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COLLEGE OF COMPUTER, MATHEMATICAL, AND NATURAL SCIENCES

ODYSSEY

TIPPING THE BALANCE

ENVIRONMENTAL SECURITY in a Time of SCARCE RESOURCES and CONFLICTING PRIORITIES

ODYSSEY

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Odyssey is published twice a year for alumni, friends, faculty, staff and students of the College of Computer, Mathematical, and Natural Sciences. Your comments and feedback are welcome. Please send them to abbyr@umd.edu.

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Dear Friends,

When scientists announced their discovery of gravitational waves in February, our campus soared with excitement! Not only because the observation opened an unprecedented new window on the universe, but also because this entire field of research began at Maryland in the 1960s when Physics Professor Joseph Weber (1919-2000) built the world's first gravitational wave detectors on our campus.

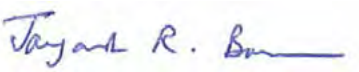
The international team that discovered gravitational waves included two principal investigators from UMD—Peter Shawhan, an associate professor of physics, and Alessandra Buonanno, a College Park Professor of Physics—and several Terp graduate students. You can read more about their contributions at **go.umd.edu/gravwaves**.

Moving from science fact to science fiction, we hosted an event to celebrate the season finale of *The X-Files* in February. Did you know that one of the show's main characters, Scully, received her bachelor's degree in physics from UMD? It's true. UMD Professor of Cell Biology and Molecular Genetics Anne Simon serves as science advisor to the show and shared story credit for the finale episode. She spoke about the science behind *The X-Files* and answered audience questions following the episode (which you can watch at **go.umd.edu/simon**).

Last December, we welcomed dozens of reporters into our Virtual and Augmented Reality Laboratory—also known as the Augmentarium—to experience firsthand the technologies that have the potential to revolutionize health care delivery, public safety, education and entertainment. Led by Computer Science Professor Amitabh Varshney, UMD is taking a leading role in developing these exciting new technologies. You can read a Yahoo! Tech reporter's take on his Augmentarium visit at **go.umd.edu/virtualreality**.

Across Route 1 from the Augmentarium at our Earth System Science Interdisciplinary Center located in UMD's M-Square Research Park, researchers are working to assess the significance and extent of "environmental security" threats in the United States and abroad. You can read more on page 4 about our researchers' efforts to tackle these imminent threats to human safety and prosperity that demand immediate solutions.

As always, we thank you for your continued dedication and support, which helps to ensure that our college remains a leader in scientific research and education.



Jayanth Banavar
Dean
College of Computer, Mathematical, and Natural Sciences

Photo by John T. Consoli

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ON THE COVER

Environmental security highlights imminent threats to human society that demand immediate solutions. The topic is complex, involving difficult trade-offs among many moving parts. (L-R) UMD researchers Melissa Kenney, Antonio Busalacchi and Fernando Miralles-Wilhelm play a popular block-stacking game, with blocks representing three critical, often scarce resources—food, energy and water—which must be thoughtfully balanced to achieve environmental security.

Photos by John T. Consoli
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(Top) Death Valley flooded photo by Tuxyo (CC BY-SA 3.0) /
(Center) Photo courtesy of Lynn Montgomery / (Bottom) Willie May photo courtesy of NIST

TIPPING THE BALANCE

ENVIRONMENTAL SECURITY in a Time of SCARCE RESOURCES and CONFLICTING PRIORITIES

By **MATTHEW WRIGHT**

WE CAN NO LONGER IGNORE THE FACT THAT THE WORLD IS CHANGING. The one-two punch of climate change and rampant population increase is already squeezing the world's limited resources, forcing us to make difficult choices about how we use our land, feed ourselves and power our technology. With time, these trade-offs will only become harder to negotiate.

News headlines across the country bear witness to environmental pressures in real time: a historic drought in California, record-breaking floods in South Carolina, receding glaciers and polar ice, and ever-expanding "dead zones" in the Chesapeake Bay and Gulf of Mexico are just a few examples from 2015 alone.

In the United States, environmental pressures fuel acrimonious political disagreements. But in other parts of the world, environmental stresses can result in armed conflict. Although the idea is not without controversy, some have suggested that the ongoing civil war in Syria was caused, at least in part, by drought conditions that strained the country's agricultural industry.

Discussions that were once framed in terms of environmental sustainability—a forward-looking endeavor by nature—have now taken on a more urgent tone. The emerging concept of environmental security implicitly reframes the discussion, highlighting imminent threats to human safety and prosperity that demand immediate solutions.

The connection with other, more well-worn terms that use the word "security" is deliberate. National security, food security and economic security carry recognizable meaning and an immediate sense of purpose. Indeed, these ideas all overlap with the idea of environmental security. When the environment is strained and changing too rapidly for humans to keep pace with solutions, every construct of our civilization stands on uncertain ground.

University of Maryland researchers are already working to assess the scope and severity of environmental security threats in the United States and abroad.

"In this area, the University of Maryland is unique. And I don't use that word often," says Antonio Busalacchi, professor of atmospheric and oceanic science and director of the Earth System Science Interdisciplinary Center (ESSIC), a joint center between UMD's Departments of Atmospheric and Oceanic Science, Geology, and Geographical Sciences that was initiated under a cooperative agreement with NASA's Goddard Space Flight Center. "We have the depth and breadth of a top-tier research institution, and our location has allowed us to build strong partnerships with federal agencies—NASA and the National Oceanic and Atmospheric Administration (NOAA) in particular—as well as the intelligence community. Maryland is as well or better poised than any other university in America to take on and meet this challenge."

Busalacchi also notes that the topic cuts across nearly every college on campus. Physical, agricultural and social scientists, engineers, public policy scholars and others at UMD will certainly be at the forefront as the world formulates responses and solutions to environmental security threats. But, as with any question of security, the first step is to gather intelligence and translate it for decision-makers.

"Environmental security encompasses the development and delivery of novel, actionable science that can be used to solve some of our most vexing environmental challenges," says Melissa Kenney, an assistant research professor at ESSIC whose research focuses on environmental decision analysis. "These challenges demand an interdisciplinary approach. Just capturing the physical aspect is not enough—humans are always in the mix and part of these systems."

With expertise in environmental science, observation and modeling across departments and in focused centers of knowledge, researchers in the College of Computer, Mathematical, and Natural Sciences are equipped to work with governments, nonprofit institutions and corporations that are ready to invest in actionable solutions to environmental threats.

"WE CAN'T LOOK AT FOOD, ENERGY OR WATER IN ISOLATION. WE NEED TO CHART A PATH BASED ON INTERDEPENDENCIES IN ORDER TO INFORM SOLUTIONS."

Antonio Busalacchi

Photos by John T. Consoli

"WATER IS THE LIFEBLOOD OF THE SYSTEM. WHERE WATER GOES, SO GO ENERGY AND FOOD. AND WHEN WATER GOES AWAY, SO DO ENERGY AND FOOD."

Fernando Miralles-Wilhelm

FEW FOR THE MANY

The most pressing environmental security challenges intersect with the most basic human needs. Clean water, nutritious food and reliable energy supplies are universally important, yet there are wide disparities in access to these resources across the globe. These three areas are so closely intertwined that they have spawned a new area of research, framed in terms of investigating the nexus where food, energy and water overlap. The idea has gained enough traction to earn its own acronym: FEW.

"You need water to produce energy, you need energy to produce water and you need both to produce food," explains Fernando Miralles-Wilhelm, a professor of atmospheric and oceanic science at UMD.

It's tempting to think of these three resources as equally important legs of the same stool, but one stands out as particularly critical: water.

"Water is the lifeblood of the system. Where water goes, so go energy and food. And when water goes away, so do energy and food," says Miralles-Wilhelm, who also serves as executive director of the Cooperative Institute for Climate and Satellites (CICS), a partnership between UMD and NOAA that is managed by ESSIC.

In the U.S., this dynamic plays out most dramatically in the water-starved western states. In Arizona and Nevada, rapid urban development accounts for the most severe strain on water supplies. In California, however, the state's multibillion-dollar agricultural export economy is the primary driver for water shortages.

"The water crisis in California has not been caused by the state's residents but by the large number of agricultural exports. California pumps water out of its aquifers and from as far away as the Colorado River for irrigation," Miralles-Wilhelm explains. "And there are compound effects as well. Every time they export a pound of beef, for example, there is a water cost involved."

In addition to cattle ranching, the irrigation of water-intensive crops such as almonds, as well as the practice of bottling and exporting drinking water, serve as highly visible flashpoints in the ongoing public debate about water use in California. While the debate is sometimes framed in terms of citizens versus industry, the reality is often more nuanced.

The energy sector also depends on water. California's hydroelectric dams need regular rainfall, while nuclear and coal-fired power plants use massive amounts of water for cooling. As a result, drought conditions can lead to strains on the electric grid. Desalination plants, which produce usable freshwater from salty seawater, hold some promise for relieving the strain of drought, but they require a hefty up-front investment and use large amounts of energy for operation.

AN INTERNATIONAL FEW PERSPECTIVE

As a developed country with a large economy, the U.S. is not yet on the brink of a FEW crisis, but other countries have reached that point already. The developing world is at especially high risk, while many of the world's ascendant economic powers, such as Brazil and China, are encountering new and unexpected challenges. Many of these developments carry implications for our national security. One particularly illustrative example is Pakistan.

Like California, much of Pakistan's agriculture takes place in a large central valley with a semiarid climate. Unlike California, which draws water for irrigation from a variety of sources, the crops grown in Pakistan are fed primarily by a single source: the Indus River. Glaciers situated in the Karakoram Range to the north contribute as much as 40 percent of the Indus River's flow, and climate change is putting the long-term survival of these glaciers at risk.

"In Pakistan, there are sharp trade-offs and competing interests between agriculture and the energy sector for water resources. There is also increased demand for water and energy in growing urban areas, where power outages have already led to protests and sociopolitical

Photo by John T. Consoli

instability. It rapidly becomes a security issue and could become an international issue if India becomes squeezed," explains Busalacchi, who contributed to a 2013 National Research Council report that featured a detailed case study of climate and water stress in Pakistan.

Busalacchi, Miralles-Wilhelm and Kenney all believe that the FEW nexus holds a lot of power as a conceptual framework to tackle environmental security threats at the international level.

