career before joining the College of Science reads like a Hollywood script. In her twenty-eight years with the FBI, she worked on a host of high-profile cases, including the Unabomber (Ted Kaczynski), Polly Klaas abduction, Zodiac serial murders, the disappearances of Elizabeth Smart and Natalee Holloway, and the Columbine shootings. For nearly fifteen years, O'Toole was one of the most senior FBI profilers in its elite Behavioral Analysis Unit (BAU), the venue for the *Criminal Minds* TV series, where she became the leading expert in the area of offender behavior, or "psychopathy."

O'Toole is also a trained FBI hostage negotiator, the author of *Dangerous Instincts: How Gut Feelings Betray Us*, and the editor of the internationally recognized, peer-reviewed journal *Violence and Gender*. She is regularly sought out by national media — CNN, CBS, Fox, ABC, NBC, MSNBC, and Al Jazeera — for her expert insights into violent cases and forensic issues throughout the world.

As director of the Forensic Science Program, O'Toole joins a faculty that also came straight from the field. Their extensive contacts have helped build the program. Together they are, as O'Toole proudly says, "a visionary group of people who love their work."

"The media has inspired students to learn more about forensic science," she continues, speaking of TV crime scene dramas. "Our job is to show them what the real world is like and help them find their specialized passion within our profession, whether in a lab or the field."

Elements of COS

Congratulations to College of Science researchers who submitted successful funding proposals for the inaugural Provost Multidisciplinary Research Initiatives program. Provost S. David Wu began the program in 2015 to promote multidisciplinary research by providing seed grants for cutting-edge initiatives developed by teams of researchers from two or more academic units. COS scientists, along with their Mason collaborators, claimed seven of the fourteen grants awarded. The faculty members and their research categories are: Alessandra Luchini – Biotechnology; Anthony Stefanidis, Arie Croitoru, Andrew Crooks, and Dieter Pfoser – Cyber and Computer; Paul Delamater, Timothy Leslie, and Riuxin Yang – Environmental and Public Health; Timothy Leslie – Environmental and Public Health; Padmanabhan Seshaiyer – Society and Education; Anthony Stefanidis – Society and Education; and Changwoo Ahn – Society and Education. For more information about the Provost Multidisciplinary Research Initiatives, see the spring 2015 (No. 12) issue of *Periodic Elements* or visit cos.gmu.edu/magazine.

Faces of Science, a new COS faculty profile series available at youtube.com/MasonCOS, introduces seasoned favorite Lee Talbot, Department of Environmental Science and Policy, and newcomer Sean Lawton, Department of Mathematical Sciences. Watch to learn about their passions — from racing to philosophy — their research interests, and the courses they teach. New videos are added regularly.

Photo: R. Christian Jones

Construction progress continues on the Potomac Science Center.

The Potomac Science Center is on schedule to open in late summer 2016 near Belmont Bay in eastern Prince William County. The three-story, 50,000-square-foot waterfront facility will house the Potomac Environmental Research and Education Center, as well as defense-related geoinformation research and collaborative projects with agencies such as the National Geospatial-Intelligence Agency. The center is also expected to serve as a community science resource through displays, hands-on projects, workshops, and other activities. For more information about the Potomac Science Center, see the spring 2015 (No. 12) issue of *Periodic Elements* or visit cos.gmu.edu/magazine.

Science Fridays, a lecture lunch series, are held at noon on selected Fridays throughout the year. Intriguing research on a variety of topics is presented by COS faculty members, postdocs, or graduate students at each session. For a complete schedule of speakers and dates or to register as a speaker, visit cos.gmu.edu/scifri.

To better recognize the achievements of COS faculty and staff, *NanoNotes*, previously found in *Periodic Elements*, is now available as *Accolades* at cos.gmu.edu/news.

See COS alumni and student profiles at cos.gmu.edu/news.

Dean's Message

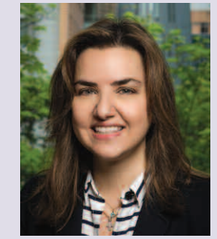


Photo: Creative Services

Peggy Agouris
Dean, College of Science

One of the most remarkable truths of science is that there is always something new to explore. That fact is true here, too, in the College of Science where every year, every semester, brings a sense of discovery, from new students and faculty members to exciting grant opportunities and new degrees.

I wish we could share everything that is happening in our labs and classrooms but as one of the largest centers of science education and research in Virginia, there's just too much to share. This issue of *Periodic Elements* offers an insider's view of College of Science activities in space and in petri dishes, and exciting discoveries hanging from the ceilings or rooting in Mason Pond. The college is like a self-contained city of curious explorers who ask a lot of questions — whether instructors are questioning students or researchers are questioning the limits of cell biology.

We are experiencing a science evolution where we have more data on everything imaginable than ever before. This is leading to a spirit of cooperation and collaboration in the college and throughout Mason, and I am excited to see how it grows. From undergraduate research opportunities to entrepreneurial companies supporting our discoveries in the marketplace, there is a lot to be excited about.

I hope we're able to share something through the stories in this issue that excites you. Science at Mason and science in Virginia is the science of the future.

Periodic Elements

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

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College of Science Convocation

Wednesday, May 11, 3pm, EagleBank Arena
Keynote Speaker: Scott Ralls, PhD
President, Northern Virginia Community College

Hanging around the Atrium

Photo: Creative Services

At left: A thirteen-foot-long, 300-pound cast of a 36-million-year-old Zygorhiza kochii *skeleton*

Photo, bottom: Mark D. Uhen shares his knowledge of prehistoric whales with students.

When paleontologist Mark D. Uhen joined the Department of Atmospheric, Oceanic, and Earth Sciences in 2009, he already was well-acquainted with prehistoric mammals, specifically whales. But no one knew he would eventually bring a life-size specimen from his studies along, too.

Also a research associate at the Smithsonian National Museum of Natural History, Uhen found his opportunity when the museum began renovations and the cast of a 36-million-year-old *Zygorhiza kochii* skeleton — a relative of modern whales, dolphins, and porpoises — was being removed from display. Seizing the chance to give the fossil a new home in the College of Science, Uhen spoke with Dean Peggy Agouris, who enthusiastically supported the idea. It took more than a year to plan the installation and move the thirteen-foot-long, 300-pound cast to the college. Explaining that it was in three pieces — skull, torso, and tail, he says, "It barely fit through the door."

Uhen points out that the project was a group effort. "I really want to thank all of those involved in the project," he says, "particularly the Smithsonian for donating the cast and Dean Agouris for providing the funds for design and installation of the exhibit."

The fossil now hangs from steel beams in the atrium between Exploratory Hall and Planetary Hall on the Fairfax Campus, but it took extraordinary efforts from the Mason Facilities team, a 40-foot lift, and a five-person crew to complete the installation.

Uhen hopes this new resident will spark students' curiosity and interest in the department's paleontology minor, the only one on the East Coast and one of the few in the nation.

Photo: Creative Services