As Busalacchi puts it, "We can't look at food, energy or water in isolation. We need to chart a path based on interdependencies in order to inform solutions."

To this end, Miralles-Wilhelm organized a workshop in October 2015, funded by the National Science Foundation and hosted by the World Bank, aimed at tackling some of the most pressing environmental security questions at the FEW nexus. The two-day event brought together experts from nearly every sector, including faculty members from four UMD colleges and schools. Representatives from U.S. federal agencies, industry, the international development community and academia gathered to offer their perspectives and share case studies.

"The FEW nexus helps us visualize points of overlap among these three systems and the experts who study them," says Kristal Jones, an assistant research scientist at the National Socio-Environmental Synthesis Center (SESYNC), which is funded by an award to UMD from the National Science Foundation. Jones presented her work on data synthesis at the October workshop. "Plant ecologists and atmospheric scientists may ask different kinds of questions and collect different kinds of data, but working together within the FEW framework can help reveal big-picture relationships, like how climate change impacts agricultural productivity and ultimately food security."

Careful synthesis of information from various sources can help scientists more closely examine the consequences of specific policy decisions. As Miralles-Wilhelm says, "Untangling connections and identifying trade-offs is our big focus."

THIS IS LAKE O.C. FISHER

Carp and gar lie dead on the exposed bed of Lake O.C. Fisher in San Angelo State Park, Texas. Located approximately 210 miles northwest of San Antonio, the lake is used for flood control and fishing and as a secondary source of drinking water. A 2011 drought resulted in a mass die-off of fish, and bacteria turned red what little water remained. By March 2012, Lake O.C. Fisher was completely dry and remained so until May 2015. As of February 2016, it stood at under 20 percent capacity.

Photo by Earl Nottingham, © Texas Parks and Wildlife Department

THIS IS FOLSOM LAKE

Created by the construction of a dam in 1955, Folsom Lake is a drinking water reservoir and recreation area serving the Sacramento, Calif. suburbs. A drought in late 2013 exposed the ruins of Mormon Island, a town submerged in the lake after the dam was built. In September 2015, a sudden, massive drainage killed thousands of fish and left boat docks on dry land hundreds of yards from the shore. By October 2015, the reservoir fell to 17 percent capacity.

A TALE OF TWO COASTS

While water shortages put pressure on the western United States, other areas find themselves with the opposite problem: too much water that often arrives far too quickly.

Storm surges that cause river flooding and coastal inundation—paired with long-term sea level rise as a result of global warming—present perhaps the greatest environmental security risk to the eastern United States. A decade's worth of news headlines tells the tale, from Katrina to Sandy and, most recently, the record-breaking floods in South Carolina caused by Hurricane Joaquin in 2015.

"There was a lot of talk about the South Carolina event being a thousand-year flood," Busalacchi explains. "Whether or not it reached that threshold, what's clear is that past is no longer prologue. We have to plan our infrastructure based not on what we experienced in the last 20 years, but what we're likely to experience in the future. A hundred-year storm may become a 20-year storm."

Coastal areas within the United States will be disproportionately affected by future hurricanes and tropical storms. This is especially problematic because many of our largest cities—home to as much as 40 percent of the country's population—are situated in coastal areas. Major structural damage notwithstanding, in best-case scenarios these storms will continue to create severe, expensive and often debilitating disruptions to transit, energy and commercial supply chain systems.

Tracking storms and predicting negative impacts—such as flooding—are crucial tasks for ensuring environmental security. On the surface, the relationship can appear simple: heavy rains lead to flooding. However, difficulties arise when predicting the scope and severity of flooding, especially in developing countries where flood data are scarce or nonexistent. Many variables have to be considered, including soil type, vegetation and topography. Depending on these parameters, the same amount of rainfall could lead to severe flooding in one area and little more than a full rain gauge elsewhere.

UMD is home to one of the best tools currently available to predict flooding. Developed by ESSIC's Robert Adler and Huan Wu, the Global Flood Monitoring System (GFMS) is a hybrid monitoring tool and predictive model.

Photo by Steenaire (CC BY 2.0)

Adler and Wu built the system using 13 years of data from NASA's Tropical Rainfall Monitoring Mission (TRMM) satellite, which was decommissioned in 2015.

The GFMS integrates real-time data from TRMM's successor project—the multi-satellite, multi-national Global Precipitation Measurement mission—with hydrologic models that account for soil saturation, topography and other relevant on-the-ground variables. The end result is a series of maps, refreshed at three-hour intervals, representing the status of floodwaters throughout the course of a storm event.

"If you have a fairly accurate measure of how much rainwater is coming down to the surface of Earth, the model helps to determine how much is going to soak in and how much is available to runoff, and you follow the water downstream," Adler says.

The maps and data the GFMS produces are valuable for scientific studies, but perhaps their greatest strength lies in providing federal agencies, international relief organizations and other stakeholders with up-to-date information that can inform their efforts.

"We check the GFMS nearly every single day to monitor current flood concerns and also to assist in discovering new flood events that may not have been reported yet or are developing," says Emily Niebuhr, a meteorologist with the Emergency Preparedness & Support Division of the United Nations' World Food Programme.

Environmental security depends on monitoring conditions and predicting storms, flooding and other threats. As these events increase in frequency and severity, maintaining and improving a robust public infrastructure of floodwalls, levees and dams will prove to be an equally important line of defense.

HARNESSING NATURE

Traditionally, assessments of protective infrastructure have primarily accounted for human-built structures. But another emerging concept—the prioritization of natural

THIS IS THE BROOKLYN–BATTERY TUNNEL

The tunnel, which connects the southern tip of Manhattan to the borough of Brooklyn on Long Island, flooded during Hurricane Sandy in October 2012 and remained closed for over a month. All road tunnels into Manhattan except the Lincoln Tunnel flooded. Subway, ferry, road and rail traffic were disrupted for days. In New York alone, Hurricane Sandy caused 53 deaths and an estimated $32 billion in damage.

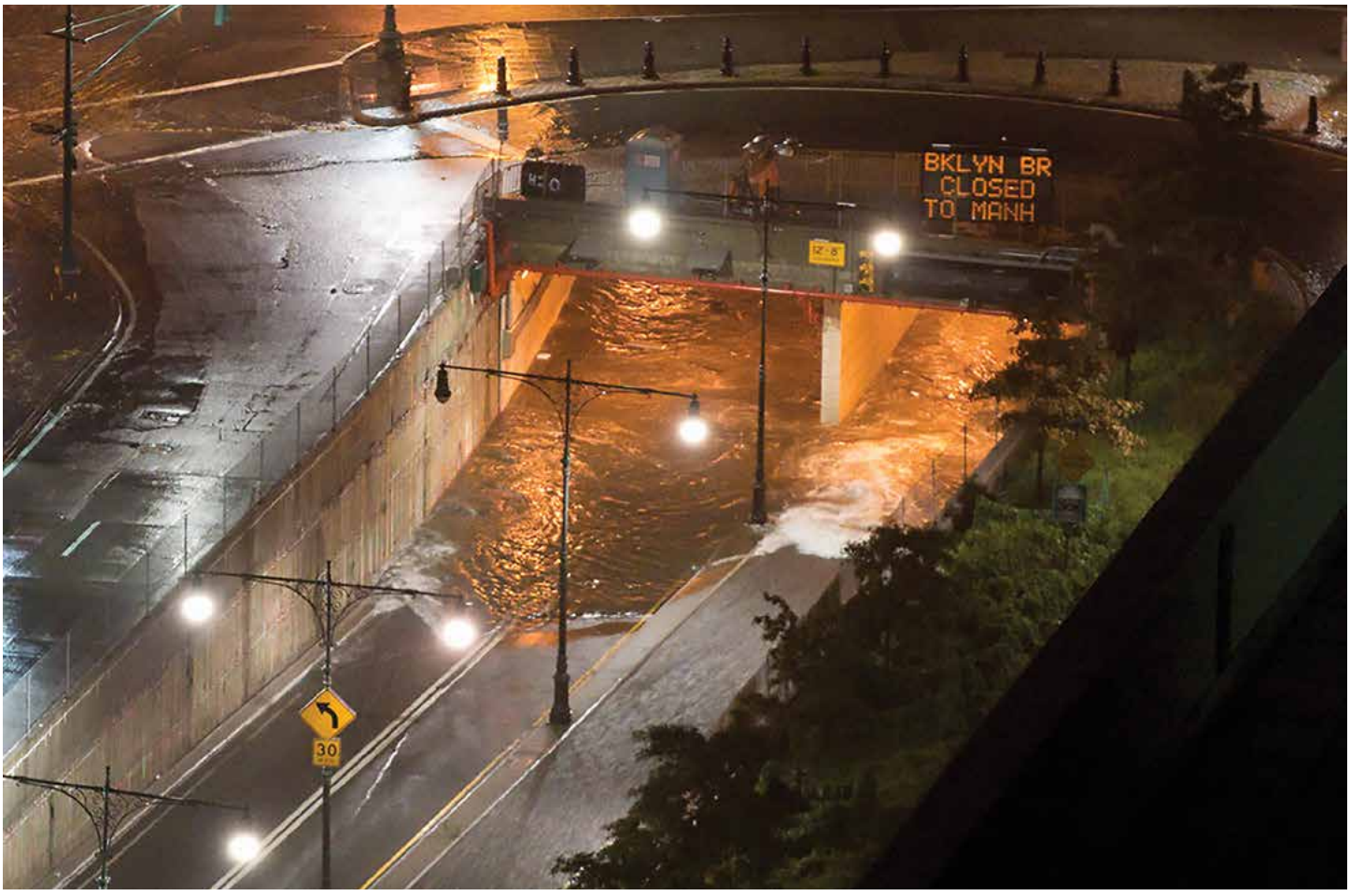


Photo courtesy of the State of New York Metropolitan Transportation Authority

infrastructure, such as wetlands and barrier reefs—is gaining traction in both the scientific and policy worlds. A key milestone occurred in October 2015, when the Obama administration issued a memo explicitly instructing all federal agencies to account for natural infrastructure in their planning processes.

Natural infrastructure is an offshoot of a concept often referred to as ecosystem services or natural capital. Broadly stated, these ideas provide a framework for describing benefits that humans receive from healthy natural ecosystems and wildlife. Natural infrastructure digs just a bit deeper, looking at efforts to augment the built environment with strategically placed artificial ecosystems, such as green roofs, or efforts to preserve intact wetlands and other valuable living systems.

"A lot of attention has been paid to the role that natural capital and ecosystem services can play in ensuring well-being for citizens," says Ariana Sutton-Grier, an assistant research scientist at ESSIC and an ecosystem science adviser for NOAA. "Three consecutive presidential administrations—Clinton, Bush and Obama—have said that we need to pay attention to the role of natural capital in our economy and how it helps support a successful society. So, this may be a watershed moment."

Coastal wetlands can, in some cases, protect against storm surges better than human-made floodwalls. Healthy oyster reefs can contribute to this effect while filtering polluted waters. Intact forests are the best defense against erosion, especially in mountainous areas with dynamic topography. Nature itself could prove to be among the most effective defenses against environmental security threats.

A PATH FORWARD

Scientifically speaking, the pursuit of an environmentally secure world won't be hampered by a lack of data. If anything, scientists have access to more data than they can handle in a productive way. Instead, the challenge lies in identifying which data sets are most important and packaging them into user-friendly formats so that they can help inform decision-makers.

SESYNC recently partnered with the U.S. Geological Survey and the U.S. Department of Agriculture to support the White House's Climate Data Initiative. The end goal of the project is a new software platform that can recognize the inherent connections between diverse FEW data sets.

"The Climate Data Initiative mandated that each federal agency make a lot of data publicly available for use," says Nick Magliocca, a research associate at SESYNC. "The platform for this, Data.gov, is centralized and open, which is great, but you're still dealing with a catalog. It doesn't tie any of the data to conceptual frameworks. We're trying to add some value by developing discovery tools that will collect all these data and organize and link them logically."

The effort to customize and package data depends on a two-way dialogue between scientists and stakeholders. Without active input from decision-makers, it can be difficult to decide what information holds the highest priority.

Everglades National Park photo by David M. Avery / Bryce Canyon National Park photo by Faye Levine

THIS IS NATURAL INFRASTRUCTURE

Natural infrastructure includes natural ecosystems and artificial ecosystems that augment the built environment. (L–R) Coastal wetlands guard against storm surges; intact forests help mitigate erosion; shellfish reefs protect against storm surges and filter polluted waters; and green roofs, such as the one on UMD's Physical Sciences Complex, help trap carbon and lower the sunlight reflectance of buildings.

"CAPTURING THE PHYSICAL ASPECT IS NOT ENOUGH—HUMANS ARE ALWAYS IN THE MIX AND PART OF THESE SYSTEMS."

Melissa Kenney

"Previously we had a 'loading dock' mentality, where we told stakeholders and decision-makers 'go ahead and back up your truck and load up whatever you need,'" Busalacchi adds. "We need a better up-front appreciation for what society really needs."

Where to start is a tricky question, often beset by the classic chicken vs. egg problem: without baseline information, it's hard to identify priorities. But without priorities, it's hard to identify what information is most valuable.

"So far, a lot of the work we've done has been on the disciplinary boxes, not the arrows that connect these disciplinary insights," Kenney says, invoking the design of the flow charts often used to describe connections and trade-offs. Kenney speaks from her experience leading the effort to develop and recommend climate change indicators for the U.S. Global Change Research Program (USGCRP), which coordinates climate research across 13 different federal departments and agencies. "You need to gather some information independently before you can look at the interconnections. Indicators are a great opportunity to connect scientific advancements with outputs needed to inform decisions."

Generally speaking, indicators such as those proposed by USGCRP are not a new idea. Indicators such as gross domestic product, consumer price index and unemployment rate are regularly reported and used to characterize the health of the U.S. economy, for example. The expansion of this approach to indicate the health of the environment has taken a lot of hard work and careful thought, but Kenney says significant progress has already been made.

"Much of what we recommended to USGCRP wasn't even low-hanging fruit—it could more accurately be thought of as 'fruit on

Oyster bed photo by Sonty567 / Melissa Kenney and green roof photos by John T. Consoli

THIS IS ALREADY HAPPENING

Clockwise (L–R) The 2013 Alder Fire in Yellowstone National Park in Wyoming. Wildfires across the western United States threaten lives and property every year; New Orleans sits underwater following Hurricane Katrina in 2005; ice and snow damaged citrus crops during the 2013 Middle East cold snap; the 2013 Forward on Climate Rally in Washington, D.C., urged President Obama to address global warming and halt development of the Keystone XL Pipeline.

the ground,'" Kenney says. "A number of our recommendations were climate indicators that are already being widely used and implemented, such as minimum arctic sea ice, global temperature and carbon dioxide levels in the atmosphere. The real opportunity now is to use our research to build out the indicators system, given the information needs of stakeholders."

EXPLORING WORST CASE SCENARIOS

Efforts to address environmental security rely on the best scientific assessments of past and present trends, with an eye to predicting the near-term future. But how will society's choices today affect longer-term outcomes?

To probe this question, Eugenia Kalnay, a UMD Distinguished University Professor and Eugenia Brin Professor of Data Assimilation in the Department of Atmospheric and Oceanic Science and the Institute for Physical Science and Technology, teamed with SESYNC systems scientist and UMD alumnus Safa Motesharrei and Jorge Rivas of the Institute of Global Environment and Society to develop the Human and Nature Dynamics (HANDY) model.

HANDY's starting point is the "predator-prey" model used by biologists to understand animal population dynamics. The researchers applied that model to coupled human-nature systems, adding two new variables: accumulation of wealth and inequality.

"HANDY shows that different types of societies can reach a sustainable state if their policies on population growth, resource depletion and consumption, and socio-economic inequality promote long-term sustainability," says Motesharrei.

The model can estimate a human system's carrying capacity, which is the population size

Alder Fire photo courtesy of the National Park Service / New Orleans photo courtesy of NOAA
Rally photo courtesy of Chesapeake Climate Action Network (CC BY-SA 2.0)

Photo by S.J. (CC BY-SA 3.0)

that can be sustained at a given level of depletion of natural resources.

"If a society overshoots its carrying capacity by a small amount, it's still possible to reach sustainability. If the overshoot is too large, a full societal collapse would be hard to avoid," says Kalnay, who is also a member of the United Nations Secretary General's Scientific Advisory Board.

Thankfully, there is still time to address the many-faceted environmental issues that threaten societies across the globe. Despite the work yet to be done, world leaders are recognizing that environmental security is and should be a huge priority for decision-makers.

"This is an issue of today. It is already happening now. We can go back just 10 years, and we will already see conflicts tied to environment-related shortages and trade-offs," Miralles-Wilhelm says. "I never say there's a point of no return, but I do think we will see the situation deteriorating over the next few decades. The time to act is now. Perfect information will never be available, but it may not even be needed. We can do a lot with what we already know." ■

ALUMNI
TIPPING THE BALANCE

CHUL "EDDY" CHUNG

Since graduating from UMD, Chul "Eddy" Chung, Ph.D. '99, meteorology, has seen quite a bit of the world: he has held positions at Scripps Institution of Oceanography, the University of Helsinki in Finland and the Gwangju Institute of Science and Technology in his native South Korea. In 2015, Chung returned to the U.S. to accept a position at the Desert Research Institute in Nevada. His focus is reducing the uncertainty in climate change estimates by determining the relative contributions of black and brown carbon—particles of organic matter more commonly known as soot—resulting from the burning of fossil fuels and other organic matter. "These man-made aerosols absorb solar radiation and have particularly large impacts on regional climate," Chung says.

JENNIFER JADIN

Jennifer Jadin, Ph.D. '09, behavior, ecology, evolution, and systematics, didn't set out to work on climate. After completing her degree, she says she changed course because "climate change is arguably the most pressing environmental issue of the day. The government needs people who are capable of advising on it and advocating about it." Jadin no longer does science research, but is engaged in policy work. She has applied her skills and knowledge at the U.S. Global Change Research Program, the U.S. Department of Agriculture and currently as climate change advisor for the United States Agency for International Development in Jakarta, Indonesia. "My job involves identifying ways the U.S. government can most effectively spend time, money and talent here to help make sure vulnerable people and landscapes can adapt to climate change," Jadin says.

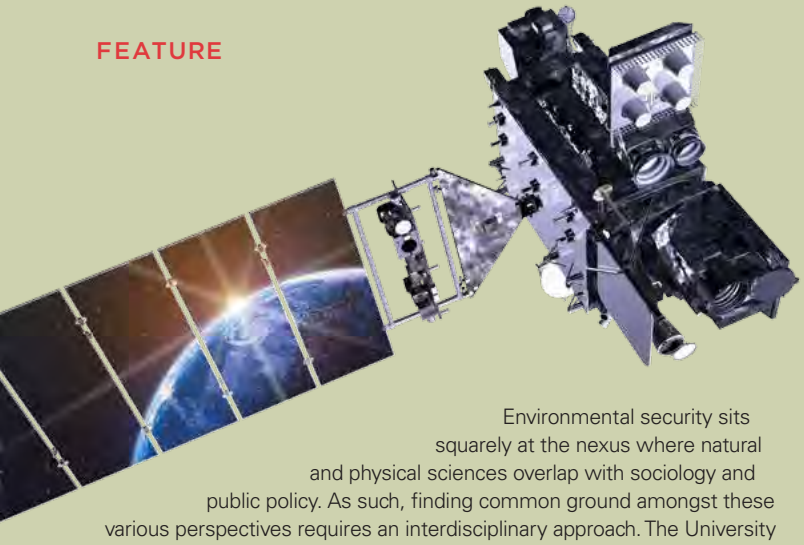
JUNJIE LIU

"Our climate is experiencing abrupt changes that have never been seen before because of increased fossil fuel emissions," says Junjie Liu, M.S. '05, meteorology; Ph.D. '07, atmospheric and oceanic science. "However, only about half of the fossil fuel emissions remain in the atmosphere. Where have these fossil fuel emissions been absorbed?" Liu has been addressing this question for nearly a decade, first as a postdoctoral researcher at the University of California, Berkeley, and, since 2011, as a research scientist at NASA's Jet Propulsion Laboratory. "My research combines observations from satellites with model simulations to quantify the carbon exchanges between the atmosphere and the ocean and land surfaces," Liu says. "I am also interested in the impact of extreme climate events, such as drought, on the carbon cycle."

C. ADAM SCHLOSSER

Astronomy is the field that first drew C. Adam Schlosser, M.S. '92, Ph.D. '95, meteorology, to study science as an undergrad. "I was quite interested in the vastness of space and the possibility of life elsewhere in the universe," he says, noting that he also considered plasma physics research to join the quest for nuclear fusion as an alternative energy source. "Ultimately, I chose to study climate and global change because we must understand and preserve our planet by protecting all of our environments—natural, managed and built," he says. Now at the Center for Global Change Science at the Massachusetts Institute of Technology, Schlosser's primary interests are the modeling, prediction and risk assessment of natural and managed hydrologic and ecologic systems under global change.

Photos courtesy of Chul Chung, Jennifer Jadin, Junjie Liu and C. Adam Schlosser



Environmental security sits squarely at the nexus where natural and physical sciences overlap with sociology and public policy. As such, finding common ground amongst these various perspectives requires an interdisciplinary approach. The University of Maryland is particularly well-equipped for this challenge, with several centers and an institute that serve as hubs for collaboration with federal agencies and others within the academic community.

A HUB FOR COLLABORATION

The university's Earth System Science Interdisciplinary Center (ESSIC) is a joint center between UMD's Departments of Atmospheric and Oceanic Science, Geology, and Geographical Sciences, initiated under a $36 million cooperative agreement with NASA's Goddard Space Flight Center. ESSIC cuts across the traditional disciplinary boundaries of meteorology, oceanography, geology and geography, in an effort to better understand how the land, oceans and atmosphere influence one another.

ESSIC also manages the Cooperative Institute for Climate and Satellites (CICS), created in 2009 through a $93 million agreement with the National Oceanic and Atmospheric Administration (NOAA). Originally founded in 1984, CICS is now housed within one center in College Park (CICS-MD) and another in Asheville, North Carolina (CICS-NC). The institute aims to enhance NOAA's ability to use satellite observations and Earth system modeling to advance major national climate research goals.

CICS will support the science goals of two vital upcoming satellite missions, both of which are collaborative efforts between NOAA and NASA.

- The Joint Polar Satellite System (JPSS), scheduled for launch in early 2017, will replace the aging National Polar-orbiting Operational Environmental Satellite System. JPSS satellites will provide full global monitoring coverage twice a day, helping to advance weather, climate, environmental and oceanographic science.

- The Geostationary Operational Environmental Satellites – R Series (GOES-R, shown at left) are scheduled for launch beginning in October 2016. This system, focused on the Western Hemisphere, will provide continuous imagery and atmospheric measurements. Capable of sending updates every 30 seconds, GOES-R will contribute to more accurate and reliable weather forecasts and severe weather predictions.

ESSIC Director Antonio Busalacchi will soon play a crucial role in guiding the future of the nation's satellite infrastructure, having recently been named co-chair of the National Research Council's Decadal Survey for Earth Science and Applications from Space. The survey committee will develop priorities and support satellite observation activities for NASA, NOAA and the U.S. Geological Survey from 2018 through 2027.

"The National Weather Service has embarked on an effort to build a 'Weather-Ready Nation' that will increase community resiliency in the face of vulnerability to extreme weather, water and climate events," says Louis Uccellini, director of the National Weather Service (NWS). "The University of Maryland and its various research entities, including ESSIC and CICS, have long-standing collaborations with the NWS across the weather, water and climate disciplines. Indeed, as we advance the NWS' abilities to provide improved operational forecasts, our links to ESSIC and CICS will grow even stronger."

The National Socio-Environmental Synthesis Center (SESYNC), based in Annapolis, Md., takes a slightly different approach to tackling environmental security topics. Funded by a $27 million award to UMD from the National Science Foundation, SESYNC brings together social, natural and computational scientists with resource managers and decision-makers to identify data-driven solutions to society's most challenging and complex environmental problems. SESYNC researchers are encouraged to work directly with stakeholders to co-develop research questions that address the intersection between human society and natural ecosystems.

Some of the college's brightest minds across a wide variety of disciplines are already working to ensure environmental security at home and abroad. With a strategic location near the nation's capital and collaborations with federal agencies, the college is rising to the challenge of environmental security in a way that few other institutions can.

WINDOW OF OPPORTUNITY

In December 2015, the parties to the United Nations Framework Convention on Climate Change met in Paris to forge a new international climate agreement. The convention involved an unprecedented number and range of stakeholders, and assigned responsibilities for all signatories. In all, the meeting reflected an emerging "bottom-up" architecture for addressing climate on a global scale, featuring significant roles for sub-national and non-state entities such as cities and private companies.

In May 2016, just five months after the Paris meeting, the University of Maryland will play an important role in this historic process by co-hosting the Climate Implementation Summit. Broadly speaking, this second meeting will seek to answer the question, "What now?" How will the many participants in the process organize to support the new agreement? How can formal mechanisms under the U.N. Convention inform efforts to implement climate solutions? As many as 700 leaders from government, industry, philanthropy and academia will gather for two days, first on the university's College Park campus and then in downtown Washington, D.C., to seek answers to these critical questions. For more information, visit **climateaction.umd.edu**.

Right: U.S. Secretary of State John Kerry speaks at the convention's "Caring for Climate" event.

Photo courtesy of the U.S. Department of State

TEAMING UP
Mathematics + Life

Three evenings a week, University of Maryland Mathematics Professor Konstantina Trivisa and her teammates carry their rowing shell down to the Potomac River for a workout on the water. For Trivisa, it's more than good exercise.

"Rowing is a celebration of teamwork," she says.

An exuberant woman with a great laugh, Trivisa brings the same enthusiasm for teamwork to her day job, where she is director of the Applied Mathematics & Statistics, and Scientific Computation (AMSC) graduate program; a member of the university's ADVANCE program for inclusive excellence; and associate director of the Institute for Physical Science and Technology.

Even Trivisa's field of applied mathematics requires teamwork between disciplines. In her current research, Trivisa mixes math with biology and physics to develop mathematical models of tumor growth and treatment.

"The mathematical analysis gives us an idea of how certain kinds of cancerous cells evolve and how various drugs affect their growth," she says.

Trivisa's work on fluids gave rise to kinetic models for the flocking behavior exhibited by certain species of fish, birds and insects.

Since joining the Maryland faculty in 2000, Trivisa has won several awards for her research, including an Alfred P. Sloan Research Fellowship, the Presidential Early Career Award for Scientists and Engineers, and a Simons Foundation Fellowship.

Math has always been a big part of Trivisa's life, even from her early days growing up in Greece.

"My mother was a factory worker with three years of high school, but she loved mathematics," Trivisa says. "She pushed my sisters and me to do puzzles and play math games. I wasn't good at spelling, but I was good in math."

Today, as director of AMSC—an interdisciplinary graduate program that boasts 150 faculty members from 33 campus units—Trivisa helps students discover what they want to do with their futures. And sometimes, the students steer Trivisa's future, too. A student interested in how different bacteria communicate led Trivisa to her current research.

"I might not have gotten into this particular research area if I hadn't invited that student into my office," she says.

The ADVANCE program also gives Trivisa the opportunity to team with others on campus. Through ADVANCE, she mentors female faculty members in science, technology, engineering and mathematics (STEM) disciplines, and she works to strengthen women's representation, retention and satisfaction on campus.

"In STEM fields, the voice of the woman is often lost," Trivisa says. "ADVANCE is working to ensure women's voices are heard and to develop women leaders who communicate concerns at the higher levels."

> **"In STEM fields, the voice of the woman is often lost.** ADVANCE is working to ensure women's voices are heard and to develop **WOMEN LEADERS** who communicate concerns at the higher levels."

One of the women Trivisa has mentored through ADVANCE is Arpita Upadhyaya, associate professor of physics. Upadhyaya says Trivisa's friendship was valuable at that critical time when she was applying for tenure.

"In a field where there aren't many women, just knowing someone is there is important," Upadhyaya says. "Konstantina sought me out to talk about work, but also about work-life balance. She always exudes enthusiasm and optimism. I hope I'll be able to show those same qualities."

"ADVANCE has brought a lot of joy to my life," Trivisa says. With her passion for teamwork with students, fellow faculty and rowing mates, the same could be said of Trivisa bringing joy to others' lives. ■

–ELLEN TERNES

GOES-R model courtesy of NOAA and NASA / Konstantina Trivisa photo by Faye Levine

STUDENT RESEARCH AROUND THE WORLD

Undergraduate students become better thinkers, innovators and problem solvers by engaging in research. These experiences cultivate a depth of understanding needed to make a positive difference in the world. While some of our students conduct undergraduate research on campus or at nearby federal laboratories, others travel the world to use science to address some of the world's most pressing problems. ■ *–RACHAEL ROMANO*

LYNN MONTGOMERY

KULUSUK, GREENLAND

From the tiny town of Kulusuk, Greenland (population: 300), atmospheric and oceanic science major Lynn Montgomery flew into the field and camped 18 days on the southeastern portion of the Greenland ice sheet to explore its hydrologic structure. "When water on the surface of the ice sheet melts during the summer due to warmer temperatures, the water can percolate down through the firn, which is porous compacted snow and ice," Montgomery explains. This melted water creates an aquifer within the ice. Along with Lora Koenig of the National Snow & Ice Data Center and UMD Assistant Professor of Geology Nicholas Schmerr, Montgomery used seismic, radar, magnetic resonance and hydrological techniques to measure the amount of water in the aquifer and to determine how the water travels and is stored within the ice sheet. "If we understand the processes of Greenland's hydrologic structure, even a small part such as this aquifer, we can develop solutions to slow sea level rise and understand how climate change is affecting our planet," Montgomery says. She plans to get her Ph.D. and become a professor who studies the polar regions of Greenland, Canada, Alaska or Antarctica. "Field work provides many challenges physically and mentally," she says, "but is a priceless learning experience."

- 18 days camping on the ice. Average temp. near 0°C (32°F)
- 1 dehydrated meal per day
- 8 gallons of water melted from snow per day for cooking and drinking
- 1 hair wash in 18 days, using 0°C aquifer water!

MEIR FRIEDENBERG

REHOVOT, ISRAEL

Meir Friedenberg, a computer science major, studied theoretical computer science at the Weizmann Institute in Rehovot, Israel, with Weizmann faculty member Robert Krauthgamer. Friedenberg studied the math behind certain types of data compression, which involve using mathematical algorithms to reduce the storage size of a piece of data. He brainstormed and analyzed new algorithms daily. The research Friedenberg worked on, while theoretical at this stage, has the potential to allow large quantities of information to be stored using less memory. "A company doing a statistical analysis of interactions within a community would be able to examine a larger community and gain higher-quality information than previously possible," he says.

← Students in the Kupcinet-Getz International Summer Science School visiting the Bahái Gardens in Acre, Israel. (Meir is 4th from the right in the front row)

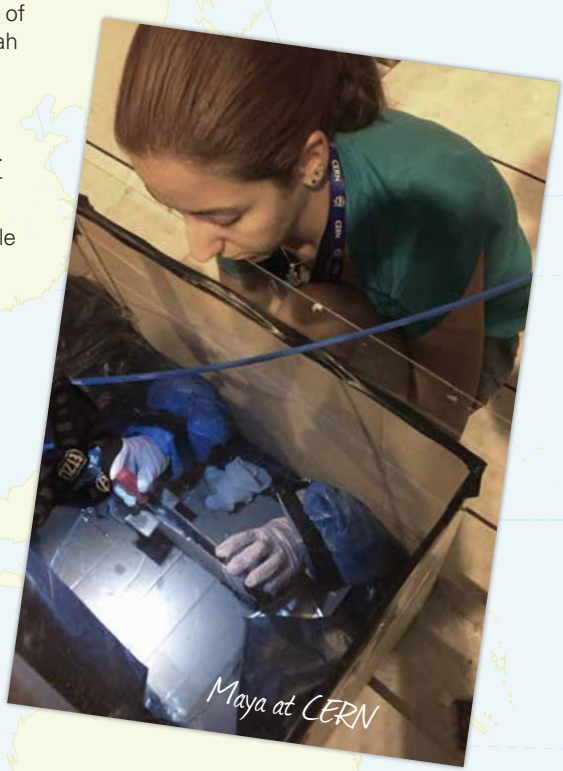
Photos courtesy of Meir Friedenberg and Lynn Montgomery

"It is very rewarding to contribute something—no matter how big or small." —Maya Amouzegar

MAYA AMOUZEGAR

GENEVA, SWITZERLAND

After spending a year and a half conducting high-energy experimental physics research in College Park, astronomy and physics double major Maya Amouzegar traveled to the CERN laboratory near Geneva, Switzerland, to assist in upgrading the Compact Muon Solenoid detector of the Large Hadron Collider (LHC). The world's most powerful particle accelerator, the LHC was responsible for the Higgs boson discovery in 2012. Under the supervision of UMD Physics Professor Sarah Eno and Assistant Professor Alberto Belloni, Amouzegar helped to install scintillator tiles in the test-beam facility. "What I did is part of a bigger project aimed at creating a candidate design for a particle detector," she says. "It is very rewarding to contribute something—no matter how big or small—to this extremely large and collaborative research effort." Amouzegar credits being an undergraduate researcher with opening her mind to creative problem solving.



Maya at CERN

"I highly recommend taking a summer to travel out of the country for research or even to a different university, to see how others approach work and school."
—Sutton Chiorini

Sutton in Japan

SUTTON CHIORINI

TŌKYŌ, JAPAN

Seismology and hazard mitigation researchers have been keenly interested in Japan since the country's 2011 earthquake in Tōhoku. Geology and physics double major Sutton Chiorini spent six weeks in Japan studying the relationship between seismic data and seasonal changes like storms and ocean currents as part of the University of Tokyo Research Internship Program. Chiorini, along with University of Tokyo Department of Disaster Mitigation Science Professor Kazuki Koketsu and graduate student Loïc Viens, investigated how seasonal changes affected the circulation of seismic waves in the area. "Studying seasonal variations in vibrations caused by natural sources contributes to our understanding of the ambient seismic field in Japan and can be applied to other areas," says Chiorini. Now back in Maryland, Chiorini is working in UMD Assistant Professor of Geology Vedran Lekic's laboratory to better understand where and why seismic swarms—surges of earthquakes with no one shock being much larger than the rest—occur.

Map by Freevectormaps.com / Photos courtesy of Maya Amouzegar and Sutton Chiorini

Story reproduced courtesy of C&EN

U.S. GOVERNMENT'S

TOP CHEMIST

Willie May rises from the segregated South through the ranks of the National Institute of Standards and Technology

The first lessons Willie May, Ph.D. '77, chemistry, learned about management came from growing up in a poor neighborhood of segregated Birmingham, Ala., in the 1950s and 1960s.

As an only son in an area where many boys had big brothers, "I learned to negotiate to keep from getting my behind beat," he remembers. "I learned to reason with people because we can't beat them all."

That neighborhood, which was in the midst of civil rights protests, was also where May absorbed the key value that continues to guide his decisions: fairness. "I used to think if I was ever in a position of authority—and I had no reason to think I would ever be—that I would go out of my way to treat everybody fairly," he says.

Now, May is applying those lessons and others in his new job as the director of the National Institute of Standards and Technology (NIST) and the undersecretary of commerce for standards and technology. The Senate confirmed him to those posts in May 2015, making him the highest-ranking chemist in the federal government.

Photo by James Kegley

May is well known at NIST. He has worked there for 44 years, starting as an analytical chemist before earning his Ph.D. at the University of Maryland and gradually moving up the ranks to become director.

"For me, this is the most exciting time to be at NIST," May explains. NIST was once just an obscure research lab working on standards, but recently it has risen into the national spotlight. "We are seen as the administration's go-to place for standards and technology. We have bicameral and bipartisan support. And we are being asked to work on some very important problems."

Those issues span the nation's science priorities. They include developing computer security standards, improving manufacturing research and reforming forensic science. May says his goal, put forward in his typical, friendly, low-key style, is to not "screw it up."

He has the staff of NIST to help him succeed in that effort. "People grew up with him in this organization. Most of them see him as Willie, not the director," says Neil Alderoty, an administrator at NIST who has worked with May for years. "They know how much he loves this place."

BASEBALL AND BIRMINGHAM

Growing up in the projects in Birmingham, May's mother, Rubie Daniels May, initially stayed home to care for him and his two sisters before opening what became a successful day care center for more than 200 children. His father—after whom May is named—was a nursing assistant at the local Veterans Administration hospital. The elder May also ran a tax service and worked as a bail bondsman, which put him in contact with civil rights leaders including Martin Luther King Jr. and Ralph Abernathy.

Walter Howlett Jr., who lived across the street, remembers May as studious but also mischievous. "We lived in a neighborhood where you had to get along with a bunch of different personality types without always getting into fights. He was able to maneuver that environment quite well," Howlett says. "He was good at getting you upset while he remained calm."

As a child, May was more serious about sports than about science. He organized pickup baseball games and designed his football team's plays. May did show an interest in experimentation—he asked Howlett to pitch a thread spool to him over and over. "If he could hit that, he thought he could hit any curveball anyone would throw at him," Howlett says.

In high school, May was a quiet, conscientious, serious student, remembers his classmate Marilyn Spencer. And that fit perfectly with the high expectations of the community. "You were encouraged by your instructors to do well because you represented them, not just yourself, not just your family," she says.

Educated African Americans in the 1960s had a limited choice of careers. Many of those who turned to teaching might have otherwise been corporate leaders, May says. "I benefited from their deprivation."

A chemistry instructor, Frank Cook, took a handful of high school students, including May, under his wing and challenged them with a college-level curriculum. "We sacrificed our study hall—since we weren't going to study anyway—and actually took advanced chemistry courses that he had taken during the summer at Alabama A&M," May says.

Spencer, May's classmate, says, with "all of us competing with each other, I think we made each other better."

BEGINNINGS. May (center) with his parents, Rubie Daniels May and Willie Edward May.

Photo courtesy of Willie May and NIST

By the time he graduated with a bachelor's degree [in chemistry] in 1968, "I was hooked on it," he says. "I got to wear a white lab coat. Being a scientist was cool in the '60s."

CHOOSING CHEMISTRY

When high school drew to a close, May's father encouraged him to become a player for one of the company teams that brought on black players. May says he was an above-average baseball player, but he had come to see his growing interest in chemistry as a means to a better life.

"I didn't want to work in the steel mills or the coal mines," May says. "My parents were not that well-to-do, and this was the post-Sputnik era; maybe I could get a scholarship. So my interest in chemistry was nothing organic."

May had his heart set on going to Howard University in Washington, D.C., but his application got lost in the high school principal's office. To make up for misplacing it, the principal arranged for him to go to Knoxville College, a historically black institution in Tennessee. May was disappointed at the time, but he now sees the situation as a blessing. "I probably would have gone buck wild, the first time away from home in a city like Washington. In Knoxville, there wasn't a whole lot of other stuff to do," he says.

The small college also gave May a chance to ease into a different way of life. "It was the first time that I'd had any relationship with whites that wasn't hostile because I grew up in segregated Birmingham. About half the faculty members were white, half were black. So it was the perfect environment for me."

Razi Hassan, now a chemistry professor at Alabama Agricultural & Mechanical University, went to high school with May and was his teaching assistant at Knoxville College. "Willie just excelled in everything, and he did it with style," he says. "He worked hard, and he had a sort of easy personality. That's his gift."

Although many people change majors in college, May decided early on to stick with chemistry because he had learned so much in high school. "I didn't feel intimidated. More

than that, I thought I had an advantage over the other students."

By the time he graduated with a bachelor's degree in 1968, "I was hooked on it," he says. "I got to wear a white lab coat. Being a scientist was cool in the '60s."

DREAMS DEFERRED

May planned to go to graduate school and was accepted into chemistry programs at Harvard University; the University of Illinois, Urbana-Champaign; and the University of Tennessee.

But then he got a draft notice with a lottery number of 42, low enough that he was likely to get shipped out to Vietnam. The universities that accepted him for graduate studies couldn't guarantee him an academic draft deferment. So instead, he took a job that ensured him a deferment at Oak Ridge Gaseous Diffusion Plant, some 20 miles from Knoxville. He hated it.

In 1971, May was offered a one-year internship at what was then called the National Bureau of Standards in Gaithersburg, Md., and he took it sight unseen. "After I had been here a week, I thought, 'If they will have me, I'll spend the rest of my career here,'" he remembers. "I got a chance to apply some of my creativity to solve problems. It was just the place for me."

May worked in the analytical chemistry division as part of a start-up group finding ways to identify trace amounts of organic compounds. His specialty was liquid chromatography. "It was exciting times for all of us, and we were upstarts in an institution with a lot of traditions," says Harry Hertz, who worked with May.

One of their assignments was traveling to Prince William Sound in Alaska to determine the background petroleum levels in the environment before the start-up of the Trans-Alaska Pipeline. "Nobody had ever done that before. But that was the fun," May remembers.

At the same time he was traveling to Alaska, May was earning a Ph.D. in chemistry at the University of Maryland. NIST would have paid for him to go to school full time, but he was having too much fun at work. "I didn't want to give that up," he says.

That analytical chemistry group eventually expanded to fields beyond environmental ones to search for trace organics in, for example, clinical or forensic samples. This work gave May important experience talking to people with expertise in other fields, Hertz says. It also helped May appreciate the freedom scientists often need.

"We were allowed to be innovative, to take the appropriate risk in terms of exploring and researching—sometimes in less traditional ways—because it was a new field," Hertz remembers.

After about a decade at the bench, including several years leading a small group, May was promoted in 1983 to division chief overseeing some 50 people. He tried to stay in the lab, but he felt he wasn't able to do both effectively. He missed the camaraderie of being in the lab and seeing the tangible benefits in discoveries and publications.

> "People grew up with him in [NIST]. Most of them see him as Willie, not the director. They know how much he loves this place."

May intended to quit management, but his supervisor told May he had the potential to become a great leader. So he decided to fully commit to being a manager. "You have a larger impact on the organization if you do a job in leadership well," May says.

EMBRACING MANAGEMENT

May grew into the role, rising through NIST's chemistry ranks to eventually lead the Material Measurement Laboratory, which includes most of NIST's respected standards-setting operation. He became deputy director in 2011.

As to what has made him a successful manager, May circles back to the sense of fairness he learned growing up. "You learn that treating everybody fairly does not mean treating everybody equally," he explains. "You have to spend some time analyzing the situation and the person."

May takes what some might call an analytical chemist's approach to problems. "I gather a lot of information, get input from a lot of folks, then make a decision," he says. Laurie E. Locascio, who now heads the Material Measurement Laboratory, says that in meetings May "likes to encourage debate, but he's willing to change his mind—even if he is so sure about a point—when presented with evidence."

JOINING NIST. May (left) with Harry Hertz (center) doing fieldwork in the Prince William Sound area of Alaska in 1974.

IN THE LAB. May was a member of NIST's analytical chemistry group throughout the 1970s.

Photos courtesy of NIST

WILLIE MAY

Met his wife, Jeannie (Tramble) May, also a Birmingham native, at Knoxville College. Jeannie spent over 30 years in chemical and laboratory equipment sales, serving as office supervisor then sales representative for Fisher Scientific and Pall Gelman, and vice president of business development at Government Scientific Source.

Has attended college basketball's Final Four games with his son Eric since 2002.

Hopes that his daughter Jeanniece, B.S. '94, art, can paint his official NIST director portrait.

However, she sees May's interest in people as his greatest management asset. When she was pregnant, Locascio wanted to take time off but was worried about hurting her career. The person she turned to for advice was May, even though he wasn't her direct supervisor. "One thing that was really obvious about Willie was that he was really an open-minded and compassionate manager," she remembers.

May encouraged her to work from home at a time when that practice was uncommon. And two years later, when she was still working part time, he offered her a promotion. "I was just stunned," she remembers. "He was willing to see beyond the fact that I was doing the mom thing … to judge people from the work they do and their productivity, and not on their life circumstance."

Victor R. McCrary, a former NIST manager now at Morgan State University, first met May at a conference for black chemists when he was a graduate student. He is impressed with how May encourages people to take research risks. "You can do a lot of incremental innovation, but that is not really innovation," he says. "That is why you need people like Willie May."

May is proudest of his efforts to mentor his fellow black scientists at NIST and elsewhere. NIST has not always been the most welcoming environment, he says, but that is changing. "I could not get up and look myself in the face every morning if I did not do everything I could to give back and to try to hoe a row for others," he says. "I have to try to make things as fair as I can within my span of control."

For example, May was vital in creating a joint NIST-University of Maryland scholarship to encourage more black chemists to get doctoral degrees. And he was also instrumental in the creation of the American Chemical Society Scholars Program, which provides scholarships to minority students.

"Regardless of how high he has been at NIST, he has always made himself super-available to students to encourage them," says Janice Reutt-Robey, chair of UMD's Department of Chemistry and Biochemistry.

Christopher Sims, Ph.D. '15, chemistry, met May when Sims was a graduate student and was amazed at how laid-back and approachable May was. Now a postdoc at NIST, Sims was excited to see May become director. "For me, it was very inspirational. It served as a motivation to say, 'If I keep doing good work, that is what you can accomplish.'"

NEW CHALLENGES

Until he took over as director, May had worked primarily on the technical side of NIST. As director, he says his biggest challenge has been taking on the policy role that comes with becoming an undersecretary at the Department of Commerce.

For example, manufacturing research is President Barack Obama's highest priority for NIST. So May is working to figure out how to make NIST an effective leader of the National Network for Manufacturing Innovation, which is designed to bring together representatives of industry, academia and government to work on important research challenges facing the manufacturing sector.

May is also focused on enhancing how NIST operates internally. Those challenges include improved hiring practices, more efficient purchasing of its one-of-a-kind instruments and better coordination with other agencies.

NIST takes it cues from the administration and Congress, but once the agency gets its assignments, it has freedom to approach problems in its own way.

And what May learned in Birmingham and since will help him guide the institute. "We have the independence now to do new and creative things," May says. "I don't think the scientists could ask for more." ■ *–ANDREA WIDENER*

RISING IN THE RANKS. May became a NIST division chief in 1983, trading the lab for leadership.

MORE THAN A FAN. May with NFL Senior Vice President Jeffrey B. Miller in January 2015, announcing a competition to create materials that help prevent concussions.

TOP SPOT. May being sworn in as director of NIST in May 2015.

Mathematics Building Named for William E. "Brit" Kirwan

The University of Maryland mathematics building now bears the name William E. Kirwan Hall to honor a man who has led institutions of higher education to unprecedented levels of distinction during his distinguished career.

"It is difficult to find words to express how much this honor means to me," says Kirwan, University System of Maryland (USM) Chancellor Emeritus and UMD Regents Professor of Mathematics. "Fifty-one years ago last August, I walked into the mathematics building as a newly minted Ph.D. graduate and was in awe of it. The thought that a half century later the building would bear my name would never have occurred to me even in my wildest dreams. I am deeply, deeply appreciative of this very special recognition, which I consider to be the greatest honor I have ever received."

Kirwan joined the University of Maryland as an assistant professor in the Department of Mathematics in 1964. In 1977, he became chair of the department. Kirwan also served as vice president for academic affairs and provost before serving as president of the University of Maryland for 10 years (1988-1998), president of Ohio State University for four years (1998-2002) and USM chancellor (2002-2015).

Among the many programs Kirwan has championed is USM's Closing the Achievement Gap initiative launched in 2007 to address the gap in college participation, retention and graduation rates between low-income students, first-generation college students and underrepresented minorities, as well as the general student population. As UMD president, his leadership launched UMD's rise into the top tier of public universities, while also making it one of the most diverse public research universities in the United States.

UMD PRESIDENT WALLACE D. LOH (LEFT) WITH BRIT KIRWAN

Student Team Advances in SpaceX Hyperloop Pod Competition

A University of Maryland-led team was one of 22 student teams selected to advance in SpaceX's Hyperloop Pod Competition. The teams will head to California this summer to test their design prototypes on the world's first Hyperloop Test Track during Competition Weekend.

SpaceX's Hyperloop Pod Competition is designed to advance a concept for a new form of transportation in which passenger-carrying pods travel between cities through above-ground tubes at very high speeds. Pod speeds of up to 700 miles per hour would be possible because of minimal resistance created by low air pressure in the tube and by the use of pods that levitate on a cushion of air and/or magnetic propulsion.

More than 115 student teams from around the world presented their plans during the competition's Design Weekend held on the Texas A&M University campus in January 2016. The teams were judged on a variety of criteria including design innovation, full system applicability and economics, strength of supporting analysis and tests, feasibility, and quality of documentation and presentation.

The UMD-led multidisciplinary team includes students from the College of Computer, Mathematical, and Natural Sciences and A. James Clark School of Engineering, as well as several students from Rutgers University who are heading up the team's electronics system efforts.

Competition pod prototypes will be scaled-down versions designed to operate on a test track currently being built adjacent to SpaceX's Hawthorne, Calif. headquarters. The UMD-led team's proposed model will be approximately 3 feet by 11 feet and weigh about 800 pounds. If successful, it will be capable of safely reaching speeds of 220 miles per hour. One of the team's key design approaches is to leverage permanent magnets, which will cause the pod to levitate upon reaching 25 miles per hour.

More than a thousand college and high school students attended Design Weekend, which included an appearance by SpaceX and Tesla Motors Co-founder Elon Musk, who first outlined the Hyperloop concept in 2013.

For more information, visit **rumdloop.com** or follow **@RUMDLoop**.

William E. Kirwan photo by John T. Consoli / Illustration courtesy of RUMD

Geology & Cell Biology and Molecular Genetics Chairs Named

Professor Richard Walker became chair of the Department of Geology in November 2015. Walker joined the university in 1990 as an assistant professor of geology and was promoted to associate professor in 1993 and to professor in 1998.

Walker is a fellow of the Geochemical Society, European Association of Geochemistry and the American Geophysical Union. He has received the University of Maryland Kirwan Faculty Research and Scholarship Prize and the Geochemical Society Clarke Medal, and was recognized as one of the 250 most cited researchers in the field of geosciences between 1988-2008. Walker has published nearly 200 articles and book chapters.

Professor Jonathan Dinman was named chair of the Department of Cell Biology and Molecular Genetics in November 2015. Dinman had been serving as interim chair of the department since July 2014. Dinman joined UMD in 2002 as an associate professor and was promoted to professor in 2008. Prior to working at UMD, he was a faculty member at the University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School.

Dinman has been awarded 14 patents and authored over 100 articles and book chapters. He serves on the editorial boards of the journal *Nucleic Acids Research* and the *Journal of Biological Chemistry,* as editor-in-chief of the journal *Virus Adaptation and Treatment,* as a grant reviewer for the National Institutes of Health and the National Science Foundation, and as chair of the biochemistry section for the Siemens Competition.

RICHARD WALKER

JONATHAN DINMAN

College Receives $2.1M from State of Maryland for Endowed Chairs

The University of Maryland received $2.1 million from the state's Maryland E-Nnovation Initiative to match donations for new endowed chairs in mathematics and computer science.

A gift of $2.5 million from Michael and Eugenia Brin to create an endowed chair in mathematics and a gift of $1.5 million from Elizabeth Stevinson Iribe to create an endowed chair in computer science each received an additional $1.05 million from the initiative.

The Brins have been long-time, generous supporters of UMD. Michael, a professor emeritus of mathematics, joined the Maryland faculty in 1980 and retired in 2011. Eugenia is also retired, following a career as a climate and weather forecasting scientist at NASA. Their endowed chair will educate students in the university's mathematics undergraduate and graduate programs, and provide students in many other fields the solid footing in mathematics they need to succeed in their careers.

"Mathematics is the foundation for every scientific field and sector of the economy," says Michael.

The endowed chair in computer science will build on the university's foundation in the growing field of virtual and augmented reality. UMD researchers are currently developing new uses for the technology, including surgical training for health care professionals.

"With my gift, I wanted to help the University of Maryland become a leader in virtual reality," says Iribe. "I couldn't be happier that my donation was matched by the state to amplify its impact."

(L–R) JAYANTH BANAVAR, MICHAEL & EUGENIA BRIN, JAMES YORKE

ELIZABETH STEVINSON IRIBE

John Dinman and Richard Walker photos by Faye Levine / Group photo by Andrea Morris
Elizabeth Iribe photo by Mike Morgan

STUDENT PROFILE

CEO ON THE GO

Christian Johnson's bag (above) reveals how he keeps up with school, work and clients no matter where he is.

Paired with a keyboard, Johnson's tablet (1) doubles as a laptop and a display. An Ethernet cable (2) is the answer to lack of Wi-Fi or poor phone (3) reception. A USB cable and outlet adapter (4) connects his devices and keeps them running. His graphing calculator (5), he says, has "gotten [him] through a lot of classes." A bow tie and a video cable (6, 7) ensure he's ready to plug into a projector and give a presentation at a moment's notice. And when he has a few moments between classes, work and activities, he grabs a snack (8) — Life Savers are his current go-to — and reads to keep up with technology industry trends (9).

A DAY IN THE LIFE OF AN

Undergraduate CEO

BEEP! BEEP! BEEP! It's 7 a.m. and junior computer science major Christian Johnson turns off his alarm. But he's not headed to an 8 a.m. class; instead, he's beginning his day as co-founder and CEO of Maplegrove Partners. Johnson established the company as a high school student in Buffalo, N.Y., to provide IT and consulting services to small businesses. Since then, he has expanded the business to include web hosting and networking services.

Once out of bed, Johnson remotely logs into his clients' systems to resolve small problems and sort through an inbox full of emails.

"My calendar is pretty much laid out to every half hour throughout the week," Johnson says. "It's very fast paced, and it's very exciting."

At noon, Johnson heads to class, which he credits with expanding his technical skills. As one of the first students to enroll in the university's Advanced Cybersecurity Experience for Students (ACES), a living-learning honors program supported by the Northrop Grumman Foundation, Johnson embraced the unique opportunity to influence his learning experience.

"I was really privileged to work with students and have a major role in shaping what the ACES program looked like," says Johnson, who served for two years as the program's board president. "ACES is having a big impact on training a talented pipeline of security specialists."

When his classes are over around 4 p.m., Johnson may go see a client—not as CEO of Maplegrove Partners, but as a cyber software engineer at Northrop Grumman Corp. or a growth hacker at Gallup. Through ACES, Johnson met and interacted with the CEO of Northrop Grumman, and after an ACES kickoff event in 2014 the company offered Johnson a position. How does Johnson manage it all?

"I use a lot of remote systems because I am working with so many different companies throughout the day," he says. "It doesn't really matter where I am. If you give me a keyboard and an Internet connection I can do my work."

At 6:30 p.m., Johnson sits down with friends in the dining hall for dinner. In addition, once or twice a month he co-hosts Cyber Frontiers, a podcast he launched in 2014. Johnson branched off from co-hosting another podcast called Home Gadget Geeks to discuss hot topics in cybersecurity and "big data" on Cyber Frontiers—from the Ashley Madison Leak to the pros and cons of Windows 10 software.

With a busy schedule and hectic lifestyle, Johnson unwinds by challenging a friend to a game of chess or playing concert violin. And he lives by a refreshingly simple motto.

"Always make your bed in the morning," he says. "Then, if nothing else goes well during the day, at least you have done that right." ■ *–RACHAEL ROMANO*

Photos by Faye Levine

Four faculty members were named 2015 Distinguished University Professors.

- **CATHERINE CARR**, biology
- **JORDAN GOODMAN**, physics
- **CHRISTOPHER MONROE**, physics
- **MARGARET PALMER**, entomology

Carr also received an honorary doctorate from the University of Southern Denmark.

RICHARD ACHTERBERG, **BRIGETTE HESMAN** and **MARCIA SEGURA**, astronomy, received the Robert H. Goddard Honor Award for exceptional support of the Cassini Composite InfraRed Spectrometer instrument operations spanning nearly two decades.

ROBERT ADLER, **YUDONG TIAN**, **JIANJIAN WANG** and **HUAN WU**, Earth System Science Interdisciplinary Center, received the Editors' Choice Award from *Water Resources Research* for their 2014 paper "Real-time global flood estimation using satellite-based precipitation and a coupled land surface and routing model."

GRETCHEN CAMPBELL, Joint Quantum Institute, was elected fellow of the American Physical Society and received the 2015 Young Scientist Prize in the field of atomic, molecular and optical physics from the International Union of Pure and Applied Physics.

BRAD CENKO, **FRANCESCO TOMBESI** and **HIROYA YAMAGUCHI**, astronomy, received 2015 Robert H. Goddard Honor awards. Tombesi also received the 2015 National Prize "Gentile da Fabriano" in Fabriano, Italy, for scientific accomplishments as an early-career scientist.

MELISSA KENNEY, Earth System Science Interdisciplinary Center, and **KAREN LIPS**, biology, were named Leshner Leadership Institute fellows by the American Association for the Advancement of Science.

STUART ANTMAN, mathematics, received the Lyapunov Award from the American Society of Mechanical Engineers.

JERRY BONNELL, astronomy, received the Klumpke-Roberts Award from the Astronomical Society of the Pacific.

ANTONIO BUSALACCHI, atmospheric and ocean science, was appointed co-chair of the National Research Council's Decadal Survey for Earth Science and Applications from Space.

GEORGE GLOECKLER, physics, received the first Johannes Geiss Fellowship from the International Space Science Institute.

SYLVAIN GUIRIEC, astronomy, received the Young Scientist Prize in Astrophysics from the International Union of Pure and Applied Physics.

MOHAMMAD HAJIAGHAYI, computer science, won the European Association for Theoretical Computer Science's 2015 Nerode Prize.

XIANGDONG JI, physics, received the 2016 Herman Feshbach Prize in Theoretical Nuclear Physics.

ZHANQING LI, atmospheric and oceanic science, was elected fellow of the American Association for the Advancement of Science.

BENJAMIN MANNING, mathematics, was recognized as an emerging leader in science and technology by the Defense Advanced Research Projects Agency.

ALICE MIGNEREY, chemistry and biochemistry, was elected fellow of the American Chemical Society.

An anthology titled "Fish Hearing and Bioacoustics" was published in honor of **ARTHUR POPPER**, biology.

MIKE RAUPP, entomology, was elected fellow of the Entomological Society of America.

EUN-SUK SEO, physics, received the Scientist of the Year Award from the Korean Federation of Science and Technology Societies and the Korean-American Scientists and Engineers Association.

BEN SHNEIDERMAN, computer science, was elected fellow of the National Academy of Inventors.

SCOTT DELLATORRE, senior majoring in computer science and mathematics, died August 23.

CHARLES ECKENRODE, B.S. '64, entomology, died July 18. He was professor emeritus at Cornell University where he began his faculty career in 1970.

BILL ERICKSON, astronomy, died September 5. Erickson was an astronomy professor at UMD from 1963 to 1988.

SIGMUND FRITZ, meteorology, died September 26. He joined UMD as a research scientist in the meteorology graduate program in 1976 after a distinguished career at the National Oceanic and Atmospheric Administration.

TERRY GODLOVE, Institute for Research in Electronics and Applied Physics, died August 20. Godlove joined UMD in 2000, following a career with the National Research Laboratory and the Department of Energy.

SIGMUND GROLLMAN, B.S. '47, biological science; M.S. '49, Ph.D. '52, zoology, died July 8. He served as a professor of biology at UMD for over 30 years, teaching and mentoring hundreds of students.

MAURICE HEINS, mathematics, died June 4. A Distinguished University Professor, he continued to publish papers after retirement into the 1990s.

AUSTIN HUGHES, B.S. '77, zoology, died October 31. Hughes was a Carolina Distinguished Professor of Biological Sciences at the University of South Carolina.

CHARLES POOLE, Ph.D. '58, physics, died November 1. Poole was a retired physics professor at the University of South Carolina.

LAWRENCE RACHUBA, B.S. '63, zoology, died October 3. Rachuba was a developer who changed Towson's landscape with hotels, office buildings and a regional shopping center.

RAYMOND SEMLITSCH, M.S. '79, zoology, died June 10. Semlitsch was a University of Missouri Curators' Professor of Biology and an international leader in amphibian ecology.

Leaving Her Mark

ALIZA LICHT

In October, Aliza Licht, B.S. '96, biological sciences, returned to a chemistry lecture hall where she once took classes. She offered current Terp students personal and professional career guidance based on her recently published book *Leave Your Mark.*

Licht spoke about her dream of becoming a plastic surgeon, which she traded in for a career in the fashion industry. Before stepping down in late 2015, Licht was senior vice president of global communications at Donna Karan International and "DKNY PR GIRL", the company's award-winning social media personality.

Using her career as the narrative, Licht's book is filled with insider secrets on how to land your dream job, kill it in your career, rock social media and create the brand of you. The book is essentially a mentorship in 288 pages, according to Licht.

"I truly hope that the book becomes a bible to young professionals who are looking to improve the way they communicate their personal brand. It's a book that I hope people read with a highlighter," says Licht.

The University of Maryland Alumni Association added Licht's book to the Robert J. & Mary Charlotte Chaney Alumni Library located in the university's Samuel Riggs IV Alumni Center.

ALUMNI NOTES ARE WELCOME.

Please send them to Odyssey, CMNS Dean's Office, University of Maryland, 2300 Symons Hall, College Park, MD 20742.

Send information to abbyr@umd.edu.

Eight alumni were elected fellows of the American Physical Society.

- **DOUGLAS ARION**, Ph.D. '84, physics, is a professor in the Department of Physics and Astronomy and a professor of entrepreneurship at Carthage College.
- **LEE BERNSTEIN**, M.S. '90, physics, is a professor in the Department of Nuclear Engineering at the University of California, Berkeley, and a staff scientist at Lawrence Livermore National Laboratory.
- **ZHENG-YU (JEFF) CHEN**, Ph.D. '88, physics, is chair of the Department of Physics and Astronomy at the University of Waterloo, Canada.
- **JAIME FERNANDEZ-BACA**, Ph.D. '86, physics, is the group leader of the Quantum Condensed Matter Division at Oak Ridge National Laboratory.
- **IRA SCHWARTZ**, Ph.D. '80, applied mathematics, is the section head of Nonlinear Systems Dynamics at the Naval Research Laboratory.
- **MICHAEL SHAY**, Ph.D. '88, physics, is a professor of physics and astronomy at the University of Delaware.
- **TROY SHINBROT**, Ph.D. '92, physics, is a professor of biomedical engineering at Rutgers University.
- **MICHAEL WITTMANN**, Ph.D. '98, physics, is an associate professor and chair of physics at the University of Maine.

Two alumni were elected fellows of the National Academy of Inventors.

- **ROBERT FISCHELL**, M.S. '53, physics, is a professor of the practice in the UMD Fischell Department of Bioengineering.
- **TOBIN MARKS**, B.S. '66, chemistry, is the Vladimir N. Ipatieff Professor of Chemistry and a professor of materials science and engineering at Northwestern University.

Fischell also received the National Medal of Technology and Innovation from the White House.

Two alumni were elected fellows of the American Association for the Advancement of Science.

- **TAMAR BARKAY**, Ph.D. '80, microbiology, is a professor in the Department of Biochemistry and Microbiology at Rutgers University.
- **LEONARD FINE**, Ph.D. '62, chemistry, is a scientific officer and fellow at Science Foundation Arizona.

CRAIG ABOD, B.S. '86, computer science, was named EY Entrepreneur of the Year in the Greater Washington Region. Abod is president of Carahsoft.

Coldbrew Collective, a live visuals company founded by **BOBAK AZARBAYEJANI**, B.S. '13, computer science, B.A. '13, linguistics, and **AASHISH GADANI**, B.S. '13, computer science, mathematics, was voted best visual artist by *Seattle Weekly.*

ANNE BRESNICK, B.S. '85, biochemistry, became director of the Belfer Institute for Advanced Biomedical Studies at the Albert Einstein College of Medicine.

CALLAN BENTLEY, M.S. '04, geology, was one of 13 awarded the State Council of Higher Education for Virginia's highest honor, the Outstanding Faculty Award. He was also named Chancellor's Commonwealth Professor. Bentley is an assistant professor of geology at Northern Virginia Community College.

FANG CAO, B.S. '15, biological sciences, received a Phi Kappa Phi Fellowship.

PAUL CASSAK, Ph.D. '06, physics, received the James B. Macelwane Medal from the American Geophysical Union.

NIEM DANG, B.S. '03, computer science, was named director of network technical operations for the Society of Cable Telecommunications Engineers.

J. DONALD DEBETHIZY, B.S. '72, biological sciences, was appointed chairman of the board by Rigontec GmbH.

CLIFFORD DE SOUZA, Ph.D. '91, physics, was elected as a new director of iStar.

MATTHEW DISNEY, B.S. '97, chemistry, received a 2015 National Institutes of Health Pioneer Award. Disney is a professor in the Department of Chemistry at The Scripps Research Institute.

Photo by Abby Robinson

RICHARD FAIRCLOTH, B.S. '68, M.S. '70, Ph.D. '73, zoology, was appointed for a three-year term on the Anne Arundel Community College Foundation Board of Directors.

CARRIE MEEK GALLAGHER, M.S. '97, conservation, was appointed to lead the New York State Department of Environmental Conservation's Region 1 office in Stony Brook.

YVES GOMES, B.S. '14, biochemistry, became the first undocumented person, as well as the youngest, to be elected to the Asian Pacific American Labor Alliance AFL-CIO National Executive Board.

CHERYL HAPKE, M.S. '92, geology, was named director of the U.S. Geological Survey's St. Petersburg Coastal and Marine Science Center.

BRADFORD HILL, M.S. '01, physics, received the Presidential Award for Excellence in Mathematics and Science Teaching.

JAMES KEANE, B.S. '11, astronomy and geology, was awarded the 2015 Eugene M. Shoemaker Impact Cratering Award from the Planetary Geology Division of the Geological Society of America. Keane is a graduate student at the University of Arizona.

SIMON LEVIN, Ph.D. '64, mathematics, received the National Medal of Science from the White House. Levin is Princeton University's George M. Moffett Professor of Biology and professor of ecology and evolutionary biology.

ALEX LOCKWOOD, B.S. '07, astronomy, physics, starred in the grad school-inspired movie "The PHD Movie 2".

THOMAS McMILLEN, B.S. '74, chemistry, was selected to lead the Division 1A Athletic Directors' Association.

MEGHAN MURPHY, B.S. '15, biological sciences, received a 2015-16 Princeton in Africa fellowship to teach science in Botswana at the Maru-a-Pula School.

SHRUTI NAIK, B.S. '05, biological sciences, won the Regeneron Prize for Creative Innovation. Naik is a postdoctoral fellow at Rockefeller University.

FORREST W. NUTTER JR., B.S. '76, botany, recently received the outstanding teacher award from the College of Agriculture and Life Sciences at Iowa State University where he is professor of plant pathology.

Real estate developer **EUGENE POVERNI**, B.S. '07, mathematics, finance, was named to *The Baltimore Sun*'s list of "10 People to Watch Under 30".

JOHN QUINN, Ph.D. '58, physics, who served as chancellor of the University of Tennessee from 1989 to 1992, was named chancellor emeritus.

ROBIN REICHLIN, B.S. '76, geology, received the Edward A. Flinn III Award from the American Geophysical Union. Reichlin is a program officer at the National Science Foundation.

SARAH RICHARDSON, B.S. '04, biological sciences, was named a 2015 L'Oréal Women In Science fellow. Richardson is a postdoctoral fellow in synthetic biology at the Lawrence Berkeley National Lab's Joint BioEnergy Institute and at the University of California, Berkeley.

THERESA STEVENS, B.S. '82, animal science; M.S. '86, zoology, was appointed chief corporate development officer at BioBlast Pharma Ltd.

DANIELE STRUPPA, Ph.D. '81, mathematics, was appointed president of Chapman University.

COLE TRAPNELL, B.S. '05, mathematics, computer science; Ph.D. '10, computer science, received a New Innovator Award from the National Institutes of Health. Trapnell is an assistant professor of genome sciences at the University of Washington.

KIM WEAVER, M.S. '90, Ph.D. '93, astronomy, was named to the West Virginia University Board of Governors. Weaver is an astrophysicist at NASA's Goddard Space Flight Center.

Three graduate students received NASA Earth and Space Science Fellowships.

- **MARGARET MARVIN**, chemistry
- **MARGARET McADAM**, astronomy
- **DAVID NEW**, atmospheric and oceanic science

Five chemistry Ph.D. candidates received U.S. Department of Education Graduate Assistance in Areas of National Need (GAANN) Fellowships.

- **CARMEN CARTISANO**
- **CHRISTOPHER HERNANDEZ**
- **KIM HUYNH**
- **TESSY THOMAS**
- **AUSTIN VIRTUE**

Computer science graduate students **MEETHU MALU** and **URAN OH** won second place at the evoHaX SE hackathon, which focused on building wearable accessible technologies.

Biological sciences major **AVAN ANTIA** won the award for best undergraduate poster at the Rustbelt RNA Conference.

KEATON ELLIS, mathematics major, placed first in the 2015 U.S. Nationals Rubik's cube 3x3 one-handed competition.

Physics graduate student **MICHAEL JARRETT** was awarded a Booz Allen Hamilton Quantum Information Fellowship.

Geology major **EMMA McCONVILLE** won the outstanding undergraduate poster award at the Geothermal Resources Council annual meeting.

Computer science graduate student **ANDREW RUEF**, B.S. '13, computer science, was recognized as an emerging leader in science and technology by the Defense Advanced Research Projects Agency.

Entomology graduate student **JONATHAN WANG**, B.S. '13, environmental science and policy, received the first place presentation award at the Society of Invertebrate Pathology's annual meeting.

CARLY MULETZ WOLZ, biological sciences graduate student, won the People's Choice Award at the International Thesis Competition.

COLLEGE OF
COMPUTER, MATHEMATICAL,
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University of Maryland
2300 Symons Hall
College Park, MD 20742

Join Us for the Iribe Center Groundbreaking

The University of Maryland plans to break ground April 30, 2016, on the **Brendan Iribe Center for Computer Science and Innovation**, which will be located at the corner of Baltimore Avenue and Campus Drive. Thanks to a $31 million gift from **Brendan Iribe**, co-founder and CEO of Oculus VR, and additional donations from faculty members, alumni and friends, this new facility will offer unprecedented opportunities for students and faculty members to explore and imagine bold new applications of computer science. The building will feature an open floor plan; an auditorium named for **Michael Antonov**, B.S. '03, computer science; maker spaces; collaborative classrooms; spacious labs; seminar rooms and a green rooftop terrace.

Illustration by HDR